ILLINOIS RIVER BASIN RESTORATION COMPREHENSIVE PLAN WITH INTEGRATED ENVIRONMENTAL ASSESSMENT

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FINAL

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Various personnel from the State of Illinois and from Federal agencies were active collaborators for the *Illinois River Basin Restoration Comprehensive Plan With Integrated Environmental Assessment*. The primary project development team members who contributed to the technical aspects of this effort are:

PROGRAM / STUDY MANAGER	Brad Thompson
ASSISTANT STUDY MANAGER	Marshall Plumley
ASSISTANT STUDY MANAGER	Jodi Staebell
ENVIRONMENTAL RESOURCES	Karen Hagerty
NEPA COMPLIANCE	Lonn McGuire
HYDROLOGY AND HYDRAULIC	Heather Bishop
ENGINEERING AND DESIGN	Troy Hythecker
ENGINEERING AND DESIGN	Kirk Sunderman
COST ESTIMATE	Terri Kirkeeng
SOCIAL ANALYSIS	Sharryn Jackson
PUBLIC INVOLVEMENT	Suzanne Simmons
HISTORIC PROPERTIES	Ron Deiss
REAL ESTATE	Joanne Lieving
REAL ESTATE	Rod Hallstrom
GIS AND MAPPING	Mary Craig

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EXECUTIVE SUMMARY

The Illinois River, described by early explorers as a "boundless marsh", has long been characterized by the productivity of its extensive backwater and floodplain complexes. However, over time the ecological health of the system has declined significantly due to the combined effects of sedimentation, altered hydrology, and other modifications to the basin. Despite these declines, the Illinois River Basin represents one of the most productive resources in the Midwest and has high potential for restoration. The National Research Council identified the Illinois River as one of three large-floodplain river systems in the lower 48 states with the potential to be restored to an approximation of their outstanding biological past.

This report represents a final response to the Comprehensive Plan portion of the Illinois River Basin Restoration authority required by Section 519(b) of the Water Resources Development Act (WRDA) 2000 and to the Illinois River Ecosystem Restoration Feasibility Study conducted under Section 216 of the 1970 Flood Control Act as a review of the completed 9-Foot Channel Navigation Project. Section 519 also provides ongoing authority to evaluate and implement Critical Restoration Projects. This report assesses the total basin restoration needs and makes recommendations regarding continuing implementation under the existing authority and conducting some further evaluations of ways to improve implementation. The Corps of Engineers and Illinois Department of Natural Resources (sponsor) worked in close coordination with numerous other state and Federal agencies in developing the plan.

This Comprehensive Plan provides the vision, goals, objectives, desired future, and identifies the preferred alternative plan to restore the ecological integrity of the Illinois River Basin System. This plan documents the need for and potential scope of the four components called for in Sec 519 (b)(3): a restoration program; a long-term resource monitoring program; a computerized inventory and analysis system; and a program to encourage sediment removal technology, sediment characterization, sediment transport, and beneficial uses of sediment. An implementation framework and criteria are also presented to guide the identification, selection, study and implementation of restoration projects, monitoring and adaptive management activities, and further system investigations.

SIGNIFICANCE OF THE ILLINOIS RIVER BASIN

The Illinois River's significance was recognized by Congress in WRDA of 1986 as a "nationally significant ecosystem" as part of the Upper Mississippi River System. A 1995 report by the U.S. Department of the Interior lists large streams and rivers as an endangered ecosystem in the United States, with a documented 85 to 98 percent decline since European settlement. The Illinois River is one of a small number of world-class river floodplain ecosystems; where biological productivity is enhanced by annual flood pulses that advance and retreat over the floodplain and temporarily expand backwaters and floodplain lakes.

The predevelopment Illinois River floodplain was a complex mosaic of prairies, forests, wetlands, marshes, and clear water lakes. In the main stem river floodplain, the main channel threaded through a variety of connected and isolated backwater lakes, bottomland forests, prairies, marshes, and swamps.

The productivity of the predevelopment system was demonstrated by the millions of migratory birds that stopped to rest and feed on their migrations or stopped to nest in the floodplain marshes. The fishery was reputed to be vast and exceptionally large fish catches were common. At the turn of the century, the river produced 10 percent of the nation's catch of freshwater fish. The Illinois River system also supported more freshwater mussels per mile than any other river on the continent. The forests supported a higher diversity of trees, many that produced fruit and seeds. Today's flora and fauna are but a remnant of these historic levels, but they still include some of the richest habitat in the Midwest, even some unique in North America.

Despite the ecological damage and degradation, the landscape and river system remain surprisingly diverse and biologically productive. The Illinois River basin is a critical mid-migration resting and feeding area of the internationally significant Mississippi River Flyway, utilized by 40 percent of all North American waterfowl and 326 total bird species, representing 60 percent of all species in North America. A survey conducted by the Illinois Natural History Survey in the fall of 1994 found that 81 percent of the fall waterfowl migration in the Mississippi flyway utilized the Illinois River. Twenty-six avian species are state listed as threatened or endangered; one of which is federally-threatened, the Bald Eagle, and four others are Federal species of concern. Many of these species are associated with wetlands or grasslands, and are also sensitive to landscape fragmentation.

The Illinois River system is home to approximately 35 mussel species, representing 12 percent of the freshwater mussels found in North America. Five mussel species are listed by the State of Illinois as threatened or endangered, one of which is a candidate for Federal listing. Fish diversity is similarly high, with 115 fish species found, 95 percent of which are native species. Many of these species require riverine, backwater, and floodplain habitat as part of their life cycle. Eighteen fish species are listed by the state of Illinois as threatened or endangered. Many of these species are endemic to the basin and/or intolerant of high silt levels. A group of aquatic organisms that is particularly representative of the Illinois River is the "Ancient Fishes" such as the paddlefish and sturgeon. The majority of these fish are migratory by nature and utilize a diversity of river habitats, flowing channel habitats, side channels, and backwater areas.

The Illinois River has long been a significant resource to the nation and the State of Illinois. It supported large Native American populations and provided a route for European explorers and settlers, and helped make the Midwest agricultural economy viable as early as the nineteen century. This waterway provides navigation from Lake Michigan and Chicago to the Upper Mississippi River, linking the inland waterway system with the Great Lakes. In 2004, 45 million tons of commodities were transported on the Illinois Waterway. The river and its tributaries provided water for residential and industrial users and also assimilated the wastes of burgeoning metropolitan communities. In Illinois, 90 percent of the state's population, more than 11 million people, reside in the basin.

The State of Illinois has demonstrated tremendous commitment to the restoration of the Illinois River System for many years. The State of Illinois initiated, developed, adopted and implemented an *Integrated Management Plan for the Illinois River Watershed (1997)* working with multiple local, state, and Federal groups and enacted the Illinois River Watershed Restoration Act (1997). In 2000, the Governor of Illinois set the vision for Illinois Rivers 2020, a proposed $2.5 billion, 20-year state and Federal restoration program to restore the Illinois River Basin. This plan was the first of many steps leading to the development of the goals and objectives for this comprehensive plan. In addition, Illinois leads the nation in the number of acres currently enrolled in the Conservation Reserve

Enhancement Program (CREP) at 110,000 in the Federal program, and the most acres permanently protected (92 of the 73,000 acres enrolled, in the state portion of the program). Local communities, counties, and non-governmental organizations have demonstrated commitment to the Illinois River, by implementing approximately 40 management plans calling for restoration of all or a portion of the Illinois River Basin. The Nature Conservancy and The Wetlands Initiative have both made major investments purchasing more than 11,000 acres of Illinois River floodplain and adjacent habitats for the purpose of restoration in recent years, adding to the approximately 135,000 acres already in State and Federal ownership in the basin. However, many of the restoration efforts have focused only on small components of the basin without considering the broader basin context, which is the focus of this comprehensive plan.

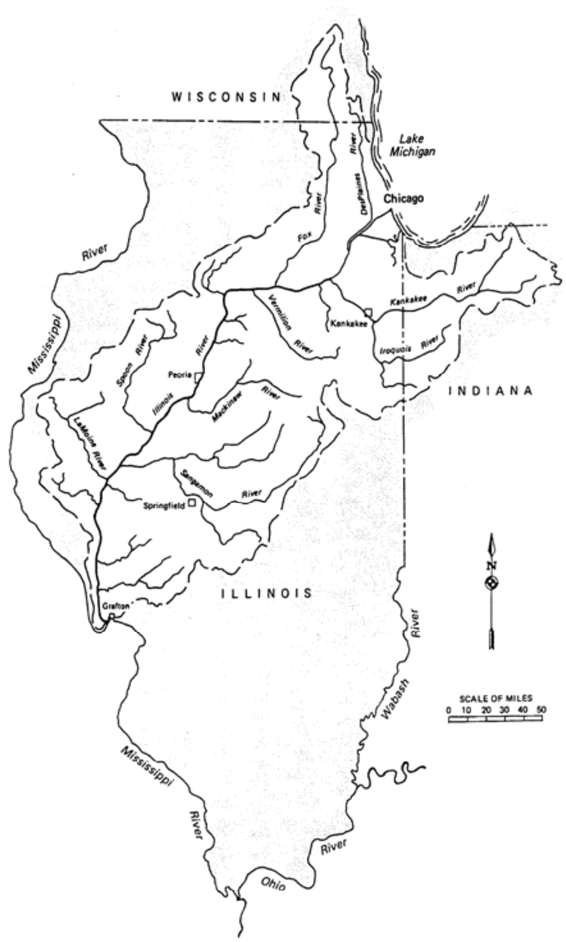


Figure ES-1. Location of Illinois River Basin

STUDY AREA

The study area encompasses the entire Illinois River Basin, defined as the Illinois River, its backwaters and side channels, and all tributaries, including their watersheds (figure ES-1). The entire Illinois River Basin includes 30,000 square miles (19 million acres), and includes 1,000 square miles in Wisconsin (upper Fox and Des Plaines Rivers), and 3,200 square miles in Indiana (Kankakee and Iroquois Rivers). In Illinois, the basin includes 44 percent of the land area, 46 percent of the state's agricultural land, 28 percent of its forests, 37 percent of its surface waters, and 95 percent of its urban areas.

SPONSORSHIP AND COLLABORATIVE PLANNING

The Illinois Department of Natural Resources (DNR) is the non-Federal sponsor. Illinois River Ecosystem Restoration activities were conducted on a 50/50 percent cost sharing basis, while efforts under the Illinois River Basin Restoration authority were cost shared 65 percent Federal and 35 percent non-Federal. Although the Illinois DNR has served as the only non-Federal sponsor to date, the Indiana DNR and the Kankakee River Basin Commission have submitted letters expressing interest in sponsoring projects in their jurisdictions. In addition, the State of Wisconsin and numerous other state and Federal agencies participated in this collaborative planning process. Section 6, identifies the organizational structure and proposed roles of the other agencies in implementation.

Proposed restoration efforts under this plan would be closely coordinated with two ongoing Corps of Engineers Restoration Programs the Upper Mississippi River – Environmental Management Program (EMP) and the Navigation and Ecosystem Sustainability Program (NESP). The EMP established in 1986 is comprised of two elements—Habitat Rehabilitation and Enhancement Projects (HREPs) and the Long Term Resource Monitoring Program (LTRMP). The NESP effort encompasses the subsequent planning and design efforts related to the Upper Mississippi River - Illinois Waterway System Navigation Feasibility Study completed in September 2004. While some planning and design activities are ongoing, the NESP is not currently authorized. Restoration activities under both programs would include features called for in this Comprehensive Plan including backwater, side channel, island, and floodplain restoration, but they would be limited to the main stem rivers and adjacent floodplains.

Most restoration activities undertaken under Section 519 authority would be located in the watersheds of the Illinois River, these areas are not covered by the EMP and NESP authorities. While this comprehensive plan identifies the need and estimates the costs for significant main stem restoration it is anticipated that most of the implementation work in these areas (approximately 75 percent or more) would actually be funded and conducted through the existing EMP and potentially NESP if authorized. A similar breakdown of efforts is planned for main stem system monitoring and adaptive management activities. The existing Long Term Resource Monitoring Program of the EMP which monitors the LaGrange Pool will be relied on to continue to provide information of the health of the Lower Illinois River. Additional monitoring effort undertaken as part of Illinois River Basin Restoration and NESP will be integrated with and expand on the existing EMP monitoring.

Finally, in regards to EMP, NESP, and Illinois River Basin Restoration coordination activities all efforts will utilize the same multi-agency coordination structures, including the River Resources Coordination Team (RRCT), River Resources Forum (RRF), and River Resources Action Team (RRAT). This joint coordination will help to ensure efficiency among restoration and monitoring activities and a forum for interagency comment and discussion on the collective efforts.

PROBLEMS AND SYSTEM LIMITING FACTORS

The Illinois River Basin has and continues to experience a loss of ecological integrity due to sedimentation of backwaters and side channels, degradation of tributary streams, increased water level fluctuations, reduction of floodplain and tributary connectivity, and other adverse impacts caused by intensive human development over the last 150 years. While many of the original plant and animal species are still present in the basin, but at reduced levels, the physical habitats (structure) and the processes that create and maintain those habitats (function) have been greatly altered. In total, these alterations have led to a decline in the ecological health to the point where aquatic plants beds have been virtually eliminated from the lower river; macro-invertebrate numbers have declined significantly; the loss of backwaters areas with sufficient depth for spawning, nursery and overwintering habitat is now considered limiting for many native fish; and floodplain, riparian, and aquatic habitat loss and fragmentation is a threat to the population viability of State and federally listed species in the basin. The following areas have been identified as the physical factors that limit system ecological integrity: excessive sedimentation; loss of productive backwaters, side channels, and islands; loss of floodplain, riparian, and aquatic habitats and functions; loss of aquatic connectivity (fish passage) on the Illinois River and its tributaries; altered hydrologic regime; water and sediment quality, and invasive species.

There are numerous opportunities for restoration. Figure ES-2 illustrates how projects formulated addressing these system limiting factors collectively, can improve ecosystem integrity to the point where higher levels of function are restored. Monitoring and adaptive management, at both the system and individual project level, would provide the vital feedback loop needed to ensure success and increase understanding of the Illinois River Basin ecosystem. Adaptive management requires that all ecosystem recovery actions be viewed, implemented, and monitored as tests of hypotheses about ecosystem responses to restoration actions. Under adaptive management, reducing uncertainty becomes an objective of management, the ecological effects of restoration are monitored, and policies are adapted depending on observations. Adaptive management has the added benefit of integrating science and resource management, ensuring applied science is well directed and scientific advances are transferred to managers.

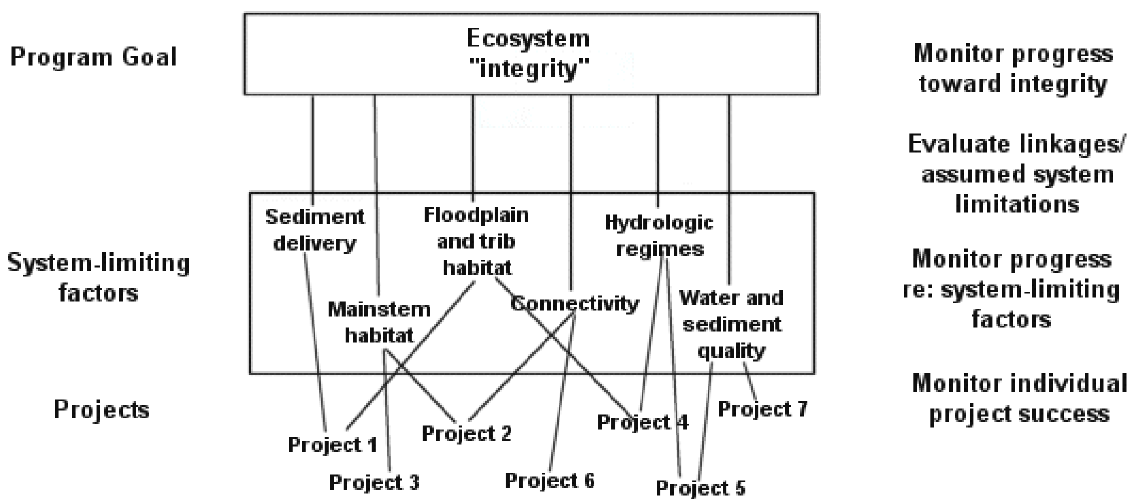


Figure ES-2. Conceptual Model of Illinois River Basin Restoration Project and Monitoring

VISION AND GOALS

The vision for the Illinois River Basin, accepted by the Federal, State and local stakeholders involved in the development of the Illinois River Basin Restoration Program, is:

> *A naturally diverse and productive Illinois River Basin that is sustainable by natural ecological processes and managed to provide for compatible social and economic activities.*

The interagency study team developed the Illinois River Basin system wide ecosystem restoration goals and objectives in direct response to the widely identified system limiting factors. Also included are proposed measures to address the limiting factors and their expected outputs. These goal categories are interrelated and improvements in all areas are needed to substantively improve ecological integrity. As efforts are undertaken across several goal categories, the restoration activities would reverse complex, systemic declines that have degraded the system below some critical thresholds.

Overarching Goal: Restore and maintain ecological integrity, including habitats, communities, and populations of native species, and the processes that sustain them

Objectives

A. Identify and address system wide limiting factors to ecological integrity (structure and function) described in the previous section

B. Restore and conserve natural habitat structure and function, including, but not limited to:
   1. Concentrations of flora and fauna or areas that are high in biodiversity; especially vulnerable to disturbance; and/or important in fulfilling a life-history requirement of the species present.
   2. Specific suitable habitat for Federal and State endangered and threatened species, or other species of concern, that is capable of supporting long-term sustainable populations at the site and protect additional acres of the identified suitable habitat as appropriate.
   3. Representative examples of all community types in the Illinois River Basin, best of kind or as needed, to protect and restore habitat structure and function at the system level.

C. Establish existing and reference conditions for ecosystem functioning and sustainability against which change can be measured; monitor and evaluate actions to determine if goals and objectives are being achieved, at both the project and system level.

System Limiting Factors

1. Excessive Sedimentation. Increased sediment loads from the basin have severely degraded environmental conditions along the main stem Illinois River by increasing turbidity and filling backwater areas, side channels, and islands. Similar problems can be seen throughout the basin where excessive sediment has degraded tributary habitats. The average amount of sediment delivered to the Illinois River each year is approximately 12.1 million tons; of which 6.7 million tons (55 percent) is deposited within the river, its bottomlands, and backwater lakes.

Goa1: Reduce sediment delivery to the Illinois River from upland areas and tributary channels with the aim of eliminating excessive sediment load (Goal 1)

Objectives

A. Reduce total sediment delivery to the Illinois River by at least 10 percent by 2025 (reduction from an average of 12.1 to 10.9 million tons per year above Valley City, based on Illinois State Water Survey (ISWS) estimate of delivery for water year (WY) 1981 to 2000)

B. Reduce total sediment delivery to the Illinois River by at least 20 percent by 2055 (reduction to an average of 9.7 million tons per year above Valley City, based on ISWS estimate of delivery for WY 1981to 2000)

C. Eliminate excessive sediment delivery to specific high-value habitat both along the main stem and in tributary areas

Measures. Incising channels would be treated with rock riffle structures, if possible, otherwise using sheet-pile grade control structures. The preferred method of treating bank erosion was assumed to be stone barbs, then stone toe (photograph ES- 1), or finally a stone armor blanket if necessary; bioengineering was incorporated in most of the bank erosion stabilization measures. Finally, upland sediment control measures include the construction of dry basins.

Photograph ES-1. Example Before and After Stream Restoration With Stone Toe Protection

Outputs. Anticipated project outputs related to Goal 1 include: reducing sediment delivery to the Illinois River, reducing turbidity in the tributaries and Illinois main stem and backwaters, increasing the life of existing and restored backwaters as critical habitats for native species. These effects would benefit system aquatic plants, mussels, invertebrates, fish, and other native species.

2. Loss of Productive Backwaters, Side Channels, and Islands. A dramatic loss in productive backwaters, side channels, and islands due to excessive sedimentation is limiting ecological health, connectivity to the river, and altering the character of this unique floodplain river system. The Illinois River has lost much of its critical spawning, nursery, and overwintering areas for fish, habitat for waterbirds (including diving ducks), aquatic species, and backwater aquatic plant communities. On average, the backwater lakes along the Illinois River have lost 72 percent of their capacity.

Goal: Restore aquatic habitat diversity of side channels and backwaters, including Peoria Lakes, to provide adequate volume and depth for sustaining native fish and wildlife communities (Goal 2)

Objectives

A. Restore, rehabilitate, and maintain up to19,000 acres of habitat in currently connected areas (1989 data shows approximately 55,000 acres of backwaters during summer low water). Restoration should result in a diversity of depths. For restored backwaters, a general target would be to have the following distributions of depths during summer low flow periods: 5 percent >9 feet; 10 percent 6 to 9 feet; 25 percent 3 to 6 feet; and 60 percent <3 feet

B. Restore and maintain side channel and island habitats

C. Maintain all existing connections between backwaters and the main channel. (connections at the 50 percent exceedance flow duration)

D. Identify beneficial uses of sediments

E. Compact sediments to improve substrate conditions for aquatic plants, fish, and wildlife

Measures. The measures evaluated for backwater restoration included various configurations and levels of sediment removal and placement. For side channels and island protection, various measures were evaluated including island protection, dredging, seed islands, and instream structures for habitat (photograph ES-2), and restoration of depth and flow.

Photograph ES-2. Example of Instream Rock Pile Structure

Outputs. Anticipated project outputs include immediately addressing critically limited off-channel aquatic habitat. These effects would benefit the system fish, invertebrates, aquatic plants, mussels, and other native species. At a completed side channel and backwater restoration project a comparison of pre- and post-project construction monitoring data showed a dramatic increase in the number and diversity of fish and waterfowl species as well as an increased total number of individuals. This success is anticipated for similar projects.

3. Loss of Floodplain, Riparian, and Aquatic Habitats and Functions. Land-use and hydrologic change has reduced the quantity, quality, and functions of floodplain, riparian, and aquatic habitats. Flood storage, flood conveyance, habitat availability, and nutrient exchange are some of the critical aspects of the floodplain environment that have been adversely impacted. Habitat loss and fragmentation are widespread problems that, in the long term, could limit attempts to maintain and enhance biodiversity. In addition, habitat forming disturbance regimes have been altered, affecting habitat and species diversity. An analysis of the main stem Illinois River floodplain cover types reveals a loss of approximately 75 percent of the forest, 81 percent of the grassland, and 70 percent of the wetlands. In addition, nearly 50 percent of the floodplain has been isolated from the river. A similar analysis of the tributary floodplains reveals approximate losses of 16 percent of the forest, 36 percent of the grassland, and 70 percent of the wetlands. Channelization is estimated to impair approximately 1,400 miles of perennial stream within the Illinois River Basin.

Goal: Improve floodplain, riparian, and aquatic habitats and functions (Goal 3)

Objectives

A. Restore up to an additional 150,000 acres of isolated and connected floodplains along the Illinois River main stem to promote floodplain functions and habitats

B. Restore up to 150,000 acres of the Illinois River Basin large tributary floodplains

C. Restore and or protect up to 1,000 additional stream miles of riparian habitats

Measures. Potential measures for implementation cover a wide range of practices designed to improve floodplain, riparian, and aquatic habitats, including riffle structures, channelization remeandering, gated levees, wetland restoration including temporary ponds (photograph ES-3), plantings (wetland, forest, prairie), and invasive species management.

Photograph ES-3. Before and After Floodplain Wetland Restoration

Outputs. A healthy functioning floodplain, riparian and aquatic systems in the Illinois River Basin would result in ecological benefits due to connectivity of the river and floodplain habitats critical to the life stages of numerous native species. In addition, restored riparian and floodplain corridors provide one of the best opportunities for landscape scale restoration and connectivity of remaining resource rich areas in the highly modified Midwestern landscape, improving the viability of sensitive populations and species.

4. Loss of Aquatic Connectivity (fish passage) on the Illinois River and Its Tributaries. Construction of dams on the main stem and tributaries alters the temperatures, flow regime, sediment transports, chemical concentrations, and isolates biotic communities. As a result, aquatic organisms do not have sufficient access to diverse habitat such as backwater and tributary habitats that are necessary at different life stages. Lack of aquatic connectivity (fish passage) slows repopulation of stream reaches following extreme events such as flooding, drought, and pollution and reduces genetic diversity of aquatic organisms. There are seven dams on the Illinois waterway and approximately 467 within the basin where fish passage could be implemented.

Goal: Restore aquatic connectivity (fish passage) on the Illinois River and its tributaries, where appropriate, to restore or maintain healthy populations of native species (Goal 4)

Objectives

A. Restore main stem to tributary connectivity, where appropriate, on major tributaries

B. Restore within tributary connectivity

C. Restore passage for large-river fish at Starved Rock, Marseilles, and Dresden Lock and Dams where appropriate

Measures. Fish passage can be accomplished through a variety of techniques. These options include dam removal; rock ramp on the downstream face of the dam to provide a relatively flat 3 to 5 percent gradient (photograph ES-4); bypass channels; and Denil fishways, rectangular chutes or flumes with baffles extending from the sides and bottoms.

Photograph ES-4. Before and After Rock Ramp Fish Passage at a Low Head Dam

Outputs. The dams found throughout the Illinois River Basin block fish movement, but most dams are partially passable under some conditions. For native fish species, fish passage must be available during the appropriate times of the year or life stages, which is often not the case. Expected outputs would include improved fish access to spawning, nursery, and overwintering areas at appropriate times. Connectivity also allows for recolonization and improved genetic diversity of populations of native fish and mussels.

5. Hydrology and Water Levels. The biotic composition, structure, and function of aquatic, wetland, and riparian ecosystems depend largely on the hydrologic regime. The flow regime (magnitude, frequency, duration, timing, rate of change) affects water quality, energy sources, physical habitat, and biotic interactions, which, in turn, affect ecological integrity. Historical basin changes and river management have altered the water level regime along the main stem Illinois River, stressing the natural plant and animal communities along the river and its floodplain. The most critical changes include an increased incidence of water level fluctuations, especially during summer and fall low water periods, and the lack of drawdown in areas upstream of the navigation dams. Approximately 32 significant water level fluctuations occur during the growing season, severely limiting plant germination, growth or survival.

Goal: Naturalize Illinois River and tributary hydrologic regimes and conditions to restore aquatic and riparian habitat (Goal 5)

Objectives

A. Reduce low water fluctuations along the main stem Illinois River where possible, concentrating on the months of May through October and using pre 1900 water level records as a reference

B. Reduce peak flows from the major Illinois River tributaries by 2 to 3 percent for 2- to 5-year recurrence storm events by 2023. This will help to reduce peak flood stages and reduce high-water fluctuations along the river. Long term, reduce tributary peak flows by at least 20 percent for these events

C. Reduce the incidence of low-water stress throughout the basin by increasing tributary base flows by 50 percent

D. Remove the dramatic water level fluctuations associated with the operation of wicket dams at Peoria and La Grange

E. At an appropriate resolution (approximately 1 square mile in urban areas, 10 square miles in rural areas) identify and quantify the land and drainage alterations that contribute to unnatural fluctuations and flow regimes

F. Draw the pools at Peoria and La Grange down for at least 30 consecutive days at least once every 5 years

Measures. Reducing peak flows and increasing base flows on the tributaries will be accomplished by increasing the volume of storm water storage in the watershed (through the use of various measures including: tile management, detention structures, and extended riparian areas) and directing storm water runoff to areas where it can infiltrate the soil and recharge groundwater (through the use of various measures including: tile management, filter strips, and grassed fields enclosed with a berm). Many of the detention and riparian areas will function as wetlands. Reducing fluctuations on the mainstem will be accomplished through the following measures including: performing pool drawdowns (photograph ES-5), installing automated dam gates, and installing new gates at existing dam sites were evaluated.

Outputs. In regard to tributary flows, regimes with reduced peaks and increased baseflows would provide more desirable levels of ecosystem function than currently occur. Within the tributaries, improved aquatic species survival is anticipated including, fish and macroinvertebrate populations. Like the tributary systems, two types of benefits were identified for the main stem: reduced fluctuations and area exposed by drawdown. In particular, the reductions in sudden water level rises in the summer is considered a critical element in restoring aquatic plant populations and reductions in rapid winter drops would protect native fish and other aquatic organism populations.

Photograph ES-5. Before and After Pool Drawdown in Backwater Area

6. Water and Sediment Quality. Water clarity is the primary factor limiting submersed aquatic plants. During periods of high turbidity, aquatic plant growth is limited, since suspended sediments interfere with light penetration into the water. In addition to turbidity, the quality of the sediments, particularly in the main stem, may limit macroinvertebrates such as fingernail clams. Water resources in the Illinois River Basin are also impaired due to a combination of point and non-point sources of pollution.

Goal: Improve water and sediment quality in the Illinois River and its watershed (Goal 6)

Objectives

A. Achieve full use support for aquatic life in all surface waters, as defined in 305(b) of the Clean Water Act, of the Illinois River Basin by 2025

B. Achieve full use support for all uses on all surface waters of the Illinois River Basin in 2055

C. Encourage remediation of sites with contaminant issues that affect habitat

D. Achieve state EPA nutrient standards by 2025, following standards to be established by 2008

E. Work to minimize sedimentation as a cause of impairment as defined by 305(b) of the Clean Water Act by 2035

F. Maintain waters that currently support full use.

Measures. Separate measures were not identified for the sole purpose of water and sediment quality restoration. However, benefits would result from reductions in sediment, nutrient processing in restored floodplain and riparian areas.

Outputs. It is expected that water quality would continue to improve somewhat in the future because of improved waste and storm water treatment practices and local conservation efforts, and that improved water quality would translate into improvements in other ecosystem components. However, future gains would be less dramatic than in the past without also working on the other limiting factors.

CONCLUSIONS

The Comprehensive Plan identified that collaborative implementation of the Illinois River Basin Restoration project with other state and Federal agencies would contribute to National Ecosystem Restoration (NER) goals consistent with the Corps policy and guidance by increasing the net habitat quality and quantity of the aquatic ecosystem within the Illinois River Basin Restoration.

The Comprehensive Plan found that over the next 50 years the Illinois River Basin Restoration Program, authorized in Section 519 of WRDA 2000, should be continued and expanded to more fully address the restoration needs of this nationally significant resource. Since Section 519 provides the necessary authority to begin implementation, no further activities are planned under Section 216 at this time.

Plan Formulation

Alternatives were formulated in coordination with State and Federal agencies to address the total additional restoration needs beyond the existing and expected future without project restoration funding levels. The evaluation of system restoration needs was not specific to just Corps of Engineers and Illinois Department of Natural Resources activities, and instead identified the total restoration costs including a relatively large portion of work for other agencies.

A series of eight alternatives were examined in the comprehensive plan study (seven action alternatives and the no-action alternative). All action alternatives would provide regional habitat and ecological integrity benefits by slowing, stabilizing or reversing the decline of ecological integrity in the Illinois River Basin. Alternatives 1, 2, 3, and 4 represent gains in ecological integrity, although system-wide ecological integrity would continue to decline over the 50-year period of analysis. Alternatives 5, 6, and 7 represent a range of gains that reverse the declining ecological trend, and provide system-wide improvements in ecological integrity over the 50-year period of analysis. In addition to restoration planning and implementation, all alternatives included a Technologies and Innovative Approaches Component and management costs. The Technologies and Innovative Approaches Component addresses the other components called for development and implementation under Section 519(b)(3) including development and implementation of: sediment removal technology, sediment characterization, sediment transport, and beneficial uses of sediment; long term resource monitoring; and a computerized inventory and analysis system.

Three types of outputs (acres benefited, stream miles benefited, and percent attainment of the objectives) were evaluated and utilized to conduct cost effectiveness and incremental cost analysis. Only Alternatives 6 and 7 were best buy plans under all three analyses. Alternative 6 was selected as the preferred Comprehensive Plan alternative, since it was more cost effective while still significantly addressing the key system limiting factors.

Alternative 6, if fully implemented over the next 50 years, would provide benefits to approximately 225,000 acres and 33,000 miles at a cost of $7.44 billion in funding from various Federal, state, and local partnering agencies. Other specific outputs include:

- provide a measurable increase in system ecological integrity
- reduce systemic sediment delivery by 20 percent
- restore 12,000 acres of backwaters
- restore 35 side channels
- protect 15 islands
- restore 75,000 acres of main stem floodplain
- restore 75,000 acres of tributary floodplain and riparian areas
- restore 1,000 stream miles of aquatic habitat
- provide fish passage along the Fox, DuPage, Des Plaines, Kankakee, Spoon, and Aux Sable Rivers
- produce an 11 percent reduction in the 5-year peak flows in tributaries
- increase tributary base flows by 20 percent
- reduce water level fluctuations along the main stem during the growing season by 65 percent
- provide system level improvements in water quality.

Fully implemented, the anticipated benefits of Alternative 6 include reaching a number of key thresholds that are currently limiting ecological integrity. These include:

- Reducing water level fluctuations and turbidity to levels that allow for reestablishment of aquatic plants beds in the lower Illinois River
- Increasing macro-invertebrate numbers as a food base for the system
- Increasing depth diversity in backwaters areas providing spawning, nursery, and overwintering habitat for native fish populations
- Providing critical habitat for the return of diving ducks
- Increasing connectivity of riparian and aquatic habitats providing improved species and population viability of state and federally-listed species

Tiered Implementation

Given the magnitude of the restoration needs, a collaborative and tiered implementation approach is proposed. The Corps of Engineers cost-shared restoration efforts should begin with $131,200,000 ($85,280,000 Federal funds) in restoration funds through 2011 (Tier I) with the potential to expand to $345,640,000 ($224,670,000 Federal funds) in restoration efforts through 2015 (Tier II). The funding and activities would begin significant restoration consistent with eventual implementation of Alternative 6 (preferred Comprehensive Plan alternative). These initial phases are proposed to demonstrate the benefits of the various practices and project components prior to seeking additional funding. If Tier I and Tier II efforts are successful additional tiers could be developed based on increased understanding of system responses to the initial restoration projects and consideration of further developments regarding interagency funding and partnerships.

Tier I efforts would result in the completion of 16 critical restoration projects cost shared 65 percent Federal ($85.28 million) and 35 percent non-Federal ($45.92 million). This funding level would provide approximately $122.3 million for planning, design, construction, and adaptive management of restoration projects; $3.5 million for site specific pre and post project monitoring, and $2.6 for additional studies and analysis including refinement of a technologies and innovative approaches component; and $2.75 million for system management. The estimated annual Operation and Maintenance cost, of the Tier I projects completed by 2011, is estimated to be $125,000. If funding is available, a report to Congress will be submitted in the 2011 timeframe, documenting the project successes and the results from Tier I restoration efforts.
The following sections describe these aspects of the initial restoration efforts in greater detail. Funding would address three major areas with funding at approximately the level indicated.

Restoration Projects. The majority of the funding, roughly 93.2 percent or $122.3 million (including $3.1 million in adaptive management if required) of the initial $131.2 million, would be targeted to address component (b)(3)(B) of Section 519 (WRDA 2000) calling for the development and implementation of a program to plan, design, and construct restoration projects.

Initial restoration efforts would focus on tributaries to the upper watershed and, in particular, the Peoria Pool and tributaries and the Kankakee River Basin. Within these areas, the focus will be on addressing excess sediment delivery, altered hydrologic regimes, and critical habitats and connectivity. These initial focus areas were chosen, since the most likely near term success is to start in the upstream reaches working on the most critical issues and then working down stream in future Tiers. In combination, these screening criteria provide considerable focus in the selection of initial projects. In addition, a few other restoration projects are also proposed in order to maintain critical habitat needs throughout the basin such as backwater, side channel, and island restoration.

The initial Critical Restoration Projects include eight small watershed projects: Waubonsie Creek, Senachwine Creek, Crow Creek West, Tenmile Creek, Yellow River, Iroquois River, Blackberry Creek, and McKee Creek; two major tributary projects on the Kankakee River and Fox River; and six main stem projects, including backwater restorations, Peoria Riverfront – Upper Island and Pekin Lake – Southern Unit and a main stem floodplain restoration at Pekin Lake – Northern Unit, and side channel and island projects in Starved Rock, LaGrange, and Alton Pools.

Based on the large study area, complexity of the ecosystem restoration and the opportunities for increased cost effectiveness, adaptive management is recommended to be included within restoration funding. An incremental process is required for the Illinois River Basin Restoration Program because of the large and complex nature of the ecosystem and its problems, and because of the uncertainties regarding the ecological responses that will occur as more natural hydrological and sediment conditions are established. These uncertainties are inherent where major alterations in the region's spatial scale and landscape have substantially changed ecological relationships among species, habitats, and communities throughout the region. If an unexpected response occurs, it becomes the basis for reviewing and revising the operating set of hypotheses, which results in an ever-improving focus on the actions required to meet the ultimate restoration objectives.

Site Specific Project Monitoring and Additional Studies and Analyses. Approximately 2.7 percent or roughly $3.5 million would be used to perform pre and post project monitoring at the initial critical restoration projects. In addition, approximately 2.0 percent or roughly $2.6 million of the $131.2 million authority would be utilized to conduct additional studies and analyses. A major focus of the additional studies and analysis will be to address areas of risk and uncertainty and to continue to refine a Technologies and Innovative Approaches Component (TIA). For example, additional studies related to the TIA Component could better define ways to combine, consolidate, and build upon existing monitoring data sets (e.g. attempt further consolidation of existing State, Federal, and local monitoring data to further leverage existing data); refine the monitoring plan to seek the most efficient approaches to gathering additional necessary data; better define representative system metrics (e.g. evaluate the use of various species/processes to serve as system indicators); and conduct special studies to collect data to increase our understanding of various processes that could reduce future restoration costs (e.g. detailed study of fish use of tributaries throughout the year and selected evaluations of sediment technologies and applications). A final area of activity would be monitoring of key focus areas to establish pre-project data for use in more completely evaluating problems, opportunities, and project success.

System Management. Approximately 2.1 percent or $2.75 million of the $131.2 million authority would be utilized to manage the restoration efforts. Management funds would include funding for both the Corps of Engineers Districts and non-Federal Sponsors for project management and coordination activities.

While the sustainability of critical restoration projects would be highest with full implementation of Alternative 6, the individual projects implemented under Tier I and Tier II will be formulated to remain sustainable on their own, even if further restoration efforts do not continue. However, these projects will require some operation and maintenance as estimated in the report. We anticipate that the sustainability of the mainstem projects would continue to improve as additional tributary projects are undertaken.

Risk and Uncertainty

As a comprehensive plan for an area of over 30,000 square miles looking at a 50 year planning horizon, there are a number of risks and uncertainties. Some of the major uncertainties relate to the lack of existing models and scientific data to relate sediment reductions to system habitat improvement and sustainability gains and defining the most effective approaches to restore a more natural hydrologic regime. A particular area of uncertainty is defining the specific amounts of restoration required to improve these system limiting factors to the point were necessary biological thresholds are exceeded and significant ecosystem recovery occurs. Some other areas of risk and uncertainty include development patterns, agricultural programs/practices, and climate change. The recommended Tier I and Tier II projects along with additional studies and analysis activities will seek to address and better understand these risks prior to more complete implementation of the Comprehensive Plan.

Areas for Additional Investigation

While Section 3 documents a large number of potential additional studies that would be beneficial to restoration efforts, some of the key issues relate to continued development and refinement of a systemic monitoring report card, improved models, and information on the ability of restoration projects to provide systemic sediment and hydrologic restoration. A particular need is the opportunities to naturalize hydrology and restore native aquatic vegetation. While existing programs have worked to define methods to sample large rivers, a critical need is to determine the best methodology and approach for monitoring large tributaries and small watersheds. These specific areas are proposed for additional study and analysis concurrent with the implementation of Tier I to help reduce the risk and uncertainty over time. If a long term program was undertaken these additional studies and activities would be pursued as part of the Technology and Innovative Approaches component working to continually reduce the risk and uncertainty in the program.

Implementation Framework and Roles of Other Federal, State and Local Agencies

The proposed assessment and implementation process described in Section 6 seeks to create a systemic, comprehensive approach that is transparent and accessible to project partners and stakeholders. The ecological merits of proposed projects will be the most important factor. Other factors to be considered will include goal-specific factors, presence of threats, sustainability, public interest and acceptability, and administrative issues. It is important to emphasize that project implementation will not proceed rigidly in strict order of numerical rankings. Flexibility is essential, and the Corps of Engineers, sponsor, and program partners, will need to exercise reasonable judgment to resolve unexpected issues, respond to opportunities, and ensure efficient program execution. Due to the watershed approach being taken during implementation, regulatory agencies will be included in the assessment and feasibility phases to better identify areas of concern.

In order for the project to succeed, collaboration and funding for a number of other agencies and programs will need to be strengthened and increased using the implementation framework provided in this report. In recognition of the technical expertise of the other Federal, state, and local partner agencies; the continued limitations on the Federal budget; and the requirements of Section 519 (e), we have worked collaboratively with our partners to evaluate the various programmatic authorities of each agency and investigate opportunities for synergy in implementing the proposed Illinois River Basin restoration initiatives. While the process of full multiple agency implementation will continue to be refined over the initial years of the program, based on collaboration to date, the following breakdown of work is anticipated:

U.S. Army Corps of Engineers (USACE). The Corps of Engineers could take the lead role in Illinois River main stem restoration utilizing the existing EMP program and proposed NESP programs to fund the majority. These programs are estimated to address approximately 75%, of main stem work and much of the main stem system monitoring activities. The Section 519 authority could focus primarily on watershed restoration addressing approximately 40% of the identified need for work in the tributaries, riparian, and floodplain areas with a focus on restoring the structure and function of aquatic and wetland areas, but would also provide a mechanism to conduct some additional main stem work,. The Section 519 authority could be utilized to develop and implement an integrated system monitoring program utilizing existing data collected by other Corps programs, other Federal agencies, and state and local groups.

U.S. Department of Agriculture (USDA). The USDA has a number of programs and experience and history in restoration throughout the basins. It is estimated that roughly 40% of the identified watershed and floodplain work could be addressed by existing and expanded USDA programs.

U.S. Environmental Protection Agency (USEPA). The USEPA has some restoration funding available. It is estimated that roughly 15-20% of the watershed work could be addressed by USEPA with a particular focus on water quality related issues. The USEPA also has active monitoring programs that could be integrated and help serve as a basis for future systemic monitoring.

U.S. Fish and Wildlife Service (USFWS). The USFWS has some limited restoration authorities and funding. It is estimated that up to 5% of the watershed work could be addressed by USFWS using existing and expanded programs, with a particular focus on private lands habitat restoration projects.

U.S. Geological Survey (USGS). The USGS Illinois Water Science Center (IWSC) performs various monitoring and study activities in the Illinois River Basin, and could serve as a key partner agency in the development and implementation of any long term monitoring.

State Agencies. The Illinois Department of Natural Resources, Illinois Environmental Protection Agency, Illinois Department of Agriculture, Indiana Department of Natural Resources, Wisconsin Department of Natural Resources would be looked to continue and expand their ongoing restoration efforts as well as serve as sponsors providing the required matching for many of the Federal programs.

Local Agencies. Local governments and non-governmental organizations are critical to future restoration efforts. In particular, they could play key roles in ensuring proper zoning and protection of sensitive areas, storm water management, land owner interaction, and protection and restoration of habitat areas. They also have the ability to match Federal funding sources.

Potential Amendments to Section 519 of the Water Resources Development Act (WRDA) of 2000, Public Law 106-541. The current authorization provides ongoing authority to evaluate and implement Critical Restoration Projects, conduct associated project-specific monitoring, and conduct additional studies and analyses. The current authority does limit some types of restoration due to the per project cost limits (e.g. not able to perform some larger backwater restorations and watershed efforts, etc.). The technologies and innovative approaches component could not be implemented without further authority, which currently limits the collection and analysis of systemic monitoring and evaluation of dredging technologies and beneficial use. In addition, collaboration could be improved if non-profit organizations were authorized to act as non-Federal sponsors for these projects. Finally, rather than following normal procurement laws and regulations, there is the potential for improved implementation efficiency with the use of methods similar to the NRCS. The NRCS is authorized to provide funding directly to landowners to undertake certain structural and land management conservation practices. In addition, NRCS assistance is often tied to shorter term measures. No recommendation is being provided at this time on whether to seek similar authority for the Corps. In summary, although the existing authorization provides adequate authority to implement much of the restoration plan, additional authority may be sought in the future to improve the efficiency of program implementation.

The following bullets highlight some potential legislative updates identified in the study process as areas of consideration to improve the future efficiency in implementing Section 519. These potential opportunities for legislative updates to Section 519 were developed in cooperation with the State of Illinois Department of Natural Resources, other Federal and State agencies, local governments, and various non-governmental organizations and are discussed more fully in the conclusions section.

- Increasing the per project Federal cost limit for Critical Restoration Project from $5 million to $20 million.
- Authorize implementation of a Technologies and Innovative Approaches Component as a component of the Comprehensive Plan that complements the Critical Restoration Project activities. Activities would include initiatives called for in Section 519 (b).(3).(A) development and implementation of sediment removal technology, sediment characterization, sediment transport, and beneficial uses of sediment; (C) long term resource monitoring; and (D) and a computerized inventory and analysis system.
- Authorization allowing the development of cooperative agreements and fund transfers between the Corps of Engineers and the State of Illinois; State of Indiana; State of Wisconsin; scientific surveys at the University of Illinois; and units of local government: counties, municipalities, and Soil and Water Conservation Districts to facilitate more efficient partnerships.
- Authorization to allow the Corps of Engineers to deviate from normal procurement laws and regulations and to provide funding directly to landowners to undertake shorter-term structural and land management conservation practices. No decision has been made on whether to seek such authority. If in the future the Corps decides to pursue, and Congress provides, such authority, it is likely that the Corps would work closely with the NRCS in the provision of such assistance. The practicality and policy implications of this approach will be evaluated during more detailed feasibility studies.
- Expand the authorization to allow non-profit organizations to serve as sponsors and sign Project Cooperation Agreements for restoration projects implemented under the Illinois River Basin Restoration program.

RECOMMENDATIONS

This comprehensive plan was prepared in response to congressional directive contained in Section 519(b) of the Water Resources Development Act of 2000. The plan was developed for the purposes of restoring, preserving, and protecting the Illinois River Basin for submission to Congress as required by Section 519(b)(5). It is recommended that the Secretary forward this report to Congress in response to their directive and the Illinois River Basin Restoration Program, as authorized in Section 519 of WRDA 2000, be continued under the existing authority to restore this nationally significant resource.

The 16 Tier I critical restoration projects identified in the Comprehensive Plan would produce independent, immediate and substantial restoration, preservation and protection benefits. As such, upon approval by the Secretary, these projects could be implemented under existing authority, subject to the availability of funds and execution of a PCA. Implementation of the Tier I projects would follow established implementation guidance and project cost sharing would be in accordance with Section 519(g), 65-percent Fedeeral/35-percent non-Federal. To date the Secretary has approved implementation of the Pekin Lake Northern Unit and Peoria Riverfront Upper Island critical restoration projects at a combined estimated total cost of $12,641,100 to be cost shared $8,216,715 Federal and $4,424,385 non-Federal. Implementation of the Tier I projects would begin significant restoration consistent with the preferred Comprehensive Plan alternative.

In addition, as Tier I planning efforts are completed, it is recommended that Tier II efforts be initiated following Assistant Secretary of the Army (Civil Works) approval to proceed with any additional critical restoration projects. This would allow for a seamless transition from Tier I to Tier II projects. Currently 45 potential projects have been identified. Specific projects for Tier II would be selected utilizing the process and criteria described in section 6 of this document.

Finally, it is recommended that additional studies and analyses be pursued in accordance with Section 519(b)(6). Pursuant to Section 519(b)(6) the Secretary shall continue to conduct such studies and analyses related to the comprehensive plan as are necessary. Potential areas for additional studies include further refinement to the Technologies and Innovative Approaches component and potentially additional monitoring to address the critical needs to determine the best methodology and approach for monitoring large tributary and small watersheds.

If fully implemented, Tier I efforts would result in the completion of 16 critical restoration projects and critical additional studies and analyses at a total cost of $131.2 million, cost shared $85.3 million Federal and $45.9 million non-Federal. The estimated annual Operation and Maintenance cost, of the Tier I projects completed by 2011, is estimated to be $125,000. These operation, maintenance, rehabilitation, and replacement costs would be the responsibility of the non-Federal project sponsors.

The recommendations contained herein reflect the information available at this time and current Departmental policies governing formulation of individual projects. They reflect neither the program and budgeting priorities inherent in the formulation of the national Civil Works construction program nor the perspective of higher review levels within the Executive Branch. Consequently, the recommendations may be modified before transmittal to Congress as proposals for authorization and implementation funding.

ILLINOIS RIVER BASIN RESTORATION
COMPREHENSIVE PLAN
WITH INTEGRATED ENVIRONMENTAL ASSESSMENT

FINAL

CONTENTS

* Denotes sections required for Environmental Assessment/NEPA Compliance

ACRONYMS

GLOSSARY

REFERENCES

APPENDICES

ILLINOIS RIVER BASIN RESTORATION
COMPREHENSIVE PLAN
WITH INTEGRATED ENVIRONMENTAL ASSESSMENT

FINAL

1. INTRODUCTION

A. STUDY AUTHORITY

Prior to initiating Federal involvement in addressing water resources problems, the U.S. Army Corps of Engineers (Corps) must have authority to investigate the problem. In the case of the Illinois River Basin, the Corps is partnering with the Illinois Department of Natural Resources (DNR) on two similar and complementary studies of the resources in the Basin.

This Report to Congress represents a final response to the Comprehensive Plan portion of the Illinois River Basin Restoration authority provided in Section 519 of the Water Resources Development Act (WRDA) 2000 and to the Illinois River Ecosystem Restoration Feasibility Study conducted under Section 216 of the 1970 Flood Control Act as a review of the completed 9-Foot Channel Navigation Project. The complementary nature of the Illinois River Ecosystem Restoration efforts and the Illinois River Basin Restoration Comprehensive Plan (Comprehensive Plan) effort led to the decision to present the findings in a joint Comprehensive Plan document. The Section 519 authorization also provides ongoing authority to evaluate and implement critical restoration projects.

Study efforts in the basin were first initiated through the Illinois River Ecosystem Restoration Study as part of the Corps' General Investigations (GI) Program. The study was initiated pursuant to the provision of funds in the Energy and Water Development Appropriations Act, 1998. The study reviewing the 9-Foot Channel Navigation Project was authorized by Section 216 of the 1970 Flood Control Act, which reads:

> *The Secretary of the Army, acting through the Chief of Engineers, is authorized to review the operation of projects the construction of which has been completed and which were constructed by the Corps of Engineers in the interest of navigation, flood control, water supply, and related purposes, when found advisable due to significant changed physical or economic conditions, and to report thereon to Congress with recommendations on the advisability of modifying the structures or their operation, and for improving the quality of the environment in the overall public interest.*

Congress provided an authority to more specifically address Illinois River Basin Restoration in Section 519 of the Water Resources Development Act (WRDA) of 2000. This authority calls for the completion of a comprehensive plan and critical restoration projects. Efforts under Section 519 were initiated following the provision of funds in the Energy and Water Development Appropriations Act of 2002. The authority states:

SEC. 519 (WRDA 2000). ILLINOIS RIVER BASIN RESTORATION.

(a) ILLINOIS RIVER BASIN DEFINED- In this section, the term `Illinois River basin' means the Illinois River, Illinois, its backwaters, its side channels, and all tributaries, including their watersheds, draining into the Illinois River.

(b) COMPREHENSIVE PLAN-

(1) DEVELOPMENT- The Secretary shall develop, as expeditiously as practicable, a proposed comprehensive plan for the purpose of restoring, preserving, and protecting the Illinois River basin.

(2) TECHNOLOGIES AND INNOVATIVE APPROACHES- The comprehensive plan shall provide for the development of new technologies and innovative approaches--
(A) to enhance the Illinois River as a vital transportation corridor;
(B) to improve water quality within the entire Illinois River basin;
(C) to restore, enhance, and preserve habitat for plants and wildlife; and
(D) to increase economic opportunity for agriculture and business communities.

(3) SPECIFIC COMPONENTS- The comprehensive plan shall include such features as are necessary to provide for—
(A) the development and implementation of a program for sediment removal technology, sediment characterization, sediment transport, and beneficial uses of sediment;
(B) the development and implementation of a program for the planning, conservation, evaluation, and construction of measures for fish and wildlife habitat conservation and rehabilitation, and stabilization and enhancement of land and water resources in the basin;
(C) the development and implementation of a long-term resource monitoring program; and
(D) the development and implementation of a computerized inventory and analysis system.

(4) CONSULTATION- The comprehensive plan shall be developed by the Secretary in consultation with appropriate Federal agencies, the State of Illinois, and the Illinois River Coordinating Council.

(5) REPORT TO CONGRESS- Not later than 2 years after the date of enactment of this Act, the Secretary shall transmit to Congress a report containing the comprehensive plan.

(6) ADDITIONAL STUDIES AND ANALYSES- After transmission of a report under paragraph (5), the Secretary shall continue to conduct such studies and analyses related to the comprehensive plan as are necessary, consistent with this subsection.

(c) CRITICAL RESTORATION PROJECTS-

(1) IN GENERAL- If the Secretary, in cooperation with appropriate Federal agencies and the State of Illinois, determines that a restoration project for the Illinois River basin will produce independent, immediate, and substantial restoration, preservation, and protection benefits, the Secretary shall proceed expeditiously with the implementation of the project.

(2) AUTHORIZATION OF APPROPRIATIONS- There is authorized to be appropriated to carry out projects under this subsection $100,000,000 for fiscal years 2001 through 2004.

(3) FEDERAL SHARE- The Federal share of the cost of carrying out any project under this subsection shall not exceed $5,000,000.

(d) GENERAL PROVISIONS-

(1) WATER QUALITY- In carrying out projects and activities under this section, the Secretary shall take into account the protection of water quality by considering applicable State water quality standards.

(2) PUBLIC PARTICIPATION- In developing the comprehensive plan under subsection (b) and carrying out projects under subsection (c), the Secretary shall implement procedures to facilitate public participation, including providing advance notice of meetings, providing adequate opportunity for public input and comment, maintaining appropriate records, and making a record of the proceedings of meetings available for public inspection.

(e) COORDINATION- The Secretary shall integrate and coordinate projects and activities carried out under this section with ongoing Federal and State programs, projects, and activities, including the following:

(1) Upper Mississippi River System-Environmental Management Program authorized under Section 1103 of the Water Resources Development Act of 1986 (33 U.S.C. 652).

(2) Upper Mississippi River Illinois Waterway System Study.

(3) Kankakee River Basin General Investigation.

(4) Peoria Riverfront Development General Investigation.

(5) Illinois River Ecosystem Restoration General Investigation.

(6) Conservation Reserve Program (and other farm programs of the Department of Agriculture).

(7) Conservation Reserve Enhancement Program (State) and Conservation 2000 Ecosystem Program of the Illinois Department of Natural Resources.

(8) Conservation 2000 Conservation Practices Program and the Livestock Management Facilities Act administered by the Illinois Department of Agriculture.

(9) National Buffer Initiative of the Natural Resources Conservation Service.

(10) Nonpoint source grant program administered by the Illinois Environmental Protection Agency.

(f) JUSTIFICATION-

(1) IN GENERAL- Notwithstanding Section 209 of the Flood Control Act of 1970 (42 U.S.C. 1962-2) or any other provision of law, in carrying out activities to restore, preserve, and

protect the Illinois River basin under this section, the Secretary may determine that the activities--
(A) are justified by the environmental benefits derived by the Illinois River basin; and
(B) shall not need further economic justification if the Secretary determines that the activities are cost-effective.

(2) APPLICABILITY- Paragraph (1) shall not apply to any separable element intended to produce benefits that are predominantly unrelated to the restoration, preservation, and protection of the Illinois River basin.

(g) COST SHARING-

(1) IN GENERAL- The non-Federal share of the cost of projects and activities carried out under this section shall be 35 percent.

(2) OPERATION, MAINTENANCE, REHABILITATION, AND REPLACEMENT- The operation, maintenance, rehabilitation, and replacement of projects carried out under this section shall be a non-Federal responsibility.

(3) IN-KIND SERVICES- The Secretary may credit the value of in-kind services provided by the non-Federal interest for a project or activity carried out under this section toward not more than 80 percent of the non-Federal share of the cost of the project or activity. In-kind services shall include all State funds expended on programs and projects that accomplish the goals of this section, as determined by the Secretary. The programs and projects may include the Illinois River Conservation Reserve Program, the Illinois Conservation 2000 Program, the Open Lands Trust Fund, and other appropriate programs carried out in the Illinois River basin.

(4) CREDIT-
(A) VALUE OF LANDS- If the Secretary determines that lands or interests in land acquired by a non-Federal interest, regardless of the date of acquisition, are integral to a project or activity carried out under this section, the Secretary may credit the value of the lands or interests in land toward the non-Federal share of the cost of the project or activity. Such value shall be determined by the Secretary.
(B) WORK- If the Secretary determines that any work completed by a non-Federal interest, regardless of the date of completion, is integral to a project or activity carried out under this section, the Secretary may credit the value of the work toward the non-Federal share of the cost of the project or activity. Such value shall be determined by the Secretary.

B. DESCRIPTION OF THE STUDY AREA

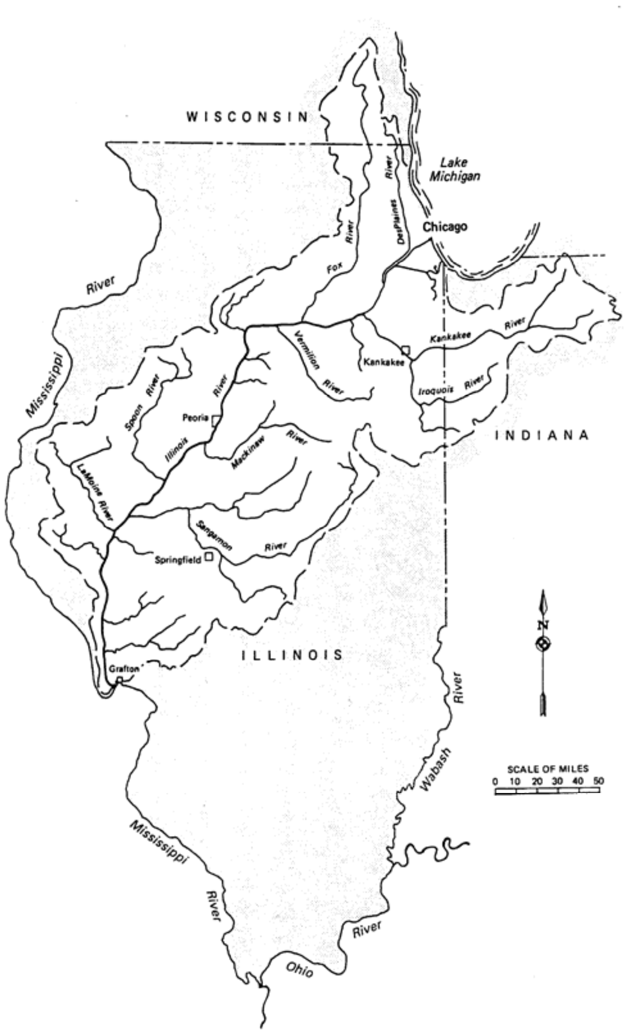


Figure 1-1. Location of the Illinois River Basin

The Illinois River begins at the point where the Des Plaines, and Kankakee Rivers converge near the Will and Grundy County lines. The river flows for a distance of 273 miles, ultimately entering the Mississippi at Grafton, IL, about 40 miles north of St. Louis. The Illinois River is the largest tributary to the Mississippi River above the mouth of the Missouri River. Major tributaries to the Illinois include the Des Plaines, Kankakee, Fox, Vermilion, Mackinaw, Spoon, Sangamon, and La Moine Rivers. The Illinois Environmental Protection Agency (IEPA) 305(b) report (2002), states that nearly 11,000 miles of perennial streams occur in the Illinois River Basin, with an estimated 20,000-25,000 additional miles of ephemeral streams. The study area encompasses the entire Illinois River Basin, the extents of which are shown in figure 1-1.

The Illinois Waterway (figure 1-2) refers to the river and the navigation system that connects it to Lake Michigan through the Des Plaines and Chicago Rivers and man-made navigation channels. With this added length, the Illinois Waterway spans 327 miles from Lake Michigan to its confluence with the Mississippi River. A series of eight lock and dam facilities maintain conditions suitable for navigation.

The entire Illinois River Basin encompasses approximately 30,000 square miles (19.2 million acres), covering 44 percent (16.5 million acres) of the land area of the State of Illinois and including more than a dozen tributaries of the main river. About 1,000 square miles of the watershed, the upper portions of the Fox and Des Plaines Rivers, extend into Wisconsin. The Kankakee and Iroquois Rivers extend 3,200 square miles into Indiana. The Illinois River Basin includes 46 percent of Illinois' agricultural land, 28 percent of its forests, 37 percent of its surface waters and streams, and 95 percent of its urban areas.

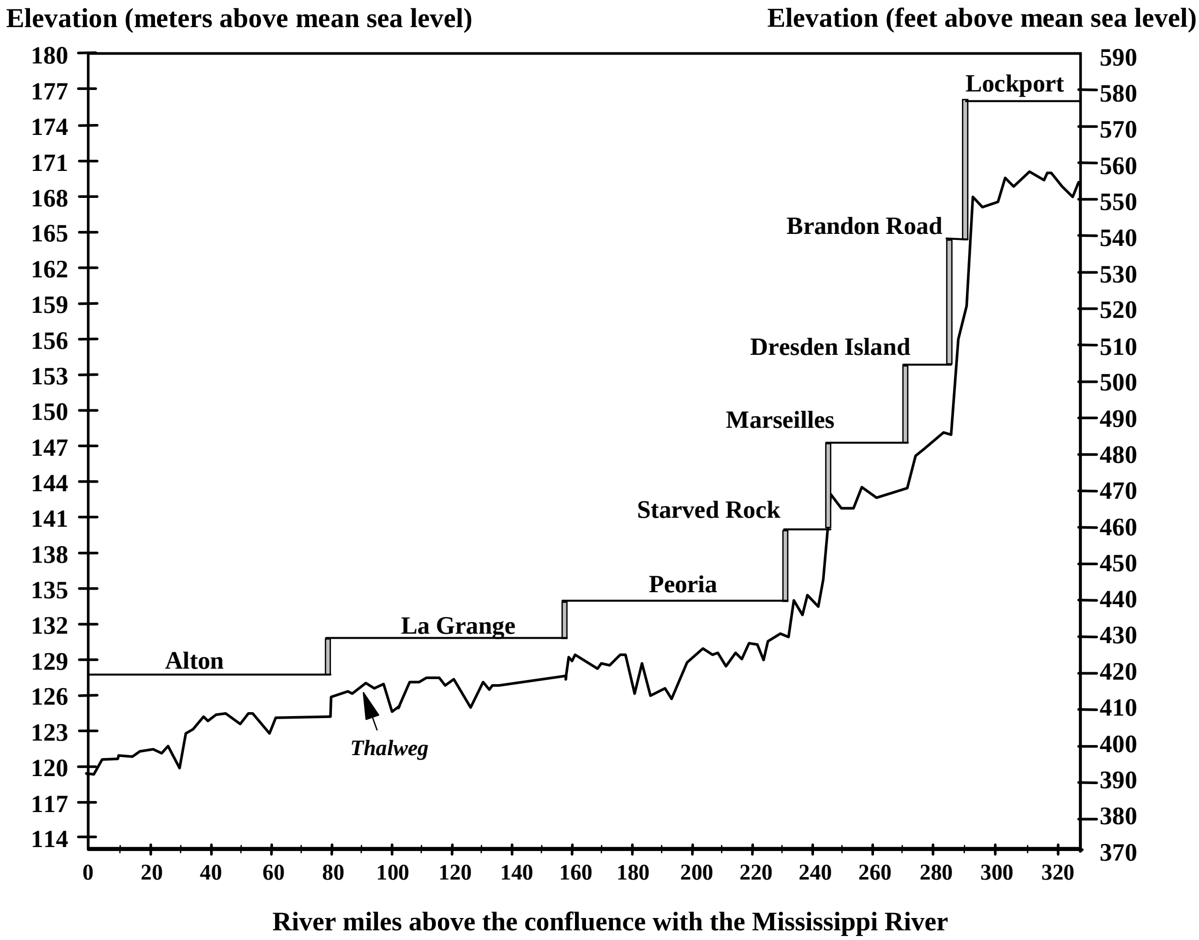


Figure 1-2. A Longitudinal Profile of the Illinois Waterway Lock and Dam System

The original efforts for this program focused on the Illinois portion of the basin. If and when future projects associated with this comprehensive plan are proposed for areas outside Illinois, individual coordination with appropriate Federal and State agencies would be required during project planning for compliance with National Environmental Policy Act (NEPA) and other Federal laws and policies applicable to all plans recommended for implementation.

The Congressional Districts located at least partially within the Illinois River Basin include Rush IL-1, Jackson IL-2, Lipinski IL-3, Gutierrez IL-4, Emanuel IL-5, Hyde IL-6, Davis IL-7, Bean IL-8, Schakowsky IL-9, Kirk IL-10, Weller IL-11, Biggert IL-13, Hastert IL-14, Johnson IL-15, Manzullo IL-16, Evans IL-17, LaHood IL-18, Shimkus IL-19, Visclosky IN-1, Chocola IN-2, Ryan WI-1, and Sensenbrenner WI-5.

C. STUDY PURPOSE AND SCOPE

The Rock Island, St. Louis, Chicago, and Detroit Districts of the Corps of Engineers and the Illinois DNR (non-Federal sponsor) collaborated to produce the Comprehensive Plan in response to two similar and complementary authorities to investigate the Federal and State interest in ecosystem restoration within the Illinois River Ecosystem. An Illinois River Basin Restoration Reconnaissance Study identifying a Federal interest in restoration under Section 216 was completed in February of 1999, with feasibility efforts initiated in 2000. Authorization of this Comprehensive Plan was provided in Section 519 of WRDA 2000 as described earlier in this Section. Following Corps Headquarters' approval of an Initial Assessment for the Section 519 authority in June 2002, the study team has progressed toward the completion of this Comprehensive Plan that presents the joint findings of investigations undertaken as part of both studies.

1. Study Purpose. At the broadest level, the Comprehensive Plan seeks to develop, evaluate, and implement a collaborative and sustainable watershed-based approach to ecosystem restoration. While a number of existing programs within the Corps of Engineers and other Federal agencies are designed to plan and implement ecosystem restoration or environmental quality improvements at specific locations in the basin, no program was in place that allowed for watershed-wide evaluation, problem identification, project selection, and implementation within one authority. Existing programs are limited in geographic extent or by available resources. The Illinois River Basin Restoration program meets that need by allowing for a comprehensive and collaborative watershed-based approach to solving the basin's problems and maximizing opportunities.

The Comprehensive Plan is being carried out in a manner consistent with the Corps' Environmental Operating Principles. The principles are consistent with NEPA; the Army's Environmental Strategy with its four pillars of prevention, compliance, restoration and conservation; and other environmental statutes and WRDAs that govern Corps activities. The Environmental Operating Principles are as follows:

- Strive to achieve environmental sustainability. An environment maintained in a healthy, diverse, and sustainable condition is necessary to support life.
- Recognize the interdependence of life and the physical environment. Proactively consider environmental consequences of Corps programs and act accordingly in all appropriate circumstances.
- Seek balance and synergy among human development activities and natural systems by designing economic and environmental solutions that support and reinforce one another.
- Continue to accept corporate responsibility and accountability under the law for activities and decisions under our control that impact human health and welfare and the continued viability of natural systems.
- Seek ways and means to assess and mitigate cumulative impacts to the environment; bring systems approaches to the full life cycle of our processes and work.

- Build and share an integrated scientific, economic, and social knowledge base that supports a greater understanding of the environment and impacts of our work.

- Respect the views of individuals and groups interested in Corps activities, listen to them actively, and learn from their perspective in the search to find innovative win-win solutions to the nation's problems that also protect and enhance the environment.

The proposed project was formulated according to the Environmental Operating Principles, especially in terms of maximizing the sustainability of ecological features. The project includes a watershed approach that seeks to address the water resources needs holistically. The goal of this project is to build on existing knowledge and share lessons learned on the restoration of this significant natural resource through the use of monitoring, adaptive management, and innovative technologies and approaches. The implementation framework proposed as part of this system study seeks to work collaboratively, fully engaging individuals, agencies, and local groups in the identification, planning, and implementation of restoration efforts.

2. Study Scope. This report assesses the total basin restoration needs and makes specific recommendations regarding modification of the existing Section 519 authority to improve implementation. The Corps and Illinois DNR (non-federal sponsor) worked together in coordination with numerous other State and Federal agencies on the Comprehensive Plan. The Illinois River Ecosystem Restoration Feasibility Study was initiated in 2000 to evaluate the need for and plan restoration at the watershed scale. Since the Illinois River Basin Ecosystem Restoration Feasibility Study was ongoing and already provided a general analysis of the basin's restoration needs. The focus of Section 519 activities was on addressing the four components identified in Sec 519 (b)(3). Less effort and focus was placed on (b)(2). The Comprehensive plan activities address the four areas of technologies and innovative approaches identified in Sec 519 (b)(2) and the four components identified in Sec 519 (b)(3), as described below."

(b) COMPREHENSIVE PLAN-

(2) TECHNOLOGIES AND INNOVATIVE APPROACHES- The comprehensive plan shall provide for the development of new technologies and innovative approaches--

(A) to enhance the Illinois River as a vital transportation corridor; <u>*Activities related to enhancing transportation are being addressed through the Upper Mississippi River – Illinois Waterway System Navigation Study and subsequent Planning, Engineering, and Design efforts. Duplication of this effort was not necessary since the Navigation Study covers navigation needs in the entire Illinois River Basin. The Navigation study looked at new technologies and innovative approaches, including the use of various small-scale measures, scheduling, and innovative construction techniques in considering improvements to the transportation corridor.*</u>

(B) to improve water quality within the entire Illinois River basin; <u>*The comprehensive plan includes a goal (Goal 6) – that addresses water and sediment quality. The proposed restoration activities if implemented will address water quality on a watershed basis through a wide range of potential measures.*</u>

(C) to restore, enhance, and preserve habitat for plants and wildlife; <u>*The major focus of the Comprehensive report and the measures and alternatives address this item. and*</u>

(D) to increase economic opportunity for agriculture and business communities *Activities related to economic opportunity are being addressed through the Upper Mississippi River – Illinois Waterway System Navigation Study and Upper Mississippi River Comprehensive Plan, duplication of these effort was not necessary as part of this effort In particular the Navigation Study referred to under (A) looked at new technologies and innovative ways to transport commodities and utilize the navigation system. The Upper Mississippi River Comprehensive Plan takes an innovative approach by focusing on the entire 500-year floodplain of the Illinois River. The study focuses on the development and evaluation of multiple systematic alternative plans composed of various combinations of structural and nonstructural measures that, if implemented, would result in reduced flood damage potential and net improvements to floodplain conditions thus benefiting economic opportunity.*

(3) SPECIFIC COMPONENTS- The comprehensive plan shall include such features as are necessary to provide for—

(A) the development and implementation of a program for sediment removal technology, sediment characterization, sediment transport, and beneficial uses of sediment; This component is planned for inclusion as part of the Technologies and Innovative Components element of this Comprehensive Plan.

(B) the development and implementation of a program for the planning, conservation, evaluation, and construction of measures for fish and wildlife habitat conservation and rehabilitation, and stabilization and enhancement of land and water resources in the basin; The major focus of this report, restoration measures, system alternatives, and the recommendations address this item.

(C) the development and implementation of a long-term resource monitoring program; This component is planned for inclusion as part of the Technologies and Innovative Components element of this Comprehensive Plan.

(D) the development and implementation of a computerized inventory and analysis system. This component is planned for inclusion as part of the Technologies and Innovative Components element of this Comprehensive Plan.

a. Comprehensive Plan. The purpose of the Comprehensive Plan is to meet Federal planning requirements and congressional authority in identifying restoration needs within the basin. The Illinois River Ecosystem Restoration Feasibility Study effort identified problems and opportunities, defined existing and future conditions in the basin, developed a consensus-based desired future condition and restoration needs, documented resource significance, and formulated at the system level to determine Federal interest and level of effort required. Related to these efforts was the development of a restoration program and prioritization process.

In addition, Section 519 funding was used to address Comprehensive Plan requirements from that legislation including: (1) the development and implementation of a program for sediment removal technology, sediment characterization, sediment transport, and beneficial uses of sediment; (2) the development and implementation of a program for the planning, conservation, evaluation, and construction of measures for fish and wildlife habitat conservation and rehabilitation, and stabilization and enhancement of land and water resources in the basin; (3) the development and implementation of a long-term resource monitoring program; and (4) the development and implementation of a computerized inventory and analysis system. The study area is the entire Illinois River Basin.

However, study and restoration initiatives placed particular focus on the rivers, streams, floodplain, and adjacent riparian corridors.

The following descriptions detail the major study investigations conducted under the Illinois River Ecosystem Restoration Study (Section 216) and Illinois River Basin Restoration (Section 519) efforts, respectively. These combined efforts resulted in an integrated Comprehensive Plan for the Illinois River Basin that satisfies both authorities for restoration of the Illinois River Basin Ecosystem.

b. Illinois River Ecosystem Restoration Study Major Investigations. Study activities being undertaken as part of the Illinois River Ecosystem Restoration Study, Section 216, were cost shared 50/50 between the Federal Government and Illinois DNR and include:

- **Develop Goals and Objectives.** System level goals and objectives were developed under the Ecosystem Study and are presented in Section 3.

- **System Restoration Needs Assessment (RNA).** The RNA aspect of the study was designed to evaluate existing data availability; compile existing data in a Geographic Information Systems (GIS) application; describe physiographic characteristics of the basin; evaluate stream channel dynamics; evaluate rapid watershed assessment techniques; evaluate existing, predicted, and desired future conditions; and compile a list of information needs.

  The RNA provided information that significantly contributed to the development of the Comprehensive Plan and monitoring program and will aid in the selection of future Critical Restoration Projects called for in Section 519 legislation. Specific items are summarized in Appendices B, *System Ecology*; C, *Hydraulics and Hydrology;* and D, *Sediment Analysis.* The following text highlights some of the major efforts:

  1. Sediment Budget. An updated sediment budget for the basin was completed.
  2. Summary of Illinois River Basin Landform and Physiographic Regions. The physiographic regions of the Illinois River Basin were updated and were used to provide part of the physical context necessary to evaluate restoration opportunities.
  3. Illinois River Restoration Needs Assessment GIS. A GIS tool has been developed to allow for the evaluation of readily available data on basin characteristics including land use/land cover, water quality, etc.
  4. Water Level Analysis. An evaluation of the causes of rapid water level fluctuations was completed. The results set the context for what types of management and restoration activities are required to improve the hydraulic regime of the Illinois River Basin.
  5. Basin Hydrologic Model. A coarse grid model of the basin was developed. This model was used to assess the potential for various types of restoration approaches to affect basin hydrology and sediment movements and identify the order of magnitude of restoration actions necessary to have an effect.

- **System NEPA and Coordination.** The NEPA documentation and required coordination for this systemic project was addressed through an integrated programmatic Environmental Assessment (EA) within this report. Subsequent NEPA documentation and coordination will be represented by individual, site-specific EAs and will be compiled for all future ecosystem restoration/critical restoration projects after they have been identified.

c. Illinois River Basin Restoration Major Investigations. Major investigations undertaken as part of the Illinois River Basin Restoration (Section 519) authority are cost shared 65/35 between the Federal Government and the State of Illinois, address the legislation, and include:

- **Development and implementation of a program for sediment removal technology, sediment characterization, sediment transport, and beneficial uses of sediment.** This task focused on the review, evaluation, and determination of applicability for existing sediment removal technology, sediment characterization, sediment transport, and beneficial use of sediment within the Illinois River Basin. Two field demonstrations of innovative sediment removal methods and technologies took place in the fall of 2002. These included the testing of the viability of various technologies (concrete pump and boom and mobile conveyor belt system) to move Illinois River sediments, and the viability of transporting sediments to the City of Chicago to add topsoil to brownfield sites. The product of this task is a concise summary of the various sediment removal, transport, and beneficial use options, their advantages and disadvantages, and appropriate application recommendations for the basin.

- **Development and implementation of a program for the planning, conservation, evaluation, and construction of measures for fish and wildlife habitat conservation and rehabilitation, and stabilization and enhancement of land and water resources in the basin.** The development of this program was the major outcome of the plan formulation efforts of the Comprehensive Plan. Based on the system level understanding gained through the various information gathering and analysis tasks, a proposed implementation framework has been developed and is presented in Section 6I, *Plan Formulation.*

- **Development and implementation of a long-term resource monitoring program.** Using contracts and interagency coordination, recommendations regarding system biological and physical monitoring as well as site-specific pre- and post-project monitoring recommendations have been developed. A program for long-term resource monitoring of the basin was documented, along with recommendations for implementation. The recommended program will help to better understand the system, identify changes, and provide a measure by which the cumulative effects of the implementation of critical restoration projects can be assessed.

- **Development and implementation of a computerized inventory and analysis system.** As part of efforts to develop a long-term resource monitoring program recommendations were developed for computerized inventory, analysis, and dissemination of information collected to interested parties.

d. Assumptions and Exceptions. The following assumptions provided the basis for development of the Comprehensive Plan:

- The without-project condition of the Illinois River Basin includes continued decline in ecological integrity due to sedimentation of backwaters and side channels, degradation of tributary streams, continued water level fluctuations, loss of floodplain and tributary connectivity, habitat loss and fragmentation, and other adverse impacts caused by human activities.

- The Comprehensive Plan was developed as a Report to Congress addressing Section 519 of WRDA 2000, and serves as a response to the complementary Illinois River Ecosystem Restoration Feasibility Study authority as well. Illinois River Ecosystem Restoration Study efforts will meet NEPA, U.S. Fish and Wildlife Service (USFWS) coordination, and programmatic cultural compliance, etc. for the system investigations. A separate feasibility level Project Implementation Report will be prepared for each Critical Restoration Project. These documents will provide the basis for individual project approvals and will address Federal and State environmental and cultural requirements.

- The Comprehensive Plan developed recommendations consistent with the Upper Mississippi River - Illinois Waterway System Navigation Feasibility Study and the Upper Mississippi River Comprehensive Plan projects, but did not include efforts and investigations regarding transportation and flood protection needs, since these areas are comprehensively addressed by these aforementioned Corps studies.

- Future implementation of currently unauthorized projects—Upper Mississippi River - Illinois Waterway System Navigation Feasibility Study; the Upper Mississippi River Comprehensive Plan; and Kankakee River Basin Study—is uncertain. As a result, the implementation framework in Section 6, *Plan Implementation,* describes how the relationship with other Corps programs would be addressed, but exact funding levels are not described. In regards to Navigation Study and follow-on efforts, Section 519 evaluated restoration alternatives throughout the entire watershed, while the Navigation Study ecosystem restoration components limit activities to areas along the Mainstem Illinois River. The mainstem restoration recommendations do overlap, but if both are authorized the Navigation Study follow-on funding would be used for the majority of mainstem restoration efforts. In addition, provisions were made to closely coordinate future restoration efforts to maximize effectiveness and avoid any duplication.

e. Critical Restoration Projects. In addition to the work on the Comprehensive Plan, Section 519 also authorized the identification and implementation of projects within the watershed and along the course of the river that repair past and ongoing ecological damage so that a more highly functioning, self-regulating ecosystem can develop within the existing basin context. Critical restoration projects would produce immediate habitat and sediment reduction benefits; will help evaluate the effectiveness of various restoration methods before application system wide; and make best use of the current strong local and State interest in ecosystem restoration within the basin. The Corps of Engineers will implement these critical restoration projects in collaboration with the non-Federal sponsor and with other Federal and local agencies. Section 6, *Plan Implementation*, contains additional information on potential project types and sixteen critical restoration projects initiated at the time of the writing of this report.

D. STUDY ORGANIZATION

1. Study Organizational Structure

The system study and further restoration and monitoring activities will be conducted under the following organizational structure:

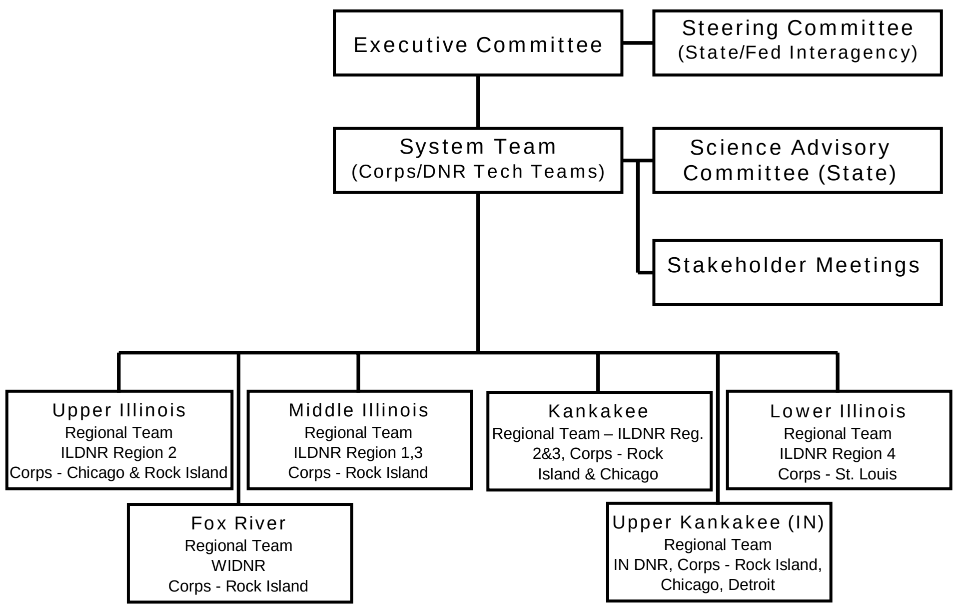


Figure 1-3. Study Organizational Structure

a. Executive Committee. The Committee will have representatives from both Regional Headquarters (i.e., Mississippi Valley Division (MVD) and Great Lakes and Ohio River Division), the Corps Districts (i.e., Rock Island, St. Louis, Chicago, and Detroit), and the non-Federal sponsors (i.e., Illinois Department of Natural Resources (DNR) and representatives from the states of Indiana and Wisconsin). The Executive Committee will be chaired by the MVD. It will be responsible for oversight on the management and implementation of the project, including decisions on project funding. The Executive Committee will meet approximately twice a year, with meeting schedules timed to synchronize receipt or provision of input from other committee meetings as needed.

b. Steering Committee. The Steering Committee will be the interagency group responsible for coordinating the Illinois River Basin and Ecosystem Restoration efforts. It will be co-chaired by the Corps of Engineers and the Illinois DNR, and will be composed of state and Federal agency representatives. This Committee will meet approximately twice a year to exchange views, information, and advice to ensure coordination among various agency programs.

c. System Team. The System Team will be composed of the multi-disciplinary technical staff primarily from the Corps of Engineers and State DNRs. Additional team members may be selected. This team will have primary responsibilities for overall project delivery and system evaluations. The team will incorporate the expertise of scientists and technical staff as necessary.

d. Regional Teams. Organizing efforts by geographic region allows for more efficient accomplishment of project activities. Four regions established for the basin are Upper Illinois, Middle Illinois, Kankakee, and Lower Illinois. The regional teams, made up of Corps of Engineers and State DNR staff, will have primary responsibilities for the evaluation and implementation of critical restoration projects. Two additional teams (Fox River and Upper Kankakee) may be added in the future if Wisconsin and Indiana choose to participate. Regional team meetings will provide a forum for groups—with detailed information on resource concerns—to exchange views and information regarding areas in need of assessment and potential critical restoration projects, evaluate the proposed site-specific projects, and facilitate the detailed study of these projects. Invited attendees include the Illinois Environmental Protection Agency, Illinois Department of Agriculture, representatives from the States of Indiana and Wisconsin, USDA Natural Resources Conservation Service and Farm Service Administration, U.S. Fish and Wildlife Service, U.S. Environmental Protection Agency, U.S. Geological Survey, Ecosystem Partnership Groups, Soil and Water Conservation Districts , Non-Governmental Organizations, Levee and Drainage Districts, and Local Governments.

e. Stakeholders Meetings. Stakeholders meetings will provide a forum to present study status and information on implementation and management to all interested Federal, State, and local agencies, as well as non-governmental organizations. Stakeholders meetings will be held approximately once a year in each of the four regions or as interim products are completed. Their primary focus will be public involvement, information sharing, and dialog among all groups and interests.

f. Science Advisory Committee. The State of Illinois Science Advisory Committee, a sub-committee of the Illinois River Coordination Council, will provide input to the System Team.

2. U.S. Army Corps of Engineers Division of Responsibilities

The following structure is similar to that of the existing Upper Mississippi River - Environmental Management Program (UMR-EMP) and is proposed as a means of defining responsibilities throughout the Corps of Engineers in relation to Section 519 implementation. These responsibilities include, but are not limited to, the following:

a. Assistant Secretary of the Army (Civil Works) [ASA(CW)]. Final approval authority for products and critical restoration projects remains with ASA(CW) unless otherwise delegated.

b. Headquarters Level. The Corps of Engineers Headquarters (HQUSACE) maintains responsibility for the overall Section 519 Illinois River Basin Restoration Program, its budget, and approval authority for individual Critical Restoration Projects and coordination with ASA(CW).

c. Regional Headquarters Level. The Corps of Engineers' Mississippi Valley Division (MVD) will be responsible for overall execution direction and management of the Section 519 Illinois

River Basin Restoration Program and coordination with the Great Lakes and Ohio River Division (LRD). Both MVD and LRD will serve on the Executive Committee, chaired by MVD.

d. Program Level. The Corps of Engineers' Rock Island District will administer regional project management responsibilities, including the following:

i. Serve as the primary point of contact for Illinois River Basin Restoration activities

ii. Report the program financial execution to MVD and others on a quarterly basis

iii. Coordinate the activities of the Executive Committee, Steering Committee, Stakeholders Group, and System Team

iv. Coordinate, consolidate, and forward to MVD all upward reporting requirements, such as budgetary information, fact sheets, and issue papers that require input from more than one district

v. Lead the comprehensive system study efforts

vi. Serve as lead responsible party for system monitoring efforts

e. Project Level. Each district shall carry out assigned tasks, participate in committees, and communicate funding and schedule information with the Rock Island District for consolidation and regional coordination. The responsibility for planning, design, construction, monitoring, and evaluation of Critical Restoration Projects will be assigned to the districts (Rock Island, St. Louis, Chicago and Detroit) based on their jurisdictional boundaries. The districts will be responsible for staffing, scheduling, and communicating funding needs for the efforts of individual Product Delivery Teams (PDTs) operating within their district boundaries. The assignment of projects that cross district boundaries will be determined by the Executive Committee, as necessary.

E. RELATIONSHIP AMONG CORPS, FEDERAL, AND STATE ACTIVITIES

Several ongoing activities involve collaborative efforts among Federal, State, and local agencies to address water and related land resources within the Illinois River Basin. The most significant Federal and state actions are briefly summarized below with additional detail on the activities and their relationship to this program described in greater detail in Section 6, *Plan Implementation.*

1. U.S. Army Corps of Engineers Efforts

The U.S. Army Corps of Engineers is currently conducting a wide range of study and implementation activities ranging from other ecosystem restoration activities to navigation and flood damage reduction. These efforts will be closely coordinated as described in Section 6. Specific ongoing activities in the basin include:

a. Peoria Riverfront Development (Ecosystem Restoration) Study, Illinois. The project is located within Peoria and Tazewell Counties, Illinois, between Illinois River Miles 162-167. The feasibility study was conducted by the Corps of Engineers and Illinois DNR (non-Federal sponsor) to investigate Federal and state interest in ecosystem restoration within Peoria Lake and the Farm Creek Watershed. The feasibility study, completed in 2003, recommended dredging and island creation. In

2004, approval was given to initiate dredging and construct the first of three islands as a Critical Restoration Project under Section 519 authority.

b. Upper Mississippi River System - Environmental Management Program. The Environmental Management Program (EMP) for the Upper Mississippi River System was established by WRDA 1986. Currently, the EMP is comprised of two elements—Habitat Rehabilitation and Enhancement Projects (HREPs) and the Long Term Resource Monitoring Program (LTRMP). This ongoing system program provides a combination of monitoring and habitat restoration activities.

c. Upper Mississippi River - Illinois Waterway System Navigation Study and the follow on Navigation and Ecosystem Sustainability Program (NESP). The study was completed in September 2004 and calls for navigation improvements and ecosystem restoration on the Upper Mississippi River and Illinois Waterway System. The study area includes 854 miles of the Upper Mississippi River, with 29 locks and dams, between Minneapolis/St. Paul and the mouth of the Ohio River, and 327 miles of the Illinois Waterway, with eight locks and dams. The study area lies within portions of Illinois, Iowa, Minnesota, Missouri, and Wisconsin. The navigation system's principal problems are delays to commercial traffic due to limited lockage capacity and increasing traffic and the continued degradation of environmental resources. While no authorization for construction has been provided, follow-on study and design efforts were initiated in 2005 for a number of navigation and ecosystem restoration components.

d. Upper Mississippi River (UMR) Comprehensive Plan. The Comprehensive Plan Study was authorized by Section 459 of WRDA 1999 to "develop a plan to address water resource and related land resource problems and opportunities in the Upper Mississippi and Illinois River basins from Cairo, Illinois, to the headwaters of the Mississippi River, in the interest of the systemic flood damage reduction . . .". This study focuses primarily on the 500-year floodplains of the reach of the UMR between Anoka, Minnesota, and Thebes, Illinois, and the reach of the Illinois River between its confluence with the Mississippi and the confluence of the Kankakee and Des Plaines Rivers. The report will be completed in Fiscal Year 2007, with subsequent submission to Congress.

e. Kankakee River Basin Feasibility Study. The Kankakee River Basin, a major tributary to the Illinois River, drains an area of approximately 5,200 square miles in Illinois and Indiana. A study by the Chicago District of the U.S. Army Corps of Engineers is investigating opportunities within the basin for flood damage reduction, sediment reduction, and ecosystem restoration. The study is currently on hold due to funding.

2. Ongoing Federal Efforts

Other Federal Agencies that perform numerous restoration and monitoring programs and activities in the basin include the: U.S. Department of Agriculture, U.S. Environmental Protection Agency , U.S. Fish and Wildlife Service, and U.S. Geological Survey. More specifics on each agency's programs, authorities, and potential role in implementation are provided in Section 6, *Plan Implementation.*

3. Ongoing Efforts by the State of Illinois

The State of Illinois has focused a great deal of resources on the Illinois River Basin. These efforts include:

a. Watershed Management Committee (WMC). The WMC was formed by the directors of eight Illinois State agencies to address and coordinate issues among the state's natural resource and environmental agencies. The WMC has the following mission:

> *To serve in an ongoing capacity to coordinate watershed-based activities and programs among Illinois' natural resource and environmental agencies. The Committee will also serve a liaison function to provide for the coordination of Federal and local involvement in watershed activities.*

In 1998, the WMC was expanded to include additional State and Federal agencies, as well as several non-governmental organizations in order to both expedite the development of watershed approaches for resource planning and to promote greater coordination between State agencies and Federal counterparts. In an effort to restore and protect watersheds within the state, the WMC published *Unified Watershed Assessment and Watershed Restoration Priorities for Illinois*. This report and the associated action plan lists priority watersheds in the State of Illinois and calls for coordination of activities and resources to help protect and restore water resources. The Illinois River Watershed and many of its tributary watersheds are listed as priority watersheds.

b. The Integrated Management Plan for the Illinois River Watershed. This document was the culmination of several years of effort by local and state governments in Illinois to build a consensus-based partnership with citizens and interest groups to address the issues that face the Illinois River Basin. Conservation, environmental, industry, Federal, State, regional, and local governments all participated in shaping a vision for the future of the basin. The plan has also given policy direction to numerous independent state conservation programs in the pursuit of a unified approach to address the problems present in the basin.

c. Illinois River Watershed Restoration Act. In July 1997, the State of Illinois enacted the Illinois River Watershed Restoration Act. The legislative purposes of the Act were to: (1) create a group of leaders representing agriculture, business, conservation, and the environment to encourage the implementation of efforts to restore the Illinois River Watershed in accordance with the recommendations of the *Integrated Management Plan for the Illinois River Watershed Technical Report;* (2) work with local communities to develop projects and regional strategies; and (3) make recommendations to appropriate State and Federal agencies, or local programs.

d. Illinois River Coordinating Council IRCC). The IRCC was created by the Illinois River Watershed Restoration Act as described in (1) above, chaired by the Lieutenant Governor. The IRCC consists of a diverse group of citizens, grassroots and not-for-profit organizations, state and federal agencies, and river enthusiasts. The Agency members of the Council shall include the Director (or designee) of each of the following agencies: the Department of Agriculture; the Department of Commerce and Community Affairs; the Illinois Environmental Protection Agency; the Department of Natural Resources; and the Department of Transportation. In addition, the Council shall include one member representing Soil and Water Conservation Districts located within the Watershed of the Illinois River and its tributaries and 6 members representing local communities, not-for-profit organizations working to protect the Illinois River Watershed, business, agriculture, recreation, conservation, and the environment. The Governor may, at his or her discretion, appoint individuals representing federal agencies. The IRCC coordinates all private and public funding for river restoration in the sprawling Illinois River Watershed. Over the past four years, the IRCC has been involved in the commitment and expenditure of nearly $500 million to restore the Illinois River Basin.

e. Conservation Reserve Enhancement Program (CREP). More than $450 million has been targeted at the State and Federal level to improve the Illinois River through the CREP, which uses state funding to enhance existing USDA CRP activities. The CREP initiative if fully implemented will help preserve up to 232,000 acres of sensitive land surrounding the Illinois River and its tributaries, including upland areas. Illinois leads the nation in the number of acres currently enrolled at 110,000 in the Federal program, and the most acres permanently protected, 92 percent of the 73,000 acres enrolled in the State portion of the program.

f. Illinois Rivers 2020. This is an initiative of the State of Illinois that proposes to establish a $2.5 billion, 20-year State/Federal partnership to restore the basin. It seeks to build upon the success of the Illinois River Conservation Reserve Enhancement Program (CREP). It is a voluntary, incentive-based approach, broader and more inclusive than CREP and applies to the entire Illinois River and its tributaries. It addresses all the threats to the economic and environmental sustainability of Illinois' vitally important waterways. Illinois Rivers 2020 utilizes existing agencies, programs, and delivery mechanisms in the Farm Bill programs and the CWA Section 319 and seeks special consideration under the WRDA. The State of Illinois views the Illinois River Basin Restoration Authority as the mechanism for the Corps of Engineers' to further develop a comprehensive plan and to initiate restoration activities. Further support for implementation of Illinois Rivers 2020 is very broad, including hundreds of individuals, elected officials, organizations, and businesses that officially support this effort.

g. Other State Programs: A number of programs administered by the Illinois DNR, Illinois Department of Agriculture, and Illinois Environmental Protection Agency (EPA) are helping to restore the basin and are described in Section 6, *Plan Implementation.*

h. Illinois Department of Natural Resources (DNR) – Conservation Lands. The Illinois DNR currently manages approximately 100,000 acres for conservation purposes in the basin. Twelve State of Illinois conservation areas totaling 26,568 acres can be found along with two state forests of 3,673 acres. Also, State Fish and Wildlife Areas can be found at 12 locations totaling 18,138 acres. Finally, the Illinois DNR operates 25 state parks within the Basin, with 42,138 acres dedicated to conservation and recreation.

F. CONCISE DISCUSSION OF STUDIES, REPORTS, AND EXISTING WATER PROJECTS

A number of documents were reviewed, including studies prepared by the U.S. Army Corps of Engineers; the Illinois DNR; the Illinois State Water Survey; the Illinois Natural History Survey; the Tri-County Regional Planning Commission; the University of Illinois; The Nature Conservancy; the Heartland Water Resources Council; and the Office of the Lt. Governor of the State of Illinois.

Some of the most notable studies and actions are as follows:

The Fate of Lakes in the Illinois River Valley, Bellrose, Frank C., et al., Illinois Natural History Survey, 1983.

This document uses historical sedimentation rates for Illinois River backwater lakes to develop mathematical models of the life expectancy of Illinois River backwater lakes. Most backwaters filled dramatically with sediment at an average annual rate of 0.10 to 0.74 inches since the 1930's. System-wide, backwater lakes have lost an average of 70 percent of their volume since 1903.

Sediment Yield of Streams in Northern and Central Illinois, Adams, J. Roger, et al., Illinois State Water Survey, December 1984.

This report developed mathematical models to estimate sediment yields for streams in the Illinois River Basin based on sediment monitoring data.

Peoria Lake Sediment Investigation, prepared for the U.S. Army Corps of Engineers by the Illinois Department of Energy and Natural Resources, State Water Survey Division, January 1986.

This report summarizes the impacts of human activities on sedimentation using data from bathymetric profiles and core samples. It concludes that controlling sedimentation in Peoria Lake would require some combination of controlling sediment input, managing in-lake sediment, drawing down Peoria Lake, creating artificial islands, selective dredging, and creating marshy areas.

Illinois River from Henry to Naples, Illinois, Peoria Lake and La Grange Pool, Illinois River Basin, U.S. Army Corps of Engineers Reconnaissance Study, March 1987.

This study, authorized in Section 109 of Section 1304 of the Supplemental Appropriations Act, investigates the advisability of the preservation, enhancement, and rehabilitation of Peoria Lake near Peoria, Illinois.

Hydraulic Investigation for the Construction of Artificial Islands in Peoria Lake, Illinois Department of Energy and Natural Resources, State Water Survey Division, Champaign, Illinois, July 1988.

This investigation identifies alternative locations for building islands in Upper and Lower Peoria Lakes. Hydraulic modeling was used to determine the effects of islands upon water surface elevations, sedimentation patterns, and current velocities.

Upper Mississippi River System-Environmental Management Program, Peoria Lake Habitat Rehabilitation and Enhancement Project Definite Project Report, U.S. Army Corps of Engineers, July 1990.

This technical publication, complete with NEPA documentation and engineering plans, was the authorizing document by which a 16-acre barrier island was created in Upper Peoria Lake. This project enhanced migratory waterfowl, fish, and aquatic habitat. Project monitoring indicates an increase in absolute numbers and diversity of water bird and fish species at the project site.

The Illinois River: Working for Our State, Talkington, Laurie McCarthy, Illinois State Water Survey, January 1991.

This document summarizes information on the past, current, and projected future conditions of the Illinois River.

Erosion and Sedimentation in the Illinois River Basin, Demissie, Misganaw, et al., Illinois State Water Survey, June 1992. This report estimates a sediment budget for the Illinois River Valley.

The report also discusses the effect of changed crop practices upon sediment loads.

Source Monitoring and Evaluation of Sediment Inputs for Peoria Lake, Bhowmik, Nani G., et al., Illinois State Water Survey, February 1993.

The objectives of this study were to identify the sediment sources to Peoria Lake and to evaluate sediment loads from local tributaries. This study evaluated the sources of sediment in Peoria Lake and estimated that a large percentage of sediment in the lake comes from local tributaries.

Section 216 Initial Appraisal, Illinois Waterway System Ecosystem Restoration and Sedimentation, Illinois, U.S. Army Corps of Engineers, Rock Island District, August 1996.

This document recommends further study of the Illinois Waterway ecosystem in light of changed physical and economic conditions since the 9-foot navigation channel was constructed.

Illinois River Characterization for Restoration and Beneficial Use of Sediment, Marlin, John C., Illinois Department of Natural Resources Waste Management and Research Center, April 1997. Proposal to U.S. Department of Agriculture.

This document reviews available information on the sediment characteristics of the Illinois River and its potential beneficial uses.

Strategic Renewal of Large Floodplain Rivers, University of Illinois, Water Resources Center.

This ongoing research effort at the University of Illinois, Urbana, Illinois, aims to develop a combined hydrologic, ecological, and economic restoration model for the La Grange Pool of the Illinois River.

Restoration of Large River Ecosystems: Hydrologic and Hydraulic Analyses of La Grange Pool of the Illinois River, Xia, R. and M. Demissie, 1997. Hydrology Division, Illinois State Water Survey, Champaign.

This report documents the hydrologic and hydraulic analysis of the La Grange Pool conducted for the Strategic Renewal of Large Floodplain Rivers research effort.

Integrated Management Plan for the Illinois River Watershed, January 1997. This plan was prepared by the Illinois River Strategy Team in cooperation with nearly 150 participants, chaired by Lt. Governor Bob Kustra.

The plan contains 34 recommendations divided into six sections: In the Corridor, Soil and Water Movement, Agricultural Practices, Economic Development, Local Action, and Education.

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, La Crosse, WI. 1998.

This is the first report since the inception of the Environmental Management Program and beginning of data collection under LTRMP in which the monitoring data are summarized into one report, alongside historical observation and other scientific findings. This report also serves as background material for the U.S. Army Corps of Engineers' Report to Congress that provided recommendations for future environmental management of the UMRS. In addition, this report provides a timely assessment of river conditions.

Mackinaw River Watershed Management Plan, The Nature Conservancy, June 1998.

This document provides a long-range plan for the 1,138-square-mile watershed of this tributary of the Illinois River that recommends the establishment or restoration of 22,500 acres of wetlands.

Illinois River Site Conservation Plan, The Nature Conservancy, December 1998.

This document presents a plan for the implementation of conservation measures in the Illinois River Basin.

The Classification of Aquatic Communities in the Illinois River Watershed and Their Use in Conservation Planning, The Nature Conservancy, December 1998.

This report focuses on the aquatic conservation planning process, beginning with a description of the aquatic community classification system and the rationale for its development. The abiotic classification of stream and lake habitats is outlined, followed by a description of the biotic classification of fish alliances. The use of this classification system in conservation planning is discussed, followed by conclusions drawn from this work.

Threats to the Illinois River Ecosystem, The Nature Conservancy, December 1998.

The document summarizes the results of the threat assessment, which concludes that altered hydrology, habitat loss, sedimentation, and altered water quality are the four most critical stresses to the system.

Unified Watershed Assessment and Watershed Restoration Priorities for Illinois, Watershed Management Committee, 1998.

This report and the associated action plan list priority watersheds in the State of Illinois and call for coordination of activities and resources to help protect and/or restore water resources. The Illinois River Watershed and many of its tributary watersheds are listed as priority watersheds.

General Investigation Reconnaissance Study, Illinois River, Peoria Riverfront Development (Environmental/Ecosystem Restoration), U.S. Army Corps of Engineers, Rock Island District, May 1998.

This study determined the Federal interest in: (1) reducing sedimentation impacts in the Illinois River at Peoria Lake, (2) restoring fish and wildlife habitat, and/or (3) providing flood damage reduction measures as related to riverfront development near Peoria. This reconnaissance effort led to the *Peoria Riverfront Development, Illinois (Ecosystem Restoration) Feasibility Study with Integrated Environmental Assessment* described below.

General Investigation Reconnaissance Study, Illinois River, Ecosystem Restoration, Section 905(b) Reconnaissance Analysis, U.S. Army Corps of Engineers, Rock Island District, January 1999.

This report concluded that ecosystem restoration in the Illinois River Basin is within the Federal interest and that Corps of Engineers involvement is appropriate. Further, measures to address the loss of backwaters, changed hydrologic regimes and water fluctuations, and other impacts upon the system were identified and found to have no anticipated negative environmental impacts. The resulting Project Study Plan and Cost Sharing Agreements with the Illinois DNR have resulted in the initiation of the Illinois River Ecosystem Restoration Feasibility Study.

Critical Trends in Illinois Ecosystems. Critical Trends Assessment Program (CTAP), Illinois Department of Natural Resources, Springfield, IL. 2001.

This report provides an overview of each of the 16 CTAP projects. The report summarizes the findings of each project, describes land cover, and provides initial ecosystem monitoring results and results of regional assessments, including resource rich areas.

Initial Assessment, Illinois River Basin Restoration, Section 519 of the Water Resources Development Act (WRDA) of 2000, U.S. Army Corps of Engineers, Rock Island District, May 2002.

The initial assessment served as a reconnaissance-level report outlining the Federal interest, work for future phases, relationship to the Illinois River Ecosystem Restoration Study, and summary of proposed Critical Restoration Projects and Long-Term Resource Monitoring.

Peoria Riverfront Development, Illinois (Ecosystem Restoration) Feasibility Study with Integrated Environmental Assessment, U.S. Army Corps of Engineers, Rock Island District, March 2003.

This Feasibility Study was conducted by the Corps of Engineers and the Illinois DNR (non-Federal sponsor) to investigate the Federal and State interest in ecosystem restoration within Peoria Lake and the Farm Creek Watershed. The recommended plan includes dredging approximately 200 acres within Lower Peoria Lake to create deepwater habitats and constructing three islands with a total area of 75 acres.

Conservation Priorities for Freshwater Biodiversity in the Upper Mississippi River Basin, R. Weitzell, E. McKhoury, P. Gagnon, B. Schreurs, D. Grossman, and J. Higgins, Nature Serve and The Nature Conservancy, July 2003.

This study evaluates the components and patterns for the freshwater biodiversity of the UMRB and identifies the most significant places to focus conservation opportunities to maintain it.

2004 Report to Congress, Upper Mississippi River System Environmental Management Program. U.S. Army Corps of Engineers (USACE), Rock Island District, Rock Island, IL.

This Report to Congress is the second formal evaluation of the Environmental Management Program (EMP). This report evaluates the EMP; describes its accomplishments, including development of a systemic habitat needs assessment; and identifies certain program adjustments.

Upper Mississippi River-Illinois Waterway System Navigation Feasibility Study, Feasibility Report 2004. U.S. Army Corps of Engineers (USACE), Rock Island District, St. Paul District, and St. Louis District.

This feasibility study examines multiple navigation and environmental restoration alternatives, and contains the preferred integrated plan as a framework for modifications and operational changes to the Upper Mississippi River and Illinois Waterway System to provide for navigation efficiency and environmental sustainability.

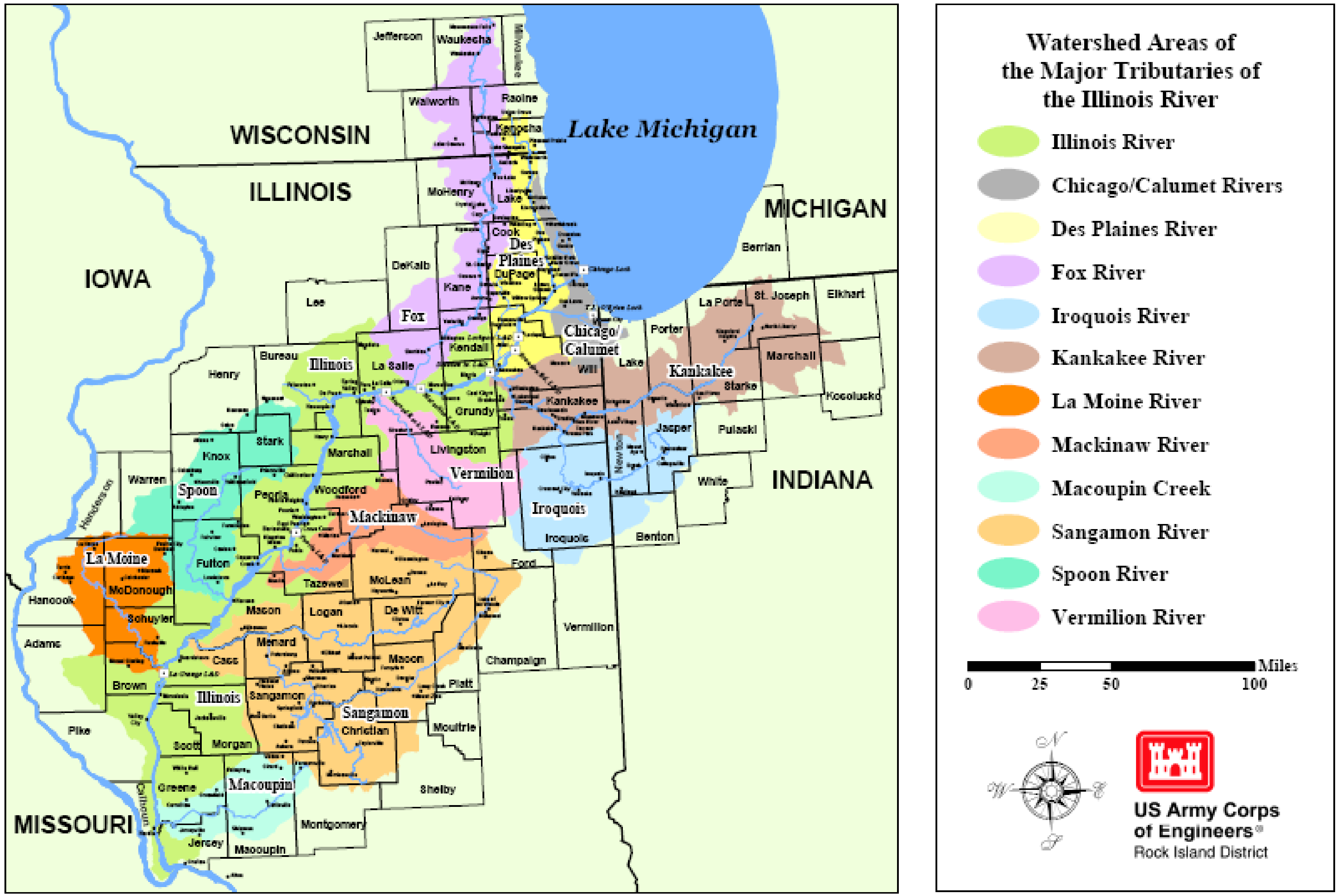


Figure 2-1. Illinois River and Tributaries

2. STUDY CONTEXT AND SETTING

A. NEED FOR ACTION

The Illinois River Basin has experienced the loss of ecological integrity due to sedimentation of backwaters and side channels; degradation of tributary streams; increased water level fluctuations; reduction of floodplain and tributary habitat and connectivity; and other adverse impacts caused by human activities. Figure 2-1 depicts the Illinois River and its tributary streams.

The combined effects of habitat losses—through changes in land use, human exploitation, habitat degradation and fragmentation, water quality degradation, and competition from aggressive invasive species—have significantly reduced the abundance and distribution of many native plant and animal species in the Illinois River Basin. Additional human alterations of Illinois River Basin landscapes have changed the timing, magnitude, duration, and frequency of habitat forming and seasonal disturbance regimes. The cumulative results of these complex, systemic changes are now severely limiting the ecological integrity of the basin.

Increased sediment loads from the basin have severely degraded environmental conditions along the main stem Illinois River by increasing turbidity and filling backwater areas, side channels, and channel border areas. Improved conservation practices have reduced the amount of sediment generated from many agricultural areas, but large quantities of sediment are still delivered to the river due to eroding channels and tributary areas, including urban and rural construction sites. The most critical problems resulting from the increased sediment loads are the loss of depth and habitat quality in off-channel areas connected to the main stem river. Similar problems can be seen at other areas within the basin where excessive sediment has degraded tributary habitats.

A dramatic loss in productive backwaters, side channels, and channel border areas due to excessive sedimentation is limiting ecological health and altering the character of this unique floodplain river system. In particular, the Illinois River has lost much of its critical spawning, nursery, and overwintering areas for fish; habitat for waterfowl and aquatic species; and backwater aquatic plant communities, limiting ecological health and altering this unique floodplain river system. A related problem is the need for timely action. If restoration is not undertaken soon, additional significant aquatic areas will be converted to lower value and increasingly common mud flat and extremely shallow water habitats.

Land use and hydrologic change have reduced the quantity, quality, and functions of aquatic, floodplain, and riparian habitats. Flood storage, flood conveyance, habitat availability, and nutrient exchange are some of the critical aspects of the floodplain environment that have been adversely impacted.

There is diminished aquatic (upstream/downstream fish passage) connectivity on the Illinois River and its tributaries. Aquatic organisms do not have sufficient access to diverse backwater and tributary habitats that are necessary at different life stages. Lack of aquatic connectivity slows repopulation of stream reaches following extreme events, such as pollution, low flows, or flooding, thereby reducing genetic diversity of aquatic organisms.

Basin changes and river management have altered the water level regime along the main stem Illinois River, stressing the natural plant and animal communities along the river and its floodplain. Land use changes, the construction of the locks and dams (which create relatively flat navigation pools), and isolation of the river main stem from its floodplain have all impacted the water level regime to varying extents. Two of the most critical results from the basin changes and river management, are the increased frequency and increased magnitude of water level fluctuations, especially during summer and fall low water periods. The lack of the ability to mimic natural hydrologic regimes in areas upstream of the navigation dams is also a problem. Increased flow variability has reduced ecological integrity in tributary areas as well.

Water resources in the Illinois River Basin are impaired due to a combination of point and non-point sources of pollution. Although effective regulatory efforts have reduced contributions from point sources, non-point sources of water quality impairment (such as sediments and nutrients) continue to degrade the surface waters.

The general ecosystem health, or integrity, of the Illinois River Basin is still declining in spite of the dramatic water quality improvements made as a result of the Clean Water Act and increasing numbers of local restoration efforts. Pressure on the remaining habitats will continue to increase as the basin's population increases. Finally, changes to the ecosystem, over time, have been dramatic. Current trends may be difficult to reverse, but with significant commitments of resources and time, this nationally-significant basin can be restored.

B. SIGNIFICANCE OF THE ILLINOIS RIVER BASIN ECOSYSTEM

The benefits of ecosystem restoration and protection projects are difficult to measure in monetary terms. When determining Federal interest, it is important that the significance of the resources being studied for restoration be clearly identified. The Corps of Engineers' *Principles and Guidelines* defines significance in terms of institutional, public, and technical recognition of the resources. For years, the State of Illinois and other agencies have been engaged in activities that clearly demonstrate the institutional, public, and technical recognition of the resources of the Illinois River Basin.

1. Institutional. The formal recognition of the Illinois River Basin in laws, adopted plans, and other policy statements of public agencies and private groups illustrates the significance of the basin to a variety of institutions. At the Federal level, the Illinois River's importance as an environmental and economic resource has long been recognized by congressional action and through the activities of several agencies. The U.S. Congress recognized the Illinois River, part of the Upper Mississippi River System (UMRS), as a unique, "…nationally significant ecosystem and a nationally significant commercial navigation system…" in Section 1103 of the Water Resources Development Act of 1986 (WRDA 86). The Upper Mississippi River System - Environmental Management Program (UMRS-EMP) was established in 1986 and has been conducting monitoring and habitat restoration activities along portions of the main stem of the Illinois River. The EMP brings together the expertise of the U.S. Army Corps of Engineers, the U. S. Fish and Wildlife Service (USFWS), the U.S. Geological Survey, and the U.S. Environmental Protection Agency (EPA). Congress reaffirmed the significance of the Upper Mississippi River System by reauthorizing the UMRS-EMP in 1999. The U.S. Department of Agriculture selected the Illinois River Basin as one of the first seven areas in the country for the Conservation Reserve and Enhancement Program (CREP), a program allowing enhanced Federal and State partnership opportunities to implement land conservation practices.

The Midwest Natural Resources Group (MVRG) is an ongoing partnership of 12 Federal Agencies, bringing focus and excellence to Federal activities supporting the vitality and sustainability of natural resources and the environment. On May 10, 2000, the U.S. Departments of Agriculture (USDA), Army, and Interior; the U.S. EPA, Federal Highway Administration, Maritime Administration and the U.S. Coast Guard signed an Intergovernmental Partnership Agreement stating that they shall work, in partnership with State and local governments, non-governmental organizations, private landowners and individuals, to restore and protect the ecological integrity of the Illinois River Basin in a manner consistent with reducing flood damage, protection of private property rights and maintaining an effective navigation system.

The State of Illinois has clearly demonstrated its institutional recognition of the Illinois River Basin as a significant resource. The state has developed, adopted, and begun implementation of the *Integrated Management Plan for the Illinois River Watershed* (1997); enacted the Illinois River Watershed Restoration Act; invested $51 million to match $271 million in Federal dollars in implementing the CREP on 110,000 acres with the potential to expand to 232,000 acres; and set the vision for Illinois Rivers 2020, a proposed $2.5 billion, 20-year Federal and State program to restore the Illinois River Basin.

The *Integrated Management Plan for the Illinois River Watershed* (1997) was the culmination of several years of effort by local and State governments in Illinois to build a consensus-based partnership with citizens and interest groups to address the issues that face the Illinois River Basin. The plan identifies 33 goals addressing restoration, economics, recreation, etc. Conservation groups, environmental groups, industry, and Federal, State, regional and local governments participated in shaping a vision for the future of the basin.

In July 1997, the State of Illinois enacted the Illinois River Watershed Restoration Act. The legislative purposes of the Act are to: (1) create a group of leaders representing agriculture, business, conservation, and the environment to encourage the implementation of efforts to restore the Illinois River Watershed in accordance with the recommendations of the *Integrated Management Plan for the Illinois River Watershed Technical Report;* (2) work with local communities to develop projects and regional strategies; and (3) make recommendations to appropriate State and Federal agencies.

More than $450 million in Federal and State funding has been targeted to improve the Illinois River through the CREP, which uses State funding to enhance existing USDA Conservation Reserve Program (CRP) activities. The CREP initiative will help preserve up to 232,000 acres of sensitive land surrounding the Illinois River and its tributaries, including upland areas. From 1998 to 2004, 110,000 acres were enrolled in Federal CRP easements and 73,000 acres in state CREP easements. While most state assets were acquired on lands enrolled in the Federal program, the State also acquired State-only easements on numerous adjacent areas and now holds roughly 28,000 acres in these State-only easements. In August 2005, the State of Illinois announced that its budget for the upcoming year included $10 million to leverage $40 million in Federal funds allowing for CREP easements on approximately 15,000 more acres.

In 2000, the Governor of Illinois set the vision for the Illinois Rivers 2020, a proposed $2.5 billion restoration effort. Illinois Rivers 2020 seeks to bring together the efforts of the Illinois Department of Natural Resources (DNR), Illinois Department of Agriculture, and Illinois EPA with Federal agencies. It is a voluntary, incentive-based approach that is much broader and more inclusive for the entire Illinois River and its tributaries than previous efforts. The support for implementation of Illinois

Rivers 2020 is very broad, including hundreds of individuals, elected officials, organizations, and businesses that officially support this effort.

In addition to Federal and State recognition, local communities, counties, and non-governmental organizations have also focused attention on the Illinois River Basin. More than 35 management plans have been developed that call for restoration of all or a portion of the Illinois River Basin. Many communities and groups have begun implementation of restoration projects. Both The Nature Conservancy and The Wetlands Initiative have made major investments by purchasing levee and drainage districts for the purpose of restoration. In total, they have recently acquired more than 11,000 acres of Illinois River floodplain and adjacent habitats. This is in addition to the 135,000 acres in State and Federal ownership within the Illinois River Basin.

Another example of the institutional significance is the Tenth Biennial Governor's Conference on the Management of the Illinois River System was held from October 4 ^{h} through the 6, 2005, in Peoria, Illinois. The conference focused on a systems approach to river management. Over 250 individuals from Federal, State, and local governments, as well as private citizens, attended the conference. The diversity of the groups attending demonstrates the importance of the Illinois River Basin to not only policy makers, but to the public as well.

2. Public. The Illinois River Basin is significant based on wide public recognition of the environmental resources present in the basin. The basin is noteworthy in that, while encompassing approximately 44 percent of the land area of the State, it includes nearly 90 percent of Illinois' population approximately 11 million people. Some level of significance of the Illinois River Basin to the public is measured through the actions of elected officials and policy makers who have forwarded legislation and enacted laws mentioned above to protect and enhance the watershed.

A further recognition of the value of the basin is the amount of participation by landowners in conservation programs. Approximately 138,000 acres of land have been enrolled in the Federal and State CREP and CRP programs. Each year, more Illinois landowners apply for the CREP program than are accepted. This demonstrates a willingness on the part of the landowners to set aside farmland to aid in the conservation of the Illinois River Basin.

Another example of public recognition is the participation by individuals and organizations in the State of Illinois' Conservation 2000 (C2000) program, which provides funding for streambank stabilization, wetland restoration, prairie restoration, riparian buffers, vegetative covers on construction sites, and restoration of oxbows in tributaries of the Illinois River. As of 2005, $61 million had been invested in all C2000 ecosystem projects. Although the program does not require matching, 52 percent of the program's overall value came from citizens and groups that invested additional money, land, and time to see projects completed. The strong public interest in restoration has resulted in State dollars consistently being matched or exceeded.

Recreation in the Illinois River Basin includes water-dependent activities such as fishing, waterfowl hunting, boating, and swimming. Recreation also includes activities that are enhanced by the proximity to water, such as hiking, picnicking, bird watching, and camping. These types of recreation are provided by local, State, and Federal agencies such as park districts, forest preserve districts, the DNRs, and the USFWS. Many private concerns also provide similar recreation opportunities.

The Illinois DNR owns or leases hundreds of outdoor recreation sites throughout the State including: State parks, conservation areas, nature preserves, natural areas, fish and wildlife areas, greenways, trails, and forests. The average annual attendance over the last 5 years at these sites was estimated to be over 42 million. This translates to about $500 million a year spent on trips to State parks and other recreational sites, leading to $790 million in economic output, 8,500 jobs, and $240.5 million in earnings. According to the 2001 National Survey of Fishing, Hunting, and Wildlife-Associated Recreation, outdoor recreation activities contribute significantly to Illinois' economy—more than $4 billion in economic output, 42,000 jobs, and $315 million in State and local taxes.

The Illinois River Basin contains some of the most productive agricultural soils in the world. These soils, combined with favorable climate, excellent transportation via water, highway and rail, and highly productive farming systems, make the Illinois River Basin a world leader in agriculture and a major exporter of agricultural products, producing more crops than 40 other states. In 2000, the farms in the basin produced approximately $2.6 billion in crops, 50 percent of the Illinois State total (Illinois Agricultural Statistics Service, http://www.agstats.state.il.us/). The basin also produced more than $600 million in livestock.

3. Technical. Numerous scientific analyses and long-term evaluations of the Illinois River Basin have documented its significant ecological resources. Since the early 20th century, researchers, government agencies, and private groups have studied the large river floodplain system and proposed ecosystem restoration in the Illinois River Basin. A few examples of the efforts to identify, quantify, and understand the ecological significance of the basin are described in the following text.

In a 1995 report, the U.S. Department of the Interior (DOI) listed large streams and rivers as endangered ecosystems in the United States. The U.S. DOI documented an 85 to 98 percent decline in this ecosystem type since European settlement. In particular, large floodplain-river ecosystems, , have become increasingly rare worldwide. Two of the large floodplain-river ecosystems lie within the UMRS, namely, the Upper Mississippi and Illinois Rivers. These two ecosystems still retain seasonal flood pulses, and more than half of their original floodplains remain unleveed and open to the rivers (Sparks et al. 1998). The UMRS is one of the few areas in the developed world where ecosystem restoration can be implemented on large floodplain-river ecosystems (Sparks 1995).

The Nature Conservancy (TNC) has developed basin-level planning documents to guide restoration efforts. In these documents, the TNC states, "The Illinois River remains one of a handful of world-class floodplain-river ecosystems. These include the Nile, Amazon, the Mekong and portions of the Mississippi, where biological productivity is enhanced by annual flood pulses that advance and retreat over the floodplain and temporarily expand backwaters and floodplain lakes." (TNC 1998)

The UMRS-EMP conducted a Habitat Needs Assessment (HNA) in 2000 to help guide future habitat projects on the UMRS. The HNA highlighted the need to restore depth to 25 percent of the existing backwaters on the Illinois River, increase depth diversity and connectivity, and restore hydrologic conditions needed to restore and maintain backwater habitats.

The Illinois River has historically hosted a vast fishery, including numerous ancient fishes, and, at the turn of the century, produced 10 percent of the nation's catch of freshwater fish (yielding 178 pounds per acre in 1908). The Illinois River and its tributaries are currently home to over 100 species of fish. Side channels and backwaters serve as nurseries and spawning areas. Sport fish at home in the Illinois include: white bass, largemouth bass, bluegill, black crappie, channel catfish, carp, buffalo, bullhead, walleye, sauger, and many other warm-water species. Game fish in the upper river include largemouth bass, black bullheads and white bass, especially around Starved Rock State Park in Utica, IL. The middle river has historically been the most productive because of the aquatic habitat in the backwater lakes and wetlands along its banks. The lower river, from Beardstown to Grafton, features approximately the same mix of fish species as the middle river, but populations are smaller.

The Illinois River is a major component of the internationally significant Mississippi River Flyway, a route followed by migratory waterfowl between Canada and the Gulf Coast. The Mississippi River Flyway, shown on figure 2-2 as the Mackenzie Valley-Great Lakes-Mississippi Valley Rivers and Tributaries, is utilized by 40 percent of all North American waterfowl and 326 total bird species, representing 60 percent of all species in North America. A survey conducted by the Illinois Natural History Survey in the fall of 1994 found that 81 percent of the fall waterfowl migration in the Mississippi Flyway utilized the Illinois River. Approximately 20 species of waterfowl, primarily ducks and geese, make their home in the Illinois River Basin. Hundreds of thousands of birds migrate along the Illinois River each year, resting temporarily in the wetlands, sloughs, and backwater lakes in the basin.

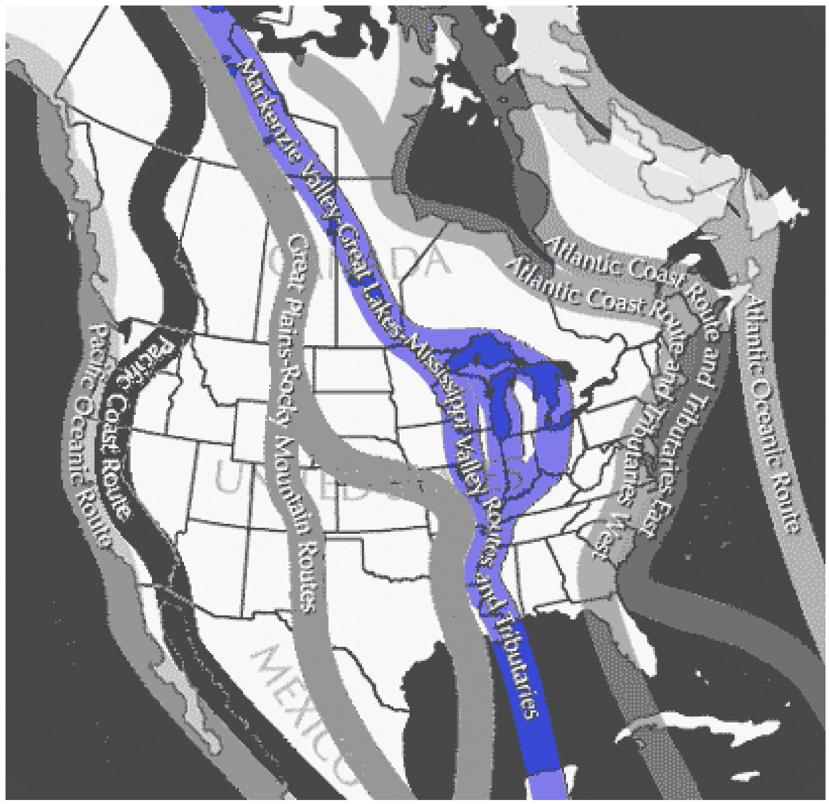


Figure 2-2. North American Flyways

The Illinois River has also been historically important to a multitude of avian species. The backwaters of the Illinois River serve as habitat for 20 to 30 species of shorebirds, 15 species of gulls and terns, and several species of marsh birds. The cottonwoods and black willows along the middle and lower river and its wetlands are host to various types of herons, egrets, plovers, sandpipers, and other migrating wading shorebirds, as well as gulls and terns. Wading shorebirds represent the farthest ranging visitors to the Illinois River Valley, traveling annually between the Arctic and South America, specifically Chile and Argentina. The river valley is a major wintering ground for the endangered bald eagle. In recent years, as many as 375 bald eagles have been counted annually, which represents about 3 percent of the total wintering population of bald eagles in the lower 48 states.

Over 4.26 million acres of Illinois land is in forest. Much of it is located adjacent to the Illinois River and its tributaries. Forest product utilization and management is important to the Illinois economy and environment. Forested riparian areas adjacent to the Illinois River and its tributaries provide a necessary buffer for surface water drainage and serve as the transition zone between land and water. Water quality benefits associated with the riparian forest are critical to the well-being of the tributary watershed. Many aquatic and terrestrial wildlife species utilize and depend upon the riparian forest found in the Illinois River Valley.

The Illinois River also serves as one of the sources for the public water supply system serving Peoria, which uses three well fields. The cities of Aurora, Elgin, Kankakee, Pontiac, Streator, Decatur, Taylorville, Springfield, Jacksonville, and Canton use water from tributaries of the Illinois River. Numerous industrial and utility providers also utilize Illinois River Basin waters for cooling purposes.

The Illinois River is a major conduit for the transport of treated wastewater throughout Illinois. It is estimated that 2,109 outfalls are currently located in the Illinois River Basin. Illinois has taken significant steps to obtain compliance for effluent limitations by dischargers in the basin. From the municipal facility perspective, approximately $5.6 billion has been expended for treatment facility construction in the Illinois River Basin alone. It can be safely estimated that several hundred million dollars have also been expended by industrial dischargers. Although the Illinois River ranks among Illinois' top recreational resources, at one time it was a primary channel for the transport of human, animal, industrial, and agricultural waste.

Archaeological and historical sites and fossil localities are found throughout the basin. Archaeological sites—localities once occupied by prehistoric or historic peoples—have been documented along the river shoreline, on the floodplain, and in valley margin and upland settings. Camps and villages established near the river by Native Americans are buried in river-deposited sediment. Major villages were often established along the river valley margin. Over the millennia, sediments eroding from nearby bluffs slowly accumulated. Preserved in these deposits, separated by lenses of sediment, are the remains of village sites representing centuries of cultural development.

C. BACKGROUND AND HISTORY

> *"The placid Illinois traverses this territory in a southwestern direction, nearly 400 miles ... Unlike the other great rivers of the western country, its current is mild and unbroken by rapids, meandering at leisure through one of the finest countries in the world. . . upwards of 400 yards wide at its mouth...The banks of the Illinois are generally high. The bed of the river being a white marble, or clay, or sand, the waters are remarkably clear. It abounds with beautiful islands,... It passes through one lake, two hundred and ten miles from its mouth, which is twenty miles in length, and three or four miles in breadth, called Illinois Lake [Lake Peoria]."* S. R. Brown 1817

The Illinois River arises at the confluence of its headwater basins, the Des Plaines, and Kankakee, and winds southwesterly through northern Illinois (figure 2-1). Along this stretch, known as the "Upper Illinois," currents are swift because the river flows down a fairly steep incline through a narrow, young valley. The upper river flows to Hennepin in Putnam County, where it encounters the "Great Bend," which marks the beginning of the middle river. Here, the Illinois turns southward and flows past Peoria to Beardstown with a gentle gradient through a broad, shallow valley 3 to 6 miles wide, the ancestral Mississippi River Valley. The banks along this stretch of the Illinois are lined with dozens of lakes and backwaters. The lower river extends from Beardstown to Grafton and was once rich with backwaters.

The Illinois River is the largest tributary of the Mississippi River above the mouth of the Missouri River. Major tributaries to the Illinois include the Des Plaines, Kankakee, Fox, Vermilion, Mackinaw, Spoon, Sangamon, and La Moine Rivers. Agriculture and urban development impacted and changed the landscape of the Illinois River Basin and the river itself. To appreciate the natural communities still found in the Illinois River Basin, one must first look at how the basin was formed, its history, and how it was developed.

1. Formation of the Illinois River Basin. The landscape of the Illinois River Basin was created by extraordinary geological processes that shaped the upper Midwest over the past one and one-half million years. The Ancient Mississippi River originally flowed in a now-buried valley from the northwest corner of Illinois near Galena to Tazewell and Mason Counties, south of Peoria, where it was joined by the westward-flowing Mahomet River. During the Pleistocene era, great continental-scale glaciers repeatedly entered Illinois from the northwest and northeast. These glaciers originated in central Canada more than 1,000 miles north of the modern Illinois River (figure 2-3). At least three major glaciations affected Illinois, and each strongly modified the landscape. Most of the lobes of glacial ice that covered Illinois emanated regionally from the Lake Michigan basin, but there is evidence that ice also flowed in from the northwest. Flowing ice and related geological agents, including winds and meltwater streams, sculpted the bedrock and pre-existing sediments, leaving sedimentary deposits up to several hundred feet thick.

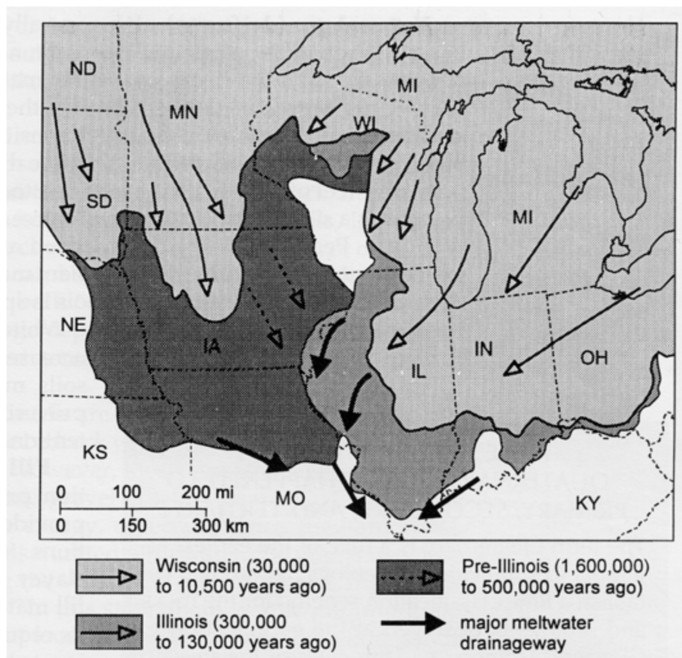


Figure 2-3. Furthest Extent of Pleistocene Ice Advances Open arrows indicate general ice flow directions; closed arrows indicate major meltwater drainage ways.

Creation of complex morainal topography, widening and incision of the Illinois Valley by huge floods, and deposition of a layer of wind-blown silt over most of the watershed uplands are effects of the last glacial episode that are perhaps most important to us today. Figure 2-4 illustrates the alterations in the flow paths of the major rivers in Illinois due to glaciation. Modification of this landscape continues today by both natural and human processes.

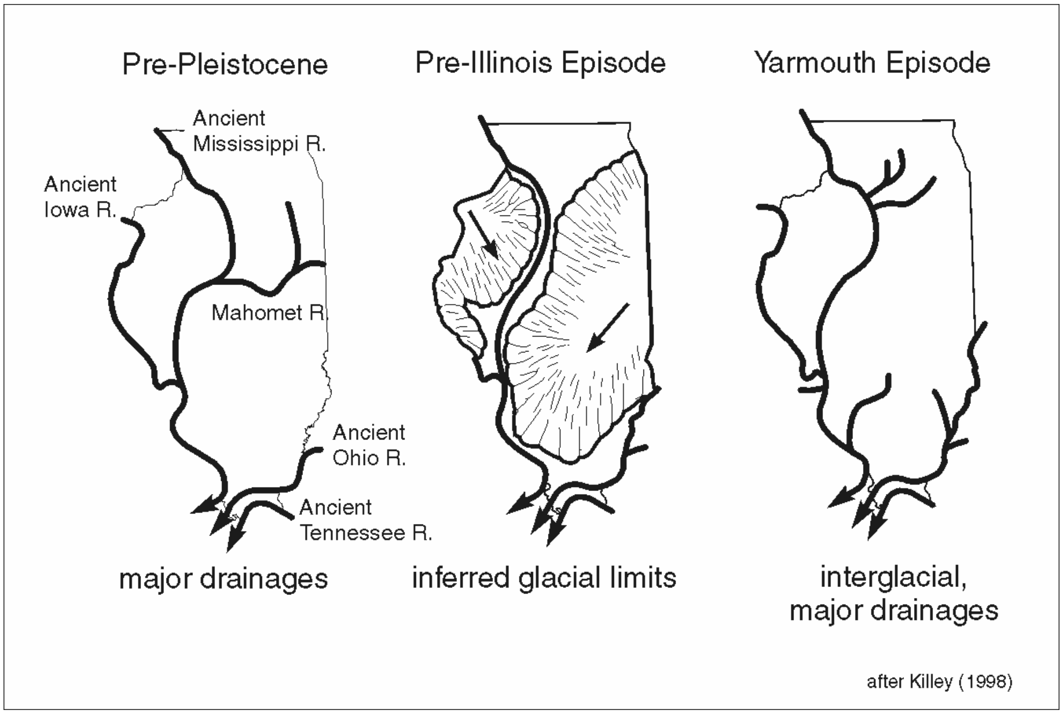


Figure 2-4. Changes in the Flow Paths of the Rivers in Illinois Over Time

The Mississippi River once occupied the lower Illinois Valley from above Henry to Grafton. With the advancement of the Wisconsin glacial-episode (~21,000 years ago), the Mississippi River was pushed westward to its present location. With the recession of the glacier and the ensuing warmer climate, meltwaters formed the Kankakee and Des Plaines Rivers, which converged into the Illinois River southwest of Chicago. From this confluence, the Illinois flowed westward, cutting a new channel until it reached the ancient and deep valley of the Mississippi River above Henry.

As the Illinois River turned southward in Putnam County, it followed a much wider and deeper glacial valley. As the waters of the Illinois entered this wide basin, their low volume produced a river of a gentle rate of fall, creating a floodplain river ecosystem. This low gradient resulted in a sluggish river that had difficulty moving the sediment load contributed by the tributary streams. Over the centuries, the sediment was deposited during overflow conditions at the interface between the faster moving water in the river channel and the slower moving waters in the bottomlands. As a result, natural levees rose, pinching off over 300 bottomland lakes and sloughs from the river channel. The floodplain below the Great Bend contains so many side channels, sloughs, swamps, and other backwater wetlands, that the river valley resembled a boundless marsh when early explores and settlers arrived.

Historical observations and measurements of flows from undisturbed areas indicate that storm flow rates from Illinois River watersheds prior to European settlement were probably much lower than current rates. Many current streams or ditches were historically ephemeral channels, wetland swales, or simply did not exist (Rhoads and Herricks 1996), and the hydrologic and hydraulic conditions likely led to a more steady discharge of water to the Illinois River from its watershed. Prior to 1900, when significant modification along the main stem began, researchers have determined that much of the

Illinois River experienced a cyclical regime in which water levels gradually rose from the late fall through the spring and then fell to stable, low levels in the summer.

2. Climate. Illinois has a continental climate, which means that its winters are cold and dry and its summers are warm and wet. The transition season of spring tends to be very wet, while the fall seasons tend to be dry. Using Peoria as representative of the basin, average temperature for the year is 50.7 degrees Fahrenheit, with a peak maximum temperature of 113 degrees Fahrenheit on July 15, 1931, and a low minimum temperature of -27 degrees Fahrenheit on January 5, 1884. The average yearly precipitation is 36.25 inches, including an average snowfall of 26.2 inches per year. During the latter half of the 20th century, there was a 2.1 percent per decade increase in annual precipitation, which has contributed to the increase in the rate of runoff (5.5 percent per decade). This upward trend may be a manifestation of natural variability and will not necessarily be sustained into the future.

3. Land Cover. The predevelopment Illinois River floodplain was a complex mosaic of prairies, forests, wetlands, marshes, and clearwater lakes (Mills et al. 1966, Talkington 1991, Theiling 1999, Theiling et al. 2000). A broad view of the Illinois River Basin prior to intensive settlement illustrates the dominance of prairies across the landscape (figure 2-5). Riparian corridors formed along waterways, and the middle and lower reaches of streams and rivers were lined with forests. Densely wooded regions occurred in the Spoon and LaMoine River watersheds, topographically diverse areas compared to the rest of the basin. In the main stem river floodplain, the main channel threaded through a variety of connected and isolated backwater lakes, bottomland forests, prairies, marshes, and swamps. Bottomland lakes, sloughs, and marshes supported abundant beds of aquatic plants, such as pondweeds (*Potamogeton* spp.), coontail (*Ceratophyllum demersum*), and water lilies (*Nymphaea tuberosa*). Common emergent plants were two or more species of duck potato (*Sagittaria latifolia, S. rigida*), marsh smartweed (*Polygonum coccineum*), river bulrush (*Scirpus fluviatillis*), as well as other, less common plants, including wild rice (*Zizania aquatica*). The abundance of aquatic plants attested to the water clarity and organic sediments. Scores of small lakes and ponds, rather than large lakes, dominated the floodplain (Bellrose et al. 1983). In this system, there was relatively free movement among scales or to similar habitats in different locations through stream channels, riparian corridors, or frequently spaced wetlands.

The presettlement landscape of the basin was approximately 66 percent prairie and 29 percent forested. Open water and wetlands accounted for 4 percent of the basin area (figure 2-5). Wetlands were not particularly well mapped in the Government Land Office surveys because their methods were coarse and many wetlands were small, isolated units that might have been easily missed. Havera (1999) used soil surveys to locate hydric soils that formed under wetland conditions as a surrogate of the former distribution of presettlement wetlands throughout Illinois. A conservative estimate of a little more than 8.2 million acres of wetland, or 23 percent of the entire State was derived for Illinois. Although only 78 out of 102 counties have been resurveyed, the presettlement wetlands estimate has been increased to almost 8.9 million acres (Havera 1999). Calculating the change from presettlement conditions revealed a 90.3 percent loss of presettlement wetlands. Most of the loss occurred in the northern two-thirds of the state, particularly through the center of the Illinois River Basin.

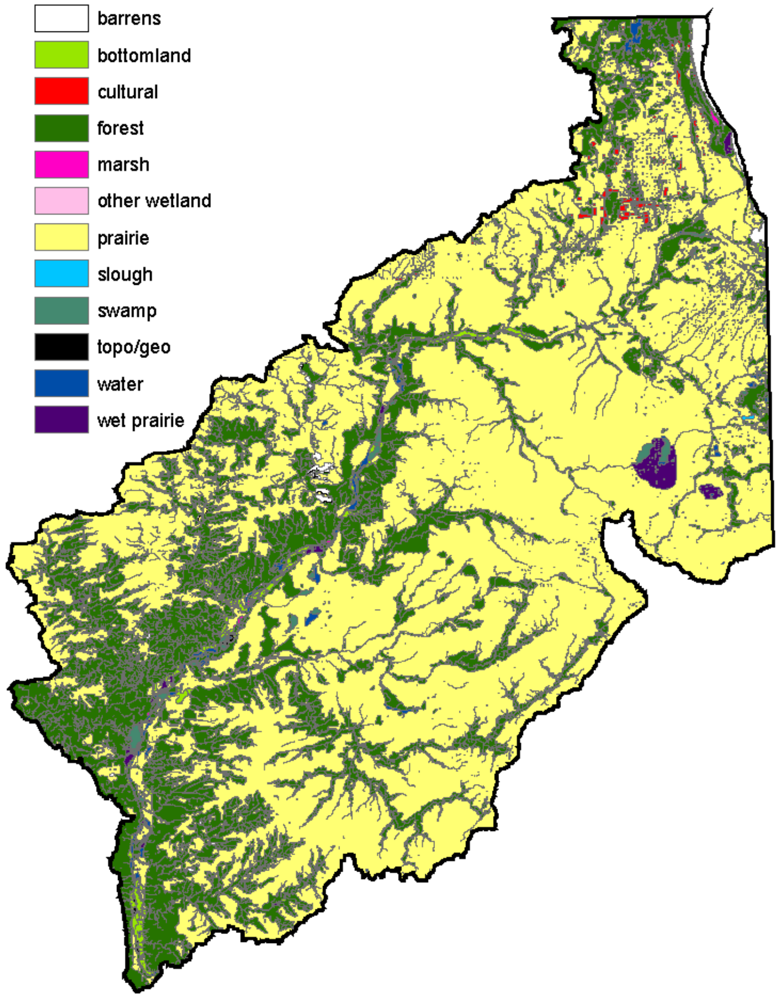


Figure 2-5. Presettlement Land Cover of the Illinois River Basin as Interpreted from Government Land Office Surveys (Szafoni 2001)

Landscapes can be described by differences in topography, glacial history, bedrock, soils, and the distribution of native plants and animals. Using these natural features, Illinois can be divided into 14 natural divisions. A division contains similar landscapes, climates, and substrate features like bedrock and soils that support similar vegetation and wildlife over the division's area.

Six of the fourteen divisions are found in the Illinois River Basin—Northeastern Morainal, Grand Prairie, Upper Mississippi River and Illinois River Bottomlands, Illinois River and Mississippi River Sand Areas, Western-Forest Prairie, and Middle Mississippi Border (figure 2-6).

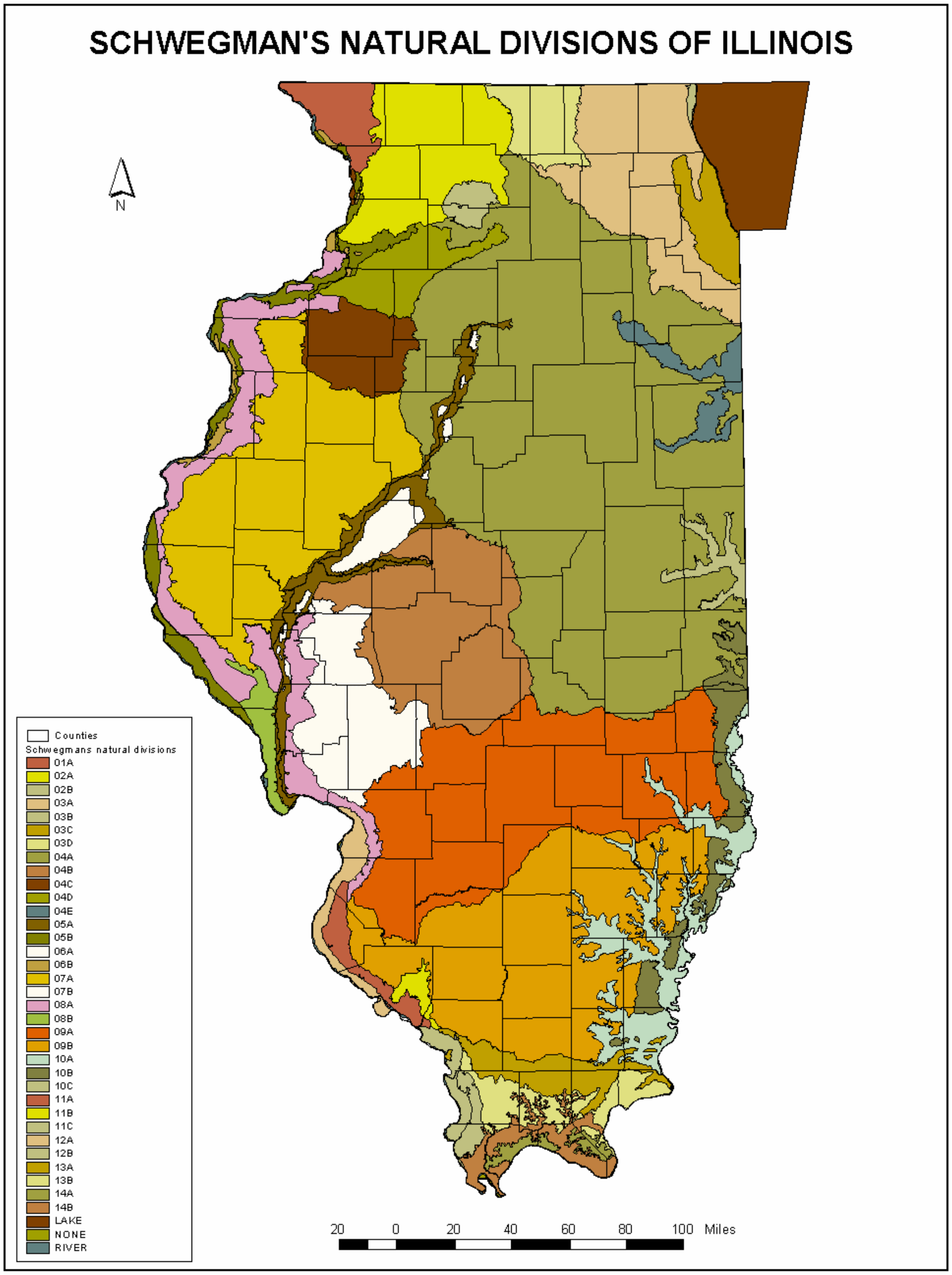


Figure 2-6. Schwegman's Natural Divisions of Illinois

Northeastern Morainal Division

- *Morainal Section (O3A)* - This section contains the moraines and related geologic features resulting from late advances in the Wisconsinian glaciation period. Most of Illinois' glacial lakes and peatlands are found here.

- *Lake Michigan Dunes Section (O3B)* - The Lake Michigan Dunes Section is distinctive for its unique plants that grow on the dunes and beaches. Plant succession from shifting sand to stabilized sand results in a variety of species. Beach grass, trailing juniper, and bearberry are three examples.

- *Chicago Lake Plain Section (O3C)* - This flat, poorly drained area is composed of the lakebed sediments of glacial Lake Chicago. Long ridges of shore-deposited sands are conspicuous features. A few natural lakes exist near Calumet City. The original vegetation of this section was prairie and marsh with scrub-oak forests on sandy ridges.

Grand Prairie Division

- *Grand Prairie Section (O4A)* - This section includes the part of Illinois that was affected by the late stages of the Wisconsinian glaciation, that is outside the Northeastern Morainal Division and that does not include outwash and sand areas. The Shelbyville and Bloomington moraines form the boundaries of this section. Black-soil prairie, marshes, and prairie potholes are common in this poorly drained area. The Kankakee mallow is found in this section, growing only on an island in the Kankakee River.

- *Springfield Section (O4B)* - The Springfield Section is part of the area covered by the Illinoian glaciation. Prairies grew on this land in presettlement times. It has better drainage than the younger Grand Prairie Section. Deep loess (a wind-blown silt) deposits support dry hill prairies along the lower Sangamon River. Large areas of floodplain forest grow in the valley of the lower Sangamon River and its tributaries.

- *Western Section (O4C)* - The Western Section was covered by the Illinoian glaciation. This well-drained land was predominantly prairie in presettlement times.

- *Kankakee Sand Area Section (O4E)* - The sand of the Kankakee Sand Area Section was deposited by the Kankakee Flood during the later stages of the Wisconsinian glaciation. Sand prairie and marsh were the predominant vegetation of this section before the land was drained for cultivation. Scrub-oak forests exist on drier sites. The primrose violet is restricted to this section in Illinois. The clear, well-vegetated, sand-bottomed streams contain fishes like the weed shiner, ironcolor shiner, and least darter.

Upper Mississippi River and Illinois River Bottomlands Division

- *Illinois River Section (O5A)* - The Illinois Section of this division is characterized by its backwater lakes and forest vegetation. Spring bogs exist along the river bluffs.

Illinois River and Mississippi River Sand Areas Division

- *Illinois River Section (O6A)* - This section differs from the Mississippi River Section by the absence of several plant and animal species.

- *Mississippi River Section (O6B)* - This section has several plant and animal species that are absent from the Illinois River Section including false heather and rock spikemoss. Both of these plants form large mats that stabilize dune blowouts.

Western Forest--Prairie Division

- *Galesburg Section (O7A)* - The Galesburg Section is the area of the Western Forest-Prairie Division that lies north of the Illinois River Valley. At the time of settlement, there were about equal amounts of forest and prairie in this section, with forests mainly along the tributaries to the Illinois River.

- *Carlinville Section (O7B)* - The Carlinville Section of this division is the land southeast of the Illinois River Valley. Originally, it was covered mostly by forest, with prairie accounting for about 12 percent of the area.

Middle Mississippi Border Division

- *Glaciated Section (O8A)* - The topography of this area was modified by the pre-Illinoian and Illinoian glaciation stages. Limestone underlies most of this section and may often be seen in cliffs along the river bluffs.

- *Driftless Section (O8B)* - This area of the state is apparently unglaciated. It has many sinkholes and sinkhole ponds.

For more than 150 years, the Illinois landscape has been shaped to serve the economic development needs of the State. Landscape development has occurred for many purposes ranging from waterway transportation, lumber harvesting, urban and suburban development, and industrial and agricultural development. The result is a managed landscape that is highly altered from its presettlement form and function. This development of the river basin has had profound effects on the river and floodplain landscape.

4. Disturbance Regimes. Disturbances such as floods and fires maintain the mosaics of habitats needed to maintain a naturally functioning ecosystem. Most of these disturbance regimes have been greatly altered or even eliminated altogether. This alteration of disturbance regimes has resulted in a more homogeneous environment, with an associated loss in ecological integrity.

Hydrology is a primary driving force for aquatic and floodplain ecosystem processes and habitats. The magnitudes, timing, and duration of flows and water levels often regulate the nature of chemical and biological functions in these systems. Because of this, unfavorable hydrologic regimes can prevent desirable levels of ecosystem function, thereby reducing biodiversity. The obvious natural disturbance pattern on the main stem Illinois River and its tributaries is the annual flood and low-flow cycle (Poff et al. 1997, Theiling et al. 2000). Prior to development, the Upper Illinois was hydrologically similar to the streams and rivers that fed it from the basin; floods rose and fell rapidly in response to storms. During low-flow periods, the river experienced base flow conditions and was fed by ground water. Some streambeds may have been nearly dry during low flow periods. On the main stem, snowmelt, spring rains, and basin runoff combined to create a long spring flood that rose into the summer and fell through the fall in what was described as a unimodal hydrograph (Sparks 1995).

Fire is another disturbance that helps shape the floodplain landscape (Nelson et al. 1996). For example, savanna and prairie habitats, both diverse habitat types, require fire disturbance to maintain their unique vegetative characteristics and accompanying biodiversity. Prior to intensive settlement, Native Americans used fire to help maintain these habitats. Fire also plays a key role in bottomland forest structure and species composition. Fire suppression is altering the species composition of forested habitat, resulting in the maple dominance of these forests (CTAP 2001). Other disturbances, such as ice and wind, sometimes kill sections of forests and create unique microhabitats that are exploited by species to create diverse landscapes (Theiling et al. 2000).

5. Biological Resources. Father Jacques Marquett (one of the first Europeans to visit the Illinois River Basin) described his impressions on the Illinois River, in 1673, as follows:

> *"We have seen nothing like this river…as regards to its fertility of soil, its prairies and woods, its cattle, elk, deer, wildcats, bustards, swans, ducks, parroquets, and even beaver. There are many small lakes and rivers."*

The productivity of the predevelopment system was illustrated by the millions of migratory birds that either stopped to rest and feed on their northward and southward migrations, or stopped to nest in the floodplain marshes (Havera 1999). The Illinois River historically was host to a vast fishery. The forests supported a higher diversity of trees, including many that produced fruit and seeds that were exploited by animals and people (Nelson et al. 1994). Although today's flora and fauna are but a remnant of these historic levels, they still include some of the richest habitat in the Midwest, even some unique to North America (Talkington 1991).

6. Development of the Basin. The assessment of the Illinois River Basin landscape history provides perspective on how and when change occurred. Native Americans arrived in the basin at least 12,000 years ago and hunted and gathered for their subsistence, causing very little impact on the habitat. Native Americans began cultivating plants in the Basin gradually, beginning around 2,000 B.C. Food production supplemented food procurement, eventually giving rise to larger, longer-term settlements, which had greater impact on local habitat.

Early explorers and trappers were in the region in the 1600s and 1700s, relying on a subsistence economy of hunting, gathering, and food production. They also introduced domesticated animals. It was not until the early 1800s, during America's Westward Expansion, that substantial numbers of settlers arrived in the Illinois River Basin. During the early 1800s, the Government Land Office (GLO) surveys of the Illinois River Basin were conducted. Significant events in history of the Illinois River are listed in table 2-1.

Table 2-1. Illinois River Timeline

Year	Event
1872	The first low dam is constructed at Henry, Illinois.
1900	The Chicago Sanitary & Ship Canal opens. The untreated wastes from a densely populated Chicago area are channeled into the Illinois River.
1902	The drainage/levee districts are established, and by 1929 there would be a total of 41 in the Illinois River Valley.
1908	The 207-mile stretch of river between Hennepin and Grafton produces 10% of the nation's catch of freshwater fish.
1910	More than 2,600 mussel boats work the Illinois River.
1919	State of Illinois begins construction in the Illinois Waterway.
1923	Illinois River devoid of oxygen to Chillicothe
1930	Levees & drainage districts removed 200,000 acres, ½ floodplain
1939	Significant completion of lock and dams.
1944	During the fall waterfowl migration, a remarkable weekly observation is recorded by biologist Frank Bellrose – over 3.6 million mallards in parts of the Illinois Valley.
1948	Last Pearl Button Factory closes
1950	Fingernail clams (major food source) disappear
1955	Aquatic Vegetation eliminated from connected aquatic areas

Settlements were first established along the lower reach of the Illinois River and on the upper reaches of its tributaries, such as the Sangamon River. Peoria, Springfield, and Chicago were in existence in the early 1800s.

The Illinois River Basin is an area that has been and remains subject to human disturbances. Some biologists argue that the degradation of the Illinois River Basin began with its opening to steamboats in 1828, while others indicate that until the turn of the century, the Illinois River remained relatively unblemished, and its waters provided a livelihood for many adjacent communities. In 1908, 2,500 commercial fishermen took nearly 24 million pounds of fish from the Illinois. The river was once one of the most productive mussel streams per mile in the United States; in 1910, over 2,600 mussel-fishing boats plied the river. Abundant waterfowl in the fall made the valley a mecca for commercial and sport hunters. As the human population increased in the basin, the prolific days of the river ended. With the increase in population came physical changes to the Illinois River and its basin that would greatly affect the river system.

Beginning in the 1830s, human activities started to exert a deleterious effect on the Illinois River and its watershed. Navigation, agriculture, levee building, and urbanization affected the natural flow of the Illinois River and the associated sedimentation processes that formed backwater wetlands. Large-scale public works projects, such as the construction of the Illinois and Michigan Canal, and private undertakings, especially draining of wetlands for agriculture, resulted in the most profound changes in the Illinois River Basin.

a. Agriculture. The Illinois River Basin is endowed with some of the best soils and climate, which support the greatest agricultural production that can be found anywhere in the world. Over the past 150 years, agriculture in the Illinois River Basin has undergone significant changes. In early settlement days, farming meant raising an assortment of crops and livestock, which would ultimately provide the food and clothing to support the farmer's family. By 1860, most of the basin's prairie had disappeared as agriculture gained in predominance. Crop production became more specialized in the late 1800s and into the 1900s as farm size and urban populations increased.

Agriculture became industrialized after the turn of the century, but especially after World War II with advances in farm machinery and chemical use. The rate at which agricultural innovations have been introduced and adopted has significantly increased over the past several decades. Adverse environmental impacts of landscape development were noticed early in the development sequence, but formal programs to address declining resource quality were not enacted until after the economic impacts to agriculture were recognized and the conservation movement became more prominent. With mechanized and labor-saving farm equipment available, intensive row crop agriculture and increased crop production became the norm. By 1935, only 20 percent of the Nation's labor force worked in farming, decreasing to 4 percent in 1974 and less than 2 percent in 2002. Since the 1950s, many farmers dramatically changed their farming operations, from diversified livestock and grain farms to specialized farms with primarily corn and soybean production, resulting in a 67 percent increase in row cropland between 1945 and 1986. From 1960 to 2000, oat, wheat, and hay acreage decreased by more than 50 percent, while soybean acreage almost doubled. This change in farming systems has resulted in considerably less land planted today with soil-conserving crops of hay, pasture, and cereal grains and significantly more land being planted to row crops that provide less protection from erosion, such as soybeans and corn. However, many farmers have implemented soil conservation practices to reduce soil erosion (Post and Wiant 2004).

b. Floodplain Alterations. Between 1902 and 1923, drainage districts greatly modified the landscape, removing approximately one-third of the terrestrial and aquatic habitat from the floodplain for agricultural purposes. By 1929, 38 organized drainage and levee districts and three private levees enclosed roughly 200,000 acres of the Illinois River Valley. Levees erected early in the 20th century isolated and facilitated the drainage of almost all of the lakes and wetlands along the lower river. Only about 53 backwater lakes now survive along the full length of the river, and the connected floodplain of the Illinois River is now just over 200,000 acres, about half its size 100 years ago. Spring and Thompson Lakes, long known for their fisheries and their concentrations of waterfowl, were leveed, drained, and converted to agricultural uses, as were a host of smaller lakes and sloughs. These levee districts isolated and altered approximately 40 percent of the total floodplain by allowing conversion of wet and mesic floodplain prairies to crops. Actual water surfaces now account for only about 60 to 100 square miles (40,000 to 70,000 acres) in the basin. The levees affected the hydrology and sediment transport processes of the river. They increased flood stages by reducing the space available for water flow, storage, and sediment deposition. The levees effectively constricted the floodplain right to the edge of the river.

c. Hydrologic Alterations. On January 1, 1900, the Chicago Sanitary and Ship Canal opened. This canal connected the Des Plaines and Illinois Rivers to Lake Michigan and as a result gave the City of Chicago a means of flushing untreated domestic sewage and industrial wastes away from Lake Michigan into the Illinois River system by diverting water from Lake Michigan into the Illinois River. At first, the diverted water enhanced the aquatic habitats of the Illinois River valley; habitats available to fishes increased as the diverted water doubled the surface area, and extended and deepened the bottomland lakes and marshes. As a result of all the water, thousands of acres of bottomland timber were inundated and eventually died as many small lakes, sloughs, and marshes were united into larger bodies of water. As late as 1940, "dead snags from this 'drowned forest' were still in evidence."

d. Navigation and Dam Alterations. Although the amount of diverted water from Lake Michigan was reduced in 1938, river levels were further altered by the construction of navigation dams. During the 1930s, six navigation dams were built along the Illinois, eventually a total of 8 locks and dams were constructed. These dams, constructed to create a 9-foot channel for commercial navigation, had a major impact on the river. This effect was not uniform along the length of the river. The upper dams raised water levels and created pools, slowing the rate of flow even more. The lower dams stabilized water levels, but did not create pools or slow river flow appreciably.

The construction of navigation dams and diversion of flows from Lake Michigan have generally increased the river water surface elevation and have altered the nature of the flooding regime along certain reaches of the river. As the water surface elevation of the river increased, so did the water surface elevations of the associated backwaters and wetlands, resulting in as many as 300 long, narrow backwater or bottomland lakes. Each dam keeps the water level in the pool upstream high enough to ensure a 9-foot navigation channel and, as a result, the floodplains immediately upstream of each dam are more continuously inundated than they would be under undammed conditions.

Short-term water level fluctuations on the mainstem, that is, water level changes over the course of several hours to several days, have been implicated in degradation of Illinois River ecosystem function because of the stress that rapid changes in river conditions places on plants and animals. The magnitude and frequency of water level fluctuations have notably increased in portions of the river since daily water level monitoring began in the 1880s.

e. Water Quality . The opening of the Chicago Sanitary and Ship Canal increased the sewage load in the Illinois River, and by 1923, the oxygen content of the river from below Chicago to Peoria was negligible. In 1911, Stephen Forbes wrote,

> "*Immediately below the mouth of the canal we have in the Des Plaines a mingling of these waters, and the Illinois River itself, below the junction of the Des Plaines and the Kankakee, the septic contributions of the former stream are largely diluted by the comparatively clean waters of the latter. Nevertheless, we had in July and August what may be called septic conditions for twenty-six miles of the course of the Illinois from its origin to the Marseilles dam. At Morris, which is on the middle part of this section, the water, July 15, was grayish and sloppy, with foul, privy odors distinguishable in hot weather*."

The pollution history of the Illinois River closely parallels population growth and hydrologic modifications by the very nature of the most influential project, the Chicago Sanitary and Ship Canal. While originally draining a basin somewhat protected from the growing population of the Chicago area, the canal increased the drainage basin by only 800 square miles (<3 percent), but increased the population pressure on the river to 4.2 million people by 1914. Untreated waste and its adverse effects progressed rapidly downstream from Chicago and Peoria. In 1911, Forbes and Richardson described the river between Morris and Marseilles as reaching its "lowest point of pollutional distress" (quoted in Starrett 1972). They describe the river during the warm summer months as completely anoxic and sludge-like, with most bottom fauna (except sludge worms and *Chironomus* larvae) and fish extirpated. The river cleared with cooler temperatures and higher river stages, but the pollution spread downstream. By 1912, the zone of degradation spread downstream to Spring Valley, and by 1920 as far as Beardstown, about two-thirds of the way to the Mississippi River. Waste treatment efforts began during the 1920s, but struggled to keep up with population growth. In 1960, wastes from a population equivalent of 9.5 million people were reduced to 1.15 million through effective treatment before being discharged to the river (summarized from Starrett 1972). Although upstream water quality and some aquatic communities have improved through time with the expenditure of more than $6 billion in waste treatment facilities, many important aquatic communities still suffer the consequences of prior perturbations and continued sedimentation (Sparks 1992).

f. Tributary Alterations. In many areas of the Illinois River Basin, current storm flows are higher than occurred under pre-development conditions due to land use changes and increased efficiency brought about by channelization in urban and rural areas. Hydrologic changes tend to be most apparent in small basins and during fairly frequent events (Knox 1977). Channelization increases peak flows as it allows flood waves to pass more quickly through the basin (Campbell et al. 1972), increasing both the volume and the erosive force of the water. In addition, drainage generally reduces low flows by lowering groundwater levels and intercepting groundwater throughflow. Small creeks that have been modified by dredging and drainage are often unstable aquatic environments because of extreme water level fluctuations and desiccation during dry periods (Larimore and Smith 1963; Rhoads and Herricks 1996).

g. Biological Impacts. As the Illinois River Basin's population increased, the combined impacts of the basin alterations described above began cause measurable changes to the flora and fauna of the basin. From 1916 to 1922, the organic pollution discharged into the Illinois River resulted in the virtual elimination of aquatic plants from the River. Aquatic vegetation returned to the river between the late 1930s and mid 1950s in response to early waste treatment efforts (Starrett 1972). After 1955, greater amounts of flocculent sediments that had accumulated in the backwater lakes and impounded areas were more frequently resuspended by wind- and boat-generated waves. Resuspended sediments lowered water clarity, and mucky sediments made poor rooting substrate, thus limiting aquatic plant growth (Mills et al. 1966, Bellrose et al. 1979, Bellrose et al. 1983, Sparks 1984, Sparks et al. 1990). As more plants were lost, a critical threshold level of plant density was reached, beyond which recovery was unlikely. Sparks and others (1990) trace the problem to the loss of plants on the perimeter of the beds that stabilized sediments and buffered wave action. As the plants on the perimeters were lost, the entire plant beds were slowly eliminated by wave disturbance and poor water quality.

In the early 1900s, the Illinois River was considered one of the most productive mussel streams in America, and young mussels (unionids) contributed a significant portion—25 percent—of the channel catfish diet. By the 1970s, extensive harvest and chemical and organic pollution resulted in the loss of 25 of the 49 species recorded in the river, and no young mussels were found in catfish guts north of Beardstown (Starrett 1972). These declines were reflected in declines in commercial activities. The last button factory on the Illinois closed in 1948, and by 1976, only two full-time commercial fishermen worked the river. The river was closed to commercial mussel harvest around 2000. In the upper Illinois River, all freshwater mussels were extirpated at one time, but they have been slowly recovering since water quality has improved. Surveys during the mid-1990s found six species had returned to the Illinois Waterway above the confluence of the Des Plaines and Kankakee Rivers (table 2-2). Beginning in 1991, unionids have been forced to compete with the exotic zebra mussel (*Dreissena polymorpha*) for food and space. Unionids also suffered from the degraded water quality common near high densities of zebra mussels.

Table 2-2. Numbers of Species of Mussels Present in the Navigation Pools of the Illinois River at Different Points in Time (Whitney 2001).

Navigation Pool	1870–1900	1906–1909	1966–1969	1993–1995
Marseilles	38	0	0	11
Starved Rock	36	0	0	8
Peoria	41	35	16	15
La Grange	43	35	18	15
Alton	41	36	20	17

Fish communities first increased dramatically with the expansion of aquatic habitat following the diversion, and the introduction of carp (Fremling et al. 1989). Commercial catch rates increased from about 8 million pounds in 1900 to over 20 million pounds in 1908. After 1908, however, fish catches declined despite a relatively high demand for fish (Starrett 1972; Fig. 32). In addition to lower catch rates, the physical condition of fishes declined through the 1970s, with the poorest condition noted in more northern reaches (Sparks 1984). There was a very high incidence of external abnormalities on sediment-associated fishes (50 to 100 percent) in the upper river during the late 1960s. There have been anecdotal and empirical observations of a small number of individuals of tolerant species with cancerous lesions and eroded fins, but the occurrence of such abnormalities has declined in all river reaches through time (Lerczac et al. 1994; Cochran, 2001)

Before the 1950s, the Illinois River Valley was one of the most productive waterfowl areas in the country, drawing local market hunters and sportsmen from around the world (Havera 1999). In 1948, the Illinois Natural History Survey initiated aerial inventories that have revealed clear patterns of the decline of the Illinois River as productive waterfowl habitat since that time. Diving ducks (lesser scaup, canvasback, etc.) were abundant before 1954 in the Illinois River Basin (figure 2-7).

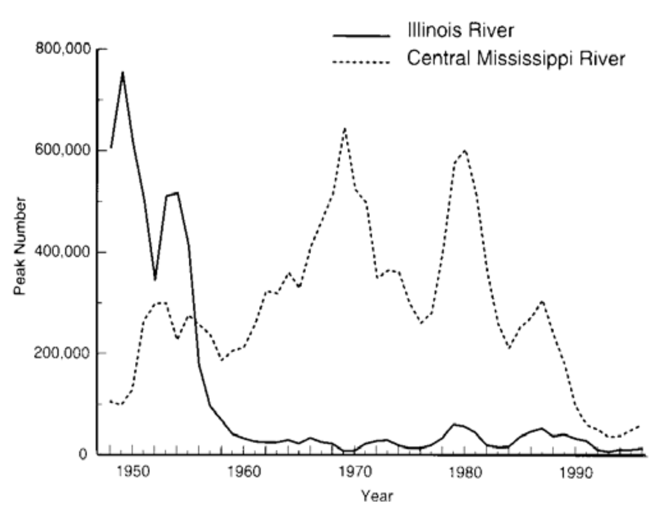
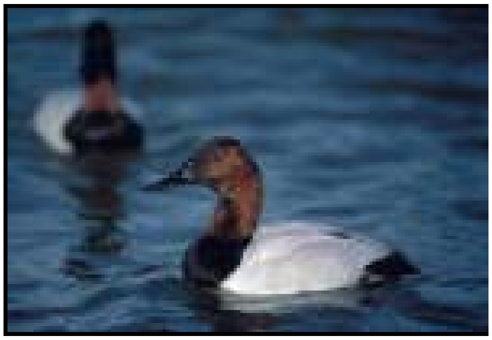


Figure 2-7. Three-Year Moving Average of Peak Numbers of Diving Ducks, Aerially Inventoried During the Fall in the Illinois River and Central Mississippi River Regions, 1948-1996 (Havera 1999)



Photograph 2-1. Canvasback Duck

The population of diving ducks along both the Mississippi and Illinois Rivers fluctuated during the early 1950s. While the Mississippi River population increased until the 1990s, the Illinois River population decreased and never recovered. The loss of fingernail clams and *Vallisneria* (primary diving duck food sources) in the mid 1950s apparently reduced the habitat value for diving ducks, such as the canvasback (photograph 2-1), in the Illinois River to the point where they shifted their migratory use patterns to the Mississippi River Valley (Havera 1999). Diving duck populations are now in serious decline nationally. Dabbling ducks were also affected by habitat loss (figure 2-8) between 1948 and 1996.

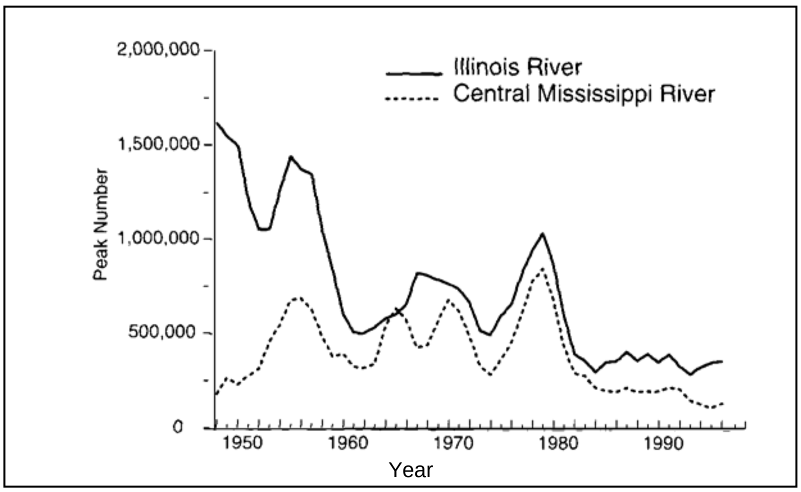


Figure 2-8. Three-Year Moving Average of Peak Numbers of Dabbling Ducks, Aerially Inventoried During the Fall in the Illinois River and Central Mississippi River Regions, 1948-1996 (Havera 1999).

Soil erosion, combined with the low gradient and flow of the Illinois River, allowed fine clay and silt particles to settle in the backwater lakes. During the 1950s, sediment deposition in the backwater lakes appears to have crossed a critical threshold, transforming the clear, vegetated lakes to turbid, barren basins (Sparks et al 1990). Fish and duck populations declined and, by the early 1960s, backwater productivity ebbed dramatically (Bellrose et al 1979).

Despite the ecological damage and degradation, the landscape and river system remain surprisingly diverse and biologically productive. The Illinois River system is home to approximately 35 mussel species, representing 12 percent of all freshwater mussels found in North America. Fish diversity is similarly high, with 115 fish species found, 95 percent of which are native species. Many of these species require both riverine and backwater (floodplain) habitat as part of their life cycle. A survey conducted by the Illinois Natural History Survey in the fall of 1994 found that 81 percent of the fall waterfowl migration in the Mississippi Flyway utilized the Illinois River. The Illinois River currently attracts more migratory ducks than nearby stretches of the Upper Mississippi River.

D. EXISTING CONDITIONS

The Illinois River Basin is ecologically degraded because of 150 years of intensive human development in the region. Figure 2-9 illustrates the change in the distribution of land cover in the Illinois River Basin. Not only have the landscapes changed, but the hydrologic regime, which drives the ecology of streams and rivers, has changed due to major initiatives to dredge channels, ditches, and drains.

In some cases, the landscape and streams are still adjusting to changes imposed by human development especially where suburban sprawl is encroaching into sensitive habitats and prime farmland. In other cases, the ecosystem has stabilized within the bounds imposed by development, and biological communities are recovering from prior disturbances.

Despite the ecological damage and degradation, the landscape and river system remain surprisingly diverse and biologically productive. The Illinois River system is home to approximately 35 mussel species, representing 12 percent of the freshwater mussels found in North America. Fish diversity is similarly high, with 115 fish species found, 95 percent of which are native species. Many of these species require both riverine and backwater (floodplain) habitat as part of their life cycle.

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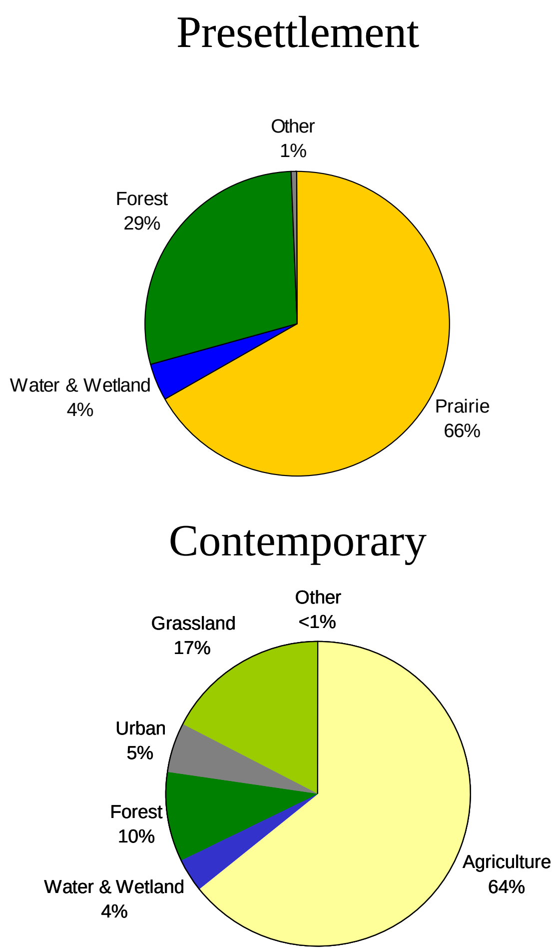


Figure 2-9. Presettlement and Contemporary Land Cover Distribution in the Illinois River Basin

1. Land Cover and Associated Biological Communities. The current basin-wide land cover, as evaluated from satellite imagery, is predominantly row crop agriculture (figure 2-9, table 2-3).

Table 2-3. Basin Land Cover in Illinois

Land Cover	Square Miles
Row Crop	14,671
Rural Grassland	3,621
Woodland/Forest - Deciduous/Closed Canopy	1,980
Small Grains	984
Urban Grassland	620
Urban/Built-Up - Medium Density	518
Woodland/Forest - Deciduous/Open Canopy	354
Urban/Built-Up - High Density	351
Forested Wetlands	344
Urban/Built-Up - Low Density	305
Open Water	260
Shallow Water Wetlands	142
Shallow Marsh/Wet Meadow	108
Urban/Built-Up - Medium High Density	106
Deep Marsh	31
Barren	15
Woodland/Forest - Coniferous	12
Orchards/Nurseries	9
Swamp	0
TOTAL*	**24,432**

* sum of urban classes not included = 1,279 mi.^{2}

In contrast to the presettlement land cover distribution (which was primarily prairie), today the landscape is approximately 64 percent agriculture, 17 percent grassland, 10 percent forest, 5 percent urban or developed, and 4 percent open water and wetlands. Row crops are widely distributed, but occur in the highest density in the central portion of the Illinois River Basin. Row crops occur in lower densities in the Spoon, LaMoine, and lower Illinois watersheds, where the hilly topography is not conducive to this type of agriculture. The area of row crops is four times greater than the next most abundant land cover class, rural grassland, which includes pasture, hay fields, conservation set asides, grass waterways, roadside grasses, and other grasses. Rural grasslands are widely distributed throughout the basin, especially along waterways. Closed canopy forests occur along the main stem river bluffs, especially in the Spoon, LaMoine, and lower Illinois watersheds. Closed canopy forests are also relatively abundant in the northeast region of the basin in county forest preserves. Urban/build-up classes are widely distributed, but there are several large clusters (figure 2-10), particularly in the greater Chicago area, Springfield, and Peoria.

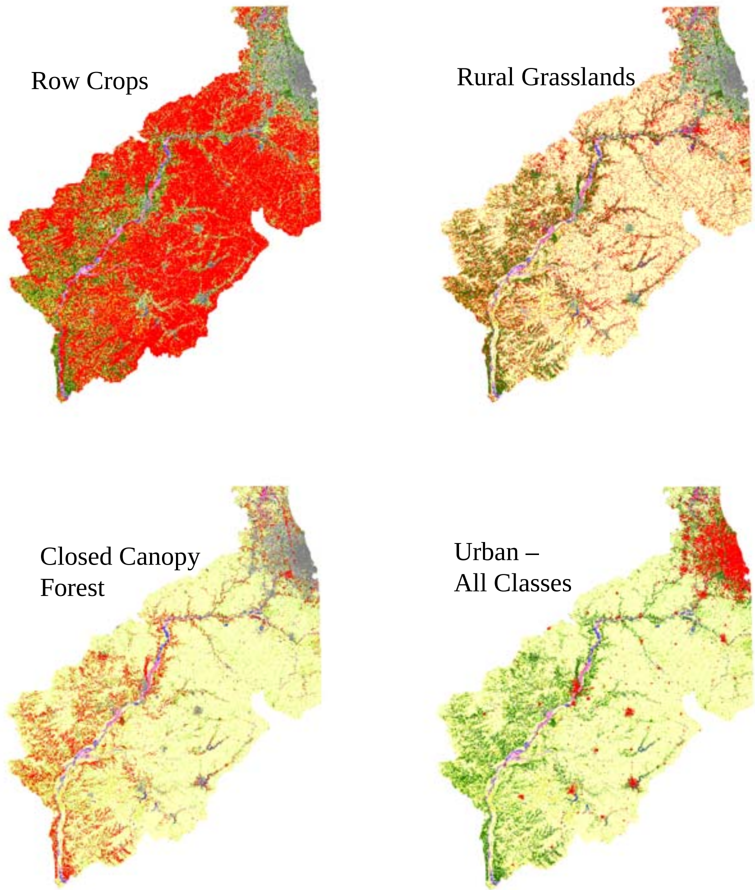


Figure 2-10. The Four Most Abundant Land Cover Classes (shaded red) in the Illinois River Basin

In addition to the losses of natural habitats in all classes, the remaining areas are highly fragmented and degraded to varying degrees. It is uncommon to find continuous natural land cover along the riparian corridor of an entire stream. Construction of roads, fields, dams, and losses of movement corridors have resulted in habitat fragmentation and the creation of small, isolated areas of forests, wetlands, prairies, and riparian corridors. Modern agriculture and the development of cities and towns have also contributed to habitat fragmentation.

The remaining animal and plant communities in these isolated tracts may only contain a few individuals or groups of each individual species. As tract size decreases, the population size of individual species also decreases because the local populations are vulnerable to disease and inbreeding stresses. Population size is the best predictor of extinction probability. Thus, fragmentation may increase the propensity for small, isolated populations to become locally extirpated (IDNR 1994, Wilson 1992). Species richness has been shown to be negatively affected with the decreasing size and increasing isolation of habitat fragments [The Nature Conservancy (TNC) 1998, Critical Trends Assessment Program (CTAP) 2001]. Fragmented habitats are often too small for species that require large home ranges or habitat blocks (such as the cerulean warbler), or are edge sensitive. Habitat fragmentation may favor competitors, predators, and parasites over native species and increases the vulnerability of native species to predators along new habitat edges. Fragmentation also severs the natural landscape links that connect blocks of similar habitat or provide access to different habitat types required by various species for different life cycle functions. Habitat loss, degradation, and fragmentation have led to measurable losses in species diversity throughout the Illinois River Basin (Fitzgerald et al. 2000, CTAP 2001).

Finally, disturbances maintain the mosaics of habitats needed to maintain a naturally functioning ecosystem. Most of these disturbance regimes have been greatly altered or even eliminated altogether. This alteration of disturbance regimes has resulted in a more homogeneous environment, with an associated loss in ecological integrity.

a. Resource Rich Areas (RRA). Critical Trends Assessment Program (CTAP) scientists used land cover data and geo-referenced biological data, such as the quantity of forests, wetlands, Illinois Natural Areas Inventory (INAI) sites, and Biologically Significant Streams (BSS), to determine where the most biologically rich areas of the state are located. Thirty such resource rich areas were identified throughout the state, 11 of which lie at least partially within the Illinois River Basin (figure 2-11).

1. Driftless Area
2. Sugar River
3. **Chain O' Lakes - Fox River**
4. Illinois Beach
5. Kishwaukee River
6. Rock River
7. **Du Page River**
8. Mississippi - Lower Rock
9. **Des Plaines River**
10. **Thorn Creek**
11. **Prairie Parklands -Midewin**
12. **Kankakee - Iroquois**
13. **Peoria Wilds**
14. Nauvoo
15. **Mackinaw River**
16. **Middle Illinois River**
17. Vermilion River
18. **Big Rivers**
19. Embarras River
20. **Sangamon River**
21. Upper Wabash River
22. Southern Till Plain
23. Karst/Cave Area
24. Lower Wabash River
25. Kaskaskia Bottoms
26. Middle Fork Big Muddy
27. Illinois Ozarks
28. Shawnee Hills
29. Cache River
30. Cretaceous Hills

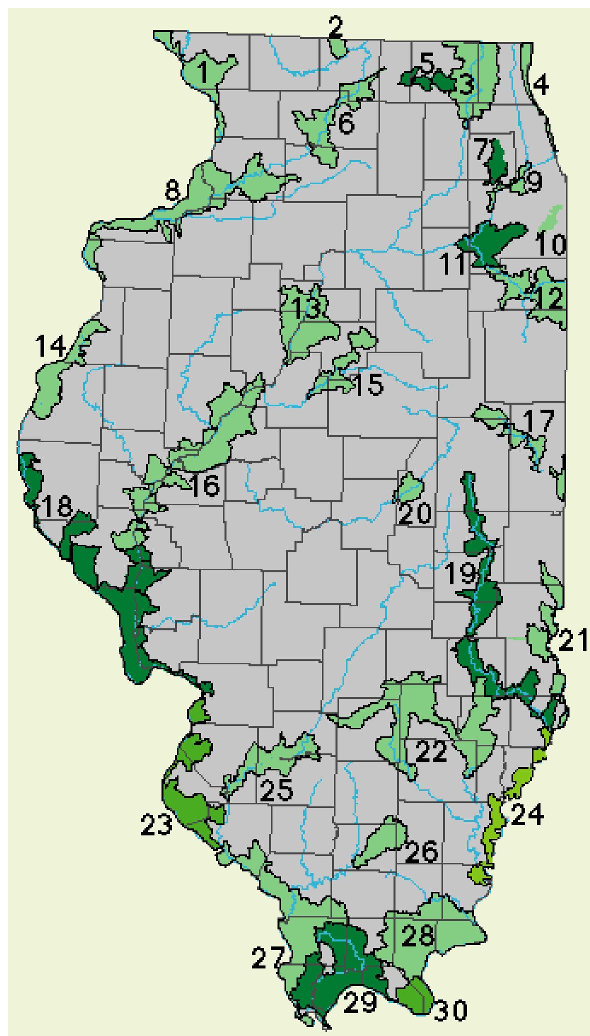


Figure 2-11. Resource Rich Areas (CTAP 2001). Those RRAs in bold are within the Illinois River Basin, wholly or in part.

The RRAs in the Illinois River Basin vary in size from 20,614 to 626,795 acres (table 2-4).

Table 2-4. Illinois Natural Areas Inventory (INAI), Biologically Significant Streams (BSS), and Natural Heritage occurrences for Resource Rich Areas within the Illinois River Basin

Resource Rich Area	Total Acres	INAI	# INAI Sites [1]	BSS Miles	# Heritage Occurrences
Chain O Lakes-Fox River	285,844	9,442	72	35.6	476
DuPage River	51,653	1,576	7	0	17
Des Plaines River	43,470	2,115	11	0	61
Thorn Creek	20,614	927	5	0	13
Prairie Parklands	152,669	10,037	18	23.8	85
Kankakee-Iroquois	231,005	6,731	17	63.3	67
Peoria Wilds	277,847	1,859	24	0	51
Mackinaw River	125,008	1,139	4	26.9	7
Middle Illinois River	575,515	13,474	38	0	134
Big Rivers	626,795	10,514	61	28.9	150
Sangamon River	53,734	880	2	15.5	8

[1] Natural areas occurring in more than one RRA are counted only once.

In most RRAs, the existing natural resources occupy a concentrated portion of the watershed, often along riparian corridors, and only a small fraction of these areas are protected from encroachment or development by being in State or Federal ownership (table 2-5).

Table 2-5. State- and Federally-Owned Lands in Resource Rich Areas

State Lands [1]						Federal Lands		
Resource Rich Area	# of Parks	# Cons Areas	# of Forests	# of FWA	State acres	% of RRA	Federal acres	% of RRA
Chain O Lakes-Fox River	2	0	0	0	5,338	1.9	0	0.0
DuPage River	0	0	0	0	0	0.0	0	0.0
Des Plaines River	0	0	0	0	0	0.0	0	0.0
Thorn Creek	0	0	0	0	0	0.0	0	0.0
Prairie Parklands	2	1	0	0	7,324	4.8	26,904	17.6
Kankakee-Iroquois	1	1	0	0	6,415	2.8	0	0.0
Peoria Wilds	0	4	0	1	9,570	3.4	1,589	0.6
Mackinaw River	0	0	0	1	1,397	1.1	0	0.0
Middle Illinois River	1	5	1	2	31,630	5.5	21,499	3.7
Big Rivers	1	1	0	0	9,547	1.5	37,901	6.0
Sangamon River	0	0	0	0	0	0.0	0	0.0

[1] Parks, Cons Areas (Conservation Areas), Forests, and FWA (Fish and Wildlife Area) refer to state lands

The RRAs include 45 percent of the bottomland, 43 percent of the nonforested wetland, and 34 percent of the upland forest in Illinois while occupying less than 20 percent of the state's total area. The RRAs include 76 percent of all INAI acreage and 55 percent of all INAI sites in the state. Forty-eight percent of all BSS mileage lies within RRA sites. The RRAs in the northeast portion of the Illinois River Basin, in and around the greater metropolitan Chicago area, are especially vulnerable to urban encroachment.

This inventory of resource rich areas has helped to establish priorities for Illinois' Conservation 2000 Ecosystem Program. Most of the program's Ecosystem Partnerships have a resource rich area in their core. These partnership groups work together to maintain and enhance ecological and economic conditions within a defined area (CTAP 2001).

b. Grassland Communities. Prairies once covered 61 percent of the Illinois landscape. While grassland still accounts for almost 7 million acres (20 percent) of the entire state of Illinois, only 2,300 acres (about 0.01 percent of the former area) of high quality prairie remains (CTAP 2001). The remainder of the grassland habitat has been plowed, heavily grazed, or frequently mowed. Scientists from CTAP monitored 71 grassland sites statewide from 1994-2001. The average number of vascular plant species per sample site was 20; the lowest diversity sites averaged 6 species and the highest diversity sites (prairie remnants) averaged 33 species per site. By comparison, high quality prairie habitats may contain 10-140 species in a few acres. Of the terrestrial habitats, grasslands are the most heavily dominated by introduced species, primarily meadow fescue and Kentucky and Canadian blue grasses. Although many introduced grasses dominate these grasslands, they still harbor many grassland-dependent species that rely on the structure and extent of the habitat more than the specific plant species.

Most of the bird species of concern for this physiographic region, identified by Partners in Flight (a cooperative effort focusing on bird conservation in the Western Hemisphere) are grassland birds (Fitzgerald et al. 2000). Grassland bird communities were assessed from 1994-2001 and CTAP scientists found fewer grassland-dependent bird species than expected. Of 12 grassland-dependent indicator species and an expectation of at least 6 species at any site, an average of only 1.8 species per site were found among 45 sites surveyed statewide. Except for the eastern meadowlark, brown-headed cowbirds (nest parasites) were detected more often than any grassland-dependent bird species. The species that were found most often exhibited only low to moderate sensitivity to grassland fragmentation.

c. Forest Communities. Two hundred years ago, 38 percent of the state was forested; only 14 percent remains as forest today (CTAP 2001). These losses are the result of conversion to agricultural land and timber harvesting for fuel wood and lumber. Floodplain forests serve as habitat for wildlife and, during floods, for fish; reduce soil erosion; and improve water quality. Leaf litter is a significant source of organic matter for secondary aquatic production (Yin 1999). Seventy-one randomly-selected forest sites around the state were monitored between 1997 and 1999. Results of CTAP forest monitoring revealed that upland forests are oak-hickory-ash-elm and bottomland forests are predominantly ash-elm-maple (CTAP 2001). Considering the total number of vascular plants, bottomland forests were less diverse than upland forests. Landowner reports and preliminary survey results indicate that many forests are in early stages of succession, comprise primarily young trees, are often small woodlots, and show evidence of grazing, logging, or farming. Older growth forests were rarely encountered. Timber harvesting of maple trees is becoming increasingly common (Timmons 2001). Scientists from CTAP identified three common disturbance related problems: (1) forests have lost disturbance sensitive species, (2) forests are being dominated by introduced invasive species, and (3) fire suppression is leading to maple dominance (with a concurrent decline in oak and hickory species). The species composition in bottomland forests has also been altered by higher water tables, resulting in decreased oak regeneration and also adding to maple dominance (Theiling et al. 2000).

Floodplain forests support a larger number of avian species than any other habitats in the Upper Mississippi River System, providing essential habitat for wood ducks, hooded mergansers, prothonotary warblers, and red-shouldered hawks (Yin 1999). Scientists from CTAP detected the impacts of forest structural and compositional change in bird communities. An average of 6.4 forest-dependent species was found at each site. Out of a total of 24 possible species, 10 area-sensitive species were found between 1997 and 1999 for this statewide monitoring program. A positive correlation between percent forested area within 1 km and the number of bird species was also detected. Despite the lack of historical data for comparison, the occurrence of fewer than one species (0.56) per site reflects the degraded condition of the average forest patch in Illinois (CTAP 2001).

Illinois forests provide the major habitat for more than 420 vertebrate species. Losses in the quality and quantity of forest habitat severely affect wildlife populations; 82.5 percent of mammals, 62.8 percent of birds, and 79.7 percent of amphibians and reptiles require forested habitat for a portion of their life cycle (IDNR 1994).

d. Wetland Communities. To date, approximately 90 percent of Illinois wetlands have been lost. The wetlands that remain are degraded by fragmentation, siltation, altered hydrology, and the introduction of aggressive species (Havera et al. 1997, CTAP 2001). High quality wetlands tend to be relatively free from aggressive introduced species, so species richness and the presence of introduced species were the indicators CTAP scientists used to assess wetland quality. Among 78 monitored sites statewide, the most important native species were Joe Pye weed (*Eupatorium dubium*), rice-cut grass (*Leersia oryzoides*), common reed (*Phragmites australis*), river bulrush (*Scirpus fluviatilis*), water smartweed (*Polygonum amphibium*), and broad-leafed cattail (*Typha latifolia*). There were generally few introduced species at each site, but many degraded wetland communities were dominated by a single aggressive species such as narrow-leaved cattail (*Typha angustifolia*), reed canary-grass (*Phalaris arundinacea*), and meadow fescue in the north, and common reed (*Phragmites australis*) in the south. Reed canary-grass, the most commonly encountered introduced species, often completely dominates wetland plant communities and was the dominant species in 22 of 78 monitoring sites (CTAP 2001). The northeastern counties (Cook, Lake, and McHenry) supported the greatest number of rare wetland plant species in Illinois. The extirpations of threatened and endangered wetland plants have been exceptionally high in several counties in the Illinois River Basin (IDNR 1994).

Photograph 2-2. Great Blue Heron

Most of the birds, mammals, amphibians, and reptiles in Illinois use wetlands to satisfy some or all of their life requisites. Up to 266 species of birds use wetlands in Illinois during some stage of their life cycle (IDNR 1994). Scientists from CTAP identified 15 wetland-dependent bird species, such as the great blue heron (photograph 2-2), that could occur in southern wetlands and 27 in northern wetlands. Among the 50 wetland sites surveyed statewide, an average of only 1.3 wetland-dependent bird species per site were detected. No wetland-dependent species were detected at half of the sites. Six species were detected in at least 10 sites. Only three of the 12 state-listed threatened or endangered wetland-dependent birds were found, at one site each. The rarity of these wetland-dependent birds is indicative of the degraded wetland conditions in the state (CTAP 2001).

Of the 59 mammal species in Illinois, at least 36 species use wetland habitats, including 8 of the 10 endangered and threatened mammal species that are wetland-dependent (photograph 2-3). Thirty-seven of 41 species of amphibians in Illinois use wetlands; all three threatened or endangered amphibians are dependent on wetlands. Forty-seven reptile species, out of 60 statewide, utilize wetlands, including seven of nine species listed as threatened or endangered. Twelve of the 29 endangered and threatened fish species occur in wetlands or use them for spawning. Overall, of the 94 vertebrate species listed as threatened or endangered throughout the state, 64 percent utilize wetlands for at least some portion of their life cycle (IDNR 1994).

Photograph 2-3. North American River Otter

e. Riparian Corridors. The riparian corridor is an important structural and functional element of the stream ecosystem. Riparian corridors are the transition areas between aquatic and terrestrial habitats. Riparian areas provide movement corridors along rivers and streams. The bank line forests provide shade and input organic matter into the aquatic ecosystem. Riparian habitat is critical habitat for migrating and breeding birds. Preserving large tracts of contiguous habitat is important for maintaining high levels of vertebrate and invertebrate biodiversity. Fragmentation or development of this habitat can disrupt migration and breeding patterns and could limit species that favor expanses of connected habitat.

Detailed analyses of riparian corridor changes have not been conducted, but the change in the distribution of forest, prairie, and wetland cover between the present and presettlement periods has been extensive. The current composition of bankside land cover is mostly forest or grassland (table 2-6). However, the dominant riparian land cover within a 300-meter (328 yards) buffer area is agriculture.

Table 2-6. Riparian Bankside and 328 yd. Buffer Land Cover (ISIS 1999)

Land Cover Class	Bankside (%)	328 yd. Buffer (%)
Agriculture/Cropland	1	66
Disturbed/Barren	0	1
Forest	49	14
Grass	33	5
Mixed	14	7
Reservoir	2	2
Urban	1	4
Water	0	1

f. Stream Communities. There is a great diversity of stream types in the Illinois River Basin, including small, coldwater, spring-fed creeks; stony and sandy-bottomed coolwater or warmwater streams; and soft-bottomed, warmwater streams and rivers. The diversity of habitats helps support a diversity of aquatic plant and animal species. The majority of streams have been manipulated either directly by modifications within the streams, or indirectly by modifications in the surrounding landscape, or both. Dams and channelization are the most apparent changes to small streams and rivers. Many streams that originally drained the prairies of Illinois were straightened and their canopies and riparian buffers were removed. Many current streams or ditches, constructed to provide more effective land drainage, were historically ephemeral channels, wetland swales, or simply did not exist (Rhoads and Herricks 1996). Landscape changes have also led to increased runoff rates. Much of the land that is currently used for agricultural purposes was tiled to drain more rapidly than it did historically. Increased bed and bank migration has resulted from the higher energy flows and erosive forces of these stream systems. This development in the basin has resulted in streams that are more structurally simple and homogeneous than in the past.

Several methods—including the Biological Stream Characterization (BSC) Index and habitat quality assessments performed as a part of the CTAP—were used to assess the stream quality within the state The BSC and habitat quality assessments are based on different criteria; therefore, the results display some similarities as well as differences. The BSC is based on biological data, while the habitat quality assessments are based on physical parameters of the streams. These two methods are described below.

Biological Stream Characterization. Illinois DNR and Illinois EPA managers developed the BSC Index to rank stream quality uniformly across the state. The BSC is a mix of quantitative variables based primarily on the Index of Biotic Integrity for fish (Karr et al. 1986), and to a lesser extent on macroinvertebrate biotic indices and qualitative judgments of Illinois DNR biologists (Bertrand et al. 1996). The results for the 1999 Illinois River Basin assessment are shown in table 2-7 and figure 2-12. In that assessment, the Mackinaw watershed had the most highly rated stream miles. Highly valued and moderate stream reaches were the most common, and they were widely distributed throughout the Illinois River Basin. Limited value streams occurred in the urban watersheds of the Des Plaines, Fox, and Chicago Rivers, the agricultural watersheds of the Sangamon River, and the Spoon River watershed. Restricted stream reaches occurred mainly in the Chicago region, and comprised only a small fraction of the total streams assessed.

Stream Habitat. State scientists have been monitoring stream water quality, habitat, aquatic insects, and fishes throughout Illinois since 1995 as part of the CTAP (CTAP 2001). Habitat quality assessments, modified from the USEPA procedure, have been conducted by CTAP scientists, examining 12 stream habitat parameters that relate to the quality and width of bankline vegetation, quantity and quality of in-stream cover, condition of banks, and relative straightness of the stream course. Natural habitat features of most Illinois streams, such as wooded riparian corridors, winding channels, and in-stream habitat such as coarse rocks and woody debris, have been removed to facilitate agriculture. The statewide average habitat index score was 88.6 out of a maximum possible 180, indicating fair habitat quality. The lowest and highest scores in Illinois were 25, indicating severe landscape and drainage alterations, and 146, indicating an aquatic and riparian resource of the highest quality. Highly agricultural basins, including the Kankakee, Vermilion, Mackinaw, and Spoon scored below the statewide average. The Sangamon basin scored higher than average since it is larger and more flood-prone, discouraging row crop agriculture close to the banks. Habitat quality scores of the streams in the Illinois River Basin reflect the modifications to the floodplain that have occurred over the past 150 years (CTAP 2001).

Table 2-7. Illinois River Sub-Basin Stream Miles Ranked Using the Illinois Department of Natural Resources Biological Stream Characterization (Bertrand et al. 1996: ISIS 1999)

Watershed	Unique	High	Moderate	Limited	Restricted
Des Plaines	11.3	68.8	189.2	260.0	19.5
Upper Fox	0.0	94.6	99.0	46.1	0.0
Chicago	0.0	0.0	64.9	156.7	24.1
Lower Fox	16.5	164.1	310.8	9.4	0.0
Lower Illinois-Senachwine Lake	8.8	124.2	113.4	0.0	0.0
Upper Illinois	45.0	163.4	28.9	0.0	0.0
Kankakee	0.0	228.8	92.6	0.1	0.0
Spoon	0.0	159.2	487.9	130.4	0.0
Vermilion	55.9	223.8	122.0	0.0	0.0
Iroquois	0.0	167.6	33.1	0.0	0.0
Lower Illinois-Lake Chautauqua	0.0	50.1	60.5	0.0	0.0
Mackinaw	156.1	211.5	65.4	1.2	0.0
LaMoine	19.6	176.3	231.9	0.6	0.0
Upper Sangamon	46.2	117.5	250.5	34.1	0.0
Salt	18.7	184.2	234.4	53.6	0.0
Lower Sangamon	0.0	12.8	193.9	36.1	0.0
Lower Illinois	0.0	219.7	33.9	0.0	0.0
South Fork Sangamon	0.0	0.6	116.1	81.8	0.0
Macoupin	0.0	101.2	0.5	0.5	0.0
Total Stream Miles	**378.1**	**2,468.4**	**2,728.9**	**810.6**	**43.6**
Percent of Sampled	**5.9%**	**38.4%**	**42.4%**	**12.6%**	**0.7%**

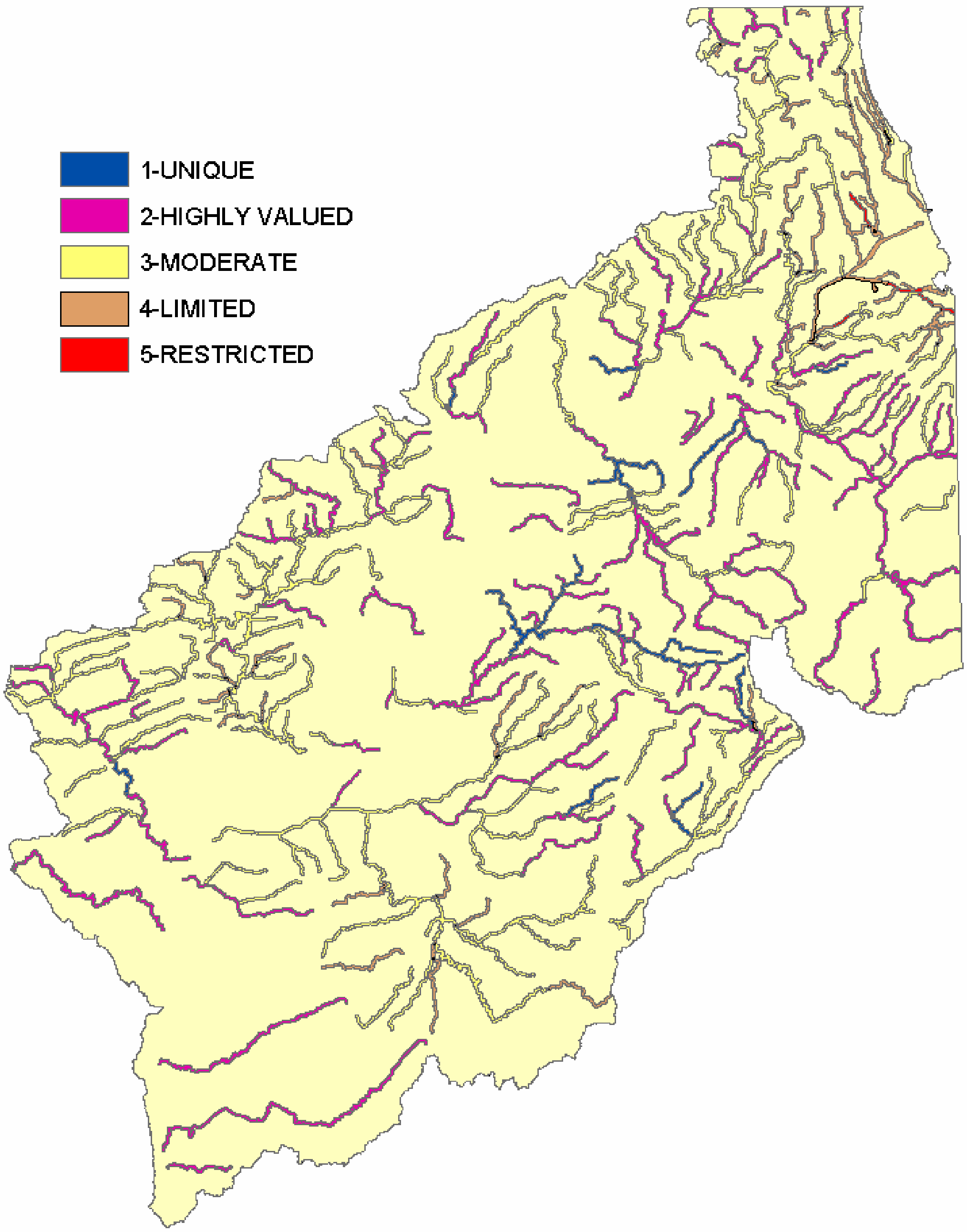


Figure 2-12. Biological Stream Characterization for Some Illinois River Basin Streams (Bertrand et al. 1996; ISIS 1999)

Compared to the species found in flowing waters in Illinois at the start of the last century, approximately 19 percent of the fish, 34 percent of the amphibians and reptiles, 55 percent of the freshwater mussels, and 22 percent of the crayfish have been extirpated or are threatened by extinction (IDNR 1994). These changes can be attributed to habitat loss, degradation due to siltation and/or poor water quality, contaminated sediments, construction of dams and levees, introduction of exotic species into the system, and overharvesting (IDNR 1994).

g. Floodplain Communities. The degree of connectivity between the main channel and its floodplain is a primary structural attribute of river ecological integrity (Lubinski 1999). Seasonal floods, creating and maintaining a mosaic of habitat types that exhibit a high degree of biodiversity, characterize river-floodplain ecosystems (Sparks 1995). The lower Illinois River, including Peoria, La Grange and Alton Pools, is a remnant of the ancient Mississippi River that once flowed across northwestern Illinois. The floodplain in this reach is exceptionally large for the current river discharge and has been filling with fine loess sediments for millennia (Theiling et al. 2000).

Prior to navigation and agricultural development, the backwaters were very numerous and diverse. Currently, water level regulation maintains fewer, larger lakes with uniform shallow depths and silty substrates. Agriculture dominates the floodplain, which is about 50 percent leveed in La Grange Pool and about 70 percent leveed in Alton Pool (Theiling et al. 2000). The levees also concentrate river flows and sediment carried in suspension. Sediment-laden waters are currently concentrated in the remaining contiguous floodplain, where it settles out, causing rapid filling in backwater lakes (Bellrose et al. 1983). Levees reduce river-floodplain connectivity, which may limit production of floodplain spawning fishes and reduce nutrient transfer between the river and its floodplain (Sparks 1995, Ward 1999).

The overall productivity of the river system may have been reduced from a natural floodplain river system with significant changes in seasonal water levels to an ecosystem in which seasonal low water conditions no longer occur (Bayley 1991). These alterations to the landscape and the flood pulse and river-floodplain connectivity have initiated long-term changes in the ecosystem that are difficult to reverse (Sparks 1995).

h. Aquatic Vegetation. Historically, emergent, submersed, and floating aquatic plants were very important components of the Illinois River floodplain ecosystem (Bellrose et al. 1979, Havera 1999). The vast floodplain marshes and backwater lakes were the resources that attracted and supported the huge abundances of migratory waterfowl and other waterbirds that have been so highly valued. The ecological response to the multiple and continued disturbances of the Illinois River has been well documented through time (see Mills et al. 1966, Starrett 1972, Bellrose et al. 1979, Sparks 1984, Bellrose et al. 1983, Theiling 1999, and USGS 1999 for comprehensive reviews). From all accounts, the river was in good condition prior to 1900. After 1900, however, the diversion from Lake Michigan permanently altered the nature of the system. Initially, the expanded backwaters were vegetated with about 50 percent cover of many species of aquatic plants, such as pondweeds (*Potamogeton* spp), coontail (*Ceratophyllum* spp), bulrush (*Scirpus* spp), and wild celery (*Vallisneria* spp) (Bellrose et al. 1979, Sparks 1984).

Photograph 2-4. Degraded Backwater

Aquatic plants have not recovered from the effects of organic pollution in the early 1900s and increased wave action from wind and boats after 1955 (Bellrose et al. 1979, Sparks 1992, Havera 1993, Havera 1999, Yin et al. 2004). The continued absence of aquatic plants in backwaters and channels open to the Illinois River is significant (photograph 2-4). When submersed aquatic vegetation died out in the mid-1950s, several things occurred: backwater substrates became easily disturbed; turbidity increased; fish communities became dominated by species tolerant of low dissolved oxygen and poorer habitat conditions; and waterfowl shifted their migrations away from the river. Currently, aquatic plants in the Illinois River are largely restricted to backwaters isolated from the river by low levees (Rogers and Theiling 1999). In addition to the physical constraints to aquatic plant re-establishment, the high abundance of rough fish, including carp, exert significant grazing pressure on any plants where they are able to grow, further limiting their re-establishment.

i. Aquatic Macroinvertebrates. In the Illinois River, the aquatic macroinvertebrate community (mayflies, fingernail clams, chironomids, and worms) was seriously affected by organic pollutants and served as a strong indicator of environmental quality (summarized by Starrett 1972 and Sparks 1984). Studies conducted by Richardson in 1915 (Richardson 1921) indicated a diverse benthic community with a dominance of small mollusks (fingernail clams and snails). By 1920, pollution-tolerant sludge worms (*Tubificidae*) and bloodworms (*Chironomus* spp) dominated the benthos.

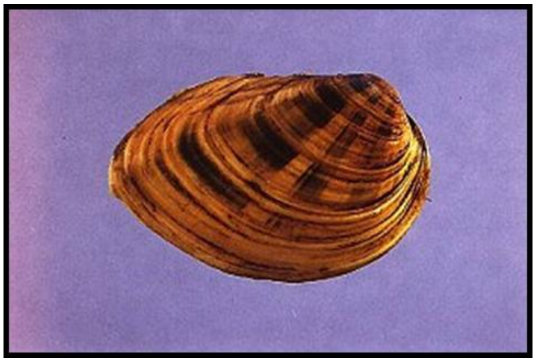
Fingernail clams were the dominant food source for many benthic feeders (diving ducks, buffalo, catfish, carp) until the mid 1950s when fingernail clams experienced a dramatic population decline (Mills et al. 1966). The likely causal agent was determined to be periodic high concentrations of ammonia, a problem from which the river has not yet recovered (Sparks and Ross 1992) and may still be occurring. The decline of fingernail clams had a substantial effect on their vertebrate predators.

Benthic communities are still poor in the northern reaches of the river, but mayflies and fingernail clams occur in low abundance in lower parts of the river. Macroinvertebrate populations in the Illinois River, such as burrowing mayflies and fingernail clams, are substantially smaller than those found in the Upper Mississippi River (Heglund 2004). However, new populations of fingernail clams have been recently documented at a few locations on the upper river (Sparks and Ross 1992, Yin et al. 2004).

Environmental conditions within the streams of the Illinois River Basin are better than those in the Illinois River itself. The EPT taxa richness index (Ephmeroptera, Trichoptera, Plecoptera) measures the number of pollution-intolerant mayflies, caddisflies, and stoneflies present in a sample. Higher EPT index values indicate less organic pollution, or better stream health. The index scores ranged from 0 to 17 statewide with an average of 7.1 EPT taxa per stream, which is a fair rating. The Illinois

River Basin watersheds scored above and below the statewide mean, with the Kankakee watershed scoring the lowest, the Fox almost at the mean, the LaMoine above the mean, and the Sangamon and Spoon higher than the mean. Hilsenhoff Biotic Index and Macroinvertebrate Biotic Index scores followed similar trends as the EPT scores, with the Spoon indicating less impaired conditions (CTAP 2001).

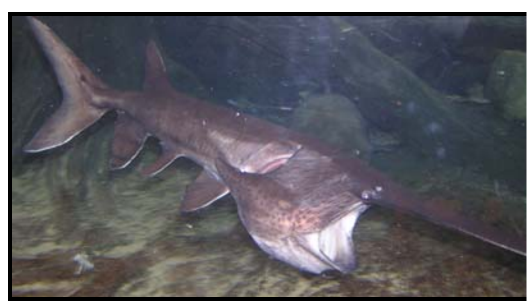
j. Mussels. Freshwater mussels (Unionaceae) (photograph 2-5) are another sediment-associated fauna that has suffered from the impacts of pollution and sedimentation; they are among the most imperiled fauna in North America (Neves 1993, Cummings and Anderson 2003). Not only are the numbers of freshwater mussels reduced due to poor water quality, the competition from zebra mussels (an invasive species) has also led to the decline in freshwater mussels. The zebra mussel infestation, which significantly affected the mussel communities in the Illinois River, has subsided considerably since 1995. No zebra mussels were detected in over 10,000 mussels collected in Alton Pool by commercial fishers in a specially regulated research harvest (Robert Maher, Illinois DNR, Brighton, Illinois, personal communication) but they can be found on riprap and other hard surfaces (Matt O'Hara,2001)



Photograph 2-5. Clubshell Mussel

The Illinois River system still retains approximately 35 mussel species, representing 12 percent of the freshwater mussels found in North America. Five mussel species are listed by the State of Illinois as threatened or endangered, one of which is a candidate for Federal listing. However, the general trend for mussels is still declining, both in population numbers and numbers of species, attributed to excessive siltation, loss of habitat, chemical pollution (including herbicide and insecticide runoff), and competition from exotic species (zebra mussels).

k. Fish . Fish communities provide a high-level indicator of environmental quality because of their position on the food chain and because they cannot significantly alter their distribution other than to escape into suitable tributaries or downstream. While Illinois streams contain a diversity of fishes (188 native species), they are often dominated by just two to three fish species, sometimes by one or more of the 15 introduced species found in the state (CTAP 2001). Fish species diversity is still considered high in the basin, with 115 species found, 95 percent of which are native species. Many of these species require riverine, backwater, and floodplain habitat as part of their life cycle. Eighteen fish species are listed by the State of Illinois as threatened or endangered. Many of these species are endemic to the basin and/or are intolerant of high silt levels. A group of aquatic organisms that is particularly representative of the Illinois River is the "Ancient Fishes," such as the paddlefish (photograph 2-6) and sturgeon. The majority of these fishes are migratory in nature and utilize a variety of habitats.



Photograph 2-6. Paddlefish

Fisheries monitoring, as part of the Long Term Resource Monitoring Program (LTRMP) conducted under the Environmental Management Program (EMP), and the Long Term Electrofishing (LTEF) conducted by the Illinois DNR since 1973, suggest that two distinct populations of fishes exist within the main stem of the Illinois River. Index of Biotic Integrity (IBI) trend data show no significant changes in populations in the lower three pools (Alton, La Grange, Peoria). However, these data reflect a recent increase in IBI scores in the upper three pools (Starved Rock, Marseilles, Dresden), approaching the IBI score for the lower pools. These differences in scores may be due to the inherent physical differences between these two areas, as well as lingering effects of water quality impacts to the upper pools (Pegg 2001). The long-term outlook (without-project conditions) may be for populations and native species diversity to decline gradually, due to increasing invasive species, declining suitable habitat, and loss of main stem benthic community.

Photograph 2-7. Green-winged Teal

l. Waterfowl and Birds. The Illinois River Basin is a critical mid-migration resting and feeding area of the Mississippi River Flyway. The numbers of waterfowl feeding and resting in the basin have dwindled since the first half of the 20th century. Diving duck numbers have not recovered from their rapid population decrease in the 1950s, due to habitat changes and loss of food resources. Waterfowl, and particularly diving ducks, have shifted their migrations away from the Illinois River. Peak numbers of dabbling ducks have hovered around 300,000 birds. By comparison, in the late 1940s, there were over 1,500,000 dabbling ducks in the Illinois River region each fall (photograph 2-7). Mallard numbers in the Illinois Valley have declined over 80 percent since the late 1940s.

Twenty-six avian species are state listed as threatened or endangered; one of which, the Bald Eagle**,** is a listed as a Federal Threatened Species, and four others are species of concern. Many of these species are associated with wetlands or grasslands, and are also sensitive to landscape fragmentation.

2. Threatened and Endangered Species. The Illinois River Basin currently contains 257 state listed threatened or endangered species in Illinois, of which 13 are federally listed and 1 is a Federal candidate species (table 2-8). Three additional federally-listed species occur in Indiana (total of 13 species, including 2 candidate species and 1 critical habitat designation). No additional threatened or endangered species occur in Wisconsin (two total species, including one candidate species). Five mussel species that live in the Illinois River Basin are listed by the state of Illinois as threatened or endangered, one of which is a candidate for Federal listing. Eighteen fish species are listed by the State of Illinois as threatened or endangered. Many of these species are endemic to the basin and/or intolerant of high silt levels. Federally listed species are discussed more completely in Section 5 and Appendix G (Coordination Act Report) of this document.

Table 2-8. Threatened and Endangered Species in the Illinois River Basin

Group	Illinois State Listed	Illinois Federal Listed Species	Indiana Federal Listed Species	Wisconsin Federal Listed Species
Birds	26	1	2 [1]	
Fish	18	0	0	
Mammals	2	2	1	
Mussels	5	1	4 [2]	
Reptiles/Amphibians	9	1 [2]	2 [2]	1 [2]
Insects	11	2	2	
Crustaceans	1	0	0	
Plants	185	7	2	1
TOTAL	**257**	**14**	**13**	**2**

[1] includes critical habitat designation
[2] candidate species

3. System Limiting Factors. The Illinois River Basin continues to experience a loss of ecological integrity due to: sedimentation of backwaters and side channels, degradation of tributary streams, increased water level fluctuations, reduction of floodplain and tributary connectivity, introduction of invasive species, and other adverse impacts caused by the intensive human development over the last 150 years. While many of the original plant and animal species are still present in the basin at reduced levels, the physical habitats (structure) and the processes that create and maintain those habitats (function) have been greatly altered. These alterations have contributed to a decline in the ecological health of the Illinois River Basin to the point where: aquatic plants beds have been virtually eliminated from the lower river; macro-invertebrate numbers have declined significantly; the loss of backwaters areas with sufficient depth for spawning, nursery and overwintering habitat is now considered limiting for many native fish; and floodplain, riparian, and aquatic habitat loss and fragmentation is a threat to the population viability of state- and federally-listed species in the basin.

a. Excessive Sedimentation. Increased sediment loads from the basin (photograph 2-8) have severely degraded environmental conditions along the main stem Illinois River by increasing turbidity and filling backwater areas, side channels, and channel border areas.

Photograph 2.8. Deposition at the Mouth of Lick Creek in LaGrange Pool

Increased sediment loads from the basin have severely degraded environmental conditions along the main stem Illinois River by increasing turbidity and filling backwater areas, side channels, and channel border areas. Excessive sediment has also degraded tributary habitats. Effective erosion control, due to the implementation of soil conservation practices, has reduced the average rate of erosion from croplands. Channel erosion from unstable streams accounts for 30-40 percent of the sediment delivered from eastern Illinois River Basin watersheds, and up to 80 percent of the sediment delivered from watersheds in the western part of the basin.

Channelization of streams has increased both flow rates and velocities within the streams, which has led to increased channel erosion. An average of 12.1 million tons of sediment per year were delivered to the Illinois River, above Valley City, for water years 1981-2000, of which 6.7 million tons per year were deposited within the river and its bottomlands. The physical effects of excessive sedimentation, coupled with an absence of complementary erosive forces, accelerate changes to aquatic and floodplain habitats, including the smothering and filling of habitats Low-velocity areas, such as backwater areas and side channels, are particularly susceptible. Addressing the contribution of fine sediments from the watershed is an effective way of reducing the negative effects of sedimentation in backwater areas because fine sediments can even be carried by slow-moving flows. Excessive sedimentation in the Illinois River Basin is discussed more fully in Section 3 under Goal 1.

b. Loss of Productive Backwaters, Side Channels, and Channel Border Areas. The loss of productive backwaters, side channels, and channel border areas due to excessive sedimentation can be attributed to the ecological problems in the Illinois River Basin, particularly because the Illinois River has lost much of its critical spawning, nursery, and overwintering areas for fish; habitat for waterfowl and aquatic species; and backwater aquatic plant communities. On average, the backwater lakes along the Illinois River have lost 72% of their capacity. The current quality of the existing backwaters is low due to the relatively shallow depths (less than 1 foot) and relatively uniform bottom surface lacking depth diversity. If current conditions persist, additional significant aquatic areas will be converted to lower value and increasingly common mud flat and extremely shallow water habitats. The loss of these areas in the Illinois River Basin is discussed more fully in Section 3 under Goal 2.

c. Loss of Floodplain, Riparian, and Aquatic Habitats and Functions. Land-use and hydrologic changes have reduced the quantity, quality, and functions of aquatic, floodplain, and riparian habitats. Flood storage, flood conveyance, habitat availability, and nutrient exchange are some of the critical aspects of the floodplain environment that have been adversely impacted. The use of levees has disconnected large areas of the floodplain from the Illinois River and its tributaries. Habitat loss and fragmentation are widespread problems that, in the long term, could limit attempts to maintain and enhance biodiversity. The degree of connectivity between the main channel and its floodplain is another primary structural attribute of river ecological integrity (Lubinski 1999). Isolation of the floodplains from the river has resulted in a reduction of habitat quality, availability, and function.

An analysis of the current main stem Illinois River floodplain cover types reveals a loss of approximately 75 percent of the forest, 81 percent of the grassland, and 70 percent of the wetlands. In addition, nearly 50 percent of the floodplain has been isolated from the river. A similar analysis of the tributary floodplains reveals approximate losses of 16 percent of the forest, 36 percent of the grassland, and 70 percent of the wetlands.

Alterations within the watershed have also had a pervasive negative effect on basin stream systems. Based on the IEPA analysis, channelization potentially impairs approximately 1,400 of perennial stream miles within the Illinois River Basin. However, unassessed streams tend to be smaller, and CTAP (1994) identified that the smaller streams tend to be channelized to a disproportionately high extent. Lopinot (1972) estimated that 27 percent of streams in the state were channelized at the time of publication; this would correspond to nearly 3,000 stream miles in the Illinois River Basin. Channelization of streams shortens overall stream lengths and results in increased velocities, bed and bank erosion, and sedimentation (photograph 2-9). Modified stream channels often have little habitat structure and variability (life requisites) necessary for diverse and abundant aquatic species. Channelization also disconnects streams from floodplain and riparian areas that are often developed into agricultural or built environments.

Photograph 2-9. Stream Incision and Stream Bank Erosion

In addition to habitat loss and fragmentation, habitat forming disturbance regimes have been altered, affecting habitat and species diversity. The degree of connectivity between the main channel and its floodplain is a primary structural attribute of river ecological integrity (Lubinski 1999). Seasonal floods, creating and maintaining a mosaic of habitat types that exhibit a high degree of biodiversity, characterize river-floodplain ecosystems (Sparks 1995). Flooding and low water regimes have been reduced or eliminated in some areas. Fire plays an important role in creating a mosaic of terrestrial habitat types, which, in turn, maintains the biodiversity of the system. Fire suppression has resulted in the increased invasion of woody species into primarily herbaceous systems and has shifted the relative abundance of species away from fire-adapted species. Fire can also suppress or kill non-native species. The loss of the oak-hickory forests in the basin is largely explained by the maple take-over, in which mature oak-hickory forest are unable to regenerate themselves because the tree seedlings are intolerant of the excessive shade that results from the absence of fire (IDNR 1994). The loss of these areas and functions in the Illinois River Basin is discussed more fully under Goal 3, “Improve floodplain, riparian, and aquatic habitats and functions.”

Photograph 2-10. Low Head Dam

d. Loss of Aquatic Connectivity (fish passage) on the Illinois River and its Tributaries.

There is diminished aquatic hydrologic connectivity on the Illinois River and its tributaries due to dam construction (photograph 2-10). Aquatic organisms do not have sufficient access to diverse habitat such as backwater and tributary habitats that are necessary at different life stages. Lack of aquatic connectivity slows repopulation of stream reaches following extreme events, such as pollution or flooding, and reduces genetic diversity of aquatic organisms. Construction of dams on the main stem and tributaries alters the temperatures, flow regime, sediment transports, chemical concentrations, and isolates biotic communities. There are seven dams on the Illinois Waterway and approximately 467 within the basin. Lateral connectivity in the Illinois River Basin is discussed more fully under Goal 4, "Restore and maintain aquatic connectivity on the Illinois River and its tributaries, where appropriate, to restore or maintain healthy populations of native species."

e. Altered Hydrologic Regime. The alteration of the hydrologic regime is considered to be the most significant change affecting aquatic biodiversity. In the developed watersheds of tributary streams feeding the river, stormwater inflows likely have higher peak flows than occurred under pre-development conditions, due to land-use changes and increased efficiency brought about by channelization. These stormflows result in rapidly rising and falling water levels and more uneven delivery of flows to the Illinois River. Land-use changes and drainage are believed to have increased the volume and the erosive force of water delivered to the river and may contribute to water level fluctuations in the main stem. A major impact of increased drainage is the decrease in base flows that impact aquatic communities in the tributaries during low water periods.

Land use changes in the basin and river management have altered the water level regime along the main stem Illinois River, stressing the natural plant and animal communities along the river and its floodplain. The increased number of water fluctuations, especially during summer and fall low water periods, and the constant inundation of the areas upstream of the navigation dams have altered the hydrologic regime of the river (figure 2-13), thereby contributing to the degradation of the river system. The biotic composition, structure, and function of aquatic, wetland, and riparian ecosystems depend largely on the hydrologic regime. The flow regime (magnitude, frequency, duration, timing, rate of change) affects water quality, energy sources, physical habitat, and biotic interactions, which, in turn, affect ecological integrity (Poff et al. 1997). Past management efforts have focused on requirements of one or few species of fish. The range of flows needed to sustain aquatic and riparian ecosystems may be much greater. Elimination of the summer low water periods prohibits compaction of sediments. Therefore, suspended sediments settle only loosely to the lakebed, creating a soft bottom in which aquatic plants cannot take root.

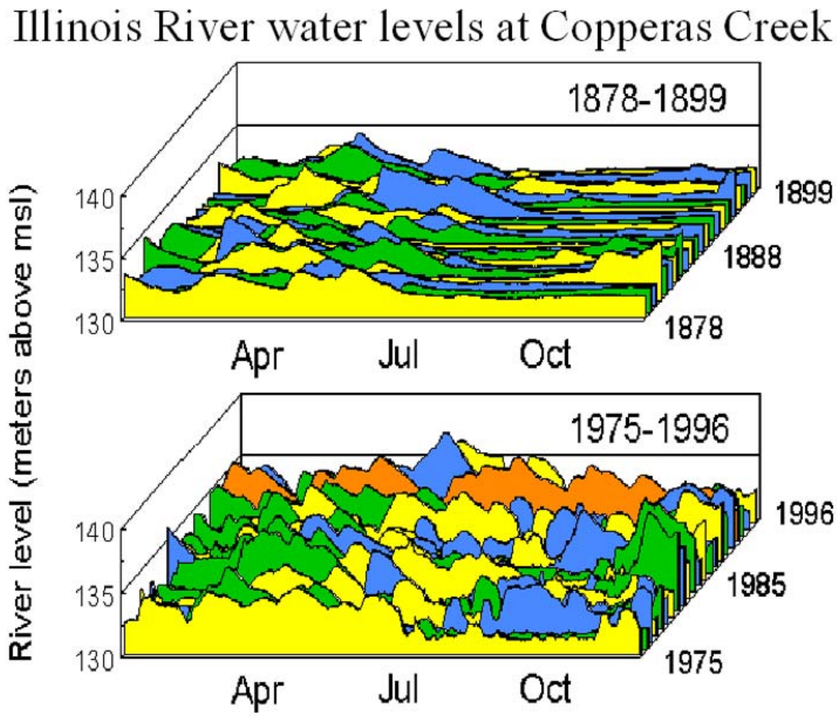


Figure 2-13. Change in Water Level Fluctuations at Copperas Creek Gage

Rapidly changing water levels of the Illinois River during the growing season (a.k.a. the summer "bumps") frequently flood young, moist soil plants on mud flats before they are developed enough to survive inundation. In predevelopment conditions, water levels receded during the summer and allowed moist soil plants to grow on exposed mud flats. The summer "bumps" appear to be a critical factor, limiting these plants growing in areas within or connected to the river. Significant water level fluctuations occur during the growing season, severely limiting plant germination, growth or survival. Past efforts may have failed to consider the full range of hydrological variability and the influence of hydrologic process on geomorphic changes and ecosystem functions (Richter et al. 1996). Hydrologic modifications to the Illinois River Basin are discussed more fully in Section 3 under Goal 5, "Naturalize Illinois River and tributary hydrologic regimes and conditions to restore aquatic and riparian habitat." See the following paragraph on water and sediment quality for a discussion of the effects of altered hydrology and turbidity on aquatic plants.

f. Water and Sediment Quality. Water resources in the Illinois River Basin are impaired due to a combination of point and non-point sources of pollution. Although effective regulatory efforts have reduced contributions from point sources (such as wastewater treatment plants), non-point sources of water quality impairment (such as sediments and nutrients) continue to degrade the surface waters.

Water clarity is the primary factor limiting submersed aquatic plants. During periods of high turbidity, aquatic plant growth is limited, since suspended sediments interfere with light penetration into the water. The high rates of sediment delivery, and subsequent resuspension, are thought to be the primary causes of this turbidity. Loss of aquatic plants also decreases the stability of the bottom substrates for colonization by rooted plants (Wiener 1997). Under the current degraded habitat conditions, including excessive sedimentation and altered hydrology, it will be difficult to achieve the critical mass to maintain healthy aquatic plant beds. Goals 1 and 5 in Section 3 address both of these limiting factors.

In addition to turbidity, the quality of the sediments, particularly in the main stem, may limit macroinvertebrates, such as fingernail clams. Ammonia, an agricultural fertilizer, is found in the upper layers of the sediments, sometimes in toxic amounts. Toxic conditions in the sediment may have contributed to the widespread decline of fingernail clams in the Upper Mississippi River Basin, including the Illinois River (Wilson et al. 1995). Fingernail clams are very sensitive to un-ionized ammonia. During drought conditions, concentrations of un-ionized ammonia in the sediment pore water may become high enough to adversely affect fingernail clams (Frazier et al. 1996). The declines in fingernail clams may adversely affect bottom-feeding fish and wildlife, such as migrating lesser scaup, which feed heavily on this mollusk (Wilson et al. 1995). This trend has already been observed on the Illinois River since the 1950s, and may also be occurring on the Upper Mississippi River (Sparks 1984, Weiner 1997).

The impaired water and sediment quality in the Illinois River Basin is discussed more fully under in Section 3 under Goal 6, "Improve water and sediment quality in the Illinois River and its watershed."

g. Invasive Species. Invasive species threaten biodiversity, habitat quality, and ecosystem function. These biological invasions produce severe, often irreversible impacts on agriculture, recreation, and our natural resources. They are the second-most important threat to native species, behind habitat destruction, having contributed to the decline of 42 percent of U.S. endangered and threatened species. Introduced species also present an ever-increasing threat to food and fiber production. In the United States, the economic costs of non-native species invasions reach billions of dollars each year (Pimentel et al. 2000). Invasive species compete with native species for habitat and food. Some invasive species are less sensitive to the changes that have taken place in the Illinois River Basin than the native species.

An introduced species can change the look and makeup of an entire system by changing species composition, decreasing rare species, and even changing or degrading the normal functioning of the system. Maintaining intact natural systems is important to ensure the continuation of ecosystem goods and services upon which humans depend. Many factors may cause nonindigenous species to become abundant and persist. These include the lack of natural predators and artificial and/or disturbed habitats that provide favorable conditions for invasive species (Pimentel et al. 2000).

Non-native plants can monopolize the landscape, out-competing and replacing native species in the absence of normal population controls, such as disease, insects and other controls found in their native habitats (Ikenson 2003). Invasive-dominated areas tend to provide significantly less habitat than those areas with primarily or only native species. Non-native/invasive plants common to the Illinois River Basin include reed-canary grass, purple loosestrife, garlic mustard, Japanese and shrub honeysuckle, multiflora rose, and buckthorn. Once established, these plants can be difficult and costly to control. If these invasions continue unchecked, wildlife populations will decrease as their habitat is degraded, and some species will likely become extirpated or extinct.

There are at least 15 introduced fish species in Illinois. Some of these are U.S. natives whose range has been expanded or species from other parts of the world. There has been a great nationwide increase in the total number of species introduced since 1950, and the proportion of non-U.S. species also has increased significantly (Chick and Pegg 2001). The mode of transport is shifting from intentional releases of food or sport fishes to accidental releases of aquarium fish, aquaculture species, and those carried in international shipping ballast water. The greatest proportion of non-U.S. species comes from Asia and South America.

In the Illinois River, the common carp is so plentiful and has been present for so long that few people realize it is non-native. It has been very successful since its introduction in the1880s and soon displaced buffalo and catfish as the major component of the commercial catch. More recently, grass carp have been increasing in the Long Term Resource Monitoring Program (Heglund et al. 2004) (figure 2-14) and commercial catch (figure 2-15). Asian carp are a more recent arrival and their numbers are growing rapidly. The Asian carp compete for the same food (drifting plankton and invertebrates) as gizzard shad and paddlefish. The Illinois Natural History Survey Great River Field Station is currently investigating the implications of these introductions on native species (John Chick, Illinois Natural History Survey).

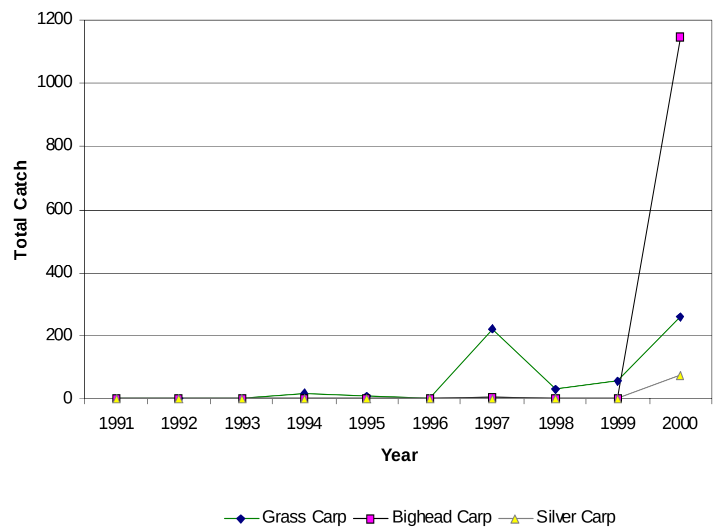


Figure 2-14. Incidence of Recently Introduced Carp Species in LTRMP Catches between 1991 and 2000

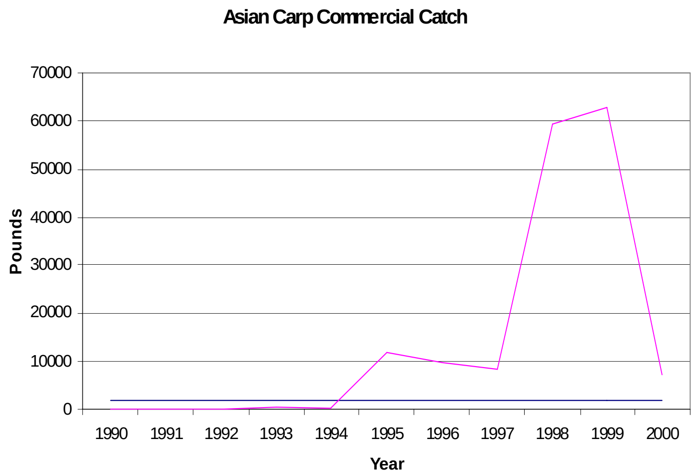


Figure 2-15. Occurrence of Asian carp in the Illinois River Commercial Catch. The great decline in 2000 is suspected to be an artifact of reduced reporting rather than a decline in abundance (Maher, 2001)

Other exotic species include zebra mussels, round gobies, European rudd, and at least two exotic zooplankton species that are entering the Illinois River system from Lake Michigan. The Corps of Engineers, the State of Illinois, the Sea Grant Program, and Smith-Root Manufacturing have recently installed an electric barrier on the Chicago Sanitary and Ship Canal to help block the movement of exotic species (figure 2-16). The initial purpose was to keep Great Lakes invaders from entering the river system, but the barriers may also prevent Asian carp from the Illinois River, such as grass carp, bighead carp and silver carp from getting into the Great Lakes. The construction of a second barrier, within one mile downstream, is currently under development. In combination, these two barriers should prevent some fish species from entering either the Great Lakes or the Illinois River. The damage done by these species will continue to impact the biodiversity of the Illinois River Basin.

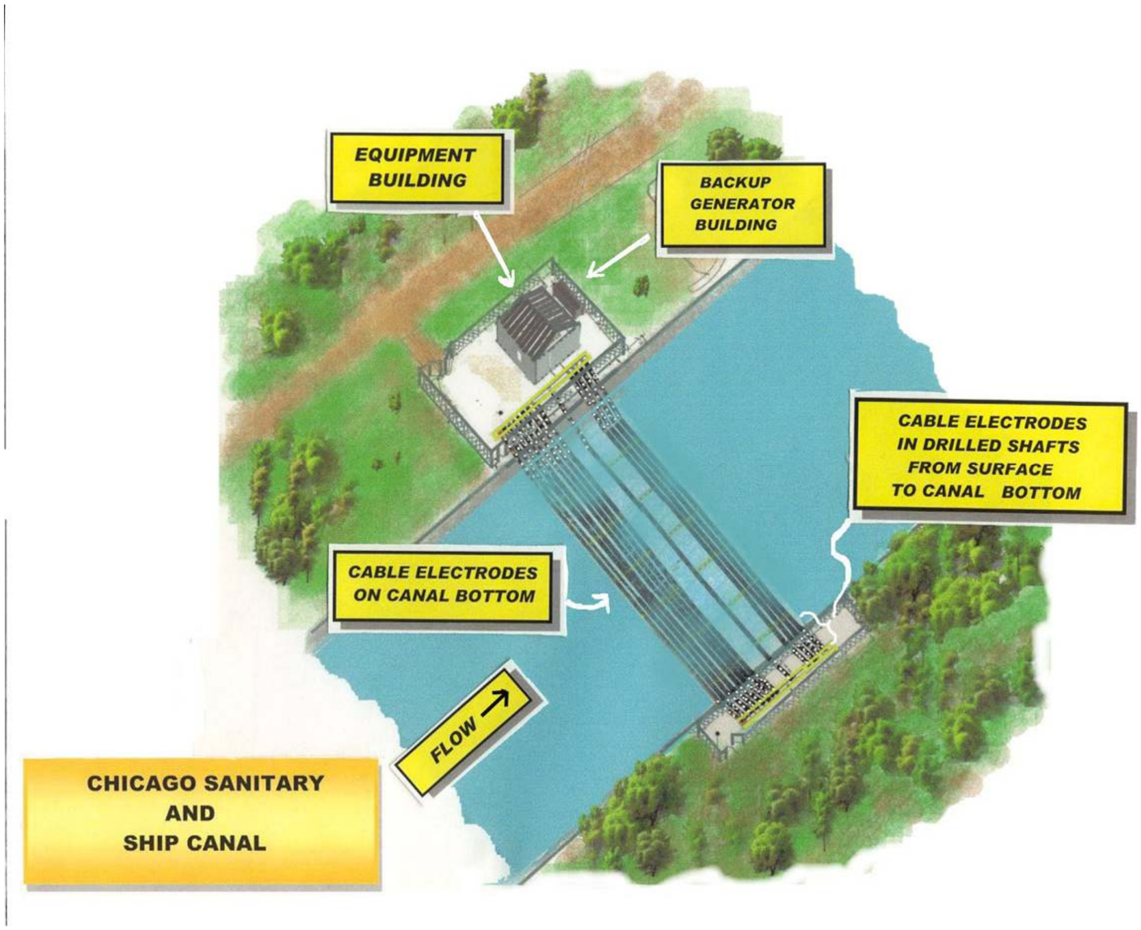


Figure 2-16. Diagram of the Fish Barrier in the Chicago Sanitary and Ship Canal

E. FUTURE WITHOUT PROJECT CONDITIONS

The future of Illinois River Basin resources is difficult to predict with accuracy. People have changed the way they treat land and water resources of the basin, which has resulted in significant improvements in environmental conditions and ecosystem health. Unfortunately, environmental conditions within the Illinois River and its basin were allowed to become extremely degraded before the changes were made.

Great strides have been made through the Clean Water Act and improved wastewater treatment facilities to curb urban and industrial pollution in an effort to improve Illinois River water quality. Through improved water quality conditions, the river has slowly regained its former oxygen carrying capacity, thus allowing fish and invertebrates to recolonize the upper river. Fish communities that were reduced to primarily the most pollution-tolerant species have become more diverse as water quality improved. Sport fishing recovered to allow professional fishing tournaments for walleye in the Upper River and largemouth bass in the lower reaches, though these species are regularly stocked by the Illinois DNR. There is evidence that fingernail clam and freshwater mussel populations are returning to portions of the upper river (Heglund et al. 2004).

Continued improvement in chemical water quality and current levels of restoration will not be sufficient to prevent further degradation of many aspects of the Illinois River ecosystem. Without further reduction of sediment entering the system from degraded tributaries and management of sediment already within the system, backwater areas will continue to rapidly fill and aquatic vegetation beds will not recover. A more subdued hydrologic regime will be necessary to allow aquatic and moist soil vegetation to return. Aquatic, floodplain, and tributary habitats that have been removed or disconnected from the system will have to be reconnected to restore appropriate system functions. Without coordinated restoration efforts, many ecological functions of the Illinois River system, such as its support of backwater fisheries and waterfowl, will continue to decline.

Natural resource managers and the public have recognized the loss of important habitats and have initiated numerous investigations and projects to better understand and reverse habitat loss throughout the Illinois River Basin. Upland terrestrial habitats show signs of recovery as landowners have taken advantage of conservation programs to protect marginal farmlands and restore grass and woodland habitats. Agriculture occupies 60 percent of the basin and the legacies from environmentally damaging practices are widespread in the basin's stream channels. The Natural Resources Conservation Service (NRCS) offers many programs to private landowners to promote the conservation and improvement of soil, water, air, energy, plant and animal life, and other conservation purposes on private working lands. One such program, in partnership with the State of Illinois, is the Conservation Reserve Enhancement Program (CREP), discussed in Section 6 of this report.

In addition to the NRCS programs, many other restoration programs or activities are ongoing in the basin (see Section 6.). These include, but are not limited to, the Corps' Environmental Management Program, the USFWS National Wildlife Refuge System, the EPA's various water quality activities, and NGO floodplain restorations. However, the magnitude of these efforts, while critical in slowing further declines in the basin, is not enough to restore ecological integrity in the Illinois River Basin. Currently, there is no program in place to holistically evaluate restoration needs and implement restoration projects at the basin scale.

1. Ecological Integrity. The general ecosystem integrity, or health, of the Illinois River Basin is still declining in spite of the dramatic water quality improvements made as a result of the Clean Water Act, as illustrated in figure 2-17. Pressure on the remaining habitats will continue to increase as the population increases. Scientists and natural resource professionals believe that the Illinois River Basin will continue to see a decline in system ecological integrity and populations of native species, resulting from continued habitat loss and fragmentation, altered natural disturbance regimes, and continued invasive species colonization.

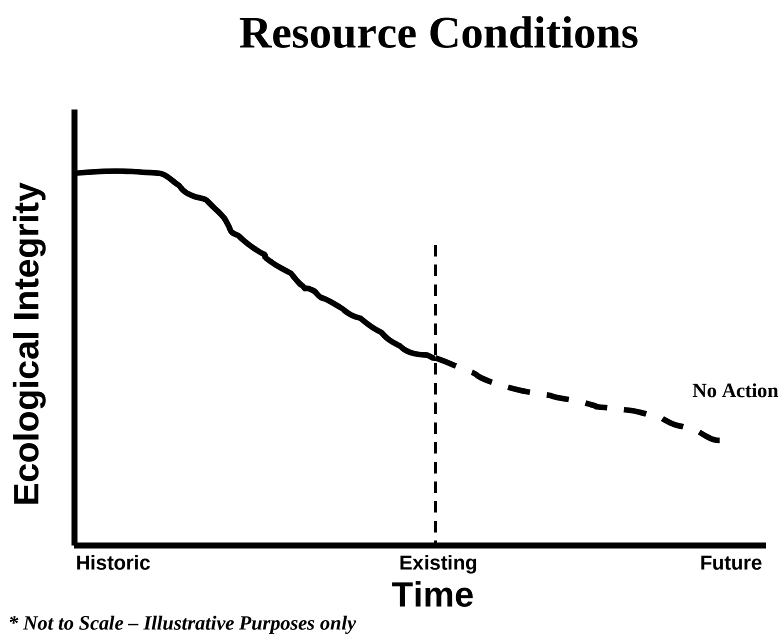


Figure 2-17. Illinois River Resource Conditions

The introduction of nonindigenous species into the Illinois River Basin is expected to continue. The electric barrier in the Chicago Sanitary and Ship Canal will only block some species from entering the Illinois River. Organisms suspended in the water column will pass through this barrier. Other non-native aquatic species may enter the system from downstream, such as the Asian carp have done. Cumulatively, these changes to the ecosystem over time have been dramatic. Current trends may be difficult to reverse and will require significant commitments of resources and time.

2. Sediment Delivery. If current conditions persist, sediment delivery from croplands and upland areas is not anticipated to decrease. Depending on economic and political conditions, the programs that have reduced sediment loading from upland practices may expand or contract in the future. Although far from certain, it is anticipated that the benefits of conservation practices will probably remain constant and possibly increase somewhat in the future. There will continue to be significant sediment transported to the Illinois River from areas not addressed by these programs, namely the stream channels themselves where approximately 40 to 60 percent of the sediment originates. Sediment delivery will increase due to continued landscape alterations, increased impervious surface area and resulting runoff, and continued channel instability due to prior alterations.

Significant sediment sources will continue to arise at points in the basin where restoration practices and sediment control regulations are inadequate or inadequately enforced. It is expected that without this program, there would be no overall program to address stream instability throughout the Illinois River Basin and that future channelization projects may destabilize additional stream miles. Without measures to naturalize the sediment transport in these streams, they will continue to incise or migrate into the foreseeable future, contributing sustained high rates of sediment loading to the main stem Illinois River.

Without action, the sediment loading to the Illinois River from unstable streams and other sources in the basin will continue at the unacceptably high levels experienced during water years 1981 - 2000. The sediment will continue to degrade vulnerable aquatic habitats and impede downstream restoration efforts. Local projects may show site-specific benefits, but the effects of high sediment loading will limit the extent where benefits may be observed.

3. Backwaters and Side Channels. By the year 2050, the Illinois River is predicted to lose a significant portion of its off-main channel backwater areas under current conditions of sediment supply, losing both surface area and volume, with continued low aquatic habitat quality. The affected contiguous and isolated backwater areas are expected to convert to mud flats or marshy wetlands. Further degradation of side channels, due to island erosion and channel sedimentation, is predicted. This will further limit off-channel habitat for fish and other aquatic species. The consensus of a number of scientists is that, due to the increasingly shallow condition of existing areas, even more rapid losses are expected in the future. This resulted in the estimation of a 1 percent loss rate per year of backwater acreage as the most likely future condition. If this rate were to continue throughout the 50-year program life, the acreage of backwaters would drop to just 32,605 acres, or a 40 percent loss of backwaters over 50 years.

Some side channel areas are experiencing sedimentation and are anticipated to be lost in the future (approximately 17 percent of side channel area in the Alton and Peoria Pools and greater in La Grange Pool). Another widespread threat to the side channels is the loss due to erosion of their protective islands. Based on data collected as part of this study, it is anticipated that, without any action, continued loss of side channel length would occur at the rate of approximately 0.25 percent per year, if it follows trends from 1903 to the present. This would result in a loss of approximately 6.5 additional miles of side channel habitats throughout the Illinois River. Some restoration of backwaters, side channels, and islands has been proposed through the NESP, though it is not currently authorized.

4. Floodplain, Riparian, and Aquatic. The habitats and ecological functions within the Illinois River main stem floodplain and the aquatic, floodplain, and riparian areas of the basin tributaries are likely to experience some further degradation in the future. The main stem Illinois River study area will likely remain relatively unchanged in terms of land use over the 50-year period of analysis. Habitat quality and ecological functions will likely remain at current degraded levels. Habitat fragmentation and unstable hydrologic regimes will continue to degrade the remaining habitat areas. Additional floodplain restoration efforts are currently proposed by several groups, including the USFWS (under the EMP), NGOs, such as The Nature Conservancy, and the Corps' Navigation Study (though not currently authorized). However, systemic restoration benefits, such as ideal spacing or connectivity of habitats, would not be as likely without a systematic plan for restoration.

The Nature Conservancy and The Wetlands Initiative have acquired more than 11,000 acres of Illinois River floodplain and adjacent habitats at Emiquon and Hennepin, respectively. Restoration efforts have begun on these sites, such as shutting off drainage pumps and planting native species.

The USFWS currently manages four refuges along the Illinois River, totaling approximately 12,000 acres. The recently completed *Illinois River National Wildlife and Fish Refuges Complex Draft Comprehensive Conservation Plan and Environmental Assessment* recommends protection management on an additional 380 acres of native grassland, 200 acres of savanna, 1,300 acres of native forest, and 4,000 acres of wetlands within the focus areas through voluntary partnerships.

Finally, the UMRS-IWW System Navigation Feasibility Study recommends restoration of 20,000 acres of Illinois River floodplain. The restoration measures identified under the Navigation Study are consistent with those of this study, and would reduce needs under this study if authorized and implemented.

Overall, the tributary floodplains are also likely to remain in a state consistent with their current degraded conditions. Urban development is perhaps more likely than on the main stem, particularly near the larger urban areas. Land conversion, outside the floodplain, to urban use and development in the State of Illinois is currently estimated at 40,000-50,000 acres of land per year. Much of this development is in the Illinois River Basin, particularly in the western Chicago suburbs. In-stream habitats throughout the basin are likely to degrade over the 50-year period of analysis. Stressors on the stream network include: (1) direct modification of stream channels for urban and rural development, (2) increases in impervious land surfaces resulting in increased runoff and higher flow, (3) increases in tile-drained agricultural areas, (4) point and non-point source pollutants into the system, and (5) invasive and exotic species invasion.

In the tributaries, the Conservation Reserve and Enhancement Program (CREP) should continue in the immediate future. While focused on sediment, the acreages that have been enrolled and are currently being enrolled are in the floodplain and riparian areas of Illinois River Basin streams. This provides opportunities for increased connectivity of various riparian habitats. These benefits may be offset by the continued degradation of aquatic stream and riparian habitats, resulting from bed and bank erosion.

5. Connectivity. No significant change in the number of dams blocking fish and aquatic species migration is anticipated. The need for potable water for increasing populations in northeast Illinois may result in construction of dams or modification of existing dams for water supply purposes. It is anticipated that new dams may be constructed to accommodate fish passage; however, any new dams would likely have some impact on connectivity. It is likely that some of the older, low-head dams will be removed in the future. Dam removal will be municipality driven and will be related to the costs of continued operations and maintenance. Municipalities will weigh the benefits and services provided by the dam with the costs of reconstruction, repair, and continued operation and maintenance. The Illinois DNR Office of Water Resources is evaluating dam modification or dam removal at State-owned dams when requested by municipalities.

6. Water Levels. Without the program, water level regulation will continue to induce fluctuations in dam tailwaters, and wicket operations will be fundamentally unchanged. Implementation of the Tunnel and Reservoir Plan (TARP), a Chicago area initiative to store stormflows in an underground reservoir system, may reduce some of the peak flows entering the river from northeastern Illinois, but increased development, even with peak flow control requirements, will increase the volume and rate of storm water entering the Illinois River, likely increasing the high-water fluctuations in the river. Without site-specific regime manipulation, backwater and floodplain areas are likely to continue to either degrade or maintain relatively low levels of ecological function.

Tributary hydrologic regimes will commonly exhibit high peak flows and low baseflows that stress aquatic biota; these conditions will likely become more stressful in areas that experience increased urbanization.

7. Water Quality. Water resources in the Illinois River Basin are impaired due to a combination of point and non-point sources of pollution. Although effective regulatory efforts have reduced contributions from point sources, non-point sources of water quality impairment (such as sediments and nutrients) continue to degrade the surface waters. Continued improvement in chemical water quality will be insufficient to prevent further degradation of many aspects of the Illinois River ecosystem. Without further reduction of sediment entering the system from degraded tributaries and management of sediment already within the system, backwater areas will continue to rapidly fill and aquatic vegetation beds will not recover. In addition to turbidity, the quality of the sediments, particularly in the main stem, may limit macroinvertebrates such as fingernail clams. Ammonia, an agricultural fertilizer, is found in the upper layers of the sediments, sometimes in toxic amounts. Minor improvements in water quality may be made due to regulation and improvements in best management practices (BMPs). The EPA's programs to reduce nonpoint source pollution and its Targeted Watersheds Grant Program will continue to provide some improvements in general water quality.

8. Natural Resources

a. Fisheries. Although fish populations improved as significant gains in water quality were made through the Clean Water Act, continuing declines in habitat quality and increasing numbers of invasive species threaten these populations. Data has been analyzed from the Illinois DNR Long Term Electrofishing Program in the main stem Illinois River (1957 to 2002), including trends and larger river IBI values. The monitoring period occurred during a period of very impaired water quality; therefore, the highest levels achieved during this time reflect impaired conditions. Fish populations and diversity are thought to be stable in the lower pools and still improving in the upper pools, although at lower levels than prior to European settlement. The long-term outlook (without-project conditions) may be for populations and native species diversity to decline gradually (increasing invasive species, suitable habitat declining, and loss of main stem benthic community).

b. Waterfowl and Wetlands. The declines in diving ducks (essentially gone since the 1950s) and dabbling ducks (80 percent decline in mallard populations) in the basin have been documented by the Illinois Natural History Survey. These losses can be linked to a loss of food sources (aquatic plants, macroinvertebrates) in the 1950s and ongoing habitat degradation and loss. On the main stem, habitat conditions are typically favorable only in areas isolated from the river. The loss of aquatic plants and the benthic community were identified as limiting factors on waterfowl populations. The current limited quantity and degraded wetland conditions, and lack of aquatic plants in areas hydraulically connected to the Illinois River are predicted to continue. Waterfowl populations that rely on these habitats are not anticipated to return to historic levels.

c. Mussels. Mussels declined severely in response to overharvesting and poor water quality, as well as ongoing problems with excessive sedimentation. After water quality improved, mussel populations improved also. This improvement was most evident in the upper river, where water quality impacts were most severe. Commercial mussels harvests have resumed in the lower main stem pools. However, the general trend is still declining (numbers and species), attributed to excessive siltation, loss of habitat, chemical pollution (including herbicide and insecticide runoff), and competition from exotic species (zebra mussels).

d. Macroinvertebrates. Long-term widespread declines in benthic macroinvertebrates are linked to domestic and industrial pollution, metal contaminated sediments and ammonia, as well as increasingly silty substrates. These declines have had adverse effects on river fishes and birds. Because of their wide distribution and potential to exhibit dramatic community changes when exposed to water and sediment pollution, they are ideal indicators of environmental quality. These declines are anticipated to continue.

e. Aquatic Vegetation. Currently, submersed aquatic plants are found only in isolated areas of the main stem. This loss of vegetation has led to easily disturbed backwater substrates, increased turbidity, poorer habitat conditions, and fish communities that are increasingly dominated by species that tolerate low dissolved oxygen and poor habitat. Limiting factors to submersed aquatic plant recovery include sediment quality, excessive sedimentation and turbidity, rough fish activity, and unstable water levels. Many of these same factors affect emergent and moist soil vegetation. Under current and predicted future conditions, the outlook for recovery of aquatic vegetation in areas hydraulically connected to the main stem river is very poor.

f. Forests. Forests in the Illinois River Basin will become increasingly fragmented though habitat conversion, timber harvest, and other disturbances. Species composition will continue the current trend towards maple dominance, with an increasing invasive species component. Without restoration efforts in both reestablishing forests and restoring species diversity, forests and forest-dependent species will continue to decline.

F. DESIRED FUTURE CONDITIONS

> **Vision.** A naturally diverse and productive Illinois River Basin that is sustainable by natural ecological processes and managed to provide for compatible social and economic activities.

Desired future environmental conditions are difficult to define for large and complex ecosystems. It is particularly difficult to balance conflicting economic, social, and environmental objectives when resources are limited. The primary goal should be to restore a diverse mosaic of habitats, increase the connectivity of habitats while reducing effects of fragmentation (photograph 2-11), and restore the natural range of habitat creating processes so that the Illinois River Basin can support and sustain diverse and productive food webs.

Scientists, natural resource managers, and the public have recognized the loss of important habitats and have initiated numerous investigations and projects to better understand and reverse habitat loss throughout the Illinois River Basin. In the past, many of the restoration efforts have focused only on small components of the basin without considering the broader basin context.

The following areas have been identified as the physical factors that limit system ecological integrity: excessive sedimentation, loss of productive backwaters, and side channels, loss of floodplain, riparian, and aquatic habitats and functions, loss of aquatic connectivity on the Illinois River and its tributaries, altered hydrologic regime, water and sediment quality, and invasive species. There are numerous opportunities for restoration.

Photograph 2-11. High-quality Backwater Area

Figure 2-18 illustrates how projects formulated addressing these system limiting factors can collectively improve ecosystem integrity to the point where higher levels of function are restored. Monitoring, at both the system and individual project level, would provide vital feedback needed to ensure success and increase understanding of the Illinois River Basin ecosystem.

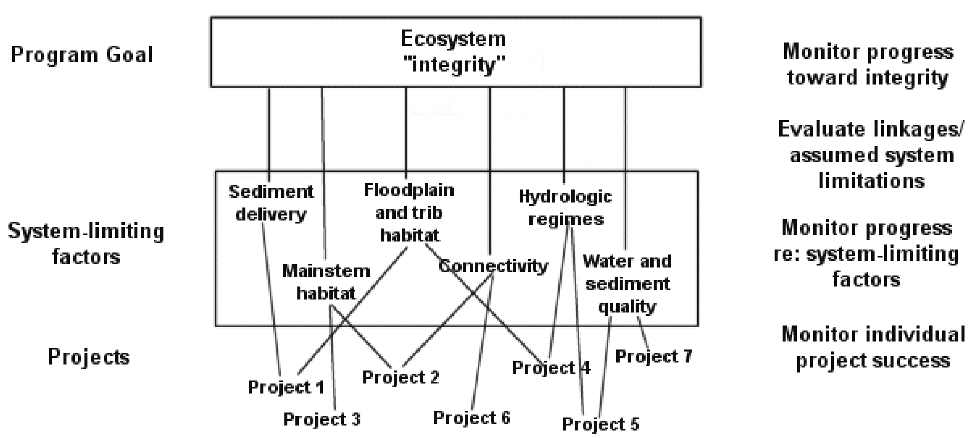


Figure 2-18. Conceptual Model of Illinois River Basin Restoration Program and Monitoring

1. Sediment Delivery. Under the desired future conditions, the rate of sediment transport within the Illinois River Basin and the main stem river, especially the transport of silt and clay particles, would be reduced to a level that will better support ecological processes. At this time, the understanding of the interconnections between sediment transport and Illinois River Basin ecosystem processes is insufficient to support definitive numerical targets for ecosystem improvement. The U.S. Army Corps of Engineers and State of Illinois scientists and managers generally accept that an overall 20 percent reduction of sediment transported to the main stem Illinois River is an appropriate initial long-term target that would demonstrate measurable positive benefits for the system. Monitoring performed as part of the Demonstration Erosion Control (DEC) project in the Upper Yazoo River Basin in Mississippi indicated that such a reduction of watershed sediment delivery is possible using proven technology (Watson and Biedenharn 1999). An interim target of 10 percent reduction of sediment transported to the main stem after 20 years was chosen to represent a measurable improvement and is feasible by treating the most significant sediment sources first. Using the sediment budget developed by Demissie et al. (2004) for WY 1981-2000 (12.1 million tons/year delivered to the Illinois River), 10 percent and 20 percent reductions represent 1.2 and 2.4 million tons per year below current levels, respectively.

Although these objectives are formulated in terms of sediment delivery to the main stem, the benefits will be achieved nearly exclusively by projects within the tributary basins. These projects would have significant benefits within their particular tributary areas. An overall 20 percent reduction in sediment delivered would necessitate higher reductions in the immediate vicinity of each project. It is envisioned that additional ecosystem benefits will be gained by placing the sediment reduction projects in areas likely to benefit high-value downstream habitats.

2. Backwaters and Side Channels. The desired future conditions were determined largely by looking at the likely future without-project conditions and assessing needs to restore aquatic habitats for fish spawning, nursery, and overwintering habitats, diving ducks, and aquatic plants.

The backwater restoration objective of restoring 19,000 acres for the Illinois River had previously been identified in the Habitat Needs Assessment. An interagency team assessing the restoration needs of the entire Upper Mississippi River System, including the Illinois River, conducted the assessment and set the restoration target. Resource managers further identified a general target of depths for backwater restoration by recommending the following distributions of depths: 5% >9 feet; 10% 6-9 feet; 25% 3-6 feet; and 60% < 3 feet. Since virtually all areas are currently less than 3 feet, restoration of up to 19,000 acres could be focused on restoring the relative depth diversity associated with the other three depth categories.

One of the major concerns on the river system is the potential loss of connected off-channel areas. The desired future condition includes the restoration and maintenance of side channel habitats, islands, and the maintenance of all existing connections between backwaters and the main channel (connections at the 50 percent exceedance flow duration).

Backwater restoration success is also related to the quality of sediments. Options should be explored to compact sediments or remove unconsolidated material to improve substrate conditions for aquatic plants, fish, and wildlife (photograph 2-12). Due to the potential for substantial amounts of dredging, additional beneficial uses of sediment should be investigated.

Photograph 2-12. Backwater Aquatic Vegetation

3. Floodplain, Riparian, and Aquatic

a. Illinois River Main Stem. The desired future condition of the Illinois River main stem floodplain is a reversal of some of the historic loss of habitat and floodplain functions and an increase in habitat area and quality. This would be accomplished by restoring up to 150,000 acres of isolated and connected floodplain areas, representing approximately 30 percent of the Illinois River Valley. This level of restoration would provide the necessary building blocks for a sustainable floodplain ecosystem in conjunction with other restoration efforts undertaken as part of this effort, particularly water level, backwaters, and side channels.

b. Illinois River Tributaries. The desired future condition for the Illinois River Basin tributaries is the restoration of a sustainable level of floodplain and aquatic habitat functions. A portion of this would be accomplished by restoring 150,000 acres of isolated and connected floodplain areas. This represents approximately 18 percent of the Illinois River Basin tributary floodplain and riparian habitat areas. This level of restoration would provide the necessary building blocks for a sustainable floodplain ecosystem within the tributaries in conjunction with other restoration efforts undertaken as part of this effort, particularly sediment delivery.

General conditions for floodplains and riparian areas include terrestrial patch size recommendations (amount shown or greater). Bottomland hardwood forest would range from 500 to 1,000 acres in size, with 3,000 acres needed for some interior avian species. Grasslands would range from 100 to 500 acres in size. Nonforested wetlands require a minimum of 100 acres, spaced 30 to 40 miles apart, and riparian zones for streams require a minimum of 100 feet on each side.

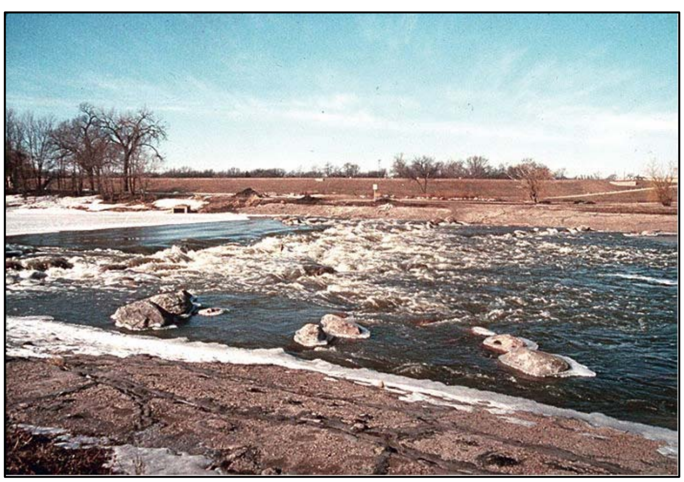
c. Aquatic Habitats. Approximately 1,000 miles of impaired streams would be restored as part of the desired future condition (photograph 2-13). This represents approximately one-third of the perennial streams impaired by channelization within the Illinois River Basin. This level of restoration would provide the necessary building blocks for sustainable aquatic environments in the perennial and intermittent streams of the Illinois River Basin.

Photograph 2-13. Restored Stream

Another general consideration for the future is developing a landscape free of introduced species that change the look and makeup of an entire system by changing species composition, decreasing rare species, and even changing or degrading the normal functioning of the system. Once the invasive species have been controlled or eliminated and restoration is initiated, ecosystems may see lost components or functions restored.

4. Connectivity. The desired future condition is a river system that provides connected habitats for native aquatic species, allowing them to utilize critical habitats at critical time periods and recolonize areas after extreme events or disturbance. This connectivity occurs at three scales; major tributary to mainstem, within the major tributary basin, and within the mainstem of the Illinois River.

The desired future condition is significant restored connectivity between the main stem and the appropriate major tributaries. The main stem Illinois River would be connected to the majority of its tributaries, including the Sangamon, Spoon, Fox, Kankakee, and DuPage Rivers. The desired future condition is to restore or maintain within-tributary connectivity in the major tributary basins (photograph 2-14).



Photograph 2-14. Rock Ramp Fish Passage

Connectivity along the main stem of the Fox River would be reestablished, and connections would be restored to a few of the Fox River tributaries. Within-tributary connection also would be restored along the main stem of the DuPage, Des Plaines, Kankakee, Vermilion, Sangamon, and Spoon Rivers.

The desired future condition is unimpeded passage of 100 percent of large-river fish on the Illinois River main stem up to RM 286 at Brandon Road Lock and Dam. This would require improved passage at Starved Rock, Marseilles, and Dresden Lock and Dams. The Lockport and Brandon Locks and Dams would continue to block fish movement, thus limiting dispersal of invasive aquatic species between the Upper Mississippi River System and the Great Lakes. Additional study is needed to assess the desirability of facilitating passage at the Brandon Road Lock and Dam. Restored connectivity between the main stem and the Des Plaines River is desirable, but this will need to be balanced with the desire to limit dispersal of invasive species.

Restoring aquatic connectivity to aquatic systems restores a measure of ecological integrity to an area. By allowing access to habitats that supply different life requisites for fish species, the future of those species is more likely. In addition, transport of mussel glochidia by different fish species ensures that mussel communities and species have access to appropriate habitats. Finally, by restoring this component to the ecosystem, some of the building blocks for a healthy and functioning system are restored.

5. Water Levels. The desirable future seeks to minimize the water level conditions that degrade ecological function in the Illinois River Basin. This does not necessarily require a return to any particular prior state, but rather creating conditions that allow ecosystem functions to sustain themselves at an acceptable level given the constraints of multiple uses throughout the basin. Rhoads and Herricks (1996) describe this concept as “naturalization.”

In regard to tributary flows, the current state of scientific knowledge suggests that flow regimes with reduced peaks and increased baseflows will provide more desirable levels of ecosystem function than currently occur. The Lieutenant Governor’s Task Force (Kustra 1997) identified an initial goal of reducing tributary peak flows by 2 percent to 3 percent. Although the precise relationships between regime components and ecosystem functions have not been fully developed, the study team analyzed the benefits of peak flow reduction measures and decided that a peak flow reduction exceeding 20 percent would be necessary to sufficiently modify the flow conditions that are currently degrading tributary ecosystems. Likewise, a significant base flow increase, 50 percent above the current levels, is desired to reduce low-flow stress to stream organisms. Finally, as a basis for project implementation, it is necessary to document and analyze the factors that lead to undesirable hydrologic conditions and assess these factors basin-wide.

Although there is a significant desire to moderate the rate of rise and fall along the main stem Illinois River, the storage available within the system is very small relative to the flows in the river (USACE 2004a). This means that river flows are driven by tributary inflows and there is very little that can be done to significantly modify the river’s flow regime. Within this constraint, the desired future conditions include a reduction in the incidence and speed of water level changes. Reducing the amount of water level fluctuation would likely provide multiple benefits to native biological communities, including sediment consolidation for improved seed germination and rooting, decreased incidence of flood-induced mortality, increased availability of spawning habitat, and a decrease in fish stranding. As such, a desired future condition would include reduced water level fluctuations, especially from the recession of the spring flood in May through the late growing season in October, but also during the rest of the year (photograph 2-15).

Photograph 2-15. Time Lapse View of Seasonal Water Level Fluctuations

The objective identified is to reduce water level fluctuations exceeding 0.5 foot to levels observed in the 1890s, during both growing season and winter time periods; a reduction of 73 percent from current conditions. One specific measure that would reduce fluctuations is a reconstruction of the wicket dams so that the dramatic water level changes associated with their operation can be removed.

Temporarily lowering water levels in the Illinois River navigation pools would provide ecological benefits to areas of the pools that are continually inundated under current conditions, allowing sediments to consolidate and encouraging reestablishment of vegetation. Significant consolidation and benefits to plant growth have been observed in drawdowns in Illinois River and Mississippi River backwaters (Dalrymple 2000, Edwards 1988) and elsewhere (Fox et al. 1977). The desired future condition would be a successful drawdown lasting at least 30 days once every 5 years in the Peoria Pool, and once every five years in the La Grange Pool.

6. Water Quality. The desired future for water quality would include all of the following: achieve full use support for aquatic life on all surface waters of the Illinois River Basin by 2025; achieve full use support for all uses on all surface waters of the Illinois River Basin in 2055; remediate sites with contaminant issues that affect habitat; achieve Illinois EPA nutrient standards by 2025, following standards to be established by 2008; work to minimize sedimentation as a cause of impairment as defined by 305(b) by 2035; and maintain waters that currently support full use or can be considered pristine waters.

7. Natural Resources. In a meeting held in August 2003 as part of this study, state scientists and natural resource professionals from the Rock Island District of the Corps of Engineers, the Illinois DNR, the USFWS Rock Island Field Office, and The Nature Conservancy met to discuss the future conditions of the Illinois River Basin. This expert panel discussed the predicted future without this restoration program and identified potential restoration targets (desired future conditions) for the basin as follows:

a. Fisheries. Data was presented from the Illinois DNR Long Term Electrofishing Program in the main stem Illinois River (1957-2002). In addition to current conditions, trends and larger river IBI values were discussed. It was proposed to set target IBIs for various pools based on the highest value measured at each individual station within that pool as an acceptable first level target. The monitoring period (1957-2005) occurred during a period of very impaired water quality; therefore, the highest levels achieved during this time reflect impaired conditions. However, the significant gains made through the Clean Water Act were dramatic, especially for the Upper Illinois River, and the group did not foresee such dramatic improvements in the future.

If these initial targets could be achieved and maintained over a significant period of time, new targets could be established. Fish populations and diversity are thought to be stable in the lower pools and still improving in the upper pools, although at lower levels than prior to European settlement. Reducing excessive sedimentation, restoring overwintering habitat, and improving water and sediment quality should be major restoration efforts that will benefit the fisheries.

b. Waterfowl and Wetlands. On the Illinois River main stem, habitat conditions for waterfowl are typically favorable only in areas isolated from the river, with its high sediment load and frequent fluctuations. The loss of aquatic plants and the benthic community were identified as limiting factors on waterfowl populations. Increasing the number of managed areas and wetlands (100 to 500 acres, spaced 30 to 40 miles apart) would be a first step in increasing waterfowl numbers. Systemic restoration measures of naturalized hydrology, reduced turbidity, reduced ammonia delivery, and invasive plant species control would be required to restore aquatic plants and macroinvertebrates necessary to regain some measure of system function for waterfowl and associated species.

Restoring diving duck populations, as a representative target species, was agreed upon as a goal for waterfowl. A return of this guild would reflect a return of improved ecological functions in the basin, including sediment delivery, water level fluctuations, the reestablishment of aquatic plants, and increased macroinvertebrate populations; all indicators of appropriate habitat.

c. Mussels. Mussel habitat restoration efforts should include the entire watershed (main stem and tributaries), including land use, management practices, and tributary health in order to reduce the limiting factors of excessive siltation and chemical pollution. As important are preserving and restoring wetlands, and preserving existing high quality aquatic habitat (Cummings and Anderson 2003).

d. Macroinvertebrates. Because of their wide distribution, important position near the base of the food chain, and potential to exhibit dramatic community changes when exposed to water and sediment pollution, macroinvertebrates are ideal indicators of environmental quality. The effect of ammonia on macroinvertebrates was identified as a study need. Knowledge of long-term population cycles is also poor. The desired future for macroinvertebrates is a return to healthy levels needed to support fisheries, waterfowl populations, and other species dependent upon these species as a food source. This could be accomplished by decreased sediment, nutrient, and contaminant delivery to the river.

e. Aquatic Vegetation. The desired future is a return of aquatic plant beds to all areas of the river, particularly those hydraulically connected to the river. Limiting factors to submersed aquatic plant recovery include sediment quality, excessive sedimentation and turbidity, rough fish activity, and unstable water levels. Many of these same factors affect emergent and moist soil vegetation.

f . Forests. The desired future includes protecting or restoring forested habitat in large blocks (keeping edge to a minimum) of 500 acres or more, spaced throughout the watershed, which would be required to stop/reverse the current declines.

g. Invasive Species. Because invasive species do not recognize property boundaries, successfully battling these invasions will require partnerships among public and private landowners, government, industry, academia, and non-governmental organizations at all levels. As invasive species are been controlled, native species, reestablished through restoration activities, will minimize the chances that an area will be reinvaded. It is also important to encourage activities that help keep lands and waters free from invasive species.

SECTION 3 PLAN FORMULATION

A. DESCRIPTION OF THE STUDY PROCESS

The Illinois River Basin Restoration Comprehensive Plan follows the Corps of Engineers' six-step planning process specified in Engineering Regulation (ER) 1105-2-100. The process identifies and responds to problems and opportunities associated with the Federal objective and specified State and local concerns. The process provides a flexible, systematic, and rational framework to make determinations and decisions at each step so that the interested public and decision makers are fully aware of the basic assumptions employed, the data and information analyzed, the areas of risk and uncertainty, and the significant implications of each alternative plan. As a comprehensive plan for the Basin, the formulation of alternatives was not limited to Corps and Illinois DNR activities. Implementation on a basin scale will require the work of numerous Federal, State, local, and private agencies and organizations.

If a Federal and State interest is identified, the process culminates in the selection of a plan to be recommended to Congress for implementation. The Federal interest in ecosystem restoration is to restore degraded ecosystem structure, function, and dynamic processes to a less degraded, more natural condition. As part of identifying the selected plan, a number of alternative plans are developed and compared with the no action alternative, allowing for the ultimate identification of the National Ecosystem Restoration (NER) plan.

The NER plan reasonably maximizes ecosystem restoration benefits compared to costs, considering the cost effectiveness and incremental cost of implementing other restoration options. In addition to considering the system benefits and costs, it will also consider information that cannot be quantified, such as environmental significance and scarcity, socioeconomic impacts, and historic properties information.

The steps used in the plan formulation process include:

1. Identify Problems and Opportunities: The specific problems and opportunities are identified, and the causes of the problems discussed and documented. Planning goals are set, objectives established, and constraints identified. Specifically for this study, the restoration objectives were set based on the desired future conditions established by system resource managers. The desired future was based on published literature and the expert opinion of resource managers as to what the system should look like in the future to restore and maintain ecological integrity, including habitats, communities, and populations of native species, and the processes that sustain them.

2. Inventory and Forecast Resource Conditions: This step characterizes and assesses conditions in Illinois River Basin as they currently exist and forecasts the most probable without-project condition (no action alternative) over the period of analysis. This assessment gives the basis by which to compare various alternative plans and their impacts. The without-project condition is what the river basin and its uses are anticipated to be like over the 50-year planning period without any restoration implemented as part of the study. The with-project condition is what the river and its uses are anticipated to be like if restoration measures, identified in each alternative, are implemented. An important part of this step for this study was to identify "desired future conditions." The information describing this step of the planning process is presented in Section 2 of this report.

3. Formulate Alternative Plans: Alternative plans were developed in a systematic manner to ensure that reasonable alternatives were evaluated. For this study, ecological integrity was the overarching goal and drove the identification, development, and selection of restoration measures and alternative plans. The alternative plans all address ecosystem integrity, but vary in terms of restoration efforts associated with each of the remaining six study goals.

4. Evaluate Alternative Plans: The evaluation of each alternative consists of measuring or estimating the ecosystem benefits (acres of habitat or stream miles restored, tons of sediment not delivered to the system, etc.), costs, technical limitations, and risk and uncertainty of each plan, and determining the difference between the without- and with-project conditions. Due to the size and scale of the analyses and differences in output by goal category, a complete cost effectiveness and incremental cost effectiveness analysis based on habitat units could not be conducted. The quantifiable measures of system output that provide comparability across all goal categories were the percentage attainment of restoration objectives (desired future), acres, and stream miles. These measures of benefit allowed for the completion of a cost effectiveness-incremental cost analysis for five of the seven goal categories (Goals 1-5). The outputs for the Overarching Goal and Goal 6 could not be fully quantified and, as a result, were assessed qualitatively. As part of future site-specific restoration projects, detailed and complete cost effectiveness and incremental cost analysis would be conducted.

5. Compare Alternative Plans: Alternative plans are compared, focusing on the differences among the plans identified in the evaluation phase and public comment.

6. Select Recommended Plan: A Recommended Plan is selected and justification for plan selection prepared. If a viable alternative is not identified, the Recommended Plan will be the No Action alternative.

The following sections provide a description of the system problems, goals and opportunities, objectives, and constraints pertaining to the study area as a whole. Next, the report describes the affected environment, and specific objectives and alternative formulation conducted for the overarching goal and goals 1 through 6. Finally, in the System Evaluations section, alternative plans are summarized. While these steps do follow a progression, they are iterative, i.e., as additional information was learned in subsequent steps, it was often necessary to back up and repeat portions of a previous step(s). Section 4 of this report describes the preferred comprehensive plan alternative, followed by a discussion of the environmental impacts, in Section 5.

B. ASSESSMENT OF PROBLEMS, OPPORTUNITIES, AND CONSTRAINTS

1. Problem Statement. The Illinois River Basin has experienced the loss of ecological integrity due to sedimentation of backwaters and side channels, degradation of tributary streams, increased water level fluctuations, reduction of floodplain and tributary connectivity, and other adverse impacts caused by human activities.

2. Opportunities. A restoration vision was developed for the Illinois River in 1997 as part of the development of the State of Illinois' *Integrated Management Plan for the Illinois River Watershed.* This vision for the Illinois River Basin has been accepted by the Federal, State and local stakeholders involved in the development of the Illinois River Basin Restoration Program with the minor modification of replacing the word "Valley" with "Basin." It is understood that attaining this vision will likely take decades and that various types of projects will be necessary to maintain some features until natural ecological processes are reestablished. The vision is for:

> *A naturally diverse and productive Illinois River Basin that is sustainable by natural ecological processes and managed to provide for compatible social and economic activities.*

With the *Integrated Management Plan* providing context, the list of Illinois River Basin system-wide ecosystem restoration goals was developed (Goals 1 through 6 are not listed in priority order):

Overarching Goal. Restore and maintain ecological integrity, including habitats, communities, and populations of native species, and the processes that sustain them

Goal 1. Reduce sediment delivery to the Illinois River from upland areas and tributary channels with the aim of eliminating excessive sediment load

Goal 2. Restore aquatic habitat diversity of side channels and backwaters, including Peoria Lakes, to provide adequate volume and depth for sustaining native fish and wildlife communities

Goal 3. Improve floodplain, riparian, and aquatic habitats and functions

Goal 4. Restore aquatic connectivity (fish passage) on the Illinois River and its tributaries, where appropriate, to restore or maintain healthy populations of native species

Goal 5. Naturalize Illinois River and tributary hydrologic regimes and conditions to restore aquatic and riparian habitat

Goal 6. Improve water and sediment quality in the Illinois River and its watershed.

3. Constraints

- No increase in flood elevations as required by Illinois law – Illinois state law specifies that any action in the floodplain that increases flood heights is not allowable or must be accompanied by mitigation of adverse effects. Due to the potential high cost associated with mitigation actions, efforts will be made to avoid this threshold.
- No significant adverse impact on the 9-Foot Channel Navigation Project on the Illinois Waterway.
- State of Illinois limitations – For efforts sponsored by the State of Illinois constraints include funding and land ownership or the ability to acquire land interests from willing landowners.
    - Funding Limitations – As a Non-Federal Sponsor, the ability of the State of Illinois to afford various features, and the associated operations and maintenance, represents a potential limiting factor.
    - Land Ownership, Willing Landowners, etc. – As a Non-Federal Sponsor, the State of Illinois will be required to provide the necessary real estate interests for projects they sponsor. The State will only acquire the lands, easements, and rights-of-way from willing landowners.

- A final legal determination has not been made as to ownership of submerged lands in the Illinois River Basin.
- Legal Compliance – Due to the geographic size, scope, and purpose of this study, multiple levels of legal authority apply to the project area. All efforts conducted in the implementation of the Comprehensive Plan shall comply with all Federal regulations and all applicable State and local regulations pertaining to the activities undertaken by the Corps of Engineers and the non-Federal sponsor in this study.
- Efforts will be made to minimize the unnecessary and irreversible conversion of prime farmland to non-agricultural uses. These efforts include: (1) identify and take into account the adverse effects on the preservation of prime farmland; (2) consider alternative actions, as appropriate, that could lessen adverse effects to prime farmland; and (3) ensure to the extent practicable, the project is compatible with state and units of local government and private programs to protect prime farmland.
- Landowner Rights – No site investigations (such as surveys or geotechnical investigations) will be conducted without contacting property owners and obtaining permission to access potential project areas.

4. Conceptual Framework. In addition to the overall problem statement and system goals listed previously, the system team developed a specific problem statement and objectives for each of the system goals to facilitate adequate formulation. The objectives were identified for the ecosystem integrity of the system as well as for the other goal categories by the study team, resource managers, and stakeholders based on extensive research and literature. These objectives represent a desired future condition or virtual reference of ecological condition for the Illinois River Basin.

The goals and objectives developed as part of this study were formulated to address the system limiting factors. In particular, the goals for this study were adapted from published literature for the Upper Mississippi River System, specifically, the Upper Mississippi River Conservation Committee's (UMRCC) report, *A River That Works and a Working River.* The UMRCC is comprised of more than 200 resource managers working in the fisheries, recreation, wildlife, water quality, and law enforcement disciplines, whose goal is to "Promote the preservation and wise utilization of the natural and recreational resources of the Upper Mississippi River (UMR) and to formulate policies, plans and programs for conducting cooperative studies."

Additional reports and studies evaluated include: The Environmental Management Program's *Habitat Needs Assessment*; the UMR-IWW System Navigation Feasibility Study; the State of Illinois' *Integrated Management Plan for the Illinois River Watershed*; and The Nature Conservancy's *Threats to the Illinois River Ecosystem*. These documents and studies were developed by scientists and local resource managers, and included multi-agency collaboration. The information from these sources was refined in the development of the goals for this study.

Overarching Goal. Restore and maintain ecological integrity, including habitats, communities, and populations of native species, and the processes that sustain them

Problem. The combined effects of habitat losses through changes in land use, human exploitation, habitat degradation and fragmentation, water quality degradation, and competition from aggressive invasive species have significantly reduced the abundance and distribution of many native plant and animal species in the Illinois River Basin. In addition, human alterations of Illinois River Basin landscapes have altered the timing, magnitude, duration, and frequency of habitat forming and seasonal disturbance regimes. The cumulative results of these complex, systemic changes are now severely limiting both the habitats and species composition and abundance in the Illinois River Basin.

Overarching Objectives

- Identify and address system-wide limiting factors to ecological integrity (structure and function), including, but not limited to:

  ***Goal 1* -** excessive sedimentation

  ***Goal 2 (backwaters, side channels, and islands)* -** reduction and fragmentation of aquatic habitat

  ***Goal 3 (floodplain, riparian, and aquatic)* -** reduction and fragmentation of aquatic and terrestrial habitat, altered disturbance regimes, and invasive plant species

  ***Goal 4 (aquatic connectivity)* -** reduction and fragmentation of aquatic habitat

  ***Goal 5* -** altered hydrologic regimes

  ***Goal 6* -** water and sediment quality

- Restore and conserve natural habitat structure and function, including, but not limited to:

  - Concentrations of flora and fauna or areas that are:
    high in biodiversity;
    especially vulnerable to disturbance; and/or
    important in fulfilling a life-history requirement of the species present.

  - Specific suitable habitat for Federal and State endangered and threatened species, or other species of concern that is capable of supporting long-term sustainable populations at the site and protect additional acres of the identified suitable habitat, as appropriate.

  - Representative examples of all community types in the Illinois River Basin, best of kind or as needed, to protect and restore habitat structure and function at the system level.

- Establish existing and reference conditions for ecosystem functioning and sustainability against which change can be measured; monitor and evaluate actions to determine if goals and objectives are being achieved, at both the project and system levels.

Goal 1. Reduce sediment delivery to the Illinois River from upland areas and tributary channels with the aim of eliminating excessive sediment load

Problem. Increased sediment loads from the basin have severely degraded environmental conditions along the main stem Illinois River by increasing turbidity and filling backwater areas, side channels, and islands. Improved conservation practices have reduced the amount of sediment generated from many agricultural areas, but large quantities of sediment are still delivered to the river due to eroding channels and tributary areas, including urban and rural construction sites. The most critical problems resulting from the increased sediment loads are the loss of depth and habitat quality in off-channel areas connected to the main stem river. Similar problems can be seen at other areas within the basin where excessive sediment has degraded tributary habitats.

Objectives

- Reduce total sediment delivery to the Illinois River by at least 10 percent by 2025 [reduction from an average of 12.1 to 10.9 million tons per year above Valley City, based on Illinois State Water Survey (ISWS) estimate of delivery for water year (WY) 1981-2000].
- Reduce total sediment delivery to the Illinois River by at least 20 percent by 2055 (reduction to an average of 9.7 million tons per year above Valley City, based on ISWS estimate of delivery for WY 1981-2000).
- Eliminate excessive sediment delivery to specific high-value habitat both along the main stem and in tributary areas.

Goal 2. Restore aquatic habitat diversity of side channels and backwaters, including Peoria Lakes, to provide adequate volume and depth for sustaining native fish and wildlife communities

Problem. A dramatic loss in productive backwaters, side channels, and islands due to excessive sedimentation is limiting ecological health and altering the character of this unique floodplain river system. In particular, the Illinois River has lost much of its critical spawning, nursery, and overwintering areas for fish, habitat for diving ducks, other waterbirds, and aquatic species, and backwater aquatic plant communities. There is a need for timely action. If restoration is not undertaken soon, additional productive backwater and side channel aquatic areas will be converted to lower value and increasingly common mudflat and extremely shallow water habitats.

Objectives

- Restore, rehabilitate, and maintain up to19,000 acres of habitat in currently connected areas (1989 data shows approximately 55,000 acres of backwaters during summer low water). Restoration should result in a diversity of depths. For restored backwaters, a general target would be to have the following distributions of depths during summer low-flow periods: 5% >9 feet; 10% 6 to 9 feet; 25% 3 to 6 feet; and 60% <3 feet.
- Restore and maintain side channel and island habitats.
- Maintain all existing connections between backwaters and the main channel (connections at the 50 percent exceedance flow duration).
- Identify beneficial uses of sediments.
- Compact sediments to improve substrate conditions for aquatic plants, fish, and wildlife.

Goal 3. Improve floodplain, riparian, and aquatic habitats and functions

Problem. Land-use and hydrologic changes have reduced the quantity, quality, and functions of aquatic, floodplain, and riparian habitats. Flood storage, flood conveyance, habitat availability, and nutrient exchange are some of the critical aspects of the floodplain environment that have been adversely impacted.

Objectives

- Restore up to an additional 150,000 acres of isolated and connected floodplains along the Illinois River main stem to promote floodplain functions and habitats.
- Restore up to 150,000 acres of the Illinois River Basin large tributary floodplains.
- Restore and/or protect up to 1,000 additional stream miles of riparian habitats.

Goal 4. Restore aquatic connectivity (fish passage) on the Illinois River and its tributaries, where appropriate, to restore healthy populations of native species

Problem. There is diminished aquatic connectivity on the Illinois River and its tributaries. Aquatic organisms do not have sufficient access to diverse habitat such as backwater and tributary habitat that are necessary at different life stages. Lack of aquatic connectivity slows repopulation of stream reaches following extreme events such as pollution or flooding and reduces genetic diversity of aquatic organisms.

Objectives

- Restore main stem to tributary connectivity, where appropriate, on major tributaries.
- Restore within-tributary connectivity.
- Restore passage for large-river fish at Starved Rock, Marseilles, and Dresden Lock and Dams where appropriate.

Goal 5. Naturalize Illinois River and tributary hydrologic regimes and conditions to restore aquatic and riparian habitat

Problem. Basin changes and river management have altered the water level regime along the main stem Illinois River, stressing the natural plant and animal communities along the river and its floodplain. Land use changes, the construction of the locks and dams (which create relatively flat navigation pools), and isolation of the river main stem from its floodplain have all impacted the water level regime to varying extents. Increased frequency and increased magnitude of water level fluctuations, especially during summer and fall low water periods, are two of the most critical results from the basin changes and river management. The lack of the ability to mimic natural hydrologic regimes in areas upstream of the navigation dams is also a problem. Increased flow variability has reduced ecological integrity in tributary areas as well.

Objectives

- Reduce low water fluctuations along the main stem Illinois River where possible, concentrating on the months of May through October and using pre-1900 water level records as a reference.
- Reduce peak flows from the major Illinois River tributaries by 2 to 3 percent for 2- to 5-year recurrence storm events by 2023. This will help to reduce peak flood stages and reduce high-water fluctuations along the river. Long term, reduce tributary peak flows by at least 20 percent for these events.

- Reduce the incidence of low-water stress throughout the basin by increasing tributary baseflows by 50 percent.
- Remove the dramatic water level changes associated with the operation of wicket dams at Peoria and La Grange.
- At an appropriate resolution (approximately 1 square mile in urban areas, 10 square miles in rural areas) identify and quantify the land and drainage alterations that contribute to unnatural fluctuations and flow regimes.
- Draw down the pools at Peoria and La Grange for at least 30 consecutive days at least once every 5 years.

Goal 6. Improve water and sediment quality in the Illinois River and its watershed

Problem. Water resources in the Illinois River Basin are impaired due to a combination of point and non-point sources of pollution. Although effective regulatory efforts have reduced contributions from point sources, non-point sources of water quality impairment (such as sediments and nutrients) continue to degrade the surface waters.

Objectives

- Achieve full use support for aquatic life in all surface waters, as defined in 305(b) of the Clean Water Act (CWA), of the Illinois River Basin by 2025.
- Achieve full use support for all uses on all surface waters of the Illinois River Basin by 2055.
- Encourage remediation of sites with contaminant issues that affect habitat.
- Achieve Illinois EPA nutrient standards by 2025, following standards to be established by 2008.
- Minimize sedimentation as a cause of impairment as defined by 305(b), of the CWA, by 2035.
- Maintain waters that currently support full use.

C. SYSTEM FORMULATION CONCEPT

As a basin level study addressing approximately 44 percent of the area of the State of Illinois—approximately 30,000 square miles—some modification of the general formulation approach used for a site-specific project was required. The goals and objectives were first set to address the specific resource problems (system limiting factors). Then, the focus became identifying the potential restoration measures and alternatives. In general, the system alternatives developed were not specific to particular sites (i.e., Babb's Slough, Richland Creek, etc.), but instead focused on the level of restoration effort needed to reach system restoration goals and objectives. More detailed cost information using MCACES software and benefits using habitat models will be defined as part of future site-specific project evaluations.

Since no systemic measure of ecologic integrity exists, the original measures of benefit varied by goal category, e.g. acres of wetland, backwater, floodplain; tons of sediment not delivered; stream miles; percentage changes in flows (table 3-1). Based on HQUSACE guidance, the study team also quantified system benefits for each goal category into outputs of acres or stream miles to better estimate the total system area benefited. While only the benefit area was measured, it should be recognized that the area would experience a dramatic increase in habitat quality compared to the without project condition. No single habitat suitability unit could be used for the system due to the number of habitat types and complex relationships of the benefits. However, the percent of goal attainment analysis originally conducted for this study does roughly equate to a quality and sustainability assessment.

Table 3-1. Type of Benefit Quantification by Goal

Goal	Benefit - Output By Goal	Benefit - System Area Estimate
Ecosystem Integrity	Indicators Under Development	Indicators Under Development
Sediment Delivery	Tons Not Delivered	Stream Miles
Backwaters & Side Channels	Acres (backwater) x Quality	Acres
Floodplain, Riparian, and Aquatic	Acres and Stream Miles	Acres (Floodplain and Riparian) and Stream Miles (Aquatic)
Aquatic Connectivity	Stream Miles	Stream Miles
Water Level Management	# of fluctuations % decrease in tributary peak flow % increase in tributary base flow	Acres (Main Stem) Stream Miles (Tributary)
Water Quality	Impaired Reaches, Dissolved Oxygen, Sediment, Nutrients	Not Quantified

Rather than fully developed site concepts, the evaluation of restoration measures highlighted the most promising measures and general level of effort needed (e.g., X number of riffle-pools, bank stabilization, and sediment basins to meet the system sediment tonnage reduction goal). However, the system formulation did consider the general locations of various needs and the information on available restoration measures. The primary outcome of the system formulation was a preferred comprehensive plan alternative identifying how much restoration is needed to restore the ecological integrity of the system and the associated measures and funding level needed to meet the intent of the 519 authorization.

System alternative development started with consideration of the measures available (e.g., bed and bank stabilization, backwater dredging, wetland creation, etc.) to address the problems and objectives developed under each goal category. For each of the measures, the relative cost and system benefits were identified. This information was then used to put together various alternative plans for each goal (i.e., combining benefits and costs for a certain amount of bed and bank stabilization, water and sediment retention basins, etc., in putting together a plan for sediment reduction). At this level of analysis, the various measures were evaluated, comparing their costs and benefits. The most cost-effective measures were used to develop the goal and system level alternatives.

D. AFFECTED ENVIRONMENT

Section 2 D, *Existing Conditions*, describes the general affected environment of the Illinois River Basin. As illustrated in table 3-1, each goal being evaluated affects differing amounts and types of habitat. Ecological integrity (the Overarching Goal) is expressed as increases or decreases in ecological integrity and/or impacts to the quantity and/or quality of habitat available; sediment delivery (Goal 1) is expressed in % reductions in delivery from various tributaries targeted; backwaters, side channels, and islands (Goal 2) indicates units of habitat affected in acres (backwaters), or the actual number of islands and side channels proposed; floodplain, riparian, and aquatic (Goal 3) exhibits acres of main stem and tributary areas being proposed, while the aquatic portion is expressed in miles of stream proposed; connectivity (Goal 4) references actual tributary rivers/streams that may be relevant to dam removal for fish passage, and the number of dams on the main stem that have potential to improve fish passage; water level management (Goal 5) is expressed as either % tributary peak flow reductions, % tributary base flow increases, or % reductions in main stem water level fluctuations; and water quality (Goal 6) is expressed in levels and areas of improvement. The detailed descriptions for each goal below provide insight as to which habitat type or aspect of the environment may be affected from implementation of the proposed project. When future site-specific projects are identified and evaluated, Environmental Assessments (EA) or, if required, Environmental Impact Statements (EIS), will be written detailing the alternatives and potential impacts of the proposals. Those site-specific EAs will give detailed information on what aspects of the environment would be affected based on the management measures proposed for that specific project.

E. OVERARCHING GOAL: ECOLOGICAL INTEGRITY

Restore and maintain ecological integrity, including habitats, communities, and populations of native species, and the processes that sustain them.

Problem. The combined effects of habitat losses, through changes in land use, human exploitation, habitat degradation and fragmentation, water quality degradation, and competition from aggressive invasive species have significantly reduced the abundance and distribution of many native plant and animal species in the Illinois River Basin. In addition, human alterations of Illinois River Basin landscapes have altered the timing, magnitude, duration, and frequency of habitat forming and seasonal disturbance regimes. The cumulative results of these complex, systemic changes are now severely limiting both the habitats and species composition and abundance in the Illinois River Basin.

Ecological (or Biological) Integrity. Definition - A system's wholeness or "health," including presence of all appropriate elements, biotic and abiotic, and occurrence of all processes that generate and maintain those elements at the appropriate rates (Angermeier and Karr 1994). The capability of supporting and maintaining a balanced, integrated, adaptive community of organisms having a species composition, diversity, and a functional organization comparable to that of natural, unimpacted habitat of the region (Karr and Dudley 1981, Adamus 1996).

Overarching Objectives. Objectives to restore ecological integrity, including habitats, communities, and populations of native species, and the processes that sustain them are discussed in the following paragraphs.

- Identify and address system-wide limiting factors to ecological integrity (structure and function), including, but not limited to:

    Goal 1 - excessive sedimentation

    Goal 2 (backwaters, side channels, and islands) - reduction and fragmentation of aquatic habitat

    Goal 3 (floodplain, riparian, and aquatic) - reduction and fragmentation of aquatic and terrestrial habitat, altered disturbance regimes, and invasive plant species

Goal 4 (aquatic connectivity) - reduction and fragmentation of aquatic habitat

Goal 5 - altered hydrologic regimes

Goal 6 - water and sediment quality

- Restore and conserve natural habitat structure and function, including, but not limited to:

  • Concentrations of flora and fauna or areas that are:
  high in biodiversity;
  especially vulnerable to disturbance; and/or
  important in fulfilling a life-history requirement of the species present.

  • Suitable habitat for Federal and State endangered and threatened species—or other species of concern—that is capable of supporting long-term sustainable populations.

  • Representative examples of all community types in the Illinois River Basin, best of kind or as needed, to protect and restore habitat structure and function at the system level.

- Establish existing and reference conditions for ecosystem functioning and sustainability against which change can be measured; monitor and evaluate actions to determine if goals and objectives are being achieved, at both the project and system levels.

1. Introduction. The goal of ecosystem management is to restore and sustain ecosystem integrity by protecting native biodiversity and the ecological and evolutionary processes that create and maintain that diversity. In order to achieve this goal, desired ecosystem structure, function, and variability must be characterized and measured against current conditions. This requires ecologically meaningful and measurable indicators that mark progress toward ecosystem management and restoration goals (Richter et al. 1996). The primary cause in the loss of ecological integrity is not direct human exploitation but rather the habitat destruction and disruption of natural processes that result from the expansion of human populations and activities (Wilson 1988).

In river systems, the physical structure of the environment, and consequently the habitat, is primarily defined by physical processes, especially the movement of water and sediment through the system. To understand the sustainability of river ecosystems and biodiversity, one must understand the dynamic and variable physical environment created by the river, as well as the human alterations to this system. The main stem Illinois River and its backwaters are the receiving body that integrate the products from all its tributaries and, in turn, store or deliver them to the Mississippi River and eventually the Gulf of Mexico. The historical diversity of in-channel and floodplain habitat types supported species that exploited the shifting habitat mosaic created and maintained primarily by the hydrologic variability. Human-induced changes to the ecosystem include habitat alteration and/or destruction, construction of dams, navigation, urbanization, agriculture, tile drainage, levees and channelization, and groundwater pumping (Poff et al. 1997). These alterations to the physical environment and hydrology, habitat loss and fragmentation, water quality degradation, and introduction of invasive species all threaten the ecological integrity of the Illinois River Basin, its natural communities, and populations of native species. In order to restore the basin to a more natural and self-sustaining state, restoration efforts must include activities to address degradation in all of these areas. Finally, education of the general public about the values of our environment is crucial to the future health of the system.

The Illinois River Basin is ecologically degraded because of 150 years of intensive human development in the region. Not only are landscapes changed, major initiatives to dredge channels, dig ditches, and increase drainage have altered the hydrologic regimes that drive the ecology of streams and rivers. In some cases, the landscape and streams are still adjusting to changes imposed by human development, especially where suburban sprawl is encroaching into sensitive habitats. In other cases, the ecosystem has stabilized within the bounds imposed by development.

2. System Limiting Factors. The Illinois River Basin has experienced the loss of ecological integrity due to sedimentation of backwaters and side channels, degradation of tributary streams, increased water level fluctuations, reduction of floodplain and tributary habitat and connectivity, and other adverse impacts caused by human activities. Although today's flora and fauna are but a remnant of these historic levels, they still include some of the richest habitat in the Midwest, even some unique in North America (Talkington 1991), however, the physical habitats (structure) and the processes that create and maintain those habitats (function) have been greatly altered. The following areas, discussed below, have been identified as the physical factors that limit restoration of ecological integrity. Figure 3-1 illustrates how projects could be formulated addressing these system limiting factors, in turn, improving ecosystem integrity. Monitoring, at both the system and individual project level, would provide the vital feedback loop needed to ensure success and increase understanding of the Illinois River Basin ecosystem.

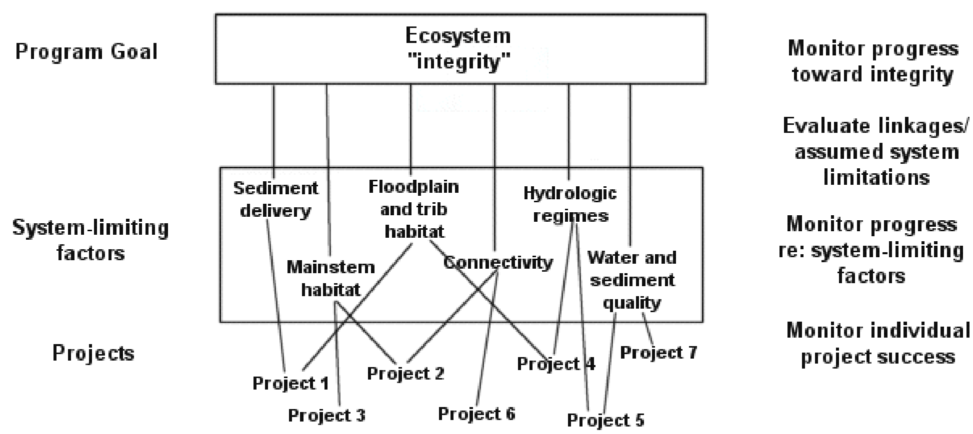


Figure 3-1. Conceptual Model of Illinois River Basin Restoration Program and Monitoring

3. Desired Future Conditions. In a meeting held in August 2003 as part of this study, natural resources professionals from the Rock Island District of the Corps of Engineers, the Illinois DNR, the USFWS Rock Island Field Office, and The Nature Conservancy met to discuss the desired future conditions of the Illinois River Basin. In addition to the declines in the biotic communities previously discussed, land conversion to urban use and development in the State of Illinois is currently estimated at 40,000 to 50,000 acres of land per year. Much of this development is in the Illinois River Basin, particularly in the western Chicago suburbs. In light of continuing habitat degradation, fragmentation, and losses, the expert panel identified preferred levels of restoration needed to restore and maintain ecological integrity to the Illinois River Basin. This expert panel also stressed that ecological integrity is the overarching goal for this restoration program and should drive the identification, development, selection, and implementation of restoration projects. In addition, the project identification and selection process should focus on the habitat quality and threats to ecological integrity and habitat sustainability. Though no specific projects or alternatives were formulated for the overarching goal, projects formulated under all of the other program goals would contribute toward restoring the ecological integrity of the Illinois River Basin.

Mapping of habitats for the evaluation species should consider edge effect and patch size. Although most birds are highly mobile, habitat fragmentation may affect species that have high fidelity to specific nesting localities. Mammals, reptiles, amphibians, and some invertebrates are particularly likely to be affected by fragmentation from development activities, and focusing protection on the relatively large tracts of natural lands remaining in the study area may conserve biological diversity. The development of corridors between terrestrial environments greatly increases the value of the formerly isolated areas. Habitat size and distribution (per pool or sub-basin) recommendations to address ecological integrity are: bottomland forest patches of at least 1,000 acres; grasslands of 100 to 500 acres each, nonforested wetlands of at least 100 acres, spaced 30 to 40 miles apart; a riparian zone at least 100 feet wide per side or 200 to 300 feet total width; and backwater depth for overwintering of at least 6 feet and spaced 3 to 5 miles apart. These recommendations are based on research and published literature, and expert panel input. Smaller areas than those described above would still provide benefits to many species and should be considered for restoration.

Preservation has a critical role in conservation of diversity; however, by itself, it is not an adequate strategy. Numerous species are already on the brink of extinction and their habitats have been degraded, reduced to a remnant, or even eliminated. Preservation of existing biodiversity, in the face of continuing change, is not enough to offset continuing declines in ecological integrity (Jordan 1988). Preservation must be coupled with restoration of both habitat structure and function in order to restore ecological integrity to the Illinois River Basin.

a. Criteria for Prioritization

- Combining habitat restoration and/or protection projects should be closely coordinated with projects developed under other goals, in order to maximize systemic ecological integrity and effectiveness of restoration efforts and dollars.
- The assessment process should focus on quality of the habitat and the presence of threats to the integrity of the quality area under consideration. Those areas threatened most immediately should be targeted for protection.
- Connectivity to the Illinois River and major tributaries and between protected areas should be key focus area.
- Preference given for improving and protecting existing moderately degraded habitat areas near rare and unique communities.
- Give special consideration to rare areas.
- Altered hydrologic regime most relevant disturbance regime.
- Terrestrial patch size recommendations (amount shown or greater):
    - Bottomland hardwood forest = 500 to1000 acres; 3000 acres needed for some interior avian species
    - Grasslands = 100 to 500 acres
    - Nonforested wetland = 100 acres, spaced 30 to 40 miles apart
    - Riparian zone = 100 feet each side; 200 to 300 feet wide total

- Aquatic habitat recommendations:
  - Main stem backwaters/side channels ≥ 6 feet deep, spaced 3-5 miles apart
  - In-stream riffles - Depending on the size of the stream, the number of structures required ranges from 4 per mile for large tributaries to 22 for minor tributaries

b. Restoration Measures Available

- Identify, restore, and maintain habitat structure and function in relation to limiting factors identified in Goals 1through 6
- Identify, protect, and restore high-quality communities on state-owned lands that are not dedicating or registering identified communities as appropriate
- Identify, protect, and restore representative examples of all community types on other lands. Where no high-quality communities can be defined, identify the best of kind and apply restoration techniques to improve ecological integrity.
- Improve areas within or adjacent to conservation sites (i.e., groupings of ecologically significant features in a geographically discrete area) by identifying degraded components of, or are adjacent to, the site and implementing restoration practices to improve resource quality
- Permanently protect lands (permanent conservation easements, Nature Preserve designation, or acquisition)
- Improve general habitat quality at the system level by restoring specific habitats, and/or net functional value, within major tributaries and pools of the Illinois River Basin
- Increase connectivity between habitat areas; focus on both lateral and aquatic connectivity of aquatic, riparian, and terrestrial habitats
- Increase use of prescribed burning - Implement the federally approved Aquatic Nuisance Species Management Plan, and other accepted management plans, to reduce invasive species in the basin. Implement invasive species control through burning, herbicide, removal, and bio-control.
- Manage currently isolated backwater areas to improve the hydrologic regime as it relates to relevant ecological processes through controlled water level management (drawdowns/flooding)

4. Risk and Uncertainty. Biological data on which to base objectives generally are not known accurately. Quite often, the most that can be achieved is to express a parameter as a best estimate and include a set of plausible bounds (i.e., range or confidence interval) (Todd and Burgman 1998).

Ecological predictions have three fundamental, interacting problems: uncertainty, contingency, and reflexivity. In most cases, the uncertainty of ecological predictions is not rigorously evaluated. Ecological predictions are contingent on drivers that are difficult to predict, such as human behavior. Conservation biology continually confronts situations in which decisions must be made in the face of uncertainty. It is suggested that the appropriate response to uncertainty depends on the degree of uncertainty and the degree to which a system can be controlled. When control is difficult and uncertainty is high, scenario planning may provide an effective way to manage various futures for the basin. In addition, adaptive management and optimal management may also be effective ways to address uncertainty (Peterson et al. 2003).

Adaptive management is the systematic acquisition and application of reliable information to improve natural resource management over time. Ideally, under adaptive management, conservation strategies are implemented as a deliberate experiment. This approach can establish cause-and-effect relationships and point the way toward optimal strategies. Adaptive management has been promoted as essential to management under uncertainty. However, funds spent on adaptive management reduce the amount available for habitat restoration, so limited financial resources require an effective balance between restoring habitat and acquiring knowledge (Wilhere 2002).

F. GOAL 1: SEDIMENT DELIVERY. Reduce sediment delivery to the Illinois River from upland areas and tributary channels with the aim of eliminating excessive sediment load.

Problem. Increased sediment loads from the basin have severely degraded environmental conditions along the main stem Illinois River by increasing turbidity and filling backwater areas, side channels, and islands. Improved conservation practices have reduced the amount of sediment generated from many agricultural areas, but large quantities of sediment are still delivered to the river due to eroding channels and tributary areas, including urban and rural construction sites. The most critical problems resulting from the increased sediment loads are the loss of depth and habitat quality in off-channel areas connected to the main stem river. Similar problems can be seen at other areas within the basin where excessive sediment has degraded tributary habitats.

Objectives

- Reduce total sediment delivery to the Illinois River below current levels by at least 1.2 million tons per year by 2025 (10 percent reduction from an average of 12.1 to 10.9 million tons per year above Valley City, based on ISWS estimate of delivery for 1981-2000)
- Reduce total sediment delivery to the Illinois River below current levels by at least 2.4 million tons per year by 2055 (20 percent reduction to an average of 9.7 million tons per year above Valley City, based on ISWS estimate of delivery for 1981-2000)
- Eliminate excessive sediment delivery to specific high-value habitat areas along the main stem and along tributaries

Expected Outputs

Anticipated project outputs related to Goal 1 include: stabilizing tributary streams by reducing downcutting and widening of the streambed, reducing sediment delivery to the Illinois River, reducing turbidity in the Illinois River main stem and its backwaters and tributaries, and increasing the life of existing and restored backwaters as critical habitats for native species. Anticipated benefits to the Illinois River and its tributaries resulting from Goal 1 include:

- Increased light penetration - will help lead to increased production by phytoplankton and aquatic vegetation. Increased light will also aid sight-feeding fish, such as sauger and largemouth bass.

- Improved substrate conditions - will benefit benthic invertebrate and macroinvertebrate communities (i.e. mussels, fingernail clams, and mayflies) as well as most fish species (i.e. bass and bluegill), who rely on this food source and need silt free areas for spawning (i.e. paddlefish).
- Increased aquatic habitat – The riffles and other structures proposed as part of the project will provide habitat for a wide variety of species, including darters, redhorse, and suckers. Reduced sedimentation rates in existing and restored Illinois River Backwater areas will also help to protect and maintain habitat.

Working Concepts

- Stream "stability" refers to the condition under which a stream has adjusted its cross-sectional geometry, slope and planform such that it transports the water and sediment loads applied to it without experiencing aggradation, degradation or significant planform changes. "Unstable" stream systems are those that are out of balance with their sediment or water regimes, and these demonstrate progressive changes in planform or sediment storage with time. Note that stable streams transport sediment and exhibit change in planform, or cross section, over time—instability refers to the degree of adjustment required to adapt to current geomorphic conditions.
- There are different ways to define "excessive" sediment load. From a geomorphologic perspective, excessive sediment load is simply that which exceeds the sediment transport capacity of a given reach. From a watershed management perspective, an excessive sediment load may be that which is generated by unstable behavior of tributary streams, or that above an expected level of delivery. From a habitat perspective, excessive load is that which leads to increased degradation of habitat quality. For the purposes of this goal, "excessive" can refer to either perspective, but it should be noted that a load to a system might be excessive from one perspective but not the other.
- Watershed-level planning is necessary to identify the most effective means to reduce erosion within and sediment delivery from each river or stream.

1. Inventory Resource Conditions

a. Historic Conditions. Soil erosion and sedimentation are natural processes that have been accelerated by anthropogenic changes to the landscape. Prior to the last glacial period, the Illinois River Valley was carved by the Mississippi River which has much higher flow rates than the Illinois River; therefore, the valley is oversized for its current flow rate. This led to the inability of the Illinois River to transport all of the sediment it received even before land disturbance and subsequent sedimentation in many areas of the valley (Bhowmik and Demissie 1989). Early observations suggest that prior to land clearance, the rate of sediment delivery from most Midwestern watersheds was significantly lower than current rates, although no monitoring data exists for verification. Native vegetation promoted infiltration of rainfall and stabilized erodible soils (Meek 1892). Many streams or ditches of today's landscape were historically ephemeral channels, wetland swales, or simply did not exist (Rhoads and Herricks 1996). The historical hydrologic and hydraulic conditions within the basin limited sediment delivery to the Illinois River. Even under these moderate flow and erosion conditions, however, sediment transport to the Illinois River was still sufficient to form deltas at points where streams fed into slower river reaches. Because of its flat slope, the lower portion of the river has had a depositional environment since the last ice age, accumulating some of the sediment delivered from the basin within its associated backwater and floodplain areas.

The clearing of land (especially on marginal land) in the Illinois River Watershed, for cropping and for construction activities, has led to high erosion rates because soil-retaining vegetation was removed, thereby creating conditions that resulted in larger storm flows (Knox 2002). Eroded sediment carried into tributary waterways resulted in very turbid streamflows (Meek 1892) and increased sediment delivery to the Illinois River. The effects of land clearance on sediment production and transport tend to be especially pronounced in steeply sloped areas (Knox 1977). Eroded sediment degraded ecosystem integrity by both reducing water clarity and covering or filling downstream habitat. Eroded sediment also contributed to water quality impairments by transporting sorbed compounds, such as the nutrient phosphorus.

The higher levels of sediment transport accelerated the rate of sedimentation in downstream areas. Analyses completed by the Illinois State Water Survey (ISWS) indicate that, on average, the backwater lakes along the Illinois River have lost 72 percent of their original capacity. Peoria Lake is a classic example of the sedimentation problem along the Illinois River. Demissie and Bhowmik (1986) found that Peoria Lake had lost about 68 percent of its 1903 capacity by 1985. They estimated that the rate of sediment accumulation of this lake was 1.7 million tons per year for the period 1965 through 1976 and about 2 million tons per year from 1976 to 1985.

In response to the negative impacts of soil erosion from nonpoint sources (eroding farm fields and urban construction projects) and the resulting sedimentation, the Illinois General Assembly passed the Illinois Erosion and Sediment Control Program and Standards Law. The goal of the law was the incremental reduction of soil erosion to tolerable soil loss levels ("T") by the year 2000, and the "T by 2000" program was instituted. In 1982, a statewide inventory showed that more than 40 percent of the State's rural land was exceeding tolerable soil loss levels. The average soil loss from cropland was estimated to be about 6 tons per acre per year (NRCA 1997).

b. Existing Conditions. Effective erosion control due to the implementation of conservation practices has reduced the average rate of erosion from croplands (NRCS 1997, Knox 2002). Technical, educational, and financial assistance to landowners through conservation programs has significantly reduced the level of soil erosion within the Illinois River Basin. The most recent estimates indicate that only about 13 percent of the cropland acres statewide exceed "T" (IDA 2000).

Despite conservation efforts, soil erosion and sediment transport from most of the basin is still higher than occurred pre-settlement. Channelization, increased flows within the basin and increased flow velocities have resulted in high levels of channel erosion (photograph 3-1). Channel erosion can be manifested as either down-cutting or lateral migration of streambeds, or both, and leads to significant downstream sediment transport. Research by the ISWS indicates that channel erosion from unstable streams accounts for 30 to 40 percent of sediment delivered from eastern Illinois watersheds and as much as 80 percent of the sediment delivered from watersheds in the western part of the basin. Odgaard (1984) observed comparable contributions in two Iowa rivers.

Sediment transported from the watershed continues to deposit in deltas, backwaters, and floodplain areas along the Illinois River. The sparse coverage of ongoing sediment data collection efforts makes it difficult to evaluate basin-scale sediment transport trends with confidence, but using the available information, the ISWS estimated that an average of 12.1 million tons of sediment per year were delivered to the Illinois River above Valley City for water years (WY) 1981-2000 (Appendix D-3, Demissie et al. 2004).

Photograph 3-1. Incised Stream

Figure 3-2 illustrates the relative contributions from various tributaries. If the extreme water year of 1993 is not included, the average amount delivered to the river is approximately 10.5 million tons per year. Of this, 6.7 million tons per year (5.1 million tons per year without 1993) were retained within the river and its bottomlands. Most of this sediment is presumably deposited within the backwater lakes along the Illinois River, located from Lake DuPue to Meredosia Lake. It should be noted that average annual precipitation in recent years has been higher than occurred during some previous historical periods (Changnon et al. 1997) and that sediment delivery tends to be sensitive to shifts in climate conditions, especially in agricultural basins (Knox 2001). Sediment budgets for future years will be influenced by climate conditions that must be considered when interpreting any observed changes.

The size of sediment transported from the basin largely determines its potential effects on the main stem environment. Although sands and gravels (bed material) have deposited where high-gradient streams enter low-gradient reaches and have filled certain high-quality areas (Bhowmik et al. 2001), it is the finer particles (silt and clay) deposited in backwater areas that have most disrupted the ecological integrity of the Illinois River system (Lee and Stall 1977, Bellrose et al. 1983, Demissie and Bhowmik 1986). Silt and clay particles make up the bulk of the sediment load delivered to the Illinois River and approximately 80 to 90 percent of the load transported in the river (Bhowmik and Demissie 1989). Demissie et al. (2004) estimate that bed material load ranges from 5 to 20 percent of total sediment loads throughout the watershed. Unlike sand, which often deposits as a bar immediately downstream of erosion sites (Odgaard 1984), finer particles remain within the water column and tend to be transported into downstream lakes or floodplains. Because of the dominant influence of fine sediment on a system-wide scale, control of silt and clay particles bound for the river will be a major project focus to reduce the level of suspended sediment transported into the Illinois River floodplain and backwater lakes. Control of sand-sized particles will also have ecosystem benefits in specific locations, such as in rivers or backwater lakes with valuable habitat being filled or covered by materials from direct tributaries, and projects to control sediment delivery in these areas may be developed as well.

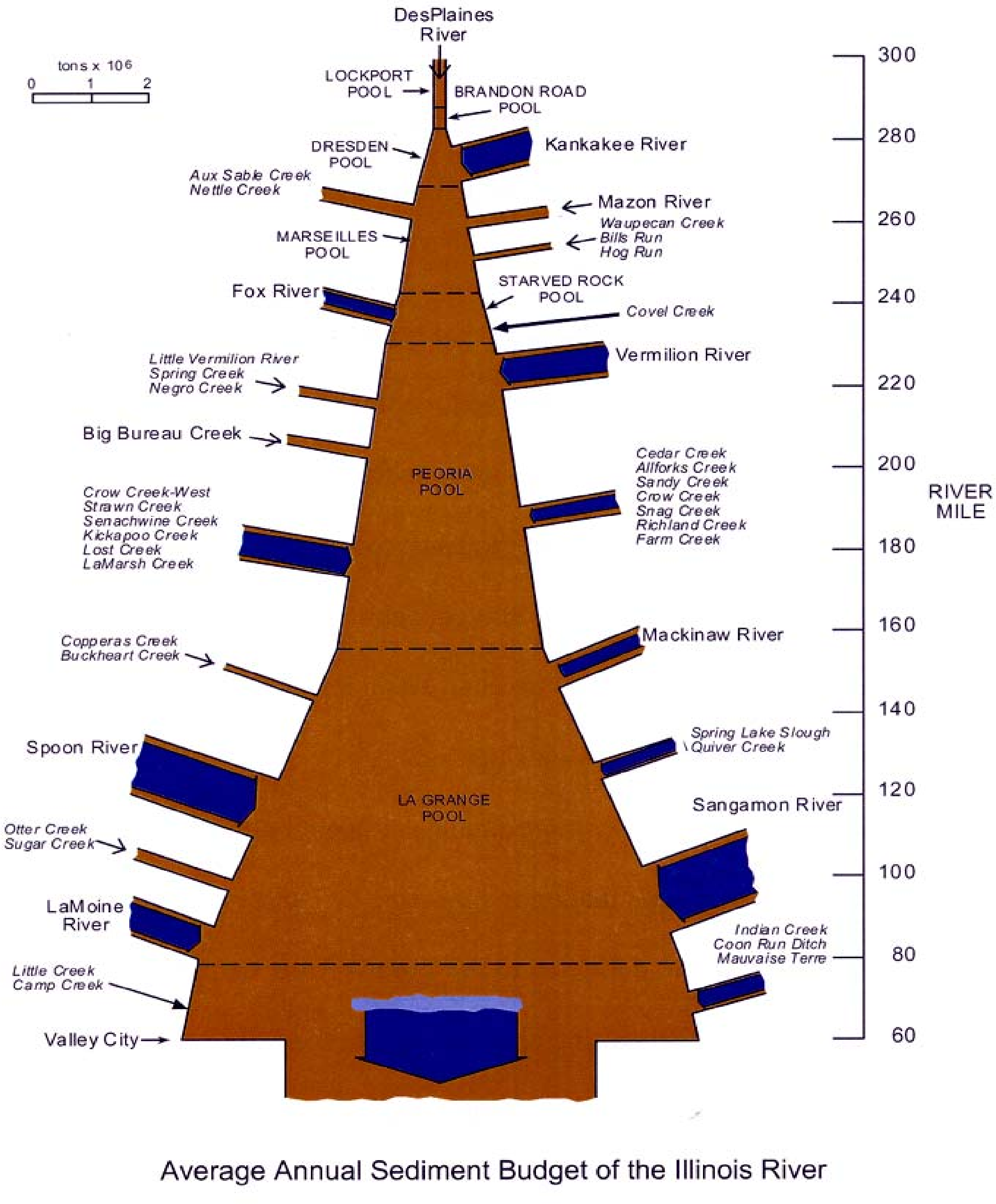


Figure 3-2. Sediment Budget Along the Main Stem Illinois River (Demissie et al. 2004) Brown shaded areas represent quantity of sediment.

The magnitude and characteristics of sediment delivery differ from watershed to watershed. At their confluence, the Kankakee River generally has a much larger flow than the Des Plaines River, and it carries a great quantity of sand as bed material load. The Des Plaines River carries proportionally much less sediment. The Fox, Mazon, and Vermilion Rivers are other major water sources upstream of the Peoria Lake. Numerous small creeks and streams (local tributaries) that drain from bluff line watersheds are often significant sources of fine sediment (silt and clay). Although the local tributaries of Peoria Lake contain only 4 percent of the drainage area, the sediment budget developed by Demissie et al. (2004) indicates that they contribute approximately 31 percent of the sediment delivered to the lake. Data collected in the La Grange Pool similarly indicate that local tributaries contribute a significant portion of the sediment load to the pool (U.S. Geological Survey, unpublished data). The Mackinaw, Spoon and Sangamon Rivers all drain into the La Grange Pool where they transport substantial quantities of materials from the basin. Bluff line tributaries drain directly to the main stem through Alton Pool. Some watersheds have excessive sediment transport from upland sources, others are dominated by in-channel erosion and yet others may be stable in that the sediment transport is at a relatively “natural” rate. Although west-central Illinois watersheds and direct tributaries to the river have the highest sediment production rates (delivery per unit area) in the basin, sediment sources such as unstable stream banks, mining activity, and construction sites occur throughout the Illinois River Basin. Because of this, effective measures to reduce sediment delivery must be developed on a watershed-by-watershed basis and must consider the geomorphologic characteristics of each particular area.

c. Future Without-Project Conditions. Depending on economic and political conditions, the programs that have reduced sediment loading from upland practices may expand or contract in the future. Although far from certain, it is anticipated that the benefits of conservation practices will probably remain constant and possibly increase somewhat in the future. However, there will continue to be significant sediment transported to the Illinois River from areas not addressed by these programs.

Significant sediment sources will continue to arise at points in the basin where sediment control regulations are inadequate or inadequately enforced. It is expected that without this program there would be no overall program to address stream instability throughout the Illinois River Basin and that future channelization projects may destabilize additional stream miles. Without measures to naturalize the sediment transport in these streams, they will continue to incise or migrate into the foreseeable future, contributing sustained high rates of sediment loading to the main stem Illinois River.

Without action, the sediment loading to the Illinois River from unstable streams and other sources in the basin will continue at unacceptably high levels. Sediment loading will continue to degrade vulnerable habitats and impede downstream restoration efforts. Local projects may show site-specific benefits, but the effects of high sediment loading will limit the extent where benefits may be observed.

Among the significant unknowns that will affect future sediment conditions are climate, land use, and land cover conditions. These are generally beyond the influence of the Illinois River Basin Restoration Project. Increases in precipitation could lead to increased sediment loads despite improved watershed conditions; likewise, decreases in precipitation could reduce sediment loads even if no beneficial actions were taken. Land use and land cover changes could similarly increase or decrease sediment delivery from the basin, depending on the nature of the changes. Without additional monitoring, it will be very difficult to determine trends in the sediment transport processes within the Illinois River and its basin or to evaluate systemic benefits of improvement projects.

d. Desired Future Conditions. Under the desired future conditions the rate of sediment transport within the Illinois River Basin and the main stem river, especially the transport of silt and clay particles, would be reduced to a level that will better support ecological processes. At this time the understanding of the interconnections between sediment transport and Illinois River Basin ecosystem processes is insufficient to support definitive numerical targets for ecosystem improvement. In the absence of a scientific model of sediment effects, Corps of Engineers and State of Illinois scientists and managers generally agree that an overall 20 percent reduction of sediment transport to the main stem Illinois River is an appropriate initial long-term target that would demonstrate measurable positive benefits for the system. Monitoring for the Demonstration Erosion Control (DEC) project in the Mississippi River indicated that such a reduction of watershed sediment delivery is possible using proven technology (Watson and Biedenharn 1999). An interim target of 10 percent reduction after 20 years was chosen to represent a measurable improvement and is feasible by treating the most significant sediment sources first. Using the sediment budget developed by Demissie et al. (2004) for WY 1981-2000, 10 percent and 20 percent reductions represent 1.2 and 2.4 million tons per year below current levels, respectively. Slightly smaller reduction targets would arise if the extreme year of 1993 were excluded.

Although these objectives are formulated in terms of sediment delivery to the main stem, the benefits will be achieved nearly exclusively by projects within the tributary basin. These projects would have significant benefits within their particular tributary areas as an overall 20 percent reduction would necessitate higher reductions in the immediate vicinity of each project. It is envisioned that additional ecosystem benefits will be gained by placing the sediment reduction projects in areas likely to benefit high-value downstream habitats.

Achievement of the sediment reduction objectives will require four components: maintaining existing sediment control benefits, identifying and controlling sources of sediment in upland areas, identifying and treating unstable streams, and assessing system response to individual projects. To maintain existing benefits, it will be necessary to ensure that the conservation practices currently installed within the basin remain effective. It is also necessary that existing regulations are enforced and are evaluated to determine if they could better protect the resources within the Illinois River system. Under these conditions, it is assumed that without-project sediment loads would remain constant at WY1981-2000 levels. Additional sediment control practices would be implemented through this project and coordinated efforts based on assessment of sources within specific watersheds.

Recognizing that streams always transport sediment, reduced delivery would be accomplished by implementing projects that reduce bank erosion, allow streams to reach a relatively stable state, or control upland sediment as appropriate based on watershed conditions. To guarantee an accurate understanding of the sediment transport status and trends, assess project success and guide future project development, a basin-wide monitoring network is needed to compile and evaluate sediment data. The systemic understanding gained from the monitoring data will be used to refine basin-wide hydrologic and sediment models so as to forecast system response to additional management activities.

2. Formulation of Alternative Plans. The objectives for this ecosystem goal were formulated to reduce sediment delivery to both the Illinois River and to high-quality areas within the basin. Because of their effects on the river's ecological functions, much of this effort will concentrate on the control of silt and clay particles. Sediment control requires assessing sediment transport on a watershed scale, identifying major sources of erosion as related to downstream sediment delivery, and addressing these sources as feasible. It cannot be overstressed that the benefits achieved through these efforts would be erased if inadequate enforcement of local regulations or unmitigated land-use changes allow large amounts of sediment to enter the river system. The efforts here are designed to augment, and not replace, local and regional sediment control efforts.

Sediment delivery would be reduced using a combination of upland controls and stream stabilization as appropriate for each individual watershed (e.g. White et al. 2003). Information such as that developed for NRCS Erosion and Sediment Investigations can be used to identify the major sources within each watershed and develop treatment measures. Stream stabilization measures would be undertaken using measures that take into account system geomorphological influences (Shields et al. 2003). For each watershed, an alternative analysis would be developed to determine the most cost-effective set of projects to address the sediment delivery issues particular to that watershed.

a. Approach/Assumptions. Although it is unlikely that incremental changes in sediment load will always have directly proportional benefits for ecosystem integrity, there is currently no model to relate these factors on a system-wide level. For the purposes of plan formulation, the study team assumed a direct relationship between sediment load reduction and ecosystem benefits for the range of changes considered. The team also generally agreed that a 20 percent reduction from current levels would lead to significant improvements in ecological integrity within the Illinois River Basin. Because the river was a depositional environment even prior to land clearance (Bhowmik and Demissie 1989), it is expected that a load reduction of that magnitude would not have adverse geomorphic effects.

Systematic alternatives were developed based on strategies to achieve specific reductions (tons per year) in sediment delivery to the river. Due to differences in watershed conditions and restoration potential, basin tributaries were divided into three regions, based on the Physiographic Regions of the Illinois River Basin (Appendix D-1); the tributaries that drain to the river upstream of Peru and also the Mackinaw River are categorized as “eastern,” “southern” tributaries drain to the river from the left bank downstream of the Mackinaw River, and “western” tributaries are the rest, including all direct tributaries to Peoria Lake (figures 3-2 and 3-3). The eastern, western, and southern tributaries contribute approximately 3.8, 5.2, and 3.1 million tons per year, respectively, of sediment to the Illinois River. The percent reduction to be achieved within each tributary region was set by the various alternatives, and the sediment delivery calculated for the Sediment Budget of the Illinois River (Demissie et al. 2004) was used to develop quantitative reduction goals for each region. The differing characteristics between regions led to differences in the effectiveness of sediment control measures and thereby differences in the cost to control sediment delivery.

The maximum attainable delivery reduction for large watersheds was estimated to be 20 percent of current levels. Delivery reduction in the immediate vicinity of stabilization projects, however, tends to be significantly higher, implying that larger reductions are possible when viewed at smaller scales. Applying this to entire watersheds suggests that potential reduction may be a function of watershed area. Figure 3-4 proposes a relationship between watershed size and potential maximum reduction of watershed sediment delivery assuming a threshold maximum at 200 square miles (the size of the larger DEC watersheds) and that delivery reduction is a function of watershed area to the –0.3 power, as suggested in Figure 12.10.4 of Shen and Julien (1993). This relationship is consistent with the experience of state resource managers that significant reductions in sediment delivery are achievable when working with small but highly disturbed watersheds.

For all of the alternatives, the sediment sources and potential reduction options will be assessed on a watershed basis to preserve or restore systemic geomorphic balance. Out of these assessments, plans encompassing both structural and non-structural actions will be developed. It is expected that existing efforts such as federal and state conservation programs as well as state and local erosion control ordinances will play an important role in delivery reduction, and that the assessments may provide a basis for expanding these efforts.

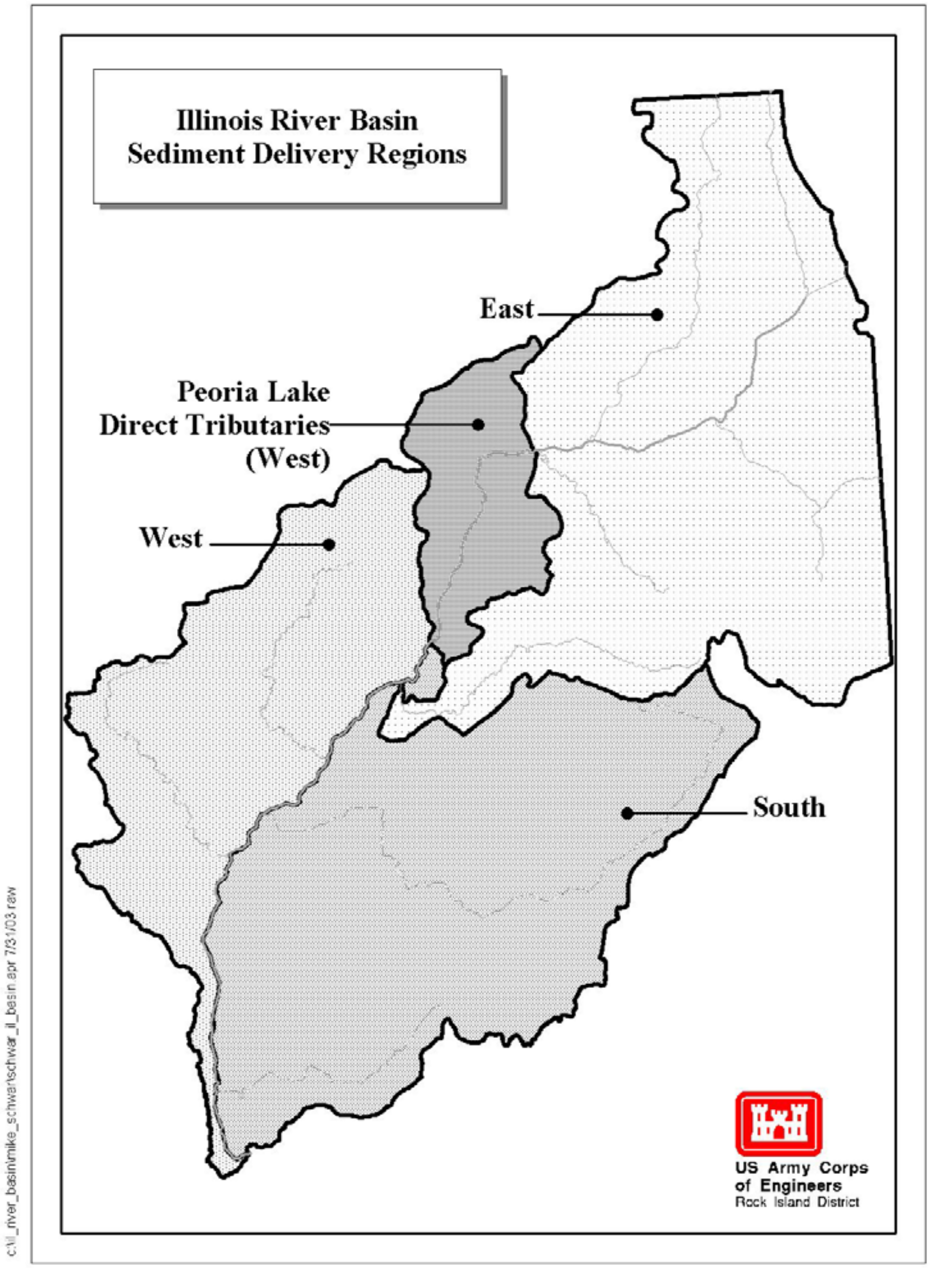


Figure 3-3. Regions Used To Delineate Assumed Tributary Characteristics.
Differing characteristics between regions result in differences in the effectiveness of sediment control measures and thereby differences in the cost to control sediment delivery.

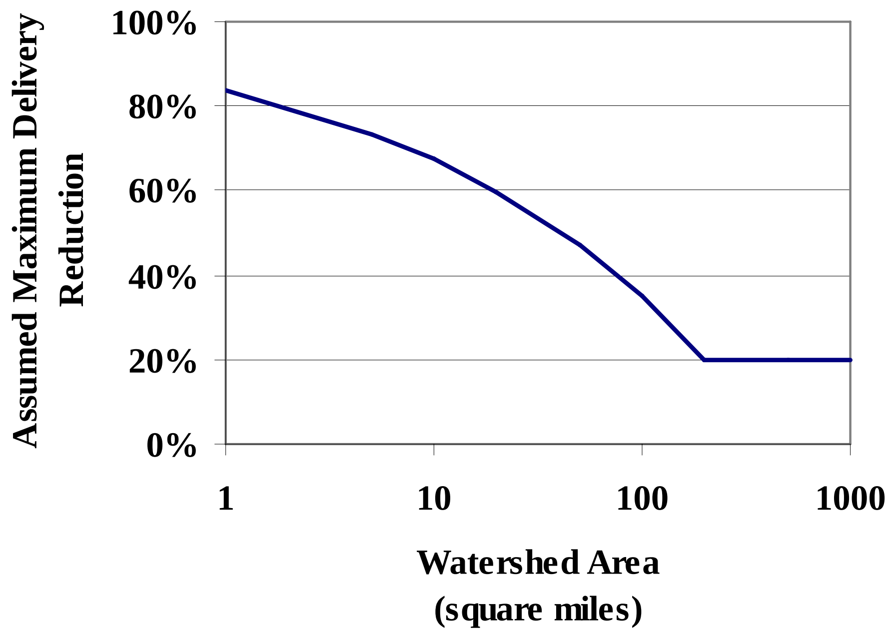


Figure 3-4. Estimated Potential Watershed Sediment Delivery Reduction Relationship

b. Criteria and Constraints. Benefits for this goal are quantified in terms of annual tons of sediment not delivered to the Illinois River main stem, and are sometimes expressed as a percent reduction from current levels. By quantifying the benefits in this way, the inherent assumption is that each increment of sediment reduction provides the same level of benefit; it is probable that there is some variation in incremental benefits of sediment reduction, but the linkages between reductions and ecological benefits are not understood to a sufficient level to justify a different approach so the simple linear relationship was used here.

Because of the interest in maintaining the quality of Peoria Lake, benefits for each alternative have been calculated at both Peoria Lake and at Valley City. Tributary benefits were not specifically quantified but reductions in sediment delivery to the main stem Illinois River necessitate significantly larger percent reductions at some upstream points in its tributaries. Stabilization of eroding channels has been shown to provide ecological benefits within those channels (Shields et al. 1997) and watershed-based sediment control strategies can be expected to provide significant benefits to areas some distance downstream. Because of this, it is reasonable to expect that significant benefits would also accrue in the tributary systems.

Site-specific conditions will have a large effect on the potential for particular measures to provide benefits, the extent that those measures provide additional ecological benefits, and the cost of implementation. For example, in developing watershed plans, local support and involvement will play a large role in the scope of project implementation. Also, sediment control projects located upstream of vulnerable habitat areas would provide more ecological benefits than the same projects downstream of the same areas. The estimates of costs and benefits developed here attempt to reflect a representative average of a number of projects placed over a large area and so balancing overall effects of site-specific conditions.

c. Measures. Although the precise mix of measures to be applied throughout the Illinois River Basin will be developed on a watershed basis, representative project scenarios were developed based on several potential combinations of an abbreviated suite of cost-effective measures. For the purpose of programmatic estimates, it was assumed that incising channels would be treated with rock riffle structures if possible; otherwise, sheet-pile grade control structures would be used. It was assumed that the preferred method of treating bank erosion was stone barbs, then stone toe, or finally a stone armor blanket if necessary. Bioengineering was incorporated in most of the bank erosion stabilization measures. Upland sediment control measures were assumed to be dry basins for costing purposes. Other measures are likely to be used, but it is assumed that overall cost estimates should not greatly change.

Sediment benefits were defined based on the total quantity trapped or from the reduction in sediment generation. Sediment trapping in upland facilities was estimated using an average capacity of similarly sized sediment basins. Sediment generation from unstable streams was estimated using average stream characteristics and rate of channel movement. Stable streams do transport sediment; for purposes of estimating benefits, it is assumed that sediment delivery from stabilized stream banks or beds would be 25 percent of unstabilized levels. Benefits were annualized as necessary to evaluate the yearly delivery reduction after construction of each suite of projects.

d. Alternatives. Three acceptable geographic distributions of projects were developed:

- The alternatives in the first distribution (Alternatives 1A through 1D, table 3-2) were designed to provide equal treatment to the entire Illinois River Basin by focusing on treating “hot spots” in each watershed.

- The alternatives in the second distribution (Alternatives 1E through 1G, table 3-2) identifies Peoria Lake as a focus and concentrates on reducing inputs equally from the entire area contributing flow to Peoria Lake while addressing sediment delivery from downstream watersheds to a lesser extent.

- The alternatives in the third distribution (Alternatives 1H through 1W, table 3-2) were designed to focus sediment delivery reduction measures in the direct tributary watersheds to Peoria Lake, while treating the rest of the basin, both upstream and downstream of Peoria Lake, to lesser extents. Due to their small watersheds, it should be possible to reduce sediment delivery from Peoria Lake direct tributaries by a higher percentage than is possible in the larger tributary systems. Two levels of treatment for the direct tributaries to Peoria Lake are evaluated: those necessary to reduce sediment delivery rates by 20 percent (Alternatives 1H through 1O) and by 40 percent (Alternatives 1P through 1W) below current levels.

It is important to note that although sediment reduction benefits may accrue from projects designed to meet other goals, most notably Goal 5, those benefits are not incorporated into this analysis.

Table 3-2. Alternatives

Alternative	Total Sediment Delivery Reduction (%)	Sediment Delivery Reduction to Peoria Lake (%)	Sediment Delivery Reduction from Watersheds Upstream of Peoria Lake (%)	Sediment Delivery Reduction from Watersheds Downstream of Peoria Lake (%)	Sediment Delivery Reduction from Direct Tributaries to Peoria Lake (%)
1-0	No Action				
First Distribution – Equal Treatment to the Entire Basin					
1A	5.00	5.00	5.00	5.00	5.00
1B	7.50	7.50	7.50	7.50	7.50
1C	10.00	10.00	10.00	10.00	10.00
1D	20.00	20.00	20.00	20.00	20.00
Second Distribution – Focus on Direct Tributaries to Peoria Lake and Upstream Inputs					
1E	5.00	10.00	10.00	2.00	10.00
1F	7.50	15.00	15.00	3.00	15.00
1G	10.00	20.00	20.00	4.00	20.00
Third Distribution – Focus on Direct Tributaries to Peoria Lake					
1H	5.00	10.00	5.50	2.00	20.00
1I	7.50	10.00	5.50	6.00	20.00
1J	10.00	10.00	5.50	10.00	20.00
1K	10.00	12.50	9.10	8.50	20.00
1L	7.50	15.00	12.80	3.00	20.00
1M	10.00	15.00	12.80	7.00	20.00
1N	2.30	6.30	0.00	0.00	20.00
1O	5.00	6.30	0.00	4.25	20.00
1P	5.00	12.50	0.00	0.50	40.00
1Q	10.00	12.50	0.00	8.50	40.00
1R	7.50	15.00	3.60	3.00	40.00
1S	10.00	15.00	3.60	7.00	40.00
1T	4.27	12.50	0.00	0.00	40.00
1U	10.00	20.00	11.00	4.00	40.00
1V	20.00	20.00	11.00	20.00	40.00
1W	22.00	26.00	20.00	20.00	40.00

3. Evaluation and Comparison of Plans. Depending on the particular watershed conditions, a variety of combinations of sediment reduction measures may be applied within the different watersheds. To estimate the programmatic cost, a representative range of potential project combinations was evaluated, including a number of different project combinations for differing treatment strategies and watershed geomorphic conditions. It is expected that sediment control through in-channel work will account for at least 50 percent of the reduction attained; upland projects are generally not considered to be sufficient to control destabilized channels within an acceptable time period without some in-channel remediation, and it is anticipated that restoring such channels would be a major portion of the sediment control undertaken. The range of potential measures assumed different extents of incision, different project locations (small stream vs. large stream vs. upland) and different combinations of upland vs. in-stream measures. Each strategy was standardized to develop the range of costs required to reduce sediment delivery by one ton per year.

From this analysis, estimates of delivery reduction cost were developed for the three watershed regions from figure 3-3. Among the key assumptions of these estimates are:

- The incremental cost for sediment delivery reduction is the same for all units; that is, the first ton costs same as final ton for the range analyzed, and
- Corps construction costs include a 35 percent contingency, an additional 30 percent for engineering and design, and 9 percent for supervision and administration. Real estate costs include a 35 percent contingency as well.
- The cost estimates provided in table 3-3 are the initial (not annual) costs for sediment control measures (e.g. rock riffle structures, stone barbs, etc.) that would be designed to reduce sediment delivery to the Illinois River by one ton per year.

The range of cost estimates for the various watershed alternatives is shown in table 3-3. Please note that the initial project costs (also referred to as the initial costs) identified are the cost of construction plus the cost for real estate and as such are not an annual cost of the project. The initial costs were developed with the goal of reducing sediment delivery by one ton per year. Due to the higher levels of sediment delivery arising out of channel erosion in southern and western tributary watersheds, in-channel treatments were much more cost effective in those areas and overall delivery reduction was possible at a lower cost than reduction in eastern tributaries.

Table 3-3. Cost Estimates To Reduce Sediment Delivery to the Illinois River by One Ton Per Year, by Tributary Region

	Average Costs ($/ton)		Initial Project Costs ($/ton)	
	Construction	**Real Estate**	**Average**	**Range**
In-channel only				
East	623	26	649	502 - 776
West	149	7	156	133 - 185
South	138	6	144	125 - 162
Mixed focus (75% in-channel work)				
East	667	46	713	633 - 778
West	312	32	344	295 - 396
South	357	39	396	296 - 596
Mixed focus (50% in-channel work)				
East	708	66	775	721 - 828
West	472	56	528	452 - 607
South	413	48	461	311 - 587

Although in-channel work is the most cost-effective way to reduce sediment delivery, it is likely that there will be some distribution of in-channel and watershed measures, therefore, the average costs for 75/25 mixes of channel/upland projects were used to develop the cost estimates for each of the 24 alternatives identified in table 3-2. The estimated initial cost to reduce sediment delivery in eastern watersheds by one ton per year is approximately $713in western watersheds it is $344, and in the south it is $396. It is apparent that the geographical location of the watersheds chosen for reduction efforts will have a large effect on the overall project costs. Estimates of sediment delivery to the Illinois River were developed for the tributaries flowing directly into Peoria Lake, the area upstream of Peru, and the area downstream of Peoria Lake. These estimates are as follows:

- Approximately 1.4 million tons per year of sediment is delivered to the Illinois River from the direct tributaries to Peoria Lake (all watersheds are located in the western region).
- Approximately 3.1 million tons per year of sediment is delivered to the Illinois River from the area upstream of Peru (all watersheds are located in the eastern region).
- Approximately 7.6 million tons per year of sediment is delivered to the Illinois River from the area downstream of Peoria Lake. Approximately 0.6, 3.8, and 3.1 million tons per year originate in the eastern, western, and southern regions, respectively.

The initial costs estimates were used to develop cost estimates for each of the alternatives identified in table 3-2. Table 3-4 summarizes the estimated benefits and costs for each alternative considered.

Table 3-4. Alternative Comparison

Alternative	Delivery Reduced (100,000 tons/year)						Reduced Delivery (%)		Initial Cost ($ Million)
	Tributaries Upstream of Peru	Peoria Lake Direct Tributaries	Tributaries Downstream of Peoria Lake				to Valley City	to Peoria Lake	
			East Region	West Region	South Region	Total			
1-0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0.00	0
First Distribution									
1A	1.6	0.7	0.3	1.9	1.6	3.8	5.00	5.00	288
1B	2.3	1.1	0.5	2.9	2.3	5.7	7.50	7.50	425
1C	3.1	1.4	0.6	3.8	3.1	7.6	10.00	10.00	573
1D	6.2	2.8	1.3	7.6	6.2	15.1	20.00	20.00	1138
Second Distribution									
1E	3.1	1.4	0.1	0.8	0.6	1.5	5.00	10.00	328
1F	4.7	2.1	0.2	1.1	0.9	2.3	7.50	15.00	499
1G	6.2	2.8	0.3	1.5	1.2	3.0	10.00	20.00	662
Third Distribution									
1H	1.7	2.8	0.1	0.8	0.6	1.5	5.00	10.00	276
1I	1.7	2.8	0.4	2.3	1.9	4.5	7.50	10.00	400
1J	1.7	2.8	0.6	3.8	3.1	7.6	10.00	10.00	521
1K	2.8	2.8	0.6	3.2	2.6	6.4	10.00	12.50	555
1L	4.0	2.8	0.2	1.1	0.9	2.3	7.50	15.00	473
1M	4.0	2.8	0.5	2.7	2.2	5.3	10.00	15.00	590
1N	0.0	2.8	0.0	0.0	0.0	0.0	2.30	6.30	96
1O	0.0	2.8	0.3	1.6	1.3	3.2	5.00	6.30	228
1P	0.0	5.7	0.0	0.2	0.2	0.4	5.00	12.50	211
1Q	0.0	5.7	0.6	3.2	2.6	6.4	10.00	12.50	452
1R	1.1	5.7	0.2	1.1	0.9	2.3	7.50	15.00	362
1S	1.1	5.7	0.5	2.7	2.2	5.3	10.00	15.00	487
1T	0.0	5.7	0.0	0.0	0.0	0.0	4.27	12.50	196
1U	3.4	5.7	0.3	1.5	1.2	3.0	10.00	20.00	559
1V	3.4	5.7	1.3	7.6	6.2	15.1	20.00	20.00	1038
1W	6.2	5.7	1.3	7.6	6.2	15.1	22.00	26.00	1238

Alternative cost estimates were developed using the following methodology. Alternative 1V—which plans to reduce delivery from Peoria Lake direct tributaries by 40 percent, from the rest of the upstream basin by 11 percent, and from the areas downstream of Peoria Lake by 20 percent—is used as an example.

$$TC_{PT} = R_{PT} \times S_{PT} \times C_W$$
$$0.4 \times 1.4\,M \times \$344 = \$195\,M$$

$$TC_U = R_U \times S_U \times C_E$$
$$0.11 \times 3.1\,M \times \$713 = \$243\,M$$

$$TC_D = R_D \times (S_{D\text{-}E} \times C_E + S_{D\text{-}W} \times C_W + S_{D\text{-}S} \times C_S)$$
$$0.2 \times (0.6\,M \times \$713 + 3.8\,M \times \$344 + 3.1\,M \times \$396) = \$600\,M$$

$$TC = TC_{PT} + TC_U + TC_D$$
$$\$195\,M + \$243\,M + \$600 = \$1038\,M$$

where:
TC_{PT} = total initial cost of reducing sediment delivery from the direct Peoria tributaries
TC_U = total initial cost of reducing sediment delivery from the area upstream of Peru
TC_D = total initial cost of reducing sediment delivery from the area upstream of Pekin
TC = total initial cost of the alternative
R_{PT} = reduction from the direct Peoria tributaries
R_U = reduction from the area upstream of Peru
R_D = reduction from the area downstream of Peoria Lake
S_{PT} = sediment contributed by the direct Peoria tributaries in tons per year
S_U = sediment contributed by the area upstream of Peru in tons per year
$S_{D\text{-}E}$ = sediment contributed by the area downstream of Peoria Lake from the eastern region in tons per year
$S_{D\text{-}W}$ = sediment contributed by the area downstream of Peoria Lake from the western region in tons per year
$S_{D\text{-}S}$ = sediment contributed by the area downstream of Peoria Lake from the southern region in tons per year
C_W = cost of reducing sediment delivery by one ton per year for the western region
C_E = cost of reducing sediment delivery by one ton per year for the eastern region
C_S = cost of reducing sediment delivery by one ton per year for the southern region
M = million

4. Plans Recommended for System Analysis

a. Restoration Alternatives. The alternatives were compared for cost-effectiveness to achieve sediment reduction benefits at Peoria Lake and Valley City (table 3-4). Two cost-effectiveness analyses were performed, one assuming that the maximum delivery reduction anywhere in the basin would be 20 percent (table 3-5), and the other assuming that it would be possible to effect a 40 percent reduction from the smaller watersheds of the direct tributaries to Peoria Lake (table 3-6). In the first comparison, 1A through 1C and 1E and 1F were found to be not cost effective because the same sediment reduction benefits at both Peoria Lake and the Illinois River can be achieved at lower costs by one of the alternatives 1H through 1L (table 3-5). This emphasizes that under the assumed conditions the most cost-effective way to develop benefits is by maximizing the focus on the direct tributaries to Peoria Lake. If larger reductions were possible on these particular tributaries, the cost-effectiveness would increase further; table 3-6 demonstrates that, by concentrating on those tributaries to maximize their potential reduction, Alternatives 1P through 1S are better buys than Alternatives 1I through 1M and 1O.

Alternatives 1U and 1V increase the efficiency of reducing the load to Peoria Lake, so they are also better buys than Alternatives 1G and 1D, which would concentrate half as much effort on the direct tributaries to Peoria Lake.

Table 3-5. Cost-effective Alternatives
Assumes 20% maximum reduction possible for Peoria Lake direct tributaries

	Reduced Delivery (%)		
Alternative	**to Valley City**	**to Peoria Lake**	**Initial Cost ($ Million)**
1-0	0.00	0.00	0
1N	2.30	6.30	96
1O	5.00	6.30	228
1H	5.00	10.00	276
1I	7.50	10.00	400
1L	7.50	15.00	473
1J	10.00	10.00	521
1K	10.00	12.50	555
1M	10.00	15.00	590
1G	10.00	20.00	662
1D	20.00	20.00	1138

Table 3-6. Cost-effective Alternatives
Assumes 40% maximum reduction possible for Peoria Lake direct tributaries

	Reduced Delivery (%)		
Alternative	**to Valley City**	**to Peoria Lake**	**Initial Cost ($ Million)**
1-0	0.00	0.00	0
1N	2.30	6.30	96
1T	4.27	12.50	196
1P	5.00	12.50	211
1R	7.50	15.00	362
1Q	10.00	12.50	452
1S	10.00	15.00	487
1U	10.00	20.00	559
1V	20.00	20.00	1038
1W	22.00	26.00	1238

Three key assumptions should be kept in mind when evaluating this alternatives analysis. The first is that the benefits are only accounted at two locations, Peoria Lake and Valley City. Work within each tributary will have specific local benefits that are not considered in this analysis. In some areas, these local benefits will be significantly higher than those accrued from work in other areas, but it is expected that the high-value areas are probably spread throughout the Illinois River Basin and would not change the ranking of the alternatives. Also, because the most upstream point analyzed is Peoria Lake, potential benefits (or lack thereof) to river reaches upstream are not considered in the analysis. The second assumption is that the incremental cost of sediment reduction does not change. Since it is likely that there are some relatively straightforward projects that would reduce sediment delivery, the incremental cost probably increases as the percent reduction increases. By not accounting for this, some bias is introduced into the analysis that somewhat overestimates the cost-effectiveness of concentrating projects in one area, specifically the direct tributaries to Peoria Lake. Finally, this analysis does not differentiate between the effects of silt and sand. For this analysis, the benefit is related only to the quantity of sediment reduced and not to the particle size.

b. Selected Alternatives. By consensus of the project study team, it was decided that it should be possible to reduce sediment entering the river from the direct tributaries to Peoria Lake by 40 percent. From the list of cost-effective alternatives (table 3-6), four were chosen as pieces of the seven system plans. Alternative 1N was chosen as the minimum level of effort necessary to show regional benefits for this goal, Alternative 1P was the minimum necessary to maintain current system function, and Alternative 1U was the minimum required to begin to show system-wide improvements. These were included in the system plans as shown in table 3-7. Alternative 1V is the minimum level of effort necessary to fully meet the objectives of this goal and was chosen as part of Plans 6 and 7.

i. Implementation. Although quantifying the sediment control benefits of a particular project will assess how well it addresses the numerical objectives of this goal, prioritization and implementation will help determine how these projects fit into the overall goal of improved ecosystem function. As an ecosystem restoration project, it is envisioned that the measures implemented to meet this goal will be those that best improve overall function, are cost effective, and will not have significant adverse impacts themselves. The following characteristics should be considered when prioritizing which measures to implement:

- Measures that address sources that directly affect vulnerable resources (for example, unstable streams filling backwater lakes) should be given highest priority.
- Significant consideration should be given to reduction measures that provide additional benefits, specifically improvement of stream habitat.
- Delivery is often inversely related to distance from the Illinois River, so proximity to the river should be taken into account.
- Delivery of fines (silts and clays) is problematic system-wide. Projects affecting silts and clays can be generally assumed to have benefits for downstream portions of the Illinois River.
- Delivery of bed material load (sand) can also be a major issue at local or regional levels, specifically the mouths of tributaries (i.e., backwater lakes or Peoria Lake), and should be considered on a case-by-case basis.

A primary assumption of this goal is that future sediment loads remain at approximately the same levels without the project and that the actions taken for the project will result in a net reduction in sediment load. This implies that any existing sediment controls would remain functioning and that the loading from any new sources would be offset by reductions due to other measures. Measures undertaken for this project are expected to have minimal maintenance requirements, and their project lives would be sufficient so that they would all be functioning at the end of the program (50 years). However, at that point the earliest projects would begin to exceed their design life and their sediment reduction capability might decline if they were not maintained. Therefore, the sediment reduction goal would be met in the later stages of the program life, but this success would not necessarily be permanent. Additional maintenance efforts would extend the time that delivery reduction could be maintained, and may also increase the degree of reduction possible (for example, emptying sediment traps would allow more capture).

ii. Systemic Benefits - Benefit Quantification. The benefits for Goal 1 were quantified for each alternative in terms of percent reduction of sediment delivery with an overall goal of a 20 percent reduction (2.4 million tons per year). This target was set based on experience on the Delta Headwaters Project in Mississippi and profession judgment of ERDC and Colorado State University staff. In addition to the percent of goal attainment, these benefits have been adapted to stream miles by considering the practices that would be used to reduce sediment delivery and making assumptions, based on engineering expertise, as to the length of stream that would be affected from these practices. Table 3-8 shows the quantity of stream miles with direct benefits (the length of stream immediately adjacent to the construction activity) and the area of influence (the length of stream, including those areas upstream and downstream, anticipated to benefit from the stabilized reach or sedimentation retention structure) for each alternative, and for the assumptions used to develop those quantities.

The direct benefits and the length of stream influenced from the proposed measures for each of the alternatives were calculated based on engineering expertise as described in the following text. Table 3-9 includes the number of measures proposed for each alternative. It is assumed that riffle structures, drop structures, and sills will be used for grade control. Riffle structures will be built, in most instances, such that there will be three riffles in series separated by a distance (X) equal to the height of the riffle (H) divided by the channel slope (S_o) ($X = H/S_o$). It is also assumed that for a series of riffle structures, the length of stream realizing direct benefits associated with the riffles will extend a distance of X upstream from the most upstream riffle and a distance of 3X downstream from the most downstream riffle. For other types of grade control structures, it is assumed that the length of stream realizing direct benefits will extend a distance of X upstream and 5X downstream from the structure. It is assumed that Direct Structural Measures (i.e. Riprap) and Indirect Structural Measures (i.e. Bendway Weirs, Barbs, Groins, and Spurs) will be used for Bank Stabilization. The length along the stream where riprap is placed is considered to be the stream length with direct benefits. Riprap may be used alone or in conjunction with bioengineering. The length along the stream where bioengineering is placed is considered to be the stream length with direct benefits. Indirect Structural Measures will be applied at frequency of 1 per 100 feet of stream; therefore, it is assumed that the direct benefits for each structure extend 50 feet upstream and 50 feet downstream from the structure. The relationship between Sediment Retention Structure size and stream miles with direct benefits is based on the following assumptions: (1) each acre of sediment retention built will affect 20 acres of watershed and (2) the percentage of total watershed area benefited is equivalent to the percentage of total (perennial and ephemeral) stream miles benefited.

As the streams are stabilized (through the placement of riprap, bendway weirs, etc.), upstream segments of stream will experience reduced downcutting and widening due to erosive forces. Over the 50-year life of this project, it is anticipated that for Alternatives 6 and 7 sediment reduction measures will be installed in half of the sub-basins of the Illinois River Basin; therefore, up to half of the stream miles in the basin (5,500 perennial stream miles and 11,250 ephemeral stream miles, 16,750 total stream miles) will be beneficially influenced through the project measures. The quantity of stream miles influenced for Alternatives 1 through 5 were determined by prorating the previous total (16,750 stream miles) by the ratio of the stream miles with direct benefits for each alternative to the stream miles with direct benefits for Alternatives 6 and 7. The quantities of stream miles influenced are estimates of the maximum benefits that could be realized over the 50-year life of the project.

iii. Ancillary Benefits. Additional sediment delivery benefits are likely to accrue from projects undertaken for other goals. These include:

- Reductions due to reduced transport and sediment trapping in stream and riparian restoration projects **(Goal 3)**
- Reductions from reduced stream power under naturalized hydrologic regimes **(Goal 5)**
- Sediment trapping in water quality facilities **(Goal 6)** and flood storage areas **(Goal 5)**

However, there could also be negative impacts from actions that may release sediment, such as some dam removal projects (Goal 4). It is assumed that the sediment delivery benefits or detriments due to those goals will be addressed within the project design.

In addition, the projects enacted under this goal are likely to have ancillary benefits for other goals. Habitat benefits to support Goal 3 will be provided by riffle-pools, stone structures and vegetated banks, although there is a broad range of potential benefits due to the unknown configuration of the eventual watershed projects.

Additional benefits will accrue to Goal 6 as reduced sediment delivery will reduce the transport of nutrients associated with the sediment, most notably phosphorus, into the aquatic systems. Hubbard et al. (2003) cited chemical analyses indicating that soils in the Mississippi contained approximately 200 parts per million phosphorus; assuming that soils in Illinois are comparable, each ton of sediment reduction would amount to a reduction of approximately 0.4 pounds of phosphorus delivery to the river. Other unquantified ecosystem benefits of reduced sediment delivery include:

- Improved aquatic habitat quality in tributaries and backwater areas due to reduced turbidity and sedimentation effects **(Overarching Goal and Goals 2 and 3)**
- Increased backwater longevity **(Goal 2)**
- Connectivity benefits in certain riffle-pools **(Goal 4)**
- Lower flood stages due to stabilized sediment regime **(Goal 5)**

Non-ecosystem benefits that can also be attributed to reduced sediment delivery are reduced dredging costs and beneficial use of the sediment removed from traps and/or mined deltas. These benefits were not quantified for this study.

Finally, there will be the potential to incorporate additional features into the sediment projects to support other goals. For example, the design of upland measures can be modified to attenuate peak flows or increase baseflows (Goal 5). There is also the potential to incorporate water quality features into upland facilities and bank stability measures (Goal 6). These types of added benefits would generally require additional costs as they require features that would not otherwise be included in the sediment reduction projects.

Table 3-7. Characteristics of Alternatives Selected as Part of System Plans

		Reduced Delivery (%)		Delivery Reduced (100,000 tons/year)				Initial Cost ($ Million)		
System Plan	**Alternative**	**to Valley City**	**to Peoria Lake**	**Tributaries Upstream of Peru**	**Peoria Lake Direct Tributaries**	**Tributaries Downstream of Peoria Lake**	**Total**	**Construction**	**Real Estate**	**Total**
1	1N	2.30	6.30	0.0	2.8	0.0	2.8	87	9	96
2	1P	5.00	12.50	0.0	5.7	0.4	6.0	191	20	211
3,4,5	1U	10.00	20.00	3.4	5.7	3.0	12.1	514	45	559
6,7	1V	20.00	20.00	3.4	5.7	15.1	24.2	950	88	1038

Table 3-8. Benefit Quantification for Goal 1

System Plan	Alternative	Effectiveness (% of desired future conditions)	Stream Length with Direct Benefits Resulting from the Proposed Measures (miles)	Stream Length Influenced by the Proposed Measures (miles)
1	1N	12	106	1,700
2	1P	25	201	3,220
3,4,5	1U	50	598	9,570
6,7	1V	100	1,047	16,750

Table 3-9. Quantity of Features To Be Installed for the Cost-Effective Alternatives

		Feature Quantities			
System Plan	**Alternative**	**Riffle (ea)**	**Bioengineering (mi)**	**Stone Toe (mi)**	**Stream Barbs (ea)**
	1-0	0	0	0	0
1	1N	13-110	7.3-26	4.6-15	200-870
2	1P	28-240	16-57	10-32	450-1900
3,4,5	1U	47-480	60-230	36-120	1800-7600
6,7	1V	91-880	98-370	60-200	2900-12000

c. Risk and Uncertainty. The measures selected for this goal, when correctly designed and applied, are known to effectively reduce the downstream delivery of sediment. The actual sediment delivery reduction for each individual project will vary widely based on site conditions, but it is likely that the assumed benefits for the proposed levels of project implementation are somewhat underestimated. Benefits were based on "average" conditions, while it is expected that most projects will be applied to sites with higher than average sediment delivery and thus greater potential reductions. Thus, it is fairly certain that project implementation as proposed here will in fact reduce sediment delivery to the Illinois River to the expected degree (tons per year). By using the complete time period of 1981-2000 as the baseline, including the extreme year of 1993, there is confidence that the sediment reduction goals, 1.2 million tons per year after 20 years and 2.4 million tons per year after 50 years, represent a conservative estimate of the requirements necessary to enact 10 percent and 20 percent reductions, respectively, from existing conditions.

One item of significant uncertainty is the net effect of outside influences on the sediment regime of the Illinois River in the future. Factors that will affect future sediment conditions are climate, land use, and land cover conditions. Changes in any of these factors could mask the change, or lack of change, brought about by project implementation. The uncertainty regarding this item can be addressed by incorporating monitoring results into evaluations of program effectiveness; by separating project effects from those of outside influences it will be possible to correctly assess project benefits and adapt to changing conditions. The monitoring will have to be sufficient to determine whether background sediment loads have remained at the same level (as assumed for this document), increased, or decreased over the life of the project. It must also inform regarding the influence of any extreme events encountered and allow determination of the ongoing success of the project independent of those extreme events.

Finally, an additional item of uncertainty is the ecological response from the proposed level of sediment delivery reduction. The team is confident that the proposed objectives will provide significant and measurable benefits and that the physical changes will have significant ecological benefits. However, without an adequate framework to relate sediment transport to ecosystem integrity, it cannot be confidently assumed that any particular reduction will be sufficient to maintain a specific level of integrity. Further work is necessary to move beyond the qualitative understanding of system function so that quantitative predictions of ecosystem response are possible, and that the initial target reductions may be revised if necessary.

d. Information and Further Study Needs

- Must define and quantify "excessive" on a system-wide basis (excessive sediment for a given stream may be definable by site-specific project studies).
- Research to determine the quantity of "excessive" sediment loads and sources of sediment in the main stem Illinois and its major tributaries.
- Stream surveys, sediment monitoring, and evaluation of installed practices.
- Basin-wide hydrologic and sediment models.
- Ecosystem response model for sediment.
- Quantitative understanding of the geomorphological evolution of streams in the Illinois River Basin and their response to altered sediment supply and hydrology.

G. GOAL 2: BACKWATERS AND SIDE CHANNELS. Restore aquatic habitat diversity of side channels and backwaters, including Peoria Lakes, to provide adequate volume and depth for sustaining native fish and wildlife communities

Problem. A dramatic loss in productive backwaters, side channels, and islands due to excessive sedimentation is limiting ecological health and altering the character of this unique floodplain river system. In particular, the Illinois River has lost much of its critical spawning, nursery, and overwintering areas for fish, habitat for diving ducks and aquatic species, and backwater aquatic plant communities. A related problem is the need for timely action. If restoration is not undertaken soon, additional productive backwater and side channel aquatic areas will be converted to lower value and increasingly common mudflat and extremely shallow water habitats.

Objectives

- Restore and rehabilitate 19,000 acres of habitat in currently connected areas (1989 data shows approximately 55,000 acres of backwaters during summer low water). Restoration should result in a diversity of depths. For restored backwaters, a general target would be to have the following distributions of depths: 5% > 9 feet; 10% 6 to 9 feet; 25% 3 to 6 feet; and 60% < 3 feet.
- Restore and maintain side channel and island habitats.
- Maintain all existing connections between backwaters and the main channel. (connections at the 50% exceedance flow duration).
- Identify beneficial uses of sediments.
- Compact sediments to improve substrate conditions for aquatic plants, fish, and wildlife.

Anticipated Outputs

Anticipated project outputs include immediately addressing the system limiting lack of overwintering aquatic habitat (UMR-EMP Habitat Needs Assessment, 2000). These effects will benefit the system's fish (paddlefish, bass, bluegill, catfish, and mooneye), diving ducks (canvasback and greater and lesser scaup), invertebrates (mayflies and fingernail clams), aquatic plants, mussels, and other native species. At a completed side channel and backwater restoration project, a comparison of pre- and post-project construction monitoring data showed a dramatic increase in the number and diversity of fish and waterfowl species as well as an increased total number of individuals. This success is anticipated for similar projects. System quality would increase as the number of restored backwaters reaches the desired spacing of a high quality backwater approximately every 5 miles.

1. Inventory Resource Conditions

a. Historic Conditions. Historically, the complexes of backwaters and side channels along the main stem Illinois River have provided incredibly rich habitat for fish and wildlife. Numerous small lakes and ponds rather than large lakes, dominated the floodplain (Bellrose et al. 1983). Early accounts record abundant beds of aquatic plants, attesting to the water clarity and suitable substrates. The fishery was exceptional, with a 200-mile reach of the Illinois River producing 10 percent of the total U.S. catch of freshwater fish in 1908, more than any other river in North America (Sparks 1992).

Glacial history directly shaped the geomorphic conditions of the Illinois River. This history can be used to illustrate the differences between two sections of the Illinois River, the upper and lower river, which are roughly separated at Hennepin, Illinois.

The upper river has an average width of 400 feet and a relatively steep slope of approximately 1 foot per mile. This reach does not contain significant backwater areas. In contrast, the lower river that occupies the former channel of the ancient Mississippi River has a width approaching 1,400 feet near Grafton, Illinois, a much wider natural floodplain, and a very flat slope of 0.1 foot per mile. Since glacial retreat, sediments eroded from steep tributaries have built large alluvial fans and deltas into the lower Illinois River valley, causing the formation of natural constrictions, lakes, and backwaters. The lower Illinois River is characteristically low gradient, aggradational, and has large backwater areas. The sedimentation occurring within this reach has increased significantly since settlement and threatens to convert the backwater areas into mudflats and extremely shallow water areas with decreased habitat value due to hydrologic regimes and turbidity, which essentially exclude vegetation from these areas.

i. Backwaters. Sedimentation of the Illinois River and its backwater areas has been the subject of numerous studies (Lee and Stall 1976; Bellrose et al. 1983, Demissie and Bhowmik 1986, Demissie et al 1992, WEST Consultants, Inc. 2000, Demissie et al. 2004, USACE 2003a, and USACE 2003b). Lee and Stall (1976) concluded that the backwater lake volume was being lost at an annual rate ranging from 0.6 to 1.1 percent over the period of 1903 to 1975.

Recently, the amount of backwater areas has fluctuated significantly. Following significant increases in the backwater surface acreage associated with diversion and dam construction, relatively steady declines have followed. The earliest recorded data comes from a survey conducted by J. W. Woermann between 1902 and 1904 for the U.S. Army Corps of Engineers. However, even by this time the survey reflects an altered system. The construction of dams and flow diversion from Lake Michigan had already raised water levels and increased the area covered by water relative to prior conditions.

Bellrose et al. (1983) estimated total surface acreage of backwaters at approximately 55,000 acres in 1903. Backwater area calculations were based on the 1903 tree line; this corresponds to lower elevations than current conditions. Ultimately, levee construction resulted in the loss or isolation of 31 lakes and approximately 22,000 acres of the original 55,000 acres of backwater area (Bellrose et al. 1983). As water levels on the system were raised through increased diversions of water from Lake Michigan and construction of dams, the total surface area also increased. At the peak of diversion, and prior to levee construction, the total acreage of backwaters is estimated to have exceeded 110,000 acres (Bellrose et al. 1983). By 1969, however, there was a relatively dramatic reduction to approximately 68,000 acres due to the combined effects of levee building, reduction in diversion, and sedimentation. The 1969 calculations were again based on the existing tree line, which were higher than the 1903 elevations due to improvements. Table 3-10 summarizes findings from the analysis. Bellrose et al. (1983) assessed potential future effects associated with sedimentation by estimating that the number of years required for selected lakes to lose half their average depth ranged from 24 to 127 years.

Table 3-10. Estimated Historic Surface Acreage of Connected Backwater Areas

Backwaters	River Mile	Estimated # of Backwaters	1903 Surface Acreage	Actual # of Backwaters	1969 Surface Acreage
Lower 3 Pools					
Peoria Pool		34	17,419	32	32,831
La Grange Pool	73	67	27,877	52	26,981
Alton Pool	77	35	10,366	21	7,881
Total Lower 3 Pools	**80**	**136**	**55,661**	**105**	**67,693**
Total Upper Pools (Dresden, Marseilles, Starved Rock)				**11**	**2,956**

Source: The Fate of Lakes in the Illinois River Valley, Bellrose et al. (1983)

Demissie and Bhowmik (1986) conducted an investigation of the sedimentation characteristics of Peoria Lake, the largest and deepest lake on the Illinois River. Their comparison of limited historic cross sections of the lake demonstrated sediment accumulation of up to 14 feet in various locations of the lake while the navigation channel was relatively stable over the period of record. As of 1985, the lake was estimated to have lost about 68 percent of its 1903 volume. The study concluded that, if sediment input continued at current rates, within 10 to 15 years, the river and lake would reach dynamic equilibrium and net accumulation of sediment in the lake would be zero. They predicted that most of the area outside the channel would become either a mudflat or a marshy wetland area, depending on the ability of vegetation to grow in the lake sediment.

A more recent study of the Peoria Lakes by the USACE (2003b) using data from 1903, 1930s, 1965, 1976, 1988, 1996 and 1999, shows that the off-channel areas (lake area outside of the navigation channel) experienced a volume loss of 60 percent from 1930 to 1999. These reductions correspond to average annual volume losses of approximately 0.87 percent. Over this same time period, the lake surface area decreased by approximately 10 percent, a 0.15 percent annual loss. This relatively slow rate of change in surface area for this large riverine lake likely does not reflect the rate of change occurring in the more isolated backwater lake areas, which probably lose surface area at a much higher rate.

Sedimentation and the related reductions in lake volume have dramatically altered habitat values. As the lake cross sections (Figures 3-5a and 3-5b) and plan view (Figure 3-6) show, lake depth diversity has been greatly simplified. While water levels currently are somewhat higher, the overall effect has been the loss of depth and dramatic reduction in habitat diversity. The lake historically had a mix of shallow and deepwater off-channel areas serving as aquatic habitat. Even the relatively shallow areas are reported to have had firm substrates and been home to large aquatic plant beds.

Demissie (1992) calculated the average capacity loss for selected backwater lakes from 1903 to 1975 (table 3-11). Their study showed an average capacity loss of 72 percent. Higher flow velocities and tow traffic in the channel keep finer sediments suspended in the vicinity of the navigation channel, but low velocities allow sediment to drop out in calmer areas.

This is consistent with results of the Cumulative Effects Study (WEST Consultants, Inc. 2000), which compared 1930s data with 1980s data and found that the main channel of the Illinois River has not changed significantly since the 1930s, even in the downstream reaches of the Illinois River. However, they noted changes in the backwater areas and anticipated further filling.

Table 3-11. Estimated Sedimentation in Selected Backwater Lakes in the Illinois River Valley

Pool	Lake Name	River Mile	Capacity (acre-feet) 1903	1975	1990 [1]	Rate inches/yr	Loss Percent
Alton							
	Swan Lake	5	4,816	2,783	2,359	0.18	51
	Lake Meredosia	72	7,791	4,207	3,460	0.43	56
La Grange							
	Muscooten Bay	89	1,459	184	0	3.12	100
	Patterson Bay	107	271	165	143	0.31	47
	Lake Chautauqua	125	14,293	11,679	11,134	0.33	22
	Rice Lake	133	3,064	1,119	714	0.32	77
	Pekin Lake	153	323	226	206	0.08	36
Peoria							
	Peoria Lake	162	120,000	56,600	29,150	0.79	76
	Babb's Slough	185	1,377	625	468	0.14	66
	Weis Lake	191	450	110	39	0.15	91
	Sawmill Lake	197	2,110	381	21	0.47	99
	Lake Senachwine	199	9,240	2,468	1,057	0.30	86
	Lake DePue	203	2,837	778	349	0.59	88
	Huse Slough	221	253	51	9	0.96	96
Marseilles							
	Ballard's Slough	248	142	36	14	0.91	90

[1]1990 capacity estimated based on sedimentation rate for the period from 1903-1975(Demissie 1992).

A sediment analysis conducted for Pekin Lake, in La Grange Pool, was conducted as part of work on the Pekin Lake Critical Restoration project. This backwater has experienced significant sedimentation during the last century. The earliest detailed survey of Pekin Lake was completed about 1903 by J. W. Woermann. The maps created from that survey depict the lake when the Illinois River was at low water conditions (approximately 432.5 feet NGVD, 1929). Under these conditions, some areas of the lake exhibited water depths in excess of 6 feet. Today, when the river falls to normal summer low-flow levels, what little open water exists is only 0 to 2 feet deep. Rates of sedimentation over the last 100 years were computed for the Pekin Lake area. The average annual sedimentation rate based on the amount of sediment that has deposited between 1903 and the present is 0.23 inches per year in the upper lakes and 0.3 inches per year in the lower lakes and 0.26 inches per year for the entire lake complex.

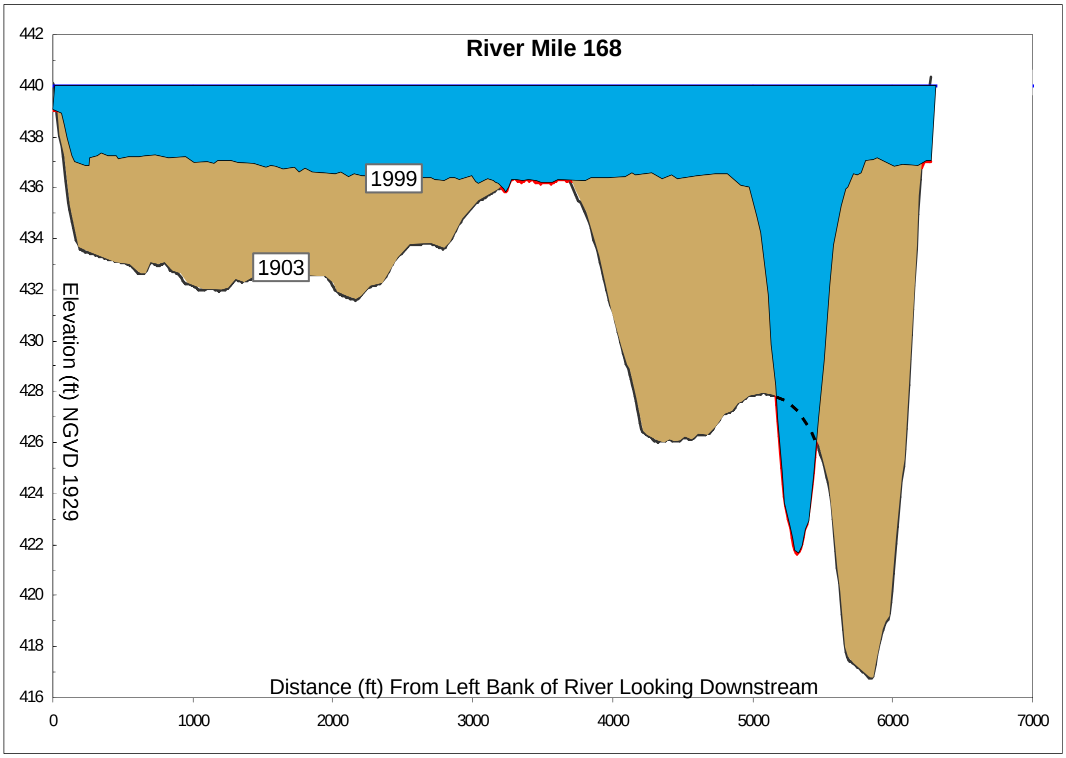


Figure 3-5a. Typical Cross Sections from Peoria Lakes Showing Dramatic Sedimentation Between 1903 and 1999, RM 168

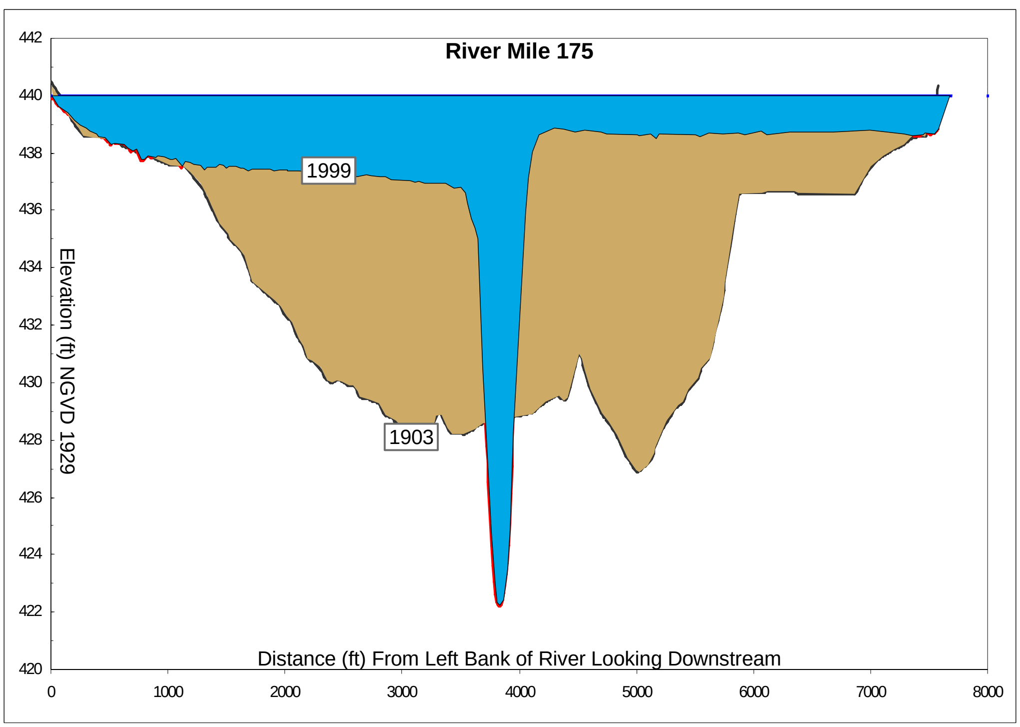


Figure 3-5b. Typical Cross Sections from Peoria Lakes Showing Dramatic Sedimentation Between 1903 and 1999, RM 175

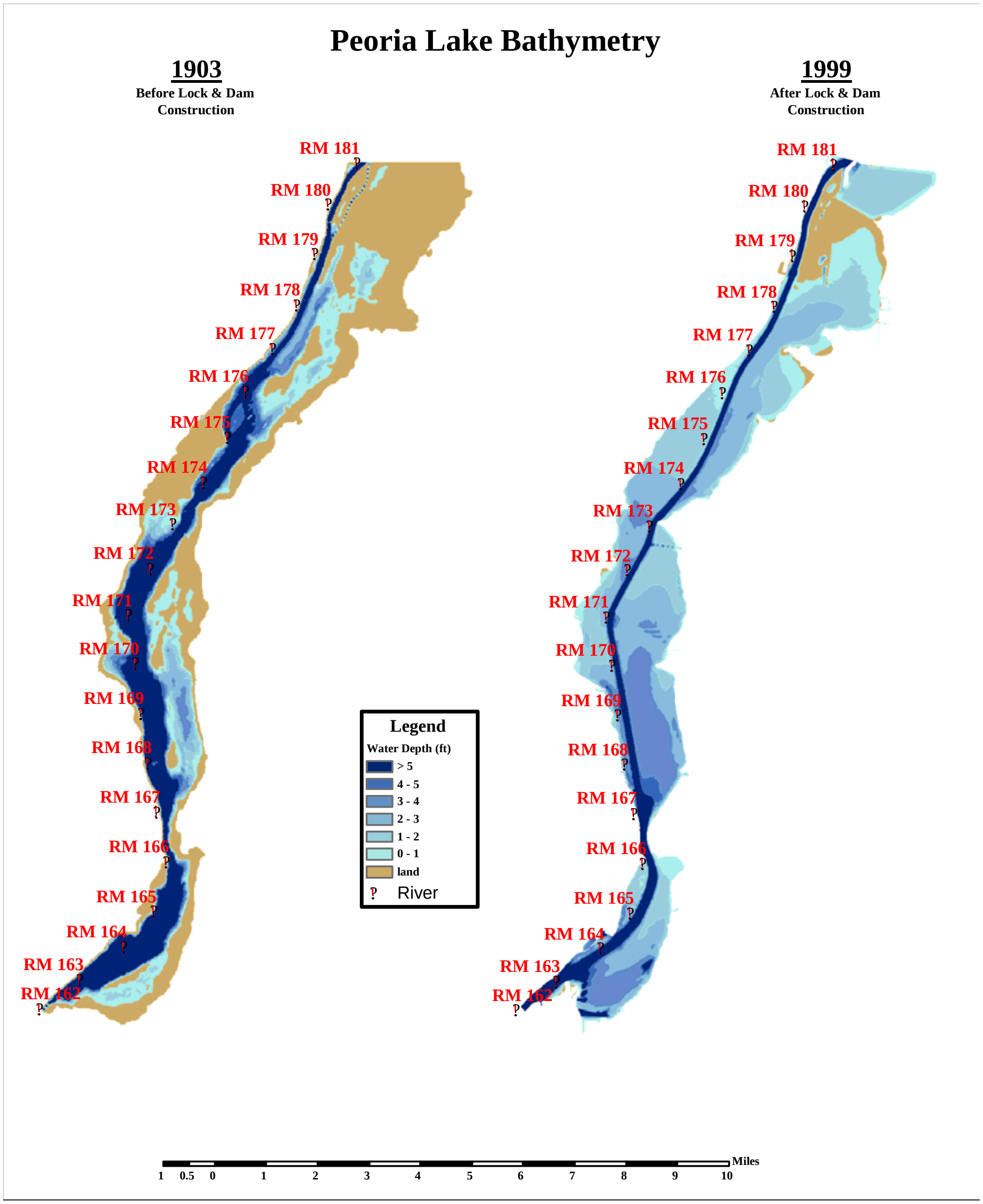


Figure 3-6. Peoria Lake 1-Foot Water Depth Contours
Note loss of numerous islands and side channels between 1903 and 1999. Also, water depths >5 feet currently are only found in the very narrow navigation channel. This loss of bathymetric diversity greatly limits the value of existing habitat within Peoria Lake.

The Corps of Engineers (2003a) conducted an analysis of the rate of loss of backwater capacity and surface area for three backwaters (Babb's Slough-Sawyer Slough, Meadow Lake, and Wightman Lake) in the Peoria Pool (tables 3-12 to 3-14). This analysis was based on the comparison of 2001 bathymetry data to data from 1903. Sedimentation rates between 1903 and 2001 for these backwaters ranged from 0.18 inches/year to 0.37 inches/year and the percentage reduction in storage capacity varied from 77.2 percent (0.78 percent/year) to 97.0 percent (0.99 percent/year). In general, deeper areas have filled more quickly than shallow areas resulting in a higher and more uniform bottom surface in 2001 as compared to 1903. The annual rates of capacity loss and sedimentation calculated between 1903 and 2001 compare closely to rates calculated in other publications for the timeframe between 1903 to the mid 1970s, indicating that sedimentation rates and rates of annual percent capacity loss have remained nearly constant in the timeframe since 1975. These recent rates are higher than expected given that the bottom surface has been progressively rising, which would be expected to result in decreased rates of sedimentation. Water elevation duration curves for the 1903 through 1975 timeframe and the 1975 through 2001 timeframe show that more recent water flow rates and corresponding water surface elevations have been higher, promoting continued high rates of sedimentation.

Table 3-12. Change in Storage Capacity of Backwater Lakes [1]

	1903	2001	1903 to 2001	1903 to 2001
Backwater Lake	**Capacity (acre-feet)**	**Capacity (acre-feet)**	**Capacity Loss (%)**	**Capacity Loss (%/Yr)**
Combined Babb's and Sawyer Sloughs	4687	544	88.4	0.90
Meadow Lake	2080	37	97.0	1.00
Wightman Lake	2134	285	87.0	0.89

[1] Capacity based on elevation 440 msl

As would be expected, the changes in depth roughly mirror the loss in capacity (table 3-13). Depths have decreased dramatically, to the point where all four lakes average only a few inches.

Table 3-13. Change in Depth of Selected Backwater Lakes

	1903 [1]	2001	1903 to 2001
Backwater Lake	**Average Depth (feet)**	**Average Depth (feet)**	**Depth Loss (inches/Yr)**
Combined Babb's and Sawyer Sloughs	2.05	0.6	0.18
Meadow Lake	3.2	0.16	0.37
Wightman Lake	3.8	0.59	0.39

[1] 1903 capacity based on elevation 440 msl

The change in surface area has been somewhat less dramatic over time in all but one backwater. The percentage reduction surface area varied from 12.6% (0.13%/year) to 65.3% (0.67%/year) (table 3-14). It is likely that the rate of loss of surface area will increase in the future since little depth remains.

Table 3-14. Change in Surface Area of Selected Backwater Lakes

Parameter	1903 [1] Surface Area (acres)	2001 Surface Area (acres)	1903 to 2001 Surface Area Loss (%)	1903 to 2001 Surface Area Loss (%/Yr)
Combined Babb's and Sawyer Sloughs	2276	875	61.5	0.63
Meadow Lake	652	226	65.3	0.67
Wightman Lake	557	487	12.6	0.13

[1] 1903 capacity based on elevation 440 msl

ii. Side Channels and Islands. While considerably less documentation has been assembled on the side channel and island habitats of the Illinois River, a review of the Woermann Maps (1903) revealed the following estimates of 94 islands with a total length of approximately 75 miles (table 3-15). Since islands separate the main channel from side channels, the island length provides a rough estimation of the amount of side channel habitat.

Table 3-15. Estimated Historic Islands and Side Channels By Pool (Woerman 1903)

Pool	Number of Islands	Length in Miles
Dresden	4	1.5
Marseilles	12	4.5
Starved Rock	8	6.0
Peoria	23	14.5
La Grange	24	25.0
Alton	23	23.0
Total	**94**	**74.5**

b. Existing Conditions. The existing resource conditions related to backwaters and side channels were estimated using available data and are summarized below.

i. Backwaters. Due to the absence of recent survey data of backwater acreage and volume, existing backwaters conditions were estimated using the USGS 1989 Aerial Photo Interpretation. This dataset is the most recent fully analyzed and readily available information, but several features should be kept in mind when comparing these results to historic data.

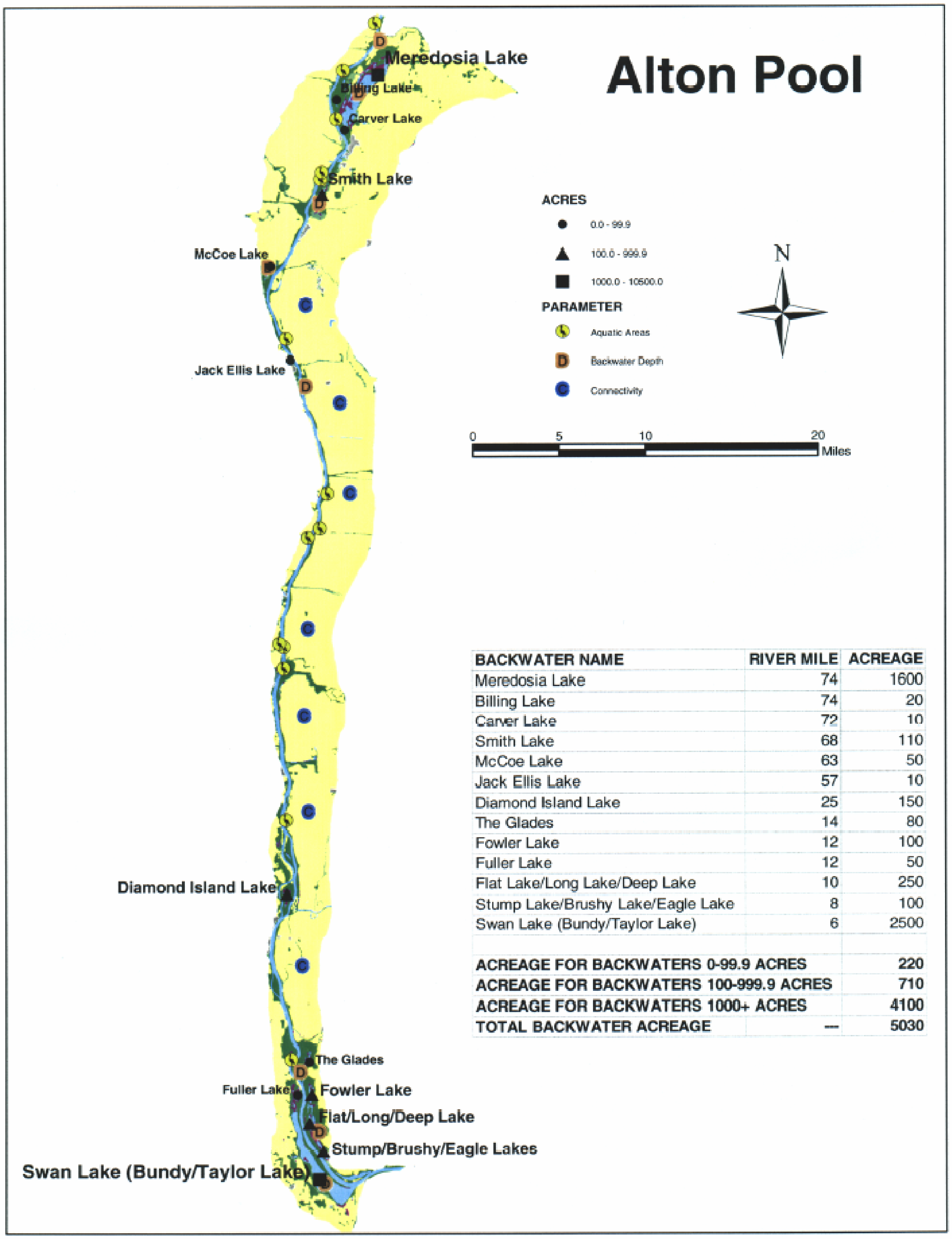
The analysis showed that in the three lower pools of the Illinois River there were approximately 54,000 acres of backwaters during summer low water periods. Table 3-16 and Figures 3-7, 3-8, and 3-9 show the numbers of backwaters and total acreage by pool.

Table 3-16. Estimated Existing Surface Acreage of Connected Backwater Areas (USGS 1989 Aerial Photo Interpretation)

Reach	Number of Back waters	Surface Acres
Peoria Pool	32	30,325
La Grange Pool	46	18,537
Alton Pool	18	5,030
Total	**96**	**53,892**

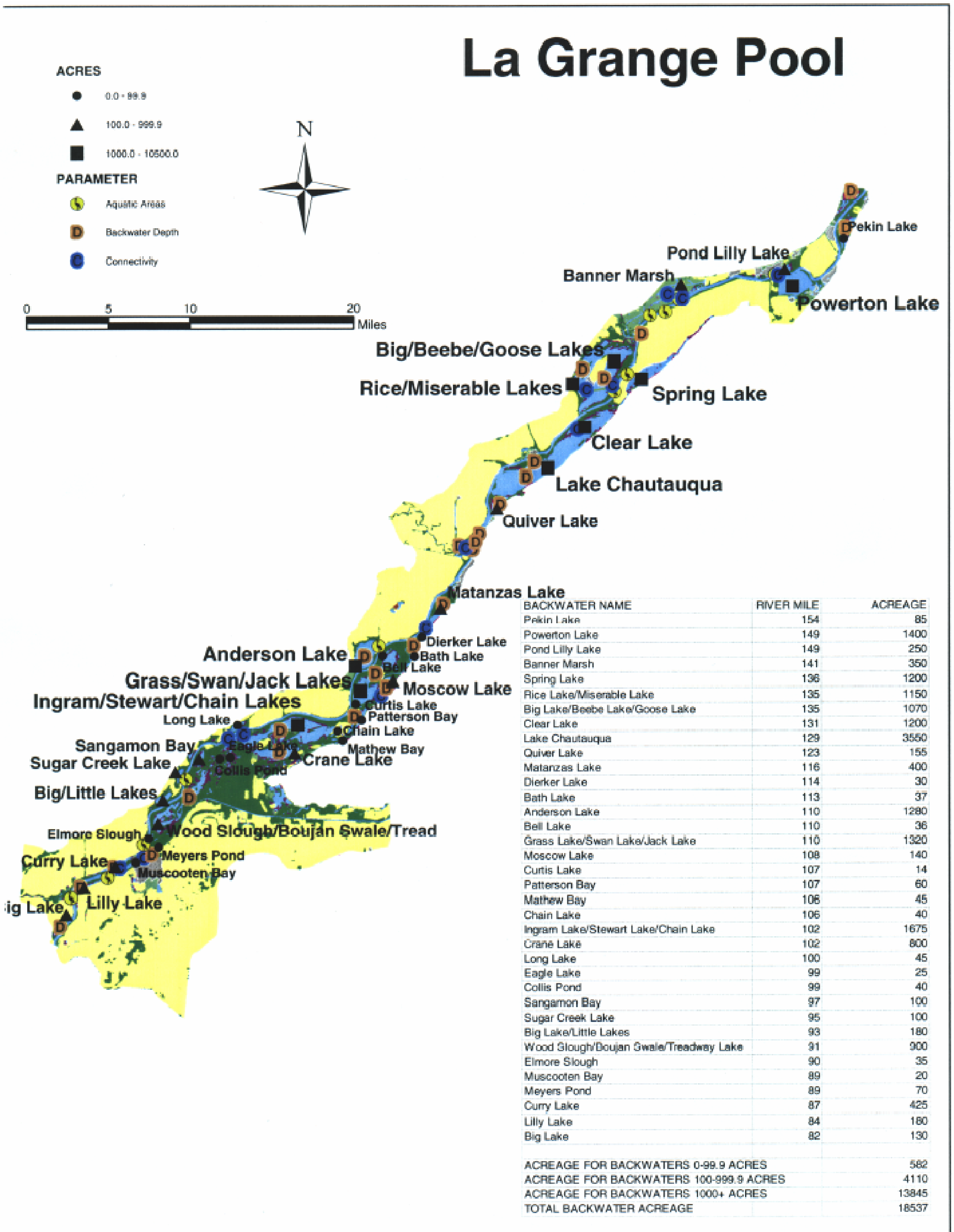
The current quality of the existing backwaters is low due to the relatively shallow depths (less than 1 foot) and relatively uniform bottom surface lacking depth diversity. The near absence of aquatic plants due to current water level regime, turbidity, and unconsolidated sediments further limits habitat values. Sediment accumulation has eliminated most deep water outside the navigation channel. This limits fish overwintering habitat to the channel, which is subject to year-round navigation and higher flow velocities.

Figure 3-10 shows the Upper Illinois River Basin backwaters and total acreage. Although this information is not directly comparable to historic measurements, it provides a baseline of relatively current conditions. While existing volumes for the system have not been surveyed in recent years, the four backwaters surveyed in 2001 and evaluated for filling rates since 1903 showed dramatic losses over time and losses continuing even in recent periods. These are believed to be fairly representative of other backwater areas.



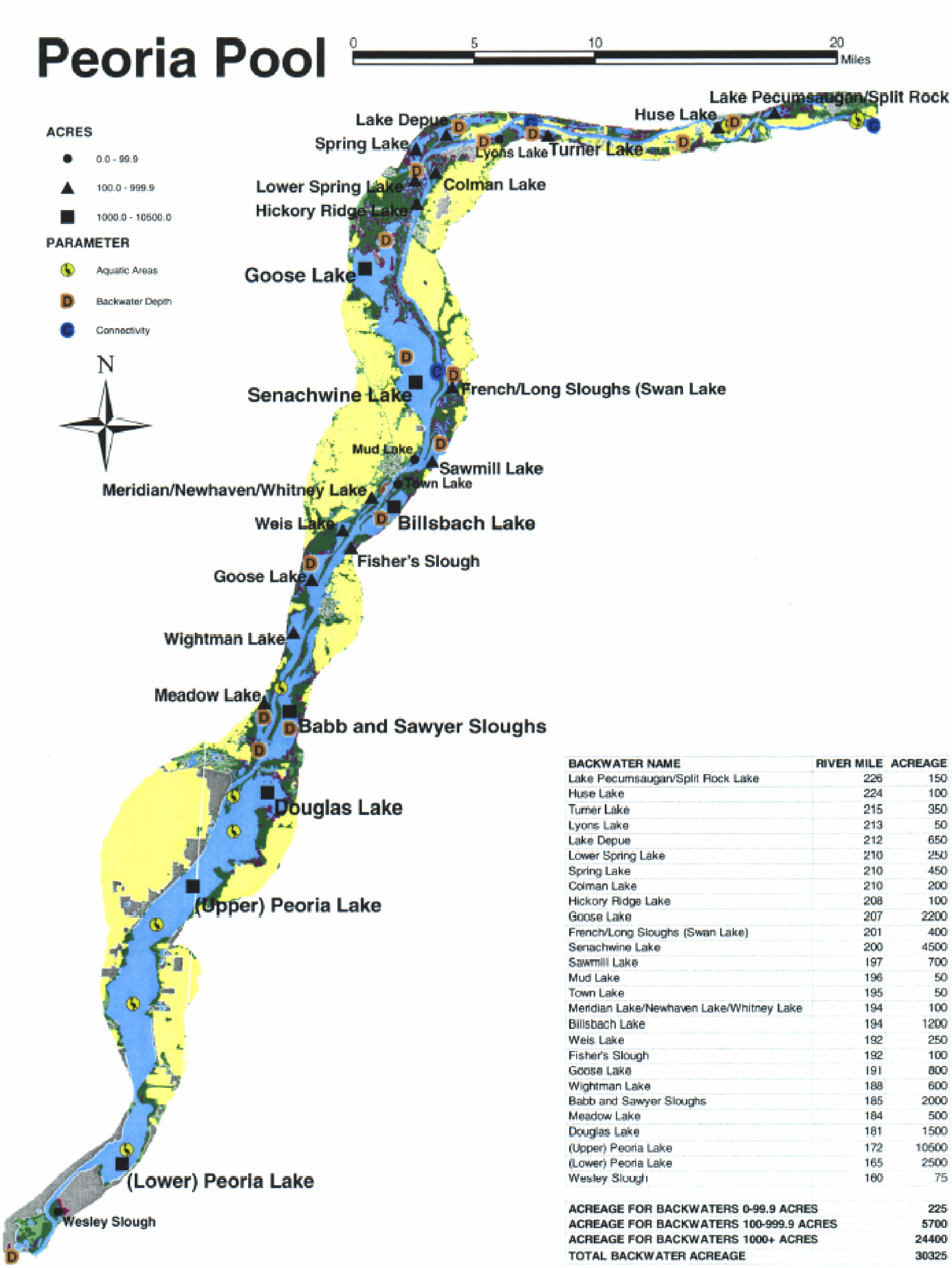
BACKWATER NAME	RIVER MILE	ACREAGE
Meredosia Lake	74	1600
Billing Lake	74	20
Carver Lake	72	10
Smith Lake	68	110
McCoe Lake	63	50
Jack Ellis Lake	57	10
Diamond Island Lake	25	150
The Glades	14	80
Fowler Lake	12	100
Fuller Lake	12	50
Flat Lake/Long Lake/Deep Lake	10	250
Stump Lake/Brushy Lake/Eagle Lake	8	100
Swan Lake (Bundy/Taylor Lake)	6	2500
ACREAGE FOR BACKWATERS 0-99.9 ACRES		**220**
ACREAGE FOR BACKWATERS 100-999.9 ACRES		**710**
ACREAGE FOR BACKWATERS 1000+ ACRES		**4100**
TOTAL BACKWATER ACREAGE	**---**	**5030**

Figure 3-7. Alton Pool Backwaters and Total Acreage



BACKWATER NAME	RIVER MILE	ACREAGE
Pekin Lake	154	85
Powerton Lake	149	1400
Pond Lilly Lake	149	250
Banner Marsh	141	350
Spring Lake	136	1200
Rice Lake/Miserable Lake	135	1150
Big Lake/Beebe Lake/Goose Lake	135	1070
Clear Lake	131	1200
Lake Chautauqua	129	3550
Quiver Lake	123	155
Matanzas Lake	116	400
Dierker Lake	114	30
Bath Lake	113	37
Anderson Lake	110	1280
Bell Lake	110	36
Grass Lake/Swan Lake/Jack Lake	110	1320
Moscow Lake	108	140
Curtis Lake	107	14
Patterson Bay	107	60
Mathew Bay	106	45
Chain Lake	106	40
Ingram Lake/Stewart Lake/Chain Lake	102	1675
Crane Lake	102	800
Long Lake	100	45
Eagle Lake	99	25
Collis Pond	99	40
Sangamon Bay	97	100
Sugar Creek Lake	95	100
Big Lake/Little Lakes	93	180
Wood Slough/Boujan Swale/Treadway Lake	91	900
Elmore Slough	90	35
Muscooten Bay	89	20
Meyers Pond	89	70
Curry Lake	87	425
Lilly Lake	84	180
Big Lake	82	130
ACREAGE FOR BACKWATERS 0-99.9 ACRES		582
ACREAGE FOR BACKWATERS 100-999.9 ACRES		4110
ACREAGE FOR BACKWATERS 1000+ ACRES		13845
TOTAL BACKWATER ACREAGE		18537

Figure 3-8. La Grange Pool Backwaters and Total Acreage



BACKWATER NAME	RIVER MILE	ACREAGE
Lake Pecumsaugan/Split Rock Lake	226	150
Huse Lake	224	100
Turner Lake	215	350
Lyons Lake	213	50
Lake Depue	212	650
Lower Spring Lake	210	250
Spring Lake	210	450
Colman Lake	210	200
Hickory Ridge Lake	208	100
Goose Lake	207	2200
French/Long Sloughs (Swan Lake)	201	400
Senachwine Lake	200	4500
Sawmill Lake	197	700
Mud Lake	196	50
Town Lake	195	50
Meridian Lake/Newhaven Lake/Whitney Lake	194	100
Billsbach Lake	194	1200
Weis Lake	192	250
Fisher's Slough	192	100
Goose Lake	191	800
Wightman Lake	188	600
Babb and Sawyer Sloughs	185	2000
Meadow Lake	184	500
Douglas Lake	181	1500
(Upper) Peoria Lake	172	10500
(Lower) Peoria Lake	165	2500
Wesley Slough	160	75
ACREAGE FOR BACKWATERS 0-99.9 ACRES		225
ACREAGE FOR BACKWATERS 100-999.9 ACRES		5700
ACREAGE FOR BACKWATERS 1000+ ACRES		24400
TOTAL BACKWATER ACREAGE		30325

Figure 3-9. Peoria Pool Backwaters and Total Acreage

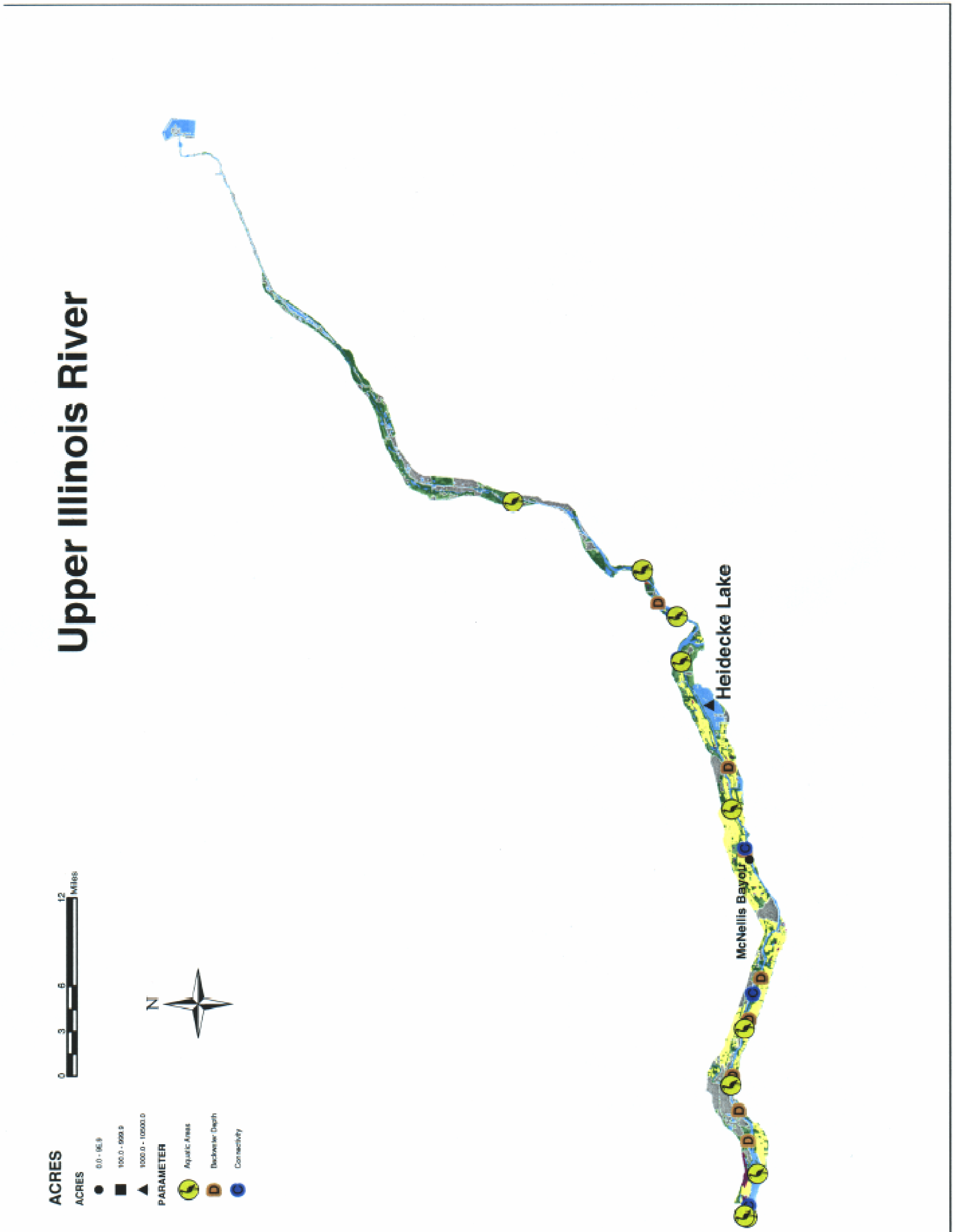


Figure 3-10. Upper Illinois River Backwater Acreage

ii. Side Channels and Islands. ***A***reas sheltered from the main river flows provide beneficial resting habitat for aquatic animals. Islands often provide such protection to their side channels, so protection of side channel habitat is tied to the protection of islands. For this study, the amount of side channel habitat was estimated using the Illinois River Navigation Charts. Based on this information, there are approximately 57 islands on the Illinois River that create approximately 54 miles of side channel (table 3-17). While the size and shape vary considerably, on average Illinois River side channels are approximately 1 mile long with widths of roughly 100 feet. This current total represents a relatively dramatic decline from the 94 islands with a total length of approximately 75 miles in 1903. While increases in water level elevations associated with impoundments and diversion are likely a primary cause, it does point to concerns over continued loss.

Table 3-17. Estimated Existing Side Channels by Pool

Pool	Number of Side Channels	Length in Miles
Dresden	3	1.9
Marseilles	6	4.7
Starved Rock	5	5.0
Peoria	12	7.6
La Grange	13	17.7
Alton	18	17.2
Total	**57**	**54.0**

In 2001, Mike Cochran, Illinois DNR (retired), and T. Miller, USACE - St. Louis District conducted a detailed evaluation of the side channels and islands in Alton Pool, the 80 mile reach upstream of the mouth. They found that many of the side channels on the system still provide relatively good habitat value and some have depths reaching 6 to 15 feet. In particular, they found that 14 of 18 islands in Alton Pool (approximately 80 percent) required bank protection to reduce excessive island erosion and loss of island/side channel length. They also found 3 of 18 side channels (approximately 17 percent) filling with sediment to the point that the channels may close completely. The side channels in jeopardy of closing had been reduced to only a few feet of depth on average.

While not directly evaluated as part of the study, Corps of Engineers channel maintenance staff observe that the loss of side channel depths due to sedimentation is a much greater concern in the La Grange Pool. In general, the quality of side channels is diminished from historic levels due to loss of depth diversity and lack of aquatic structure, such as woody debris.

c. Future Without-Project Conditions. The future without geomorphic conditions were evaluated by WEST Consultants, Inc. (2000) as part of the Upper Mississippi River and Illinois Waterway Cumulative Effects Study. The following paragraphs summarize the findings of their evaluation:

> Overall, the future geomorphic conditions of the Illinois River are well defined. The geologic history of the Illinois River created conditions where sedimentation is and will continue to be the predominant geomorphic process. More sediment supplies from tributary areas are deposited within the river valley than are transported through it. However, the rate at which sediments are supplied to the Illinois River and sedimentation occurs is undoubtedly influenced by human activities, such as land use, water regulation, and dredging.

Most of the investigators of the Illinois River agree that significant sedimentation is occurring under current conditions and most backwater areas will be filled with fine sediment within the foreseeable future. According to Demissie and Bhowmik (1986), equilibrium between the sediment supply and transport out of Peoria Lake, the largest and deepest pool along the Illinois River, will be reached within the next few years. The navigation channel has not changed significantly in plan form over the period of record. Higher flow velocities and maintenance dredging along the channel effectively prevent significant change along its length.

In summary, according to previous studies, by the year 2050 the Illinois River is predicted to lose a significant portion of its off-main channel backwater areas under current conditions of sediment supply. The affected contiguous and isolated backwater areas are expected to convert to mud flats (photograph 3-2). The location and area of the main channel is expected to remain relatively constant with the exception that it will become more defined within the various pools along the Illinois River.

Photograph 3-2. Backwater Conversion to Mudflat During Low Water Conditions

i. Backwaters. In the without-project future, it is expected that there would continue to be further loss of both surface area and volume of backwaters and continued low aquatic habitat quality. This will further limit off-channel habitat for fish and other aquatic species. The following tables look at the potential loss of acreage based on various loss assumptions. The consensus of a number of scientists working for the State of Illinois was that due to the increasingly shallow condition of existing areas, even more rapid losses are expected in the future. This resulted in the estimation of a 1 percent loss rate per year as the most likely future condition. If this rate were to continue throughout the 50-year project life, the acreage of backwaters would drop to just 32,605 acres, or a 40 percent loss.

Table 3-18 shows the anticipated future backwater acreages assuming the 1 percent rate of loss and others.

Table 3-18. Estimated Future Without Surface Acres of Backwaters in 2054 at Low Water Conditions Assuming Various Annual Loss Rates of 1989 Area

		Future Without Estimated 2054 Acres			
Pool	**1989 Surface Acres**	**0.50% loss/yr**	**1% loss/yr**	**1.50% loss/yr**	**2% loss/yr**
Peoria Pool	30,325	23,602	18,347	14,243	11,043
La Grange Pool	18,537	14,428	11,215	8,707	6,751
Alton Pool	5,030	3,915	3,043	2,363	1,832
Total Lower 3 Pools	**53,892**	**41,945**	**32,605**	**25,313**	**19,626**

The physical quality of backwaters was also assessed as part of the evaluation process. The assessment was based on an evaluation of the physical parameters, topographic diversity, etc. and did not make assumptions regarding recolonization by aquatic plants, which is dependent on other systemic improvements. Despite continued sedimentation, the increasingly shallow areas are not expected to be able to establish marsh vegetation due to current levels of water level fluctuations, unconsolidated substrates, and turbidity. It was the consensus of an interagency panel that the existing backwaters, which average roughly 500 surface acres and in many cases a depth of less than 1 foot, have a very low level of quality during summer low water and overwintering periods (tables 3-19a and 3-19b). On a scale of 0 to 1, an interagency group rated existing backwaters as having an overall habitat value of 0.1 considering value to all species. This relatively low habitat value was estimated to decrease slightly over time to an estimated value of 0.07 in 50 years. Future habitat value was estimated assuming a 1.0% annual loss in habitat quality for years 1 through 25, and a 0.5% years 26 through 50.

ii. Side Channels and Islands. Some side channel areas are experiencing sedimentation and are anticipated to be lost in the future (approximately 17 percent in the Alton and Peoria Pools and greater in La Grange Pool). Another widespread threat to the side channels is their loss due to erosion of the protective islands photograph 3-3). Based on data collected as part of this study, it is anticipated that without any action some continued loss of side channel length will occur at the rate of approximately 0.25 percent per year if it follows trends from 1903 to the present. This would result in a loss of approximately 6.5 additional miles of side channel habitats if no action were taken (table 3-19).

In the future without, it is anticipated that the quality of side channel areas will continue to remain at relatively low levels. In many areas, there will continue to be further losses of depth diversity due to sedimentation and a lack of adequate structure (woody debris, rock, etc.).

d. Desired Future Conditions. The desired future conditions or objectives resulted from a series of interagency meetings aimed at identifying the restoration needs of the system. The restoration needs were determined largely by looking at the likely future without-project conditions and assessing needs to restore aquatic habitats for fish spawning, nursery, and overwintering habitats.

Photograph 3-3. Erosion of Upstream End of Illinois River Island

Table 3-19. Estimated Future Without Miles of Side Channels in 2054 Given an Approximate Annual Loss Rate of 0.25% Loss/Year

Name	Current Miles	Estimated Miles in 2054
Dresden	1.9	1.7
Marseilles	4.7	4.1
Starved Rock	4.95	4.4
Peoria	7.6	6.7
La Grange	17.7	15.6
Alton	17.15	15.1
Total	**54**	**47.6**

The backwater restoration objective of restoring 19,000 acres had previously been identified in the Habitat Needs Assessment. An interagency team assessing the restoration needs of the entire Upper Mississippi River System, including the Illinois River, conducted the assessment and set the restoration target. Resource managers further identified a general target of depths for backwater restoration by recommending the following distributions of depths: 5% >9 feet; 10% 6 to 9 feet; 25% 3 to 6 feet; and 60% < 3 feet. Since virtually all areas are currently less than 3 feet, restoration of the 19,000 acres could be focused on restoring the relative depth diversity associated with the other three depth categories.

One of the major concerns on the river system is the potential loss of connected off-channel areas. The desired future includes the restoration and maintenance of side channel habitats and the maintenance of all existing connections between backwaters and the main channel (connections at the 50 percent exceedance flow duration).

Backwater restoration success is also related to the quality of sediments. Options should be explored to compact sediments or remove unconsolidated material to improve substrate conditions for aquatic plants, fish, and wildlife. Due the potential for substantial amounts of dredging, additional beneficial uses of sediment should be investigated.

2. Formulation of Alternative Plans

a. Approach/Assumptions. The formulation of alternative plans involves identifying measures and creating alternative plans by using combinations of measures. A range of alternative plans was developed to look at potential ways to reach the desired future conditions identified in the study process. The approach for backwaters included the use of an expert panel to incorporate an assessment of area (including predicted loss rates) and quality into the assessment of various options. The assessment of side channels and island protection focused more directly on various levels of effort associated with previously identified cost-effective approaches to restoration. The formulation of measures and alternatives for the restoration of backwaters and side channels was aided considerably by the fact that a number of projects were previously evaluated and constructed in the Midwest.

b. Criteria and Constraints. The following criteria and constraints were developed for consideration in future issues associated with implementation. The following criteria should be refined and utilized during the implementation process to best identify locations for restoration:

- Proximity to other high quality areas.
- Geographic spacing to maximize benefits to river system should be approximately every 5-10 miles to support fish populations.
- Site selection and design should consider sustainability and anticipated sedimentation rates for particular backwaters and effects of direct tributaries.
- Availability of placement areas near site (land based, island creation, shipments).
- Maintain desirable water quality (DO, turbidity, temperature, ammonia).
- Design projects for habitat diversity (including a range of depths, structure, and plant and animal communities).

The following constraints, which could limit restoration success, were identified:

- Continued excessive sediment delivery and sedimentation.
- Cost limitations of Federal and State partners.
- Corps traditional approach to projects with one time construction and then sponsor O&M. Adaptive management/continuing construction may be needed to make restoration viable.
- Resuspension of sediments by wind, wave action, and rough fish.
- Time – need action soon or additional areas may transition from aquatic to terrestrial.
- Placement locations for material removed.
- A final legal determination has not been made as to the ownership of submerged lands in the Illinois River Basin.
- Potential for areas to contain contaminated sediments.
- Project life.
- Placement in floodplain cannot affect flood heights.
- Habitat values may continue to be limited by other factors (e.g., potential for continued limitations in aquatic plant due to effects of water level fluctuations and turbidity).

c. Measures. The first step in the formulation process was to identify the range of measures to be investigated. Measures were separately identified for backwaters and side channels and are presented in this section. A key consideration in the selection of measures was sustainability. Due to the nature of the system, no backwater dredging will be fully sustainable, instead the intent is to restore habitats in ways that maximize sustainability. Although the descriptions of measures below are relatively generic given the system aspects of the study, the specifics of measures used in implementation will be based on lessons learned from previous projects, analysis using models, and monitoring and adaptive management. These types of information will be used to maximize the sustainability and cost effectiveness of the projects.

Examples of sustainable design considerations include:

- locating dredge cuts away from sediment sources (i.e. tributaries) and secondary channels;
- reducing the sediment load to the dredge cuts by reducing the inflow of sediment-laden water;
- altering local hydrodynamic conditions so that sediment is transported through and out of dredge cuts (addition of rock or timber structures, etc.);
- constructing islands to reduce sediment resuspension due to wind-driven wave action;
- establishing a reoccurring dredging cycle for implementation as a way to address ongoing sedimentation and maintain areas with firm substrates, and
- arranging features to slow conversions of habitat types (i.e. increased depth closer to bank to slow conversion to terrestrial habitats and plant colonization moving in from edges).

i. Backwaters

Sediment Removal (Dredging). The study team looked at various scales of potential restoration for particular backwaters. Based on desires for increased depths, the restoration levels were based on varying percentages of dredging. For restored backwaters, a general target identified by resource managers to provide more optimal habitat for a wide range of species would be to have the following distributions of depths: 5% >9 feet; 10% 6 to 9 feet; 25% 3 to 6 feet; and 60% < 3 feet. For formulation purposes, an average size of 500 acres was assumed per backwater (calculated based on acreage and number of backwaters), but the information is applicable to all sizes based on a percentage basis. The approximate costs are based on a 500-acre backwater lake.

- **Level 1 -** Dredge 2 percent - Maintain connection to main stem and create deep entrance channels estimated cost $910,000
- **Level 2 -** Dredge 10 percent - Configuration approximating ¼ targets established in objectives estimated cost $4.9 million
- **Level 3 -** Dredge 20 percent - Configuration approximating ½ targets established in objectives estimated cost $9.6 million
- **Level 4 -** Dredge 40 percent - Configurations following general target established in objectives estimated cost $19.6 million
- **Level 5 -** Dredge 60 percent - Configuration exceeding targets established in objectives estimated cost $29.5 million

Sediment Placement. Various placement options follow. However, due to the system scale of the analysis, specific differences were not calculated. It is further assumed that the actual placement option chosen will vary based on site-specific conditions related to placement opportunities and costs. Cost estimates for placement are included with the dredging costs shown above, for placement options near the dredging, additional costs would be incurred for placement options more removed from the dredging area.

- on existing islands (increase elevations in selected areas to increase vegetation diversity and potential for mast trees)
- creation of new islands (create habitat and potentially reduce sediment resuspension from wind and waves)
- on adjacent agricultural lands
- beneficial reuse on brownfields, former mined lands, stockpile, gravel pits, etc.

Technologies

- hydraulic, mechanical, and high solids dredging
- dewater backwater areas and use conventional equipment
- reconnect currently isolated backwater areas that have adequate depth

Construction Approach

- traditional staging (one backwater at a time)
- multiple backwaters at one time
- continuous construction (ongoing construction/O&M to address sedimentation)

ii. Side Channels and Islands

Protect Islands. Based on the analysis of Alton Pool that highlighted the loss of island/side channel length, some measures were proposed that would protect the upstream ends and banks of existing islands to maintain and possibly restore some of their historic length. Rock off-bank revetments are more costly, as shown by the cost data for an average 2,100 foot section (protecting 20 percent of the perimeter of a typical 1 mile long island). However, they create unique habitat conditions between the revetment and island. Habitat benefits would be used to evaluate their cost versus benefit relative to the other measures.

- Rock Off-bank revetments – cost estimate $2 million per island.
- Rock Bank protection – cost estimate $745,000 per island
- Timber Off- bank revetments **–** cost estimate $675,000 per island

Another innovative technique that will be considered as part of future critical restoration projects is *seed islands.* Seed islands are started by placing stones in such a way that the natural sedimentation processes create an island in the desired location downstream of the stones. This technique has been used successfully by the Corps on the Upper Mississippi River and could serve as a method to reestablish islands. Depending on the size of the desired islands the cost would be similar to Rock Off-bank revetments or bank protection.

Create Varying Depths/Maintain Scour. Other options to restore some of the historic depth diversity; to help maintain deep holes and areas for fish; and increase the sustainability of side channels following potential dredging activities included the following types of wood and rock structures that could be placed in side channel areas. Assumes the need for 7 structures per average side channel (approximately 1 mile long). Estimated cost is $127,000 for structures in one side channel.

- Stub dikes/wing dams
- Log piles
- Pile dikes
- Notching existing closing structures

Dredge. In side channel areas that are experiencing sedimentation, typically only a portion is most heavily affected by sediment. It is estimated that in many cased, dredging would only be required for approximately 1/3 of the side channel length to restore historic flow and off-channel aquatic conditions. The estimated cost assuming the dredging of a 1/3 mile, 6 foot deep, 50 foot wide channel was $265,000 per side channel.

d. Alternatives. The following section reviews and discusses the various alternatives developed for the backwater and side channel alternatives.

i. Backwaters. Two interagency assessment meetings were held on May 22 and June 10, 2003, to study backwaters and side channels in detail. The study team looked at various levels of potential restoration for particular backwaters. The levels were based on varying percentages of dredging. For formulation purposes, an average size of 500 acres was assumed per backwater, but the information is applicable to all sizes based on a percentage basis.

Two areas of primary concern in evaluating the levels were assumptions regarding changes in quantity (acreage) and quality (index values). The following tables relate the assumptions developed regarding changes in quantity and quality assuming a one-time construction sequence. Ongoing construction or active operation and management activities would allow the project to remain at levels similar to year 0 throughout the project life.

Losses in the surface acreage of backwaters were anticipated to be 1 percent loss per year. This was based on observations of the historic loss of backwater volume and area. Level 1, dredging of 2 percent (10 acres of a 500-acre backwater), was assumed to make no measurable change in the rate of loss. The other more extensive levels of dredging 10 to 60 percent of lake area, would have a progressively greater effect on reducing the rate of loss assuming proper configuration. Table 3-20 shows the loss rates assumed to be associated with the proposed restoration levels.

Table 3-20. Assumptions on Backwater Acreage Loss Over Time

	Backwater Areas			
Proposed Level	**Year 0**	**Year 25**	**Year 50**	**Assumptions**
Without-Project	500	389	303	1.00%/year loss
Level 1	500	389	303	1.00%/year loss
Level 2	500	414	343	0.75%/year loss
Level 3	500	441	389	0.50%/year loss
Level 4	500	455	414	0.38%/year loss
Level 5	500	470	441	0.25%/year loss

Note: Example is for a 500-acre backwater

Assessments of quality were made using a physical quality index (PQI). Index values range from 0 to 1, with 0 representing no valuable habitat and 1 optimal habitat. This approach is similar to the U.S. Fish and Wildlife Habitat Evaluation Procedure (HEP) developed to estimate the quality of habitat areas. The index values used for the study were determined by expert opinion of resource managers and scientists with experience in fisheries, waterfowl, wildlife, wetlands ecology, hydrology and sedimentation for the without-project and all levels 1-5 for year 0 (immediately following construction).

A simplified approach to estimate quality was used based directly on the proposed physical footprint. It was agreed that the physical quality index would only assess the physical configuration of the backwaters in terms of configurations of habitat (depth and diversity) to maximize value and use by a broad range of plant, fish, and wildlife species. This assessment is a simplification, since actual quality depends on numerous factors: temperature, dissolved oxygen (DO), plant communities, etc.. However, this approach is appropriate, since the dominate process affecting backwaters along the Illinois River is sedimentation. In many cases, the other factors will benefit directly from dredging and show similar trends. For example, as larger areas are restored with greater depths more desirable temperatures are anticipated. In other cases the quality can be affected at similar costs for various alternatives, such as introducing some flow to increase DO, etc.

The optimal level of restoration, a value of 1, was assigned to level 4 in year 0. This represents the target established to maximize backwater habitat benefits by providing the following distributions of depths: 5% >9 feet; 10% 6 to 9 feet; 25% 3 to 6 feet; and 60% < 3 feet. Since in most of the cases all of the backwater areas are less than 3 feet deep, actual restoration activities would only need to address the 40 percent targeted for deeper depths. For example, taking a 500-acre backwater, work under level 4 (dredging 40 percent or 200 acres) would result in dredging approximately 25 acres >9 feet, 50 acres 6 to 9 feet; 125 acres 3 to 6 feet; and the 300 acres already less than 3 feet would be minimally affected. It should be noted that while level 5 exceeds the target and as such had a lower PQI in year 0, it actually improves over time as sedimentation brings it closer to the desired configuration. The PQI for all subsequent years was calculated based on assumed changes in quality over time (table 3-21shows year 25 and 50 values). It was felt that for all levels the rate of loss would be highest in the years immediately following construction due to initial sedimentation. This matches observed changes in completed dredging projects where the sedimentation rates were greatest in the years immediately following construction. Ongoing dredging through operation and maintenance could be utilized to eliminate or reduce loss in quality over time.

Table 3-21. Assessment of Physical Quality and Changes Over Time

	Physical Quality				Loss Rate/Yr	
Quality	**Year 0**	**Year 25**	**Year 50**	**Loss Assumption**	**Years 1 - 25**	**Years 25 - 50**
Without-Project	0.1	0.08	0.07	Slow reduction	1.00%	0.5%
Level 1	0.11	0.08	0.07	Slow reduction	1.25%	0.5%
Level 2	0.3	0.18	0.14	Higher rate	2.0%	1.0%
Level 3	0.5	0.30	0.23	Higher rate	2.0%	1.0%
Level 4	1.00	0.60	0.47	Higher rate	2.0%	1.0%
Level 5	0.8	0.76	0.59	Higher rate	2.0%	1.0%

Assume sedimentation rates of 2 in/year in first 25 years, approximately 50 inches.
Assume sedimentation rates of 1 in/year in years 25-50, approximately 25 inches.
Level 5 - 11.5 years to get to 1.00, then decreases at rate of others.

Regarding the physical quality index, the study team was not able to identify a system threshold in terms of total acreage needs based on limited data and system understanding. As a result, the full benefits associated with the restoration of each backwater were applied to varying numbers of backwaters on the system without decreasing benefits, fixed at a maximum of 60 backwaters previously identified by resource managers.

Table 3-22 summarizes the alternatives developed for the backwater analysis. The table relates the number of backwaters to be restored in each level category and summarizes the total acreage to be dredged. For example, Alternative 2A is composed of dredging 60 backwaters to level 1 (2 percent) for a total dredging acreage of 600 acres. This level would involve only limited dredging (averaging 10 acres per backwater) in a large number of areas as a way to maintain the low water connections with the main stem and wide distribution of minimal areas for overwintering. Alternative 3B is composed of combinations of four levels for a total dredged area of 1,150 acres:

10 - Level 1
5 - Level 2
2 - Level 3
3 - Level 4

The number of backwaters included in the alternatives were formulated in consideration of a past restoration analysis that identified roughly 60 backwaters in need of restoration.

The maximum number of backwaters to address was set at 60 with some alternatives addressing less. The analysis also considered the resulting spacing and the desire for high quality backwater areas every 5 to10 miles. The total number of backwaters included in each of the alternatives 2A to 2H is shown in table 3-22.

Table 3-22. Backwater Alternatives – Number of Backwaters by Level and Total Acres Dredged

	Number of Backwaters by Category						
Alternative	**Level 1**	**Level 2**	**Level 3**	**Level 4**	**Level 5**	**Total Number**	**Total**
2A	60	0	0	0	0	60	600
2B	10	5	2	3	0	20	1,150
2C	5	5	5	5	0	20	1,800
2D	10	10	10	10	0	40	3,600
2E	10	20	10	20	0	60	6,100
2F	10	10	0	40	0	60	8,600
2G	0	0	0	60	0	60	12,000
2H	0	0	0	0	60	60	18,000

The costs for the various alternatives are shown in table 3-23. No costs were included for operation and maintenance because approximately 2 feet of overdredging was included and as a result anticipated sedimentation rates will not require additional dredging within the project horizon.

An analysis was made utilizing the estimates of quality and acreage loss over time (table 3-24). For the analysis, it was assumed that implementation of the alterative would take 50 years. As a result, 2 percent of the total restoration was implemented in any given year. The results of this analysis show that for all alternatives, year 0 or the current condition is the existing approximately 55,000 acres and a relatively low quality of 5,500 units (55,000 acres times the quality index value of 0.1). In the without-project condition, acreage is anticipated to be lost at a rate of 1 percent, resulting in 33,275 acres remaining in year 50. The total quality would also be reduced to 2,329 units (33,275 acres multiplied by the reduced quality index value of 0.07). The various alternatives show different reductions in the rate of conversion of backwaters and in many cases dramatic increases in quality based on the number and amount of restoration projects associated with the alternative plan.

For example, the backwater quality units are estimated to be approximately 10 times greater for Alternatives 2G and 2H in year 50, approximately 19,000 – 23,000, versus a value of closer to 2,300 for the without-project.

The values calculated for Alternatives 2A to 2H reflect a gradual 2 percent annual rate of construction of the total restoration proposed. For example, the analysis of Alternative 3G assumed restoration of 12,000 acres over 50 years, 600 acres per year. As the various acreage was restored a higher value of 1.0 was assigned to the restored backwater complexes following construction. The backwater acreage and index value were then lowered following the anticipated loss rates identified by the expert panel.

Table 3-23. Cost of Backwater Restoration Alternatives

Alternative	First Cost Construction 35% Contingency	Planning, Engineering, And Design 30%	Supervision and Administration 9%	Real Estate [1]	Total First Cost
2A	$36,603,000	$10,981,000	$3,294,000	$3,655,000	$54,533,000
2B	$75,173,000	$22,552,000	$6,766,000	$6,988,000	$111,478,000
2C	$117,833,000	$35,350,000	$10,605,000	$10,946,000	$174,734,000
2D	$235,666,000	$70,700,000	$21,210,000	$21,892,000	$349,469,000
2E	$400,823,000	$120,247,000	$36,074,000	$37,053,000	$594,196,000
2F	$567,067,000	$170,120,000	$51,036,000	$52,165,000	$840,389,000
2G	$791,621,000	$237,486,000	$71,246,000	$72,791,000	$1,173,145,000
2H	$1,194,296,000	$358,289,000	$107,487,000	$108,927,000	$1,768,999,000

[1] Real Estate costs do not include acquisition or appraisal costs.

Table 3-24. Summary of Acreage and Physical Quality by Alternative

	Year 0		Year 25		Year 50	
Alternative	Area (ac)	Total Quality	Area (ac)	Total Quality	Area (ac)	Total Quality
2-0	55,000	5,500	42,780	3,422	33,275	2,329
2A	55,000	5,500	42,780	3,622	33,275	2,682
2B	55,000	5,500	42,890	4,315	33,673	3,736
2C	55,000	5,500	42,964	4,874	33,942	4,618
2D	55,000	5,500	43,148	6,326	34,609	6,907
2E	55,000	5,500	43,383	8,432	35,458	10,231
2F	55,000	5,500	43,521	10,766	35,976	14,011
2G	55,000	5,500	43,793	13,831	36,978	18,926
2H	55,000	5,500	44,008	15,237	37,810	22,642

The benefits of the various alternatives were further evaluated by looking at the incremental improvements over the without-project condition and the associated costs, summarized in table 3-25. This analysis revealed that considerable total acreage would be preserved by many of the alternatives ranging from 398 acres with Alternative 2B (33,673 acres in year 50 versus 33, 275 acres in year 50 without the project) to 4,534 with Alternative 2H. This is associated with the fact that restoration activities will slow conversion of many areas to terrestrial habitats. More dramatic than the preservation of backwater acreage is the estimated increase in average annual quality of the remaining acreage. This is generally related to the fact that due to dredging activities remaining acreages will have greater depth and more habitat value and function. The figures in table 3-25 show the average annual amounts, which are the average values over the entire 50-year period of analysis.

Table 3-25. Summary of Incremental Acreage and Physical Quality Changes, Average Annual Total Quality, and Costs by Alternative

	Benefits			Costs ($1,000)	
Alternative	**Area, Year 50 (ac)**	**Total Quality, Year 50**	**Average Annual Total Quality**	**Cost Implementation**	**Cost per Average Annual Quality Unit**
2-0				-	
2A	0	353	185.1	$ 54,500	$294
2B	398	1,407	840.7	$111,500	$133
2C	667	2,289	1,370.2	$174,700	$128
2D	1,333	4,578	2,740.4	$349,500	$128
2E	2,183	7,902	4,730.2	$594,200	$126
2F	2,701	11,681	6,955.6	$840,400	$121
2G	3,702	16,596	9,869.8	$1,173,100	$119
2H	4,534	20,313	11,331.3	$1,769,000	$156

As the analysis shows, the most cost-effective alternative in terms of average annual total quality was 2G. This plan was composed of 60 backwaters restored to the level 4 effort. Based on the assumptions above, a large number of alternatives were run. In general, levels 2 (10 percent), 3 (20 percent), and 4 (40 percent) are relatively equally cost effective. Levels 1 (2 percent) and 5 (60 percent) were less effective. Level 1 did not provide a large enough area of effect to significantly improve the backwater as a whole. Also, based on the small area and proximity to the channel, it would experience relatively rapid loss of much of its depth. Level 5 provided deep-water areas in excess of the optimal targets. This, in essence, represents significant over dredging. While it does provide for higher quality in future years than the other levels, it was not as cost effective.

Traditional cost effectiveness and incremental cost analysis was also preformed on the alternative utilizing Institute of Water Resources (IWR) – Plan software. As figures 3-11 and 3-12 indicate, all plans were cost effective, but cost effectiveness increased and was greatest for plans 2G to 2H Cost effectiveness means that for a given level of benefit, no other plan costs less, and no other plan yields more output for less money. Only alternatives 2G and 2H were identified as best buy plans, which provide the greatest increase in output for the least increase in cost, and received further analysis using incremental analysis.

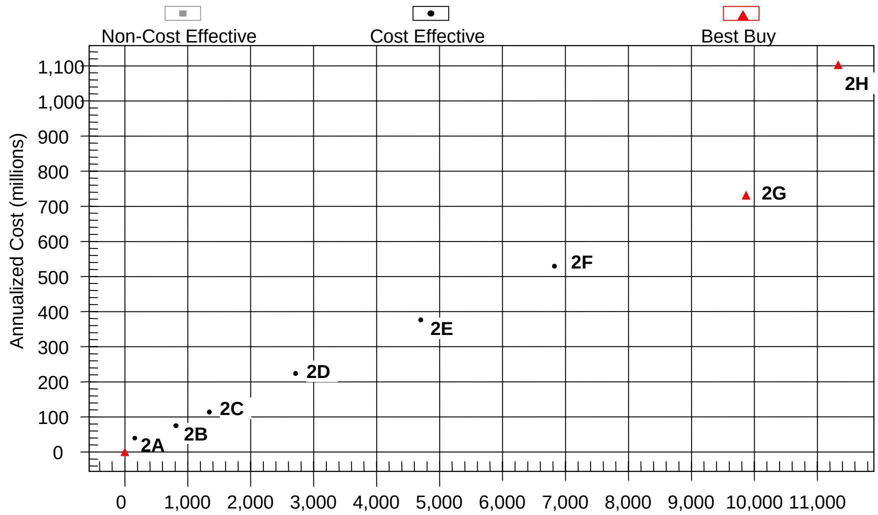


Figure 3-11. Cost Effectiveness of Backwater Restoration Alternative Plans

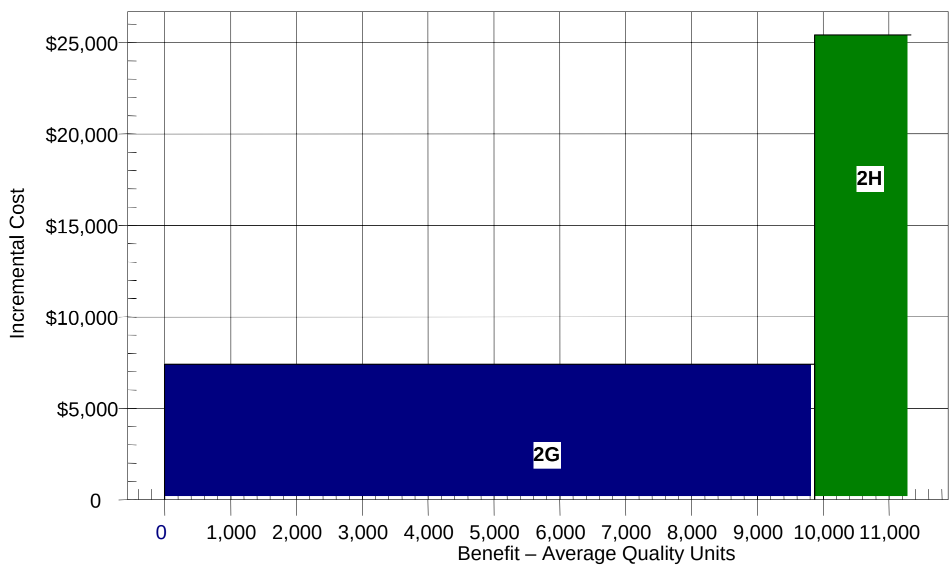


Figure 3-12. Incremental Analysis of Best Buy Plans (Acres of Benefit)

In addition to the analysis of total quality, further analysis was completed to better define the direct and indirect benefit areas. It is widely recognized that the benefits of restoring deep water habitat extend well past the actual dredging footprint. Research has shown benefits to surrounding backwater areas as well as up to a five mile reach of the main stem (Iowa DNR 2000 and Iowa DNR 2003). This is based the travel area of various fish species, which utilized backwaters for spawning, nursery, and overwintering habitat. The areas estimated below are the total indirect benefit area. In these areas the habitat suitability would be improved to varying degrees as a result of the restoration projects. For this analysis the maximum benefit area of an average backwater restoration project was limited to the entire 500 acre backwater, plus up to a five mile reach of the main stem or approximately 515 acres of main stem area (based on an average width of 850 feet). As a result an optimal backwater restoration project could have an indirect benefit area of up to 1,015 acres. The amount of this benefit area associated with each alternative was calculated by multiplying the number of backwaters being worked on, times the percent of the average annual total quality attained by the alternative, times the potential backwater and main stem area. The total backwater and main stem areas where then added together to provide the total indirect benefit area (table 3-26).

ii. Side Channel and Islands Alternative

The study team looked at various scales of potential restoration for side channels and islands. The scales were based on varying amounts of restoration features. For conceptual discussions, a typical 1-mile-long side channel and island was used, but the information is applicable to all sizes based on a percentage basis. Side channel and island widths vary considerably, but average roughly 100 feet.

Island Protection. Island erosion is a natural process that characterizes dynamic rivers; however, it is a problem when it damages important habitats (forested islands and side channels) or archeological resources or under conditions where it occurs at an unsustainable rate (additional natural island creation activity is not keeping pace). Along the Illinois River, island erosion is exacerbated by commercial and recreational boats and by wind-generated waves and in many areas islands are being lost and not replaced by natural processes.

The primary source of information for the analysis was the detailed evaluation of the side channels and islands in Alton Pool, the 80-mile reach upstream of the mouth, conducted by Mike Cochran, Illinois DNR (retired), and T. Miller, U.S. Army Corps of Engineers - St. Louis District. This information was then extrapolated to the rest of the system with the assistance of Rock Island District channel maintenance staff.

Based information from the analysis, restoration measures were proposed for protection of approximately 20 percent of the island perimeter of actively eroding islands to reduce erosion, maintaining island and side channel length. Protection of 20 percent would result in protection of approximately 2,100 feet per average island. Options included constructing these structures from rock as off-bank revetments or bank protection or as timber piles revetments, or a combination of both. For cost purposes, an average of all three costs was utilized. Habitat analysis and adaptive management will be used as part of the site evaluations to determine which of the three methods is preferred.

The protection of existing islands was identified as a relatively low-cost method to maintain existing habitats and avoid future losses of both island and side channel habitats. Island protection projects using off-bank revetments could also provide unique aquatic habitats between the revetments and islands. An additional benefit to the system would be reduced sediment delivery to the river from the island erosion. While island protection would help to reduce sediment delivery to the system, islands are not considered a major source of sediment to the system. As a result of the relative low cost and benefits, just two levels were formulated that would restore a significant portion of the sites identified as degrading/needing protection. Table 3-27 summarizes information on the number of islands protected and the costs involved.

Table 3-26. Summary of Total Benefit Area of Backwater Restoration Projects

Alternative	Number of Backwaters	AA Total Quality	% Quality	Benefit Area Backwaters	Benefit Area Main stem	Total Benefit Area	Cost $1000s	Cost Per Acre
3A	60	185	0.02	90	505	995	$54,500	$54, 800
3B	20	841	0.07	742	764	1,506	$111,500	$74,000
3C	20	1,370	0.12	1,209	1,246	2,455	$174,700	$71,200
3D	40	2,740	0.24	4,837	4,983	9,820	$349,500	$35,600
3E	60	4,730	0.42	12,523	12,903	25,426	$594,200	$23,400
3F	60	6,956	0.61	18,415	18,973	37,388	$840,400	$22,500
3G	60	9,870	0.87	26,130	26,922	53,053	$1,173,100	$ 22,100
3H	60	11,331	1.00	30,000	30,909	60,909	$1,769,000	$29,000

Table 3-27. Potential Island Protection Alternatives

Alternative	Number of Islands Protected	Construction	Real Estate [1]	Total First Cost	Annual O&M
2M	10	$11,449,000	$128,000	$11,577,000	$12,000
2N	15	$17,174,000	$192,000	$17,366,000	$18,800

[1]Real Estate costs do not include acquisition or appraisal costs

The actual direct and indirect benefit area was also calculated to provide an estimate of the area of island and side channel restored by the project. Three separate types of areas would benefit from island protection: reduced loss of island habitat, reduced loss of side channel (which would be lost if the island was eliminated), and reduced loss of habitat value of main channel and main channel border habitats that benefit from proximity to side channels.

The acreage benefits were estimated for a generic island project. However, a detail analysis of the specific individual projects will be undertaken as each site is investigated. The average Illinois River island is approximately 12.1 acres (1 mile long by 100 feet wide) as are the side channels. Based on loss rates over the past 100 years, islands are eroding at a rate of approximately .25 percent per year system-wide. For this analysis it was assumed that since a number of islands are stable, and projects would focused on the most actively eroding, a 1 percent loss rate per year was used. The following table summarizes the benefit areas including the area of island and side channel that would be lost. Based on the 1 percent loss rate approximately 7.7 acres of island and 7.7 acres of side channel would be lost at each proposed site if no action were taken. This would also result in a proportional loss of associated main channel benefits. Other study efforts in the Midwest have estimated the main stem benefit area of a side channel at approximately 100 acres of surrounding main channel and main channel boarder habitats. Based on a loss of 7.7 acres of a 12.1 acre side channel (63.4 percent loss) the loss of surrounding main stem habitat would be 63.4 acres. In total, an island restoration project would benefit approximately 788 acres. Table 3-28 summarizes the total benefit areas for the two alternatives as well as the average annual cost per acre restored.

Side Channel Restoration. In terms of improving the habitat diversity and maintaining depths in side channels, various options to add structure to side channel areas were evaluated. Based on conversations with St. Louis District staff, it was estimated that approximately 7 stub dike structures, each about 25 feet long, would be adequate per mile of side channel. These structures would create aquatic structure and localized areas of increased flow velocity, scour, and eddies, thereby providing a wide range of habitats. Costs were calculated assuming using rock to construct the structures, but timber piles or a combination of both could be used.

In addition to increased structure and diversity, a number of side channels are being affected by sedimentation. Based on available system information, it was assumed that roughly one-third of the side channel area would need some dredging to increase and maintain depths. The stub dike structures would be added following dredging (if needed) to increase sustainability and maintain depths. Hydraulic modeling will occur as part of a site specific project to maximize sustainability and habitat values of features. Table 3-29 summarizes information on the number of side channels restored and the costs involved.

The actual direct and indirect benefit area was also calculated to provide an estimate of the area of side channel and associated main stem habitat restored by the proposed projects. The acreage benefits were estimated for a generic side channel restoration project. However, a detail habitat benefit analysis will be undertaken as any individual projects move forward. The average Illinois River side channel is approximately 12.1 acres (1 mile long by 100 feet wide). Other study efforts in the Midwest have estimated the main stem benefit area of a side channel at approximately 100 acres of surrounding main channel and main channel boarder habitats, due to the beneficial effects of side channels as refuge, nursery, overwintering, and feeding areas. As a result the total benefit area of a side channel project was estimated at 112.1 acres. Table 3-30 summarizes the total benefit areas for the two alternatives as well as the average annual cost per acre restored.

Table 3-28. Summary of Total Benefit Area of Island Protection Projects

Alternative	Number of Islands Protected	Island Acres Protected	Side Channel Acres Protected	Benefit Acres Main stem	Total Benefit Area (Acres)	Total First Cost	Cost Per Acre
2M	10	77	77	634	788	$11,544,000	$14,700
2N	15	115	115	951	1,182	$17,316,000	$14,700

Table 3-29. Potential Side Channel Restoration Alternatives

Alternative	Number of Side Channels Restored	Construction	Real Estate [1]	Total First Cost	Annual O&M
2T	10	$ 3,527,591	$ 450,368	$3,977,959	$1,640
2U	20	$ 7,055,182	$ 900,737	$7,955,919	$3,280
2V	30	$10,582,773	$1,351,105	$11,933,878	$4,920
2W	35	$12,346,569	$1,576,289	$13,922,858	$5,740
2X	40	$14,110,364	$1,801,473	$15,911,838	$6,560

[1] Real Estate costs do not include acquisition or appraisal costs.

Table 3-30. Summary of Total Benefit Area of Side Channel Restoration Projects

Alternative	Number of Side Channels Restored	Acres Dredged	Side Channel Acres	Benefit Acres Main Stem	Total Benefit Acres	Total First Cost	Cost Per Acre
2T	10	30	121	1,000	1,121	$ 3,861,000	$3,400
2U	20	60	242	2,000	2,242	$ 7,722,000	$3,400
2V	30	90	364	3,000	3,364	$ 11,584,000	$3,400
2W	35	105	424	3,500	3,924	$ 13,514,000	$3,400
2X	40	120	485	4,000	4,485	$ 15,445,000	$3,400

3. Evaluation and Comparison of Plans

a. Backwaters. As discussed under the alternatives section, various levels of restoration were assessed on a per-backwater basis. The analysis framework was developed to account for acreage and quality associated with the various alternatives. The analysis revealed that Alternative 2G and 2H were best buy plans. Alternative 2G, the restoration of 60 backwaters to level 5 (40 percent dredging), was the most cost effective on a per unit basis. However, the entire range was cost effective, but the more cost effective plans were 2D to 2H. Only the most effective plans were carried forward for further system evaluation.

b. Side Channels and Islands. The various side channel and island protection options simply represented varying scales of the same cost-effective measures. As a result, all alternatives were carried forward for further system analysis.

4. Plans Recommended for System Analysis

a. Restoration Alternatives. While varying somewhat in cost effectiveness, all of the alternative plans developed are recommended for consideration at the system level, except for backwater restoration Alternative 2A to 2C.

b. Risk and Uncertainty. While a number of backwater restoration projects have been implemented in the Midwest providing valuable information on the performance of various measures and demonstrating significant ecological benefits, restoration of backwater and side channel habitats involves some risk and uncertainty due to a number of factors. Particular areas of risk and uncertainty include determining the scale of projects necessary to achieve optimal benefits, estimating future sedimentation rates to accurately capture costs and estimate sustainability, and assessing ecological responses.

The study team directly addressed various scales of backwater restoration in order to determine the optimal level of restoration activities. Due to uncertainties, future restoration projects should be pursued under an adaptive management framework where various scales of backwater dredging are undertaken and monitored in the initial years of the program to further optimize the amount of dredging and configuration of dredging that produces the greatest ecological responses and sustainability of project features. This framework would also be applied to optimize side channel and island stabilization features.

Sediment delivery from tributaries is being addressed under Goal 1. However, how those reductions in delivery translate to reduced sedimentation rates in the backwaters and side channels will affect the cost of maintaining the habitats.

A final item of uncertainty is the ecological response from the proposed level of backwater, side channel, and island protection projects. The team is confident that the proposed objectives will provide significant and measurable benefits and that the physical changes will have significant ecological benefits. However, some desired biological responses, including increases in aquatic plant and macroinvertebrate communities, depend on improving not only depth diversity and structure, but also the combined effects of more natural water levels and reduced turbidity. In addition, there is the potential for currently unknown limiting factors to reduce the effectiveness of restoration projects.

c. Information and Further Study Needs. The following information and further study needs have been identified.

- Conduct pool plans addressing backwater and side channel needs/priority/etc. throughout the basin.
- Analysis of historic and existing conditions - collecting and using bathymetry data to better assess conditions and sedimentation rates.
- Better characterization of sediments (physical and chemical).
- Better characterization of nitrogen and phosphorus loading.
- Further detailed assessment of the extent to which backwaters represent a limiting factor for fish and other aquatic species.
- Assessment of the effectiveness and sustainability of various backwater restoration configurations
- Hydraulic information along main stem channels and backwater – discharge and velocity data.

H. GOAL 3: FLOODPLAIN, RIPARIAN, AND AQUATIC. Improve floodplain, riparian , and aquatic habitats and functions

Problem. Land-use and hydrologic changes have reduced the quantity, quality, and functions of aquatic, floodplain, and riparian habitats. Flood storage, flood conveyance, habitat availability, and nutrient exchange are some of the critical aspects of the floodplain environment that have been adversely impacted.

Objectives

Illinois River Main Stem. The system objective for the Illinois main stem floodplain and riparian areas is the restoration of approximately 30 percent of the cover types lost since settlement. This amounts to 150,000 acres of isolated and connected floodplain areas.

Illinois River Basin Tributaries. The system objective for the Illinois River Basin Tributary floodplain and riparian areas is the restoration of approximately 18 percent of the habitat areas of the Illinois River tributaries lost since settlement. This amounts to 150,000 acres of isolated and connected floodplain and riparian areas.

Aquatic Habitat. The system objective for the tributary streams of the Illinois River Basin is to restore approximately 33 percent of the streams impaired by channelization in the Illinois River Basin. This amounts to 1,000 miles of aquatic habitat within the tributary streams of the basin.

Anticipated Outputs. A healthy functioning floodplain, riparian and aquatic systems in the Illinois River Basin will result in ecological benefits due to connectivity of the river and floodplain habitats critical to the life stages of numerous native species. In addition, restored riparian and floodplain corridors provide one of the best opportunities for landscape scale restoration and connectivity of remaining resource rich areas in the highly modified Midwestern landscape, improving the viability of sensitive populations and species. In addition to benefiting hundreds of thousands of waterfowl which use the Illinois River as part of the Mississippi River Flyway, numerous other bird species would benefit from the restored floodplain and riparian habitat. These species include the Federally listed bald eagle and Illinois state listed species such as the northern harrier, sandhill crane, yellow-headed blackbird, forester's tern, black tern, and least bittern. Numerous fish species would benefit from restored floodplain, riparian, and aquatic systems including the paddlefish, and State listed darter, redhorse, and minnow species. Other species anticipated to benefit from the projects include river otter, bobcat, the Federally listed Indiana bat and decurrent false aster, and the State listed Blanding's turtle and Illinois chorus frog.

1. Inventory Resource Conditions

a. Historic Conditions. The streams, floodplains, and riparian areas of the Illinois River Basin were once a rich mosaic of habitats that were represented by a variety of aquatic and terrestrial cover types, including prairies, wetlands, and forests. Important factors contributing to this diversity and function were predictable annual hydrologic cycles, including annual high water and dependable summer low flows, wetlands, and prairies that buffered flood flows and slowly released the runoff; fire disturbance that maintained diverse plant communities; and limited human demands. The healthy functioning floodplain system once found in the Illinois River Basin resulted from an un-fractured landscape that integrated the ecological outputs of the hydrologic cycle (rainfall, droughts, and floods) through the complex structure of prairies, wetlands, and forests to produce an abundance of aquatic, insect, wildlife, and plant species. Historic land cover was evaluated to characterize pre-disturbance conditions in the basin.

Prior to settlement, the vegetation found on the floodplains of the major tributaries of the Illinois River Basin was similar to that along the Illinois River main stem, with the notable difference of a higher occurrence of prairies (between 10 and 20 percent) along the tributaries than along the main stem. This difference might be explained by the use of fire within the basin by indigenous peoples; the main stem floodplain served as a larger firebreak than the tributaries and therefore more forest-based cover was able to emerge in the main stem floodplain. For the purposes of this analysis, the land cover distributions along the tributaries were differentiated from those along the main stem.

Before 1900, the floodplain and riparian areas remained connected to the rivers and streams. Following diversion of Lake Michigan water into the Illinois, numerous levee and drainage districts were created. The alternations necessary for agriculture resulted in nearly 50 percent of the main stem floodplain being isolated or disconnected from the river. Levee and drainage projects can be found in all of the major basins, especially the Mackinaw, Spoon, and Sangamon, but none of a scale comparable to the Illinois River main stem.

ii. Illinois River Basin Tributaries. GLO records were analyzed to establish historical cover types within the floodplain for the 19 major sub-basins of the Illinois River Basin (Figure 3-13). They are the Chicago, Des Plaines, Spoon, Upper Sangamon, South Fork Sangamon, Lower Sangamon, Salt Creek, LaMoine, Lower Illinois, Lower Illinois - Lake Chautauqua, Lower Illinois - Lake Senachwine, Macoupin, Upper Fox, Lower Fox, Upper Illinois, Kankakee, Iroquois, Vermilion, and Mackinaw watersheds. While the Illinois River floodplain was dominated by forests, the tributary floodplains had a much more even distribution of cover types. Forest, prairie, and wetland cover types each covered roughly a third of the total acreage.

Figure 3-13. Illinois River Basin Sub-basins

i. Illinois River Main Stem. Forest, prairie (grassland), and wetlands, were the dominant cover types in the historical floodplain. The Illinois River floodplain, within the area of analysis, consists of approximately 500,000 acres. Historically, forests accounted for nearly two-thirds of the Illinois River floodplain (340,000 acres). Wet, mesic, and upland prairies accounted for the balance (160,000 acres) of the floodplain. Wetlands, both forested and non-forested, accounted for perhaps a third (194,000 acres) of the forest and prairie communities found in the floodplain.

Government Land Office (GLO) records from 1804-1859 were analyzed using Geographic Information Systems (GIS) software to establish historical cover types within the floodplain. Separate analyses were conducted for the Marseilles, Starved Rock, Peoria, La Grange, and Alton navigation pools. Navigation pools upstream of Marseilles were not evaluated because of intense urbanization and other limiting factors, but this should not exclude them from consideration for restoration implementation as appropriate opportunities become available.

Prairie stream headwaters are not typically forested, are surface water fed, have warmer water, and have a high level of in-stream primary production because of the lack of shading. Invertebrate grazers are the dominant primary consumer (photosynthesis) and fishes are more characteristic of warm water communities. Prairie streams typically become more forested downstream as flows become more reliable because of increasing groundwater influence and contributing surface area. Riparian corridors develop and the production base shifts from an in-stream basis to one that is nourished by nutrients from upstream and from litter falling from the riparian corridor.

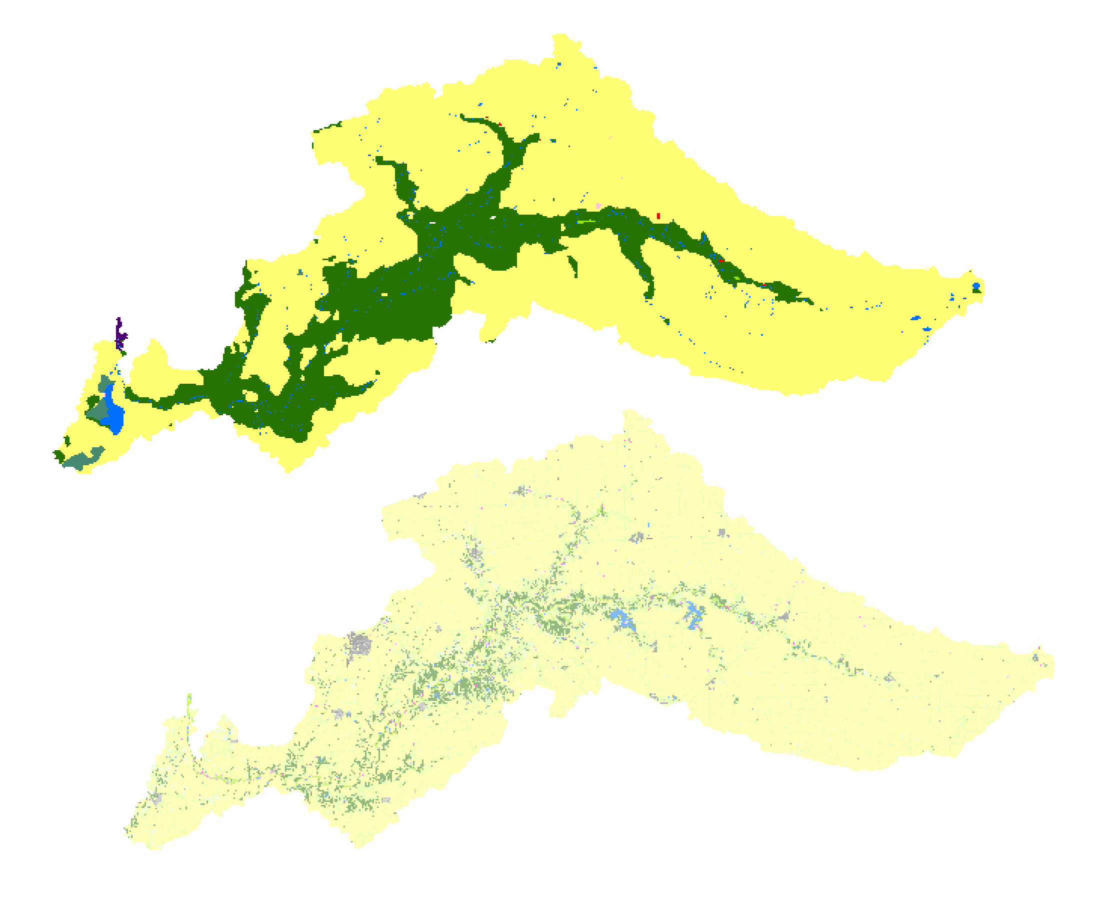


Figure 3-14. Presettlement and Contemporary Land Cover in the Mackinaw River Watershed

b. Existing Conditions. Land-use and hydrologic changes have reduced the quantity, quality, and functions of aquatic, floodplain, and riparian habitats. Flood storage, flood conveyance, habitat availability, and nutrient exchange are some of the critical aspects of the floodplain environment that have been adversely impacted because the Illinois River, and some of its major tributaries have been isolated from the floodplain through levee construction.

i. Illinois River Main Stem. Losses of the major cover types, as illustrated in table 3-31 and Figure 3-15, range from 70 to 80 percent; most dramatic has been the nearly complete elimination of prairie from the floodplain. The nature of the remaining vegetation is different from historic communities. Modern-day grasslands are limited to pasture, levees, and roadside patches with very little species diversity. Remaining bottomland forest species do not provide the ecosystem support functions of the mast-producing tree species of the historic floodplain. Finally, wetlands of all types have been severely impacted by diversion, dam construction to support navigation, and conversion to agriculture due to drainage. Nearly 50 percent of the floodplain has been isolated from the river. Wetlands were not particularly well mapped in the GLO surveys because their methods were coarse and many wetlands were small, isolated units that might have been too small to be captured at this mapping resolution. Therefore, the data in the table should be considered an underestimate. In comparison, hydric soils analyses indicate that throughout the basin about 90 percent of the wetlands have been lost due to conversion or drainage.

Table 3-31. Illinois River Main Stem Floodplain Historic and Existing Land Cover

Illinois River Main Stem Floodplain Land Cover	Forest	Grassland	Forested and Non-Forested Wetlands [1]	Total
Historic	338,680	120,620	42,473	501,773
Existing	85,530	23,245	12,775	121,550
Loss	253,150	97,375	29,698	380,223
Loss %	74.7%	80.7%	69.9%	75.8%
% of Historic Landscape	67.5%	24.0%	8.5%	

[1] This cover type includes three types of wetlands. It combines an equivalent Forest and Prairie cover type value with values indicated in the GLO data. This results from the assumption that approximately 25% of the historical forest and prairie cover type could be characterized as wetlands.

ii. Illinois River Basin Tributaries. Area l coverage of the major habitat types in tributary floodplains has been reduced by 15 to 70 percent from 1804 to 1995 (table 3-32). Tributary floodplains have been less severely impacted by agricultural conversion than the Illinois River main stem. However, the same problems exist of fragmentation and low diversity of habitat types. To counteract the underreporting of wetlands in the GLO records, interagency coordination with experts in the field estimated that approximately 25 percent of the forest and prairie acreage mapped in the GLO dataset was of wetland type. Forested cover types are relatively intact in terms of area, but habitat quality is severely degraded. Grasslands appear to have only lost one-third of their historic areas, but again quality is severely degraded. Wetlands have probably been the most impacted by conversion to other land uses.

Table 3-32. Illinois River Basin Tributary Floodplain Historic and Existing Land Cover

Illinois River Basin Tributary Floodplain Land Cover	Total Acres	Forest	Grassland	Forested and Non-Forested Wetlands [1]
Historic	851,946	422,140	409,957	19,849
Modified Historic Assumption		316,605	307,468	227,873
% of Historic Landscape		37.1	36.1	26.7
Existing	532,122	267,571	196,233	68,318
Loss	319,824	49,034	111,235	159,555
Loss %		-15.5	-36.2	-70.1

[1] This cover type includes three types of wetlands. It combines an equivalent Forest and Prairie cover type value with values indicated in the GLO data. This results from the assumption that approximately 25% of the historical forest and prairie cover type could be characterized as wetlands.

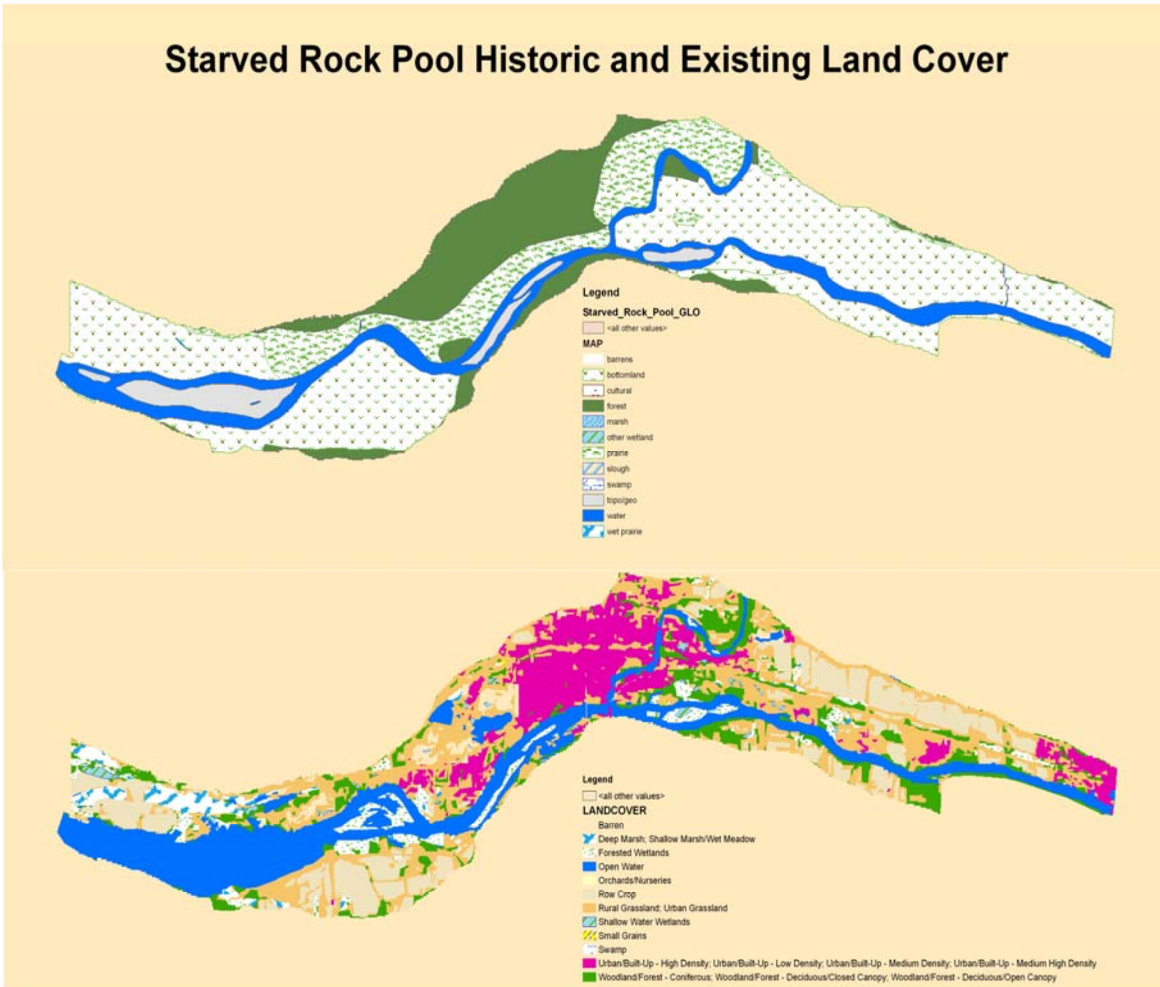


Figure 3-15. Comparison of Historic and Existing Cover Types in the Starved Rock Pool

iii. Aquatic Habitats. Alterations within the watershed have also had a pervasive negative effect on basin stream systems. The IEPA 305(b) report (2002), identified nearly 11,000 miles of perennial streams in the Illinois River Basin with an estimated 20,000 to 25,000 additional miles of ephemeral streams.

Based on the frequency observed in the IEPA analysis, channelization potentially impairs approximately 1,400 of perennial stream miles within the Illinois River Basin. However, unassessed streams tend to be smaller, and CTAP (1994) identified that the smaller streams tend to be channelized to a disproportionately high extent. Lopinot (1972) estimated that 27 percent of streams in the state were channelized at the time of publication; this would correspond to nearly 3,000 stream miles in the Illinois River Basin. To reach this level, approximately 50 percent of the unassessed streams would have to be channelized, a rate that is consistent with the observations in the CTAP report (1994).

Therefore, it is estimated that at least 3,000 miles of perennial stream habitat, mostly in small streams, is presently degraded by channelization in the Illinois River Basin.

Channelization of streams shortens overall stream lengths and results in increased velocities, bed and bank erosion, and sedimentation. Modified stream channels often have little habitat structure and variability (life requisites) necessary for diverse and abundant aquatic species. Channelization also disconnects streams from floodplain and riparian areas that are often developed into agricultural or built environments.

Illinois DNR and Illinois EPA managers developed the Biological Stream Characterization Index (BSC) to rank stream quality uniformly across the state. The BSC is a mix of quantitative variables including the Index of Biotic Integrity for fish (Karr et al. 1986), the Macroinvertebrate Biotic Index (Hilsenhoff, 1988), habitat analyses, and qualitative judgments of DNR biologists. Illinois DNR scientists completed a statewide coverage and documented the condition of 6,430 stream miles. Table 3-33 displays the results for the assessed streams in the Illinois River Basin. The Mackinaw watershed had the most unique and highly rated stream miles. Highly valued and moderate stream reaches were the most common, and they were widely distributed throughout the Illinois River Basin. Streams in the urban watersheds of the Des Plaines, Fox, and Chicago Rivers, the agricultural watersheds of the Sangamon River, and the Spoon River watershed were generally of limited quality. Restricted stream reaches largely occur in the Chicago region and were only a small fraction of the total streams assessed. Protection of remaining high-quality areas was identified under the overarching system goal as a prioritization criteria for future restoration.

Table 3-33. Illinois River Sub-Basin Stream Miles Ranked Using the Illinois Department of Natural Resources Biological Stream Characterization (Bertrand et al. 1996, ISIS 1999)

Watershed	Unique	High	Moderate	Limited	Restricted
Des Plaines	11.3	68.8	189.2	260.0	19.5
Upper Fox	0.0	94.6	99.0	46.1	0.0
Chicago	0.0	0.0	64.9	156.7	24.1
Lower Fox	16.5	164.1	310.8	9.4	0.0
Lower Illinois-Senachwine Lake	8.8	124.2	113.4	0.0	0.0
Upper Illinois	45.0	163.4	28.9	0.0	0.0
Kankakee	0.0	228.8	92.6	0.1	0.0
Spoon	0.0	159.2	487.9	130.4	0.0
Vermilion	55.9	223.8	122.0	0.0	0.0
Iroquois	0.0	167.6	33.1	0.0	0.0
Lower Illinois-Lake Chautauqua	0.0	50.1	60.5	0.0	0.0
Mackinaw	156.1	211.5	65.4	1.2	0.0
LaMoine	19.6	176.3	231.9	0.6	0.0
Upper Sangamon	46.2	117.5	250.5	34.1	0.0
Salt	18.7	184.2	234.4	53.6	0.0
Lower Sangamon	0.0	12.8	193.9	36.1	0.0
Lower Illinois	0.0	219.7	33.9	0.0	0.0
South Fork Sangamon	0.0	0.6	116.1	81.8	0.0
Macoupin	0.0	101.2	0.5	0.5	0.0
Total Stream Miles	**378.1**	**2,468.4**	**2,728.9**	**810.6**	**43.6**
Percent of Sampled	**5.9%**	**38.4%**	**42.4%**	**12.6%**	**0.7%**

Channelization, wetland drainage, and snagging were extremely common throughout the Illinois River Basin for the purposes of draining water from croplands and for flood control. The adverse effects of such activities are extensive, ranging from the direct destruction of stream habitat, to the reduction of structure and microhabitat for fishes, aquatic invertebrates, freshwater mussels, and aquatic plants, to the alteration of water conveyance, which increases erosion and sedimentation. The negative effects of channelization and drainage may persist for very long periods and adversely affect habitat many miles away.

c. Future Without-Project Conditions

i. Illinois River Main Stem. The main stem Illinois River study area will likely remain relatively unchanged in terms of land use over the 50-year period of analysis. Some areas of various cover types will be converted to urban uses. However, this is likely to be a small amount due to the high regulatory cost of new development within the main stem floodplain. Habitat quality and ecological functions will likely remain at current degraded levels. Habitat fragmentation and unstable hydrologic regimes will continue to degrade the remaining habitat areas.

The Nature Conservancy and The Wetlands Initiative have made major investments by purchasing levee and drainage districts for the purpose of restoration. In total, they have acquired more than 11,000 acres of Illinois River floodplain and adjacent habitats at Spunky Bottoms, Emiquon, and Hennepin. Some restoration efforts have begun, such as shutting off drainage pumps and planting native species.

The USFWS currently manages four refuges along the Illinois River, totaling approximately 12,000 acres. The recently completed *Illinois River National Wildlife and Fish Refuges Complex Draft Comprehensive Conservation Plan and Environmental Assessment* recommends protection management on an additional 380 acres of native grassland; 200 acres of savanna; 1,300 acres of native forest; and 4,000 acres of wetlands within the focus areas through voluntary partnerships.

Finally, the UMRS-IWW System Navigation Feasibility Study has selected a recommended plan that calls for the restoration of approximately 20,000 acres of Illinois River floodplain. The restoration measures identified under the Navigation Study are consistent with those of this study, and would be considered overlapping if implemented under either study.

ii. Illinois River Basin Tributaries. Overall, the tributary floodplains are also likely to remain in a degraded condition. Urban development is perhaps more likely than on the main stem, particularly near the larger urban areas of Chicago, Bloomington-Normal, Decatur, Peoria, and Springfield. One bright spot is the continued success of the CREP program in Illinois. While focused on sediment, the acreages that have been enrolled and are currently being enrolled are in the floodplain and riparian areas of Illinois River Basin streams. This provides opportunities for increased connectivity of various riparian habitats. However, these benefits may be offset by the continued degradation of aquatic stream and riparian habitats resulting from bed and bank erosion.

iii. Aquatic Habitats. In-stream habitats throughout the basin are likely to degrade over the 50-year period of analysis. Stressors on the stream network include:

(1) direct modification of stream channels for urban and rural development;
(2) increased impervious land surfaces resulting in increased runoff and higher flow;
(3) increased tile-drained agricultural areas;
(4) introduction of point and non-point source pollutants into the system; and
(5) introduction of invasive and exotic species.

While numerous programs are in place to address these various stressors, they do not take a systemic approach to restoration and are unable to keep pace with the rate of landscape change occurring in the basin.

d. Desired Future Conditions

i. Illinois River Main Stem. The desired future condition of the Illinois River main stem floodplain is a reversal of historic loss of habitat and floodplain functions and increase in habitat area and quality. This would be accomplished by restoring 150,000 acres of isolated and connected floodplain areas, representing approximately 30 percent of the Illinois River Valley. This level of restoration would provide the necessary building blocks for a sustainable floodplain ecosystem in conjunction with other restoration efforts undertaken as part of this effort, particularly water level, backwaters, and side channels.

ii. Illinois River Tributaries. The desired future condition for the Illinois River Basin tributaries is the restoration of a sustainable level of floodplain and aquatic habitat functions. A portion of this would be accomplished by restoring 150,000 acres of isolated and connected floodplain areas. This represents approximately 18 percent of the Illinois River Basin tributary floodplain and riparian habitat areas. This level of restoration would provide the necessary building blocks for a sustainable floodplain ecosystem within the tributaries in conjunction with other restoration efforts undertaken as part of this effort, particularly sediment delivery.

General conditions for floodplains and riparian areas include terrestrial patch size desires (amount shown or greater). Bottomland hardwood forest would range from 500 to 1,000 acres in size with 3,000 acres needed for some interior avian species. Grasslands would range from 100 to 500 acres in size. Nonforested wetlands require a minimum of 100 acres, spaced 30 to 40 miles apart, and riparian zones for streams require a minimum of 100 feet on each side.

iii. Aquatic Habitats. Approximately 1,000 miles of impaired streams would be restored. This represents approximately one-third of the streams impaired by channelization within the Illinois River Basin. This level of restoration would provide the necessary building blocks for sustainable aquatic environments in the perennial and intermittent streams of the Illinois River Basin.

2. Formulation of Alternative Plans

a. Approach to Formulation and Assumptions. Alternative plan formulation for restoration of aquatic, floodplain, and riparian habitats and functions within the Illinois River Basin was conducted over a period of 6 months in 2003. Monthly meetings of technical and scientific professionals from the U.S. Army Corps of Engineers, the Illinois DNR, and other interested parties led to the development of the criteria, constraints, measures, and alternatives detailed below. Alternative plans were developed for the Illinois River main stem floodplain and the major tributary floodplains separately. This was appropriate due to the differences inherent in large floodplain rivers such as the Illinois and its tributaries. Further, many of the physical characteristics and assumptions developed for the formulation of the Illinois main stem do not apply to tributaries.

b. Criteria and Constraints

- **Flood Protection Policies.** No increase in flood elevations as required by Illinois law – Illinois state law specifies that any action in the floodplain that increases flood heights is not allowable or must be accompanied by mitigation of adverse effects. Due to the potential high cost associated with these actions, efforts will be made to avoid this threshold.

- **Landowner Interests.** Opportunities to implement restoration projects on private lands may be limited. Real estate acquisition is the sponsor's responsibility, but several strategies can be employed to increase landowner interest. Approaches to address this constraint are high levels of stakeholder involvement in project development, education regarding the benefits of restoration projects, and sponsor acquisition of voluntary easements and/or fee title to property as opportunities present themselves. No Federal site investigations (such as surveys or geotech investigations) will be conducted without contacting property owners and obtaining permission to access potential project areas.

- **Existing Altered River Hydrology and Water Quality.** Unnatural water level fluctuations throughout the system make it difficult to restore habitats. Efforts undertaken under system Goal 5 will improve conditions for floodplain habitats, and restoration of large areas of floodplain habitats, in particular wetlands, will help improve hydrologic conditions throughout the system. Design of specific project features can be done so that the unnatural effects of water level fluctuations are minimized and the sustainability of the feature is maximized.

- **Impacts on Local Tax Base.** Implementation of large-scale restoration in the Illinois River Basin floodplain, either through acquisition of land or easements, could have an impact upon local taxing authorities if future owners pay less taxes or none at all. Most of the floodplain is rural in nature and in some cases is a significant portion of a county's tax base. Negative impacts to that tax base would potentially generate public opposition to restoration. However, tax base decline could be offset by revenue generated through consumptive and non-consumptive wildlife uses.

c. Measures. Potential measures for implementation cover a wide range of practices designed to improve aquatic, floodplain, and riparian habitats. The following list shows the potential restoration measures that could be implemented under this program, with those in bold being evaluated for direct restoration benefits and costs. Site-specific investigations will be critical for optimization of project measures to be used. These measures correspond with those found in Section 4.

Aquatic, Floodplain, and Riparian Restoration Measures

- **Riffle Structures**
- **Channelization Remeander**
- In-Stream Structures (rock piles, lunkers, etc.)
- Moist Soil Units

- **Gated Levee**
- **Wetland Restoration**
- Lateral Wetlands
- Levee Setback
- Filter Strips/Contour Buffer Strips
- Riparian Forest Buffer
- **Wetland Plantings**
- **Mast Tree Planting**
- **Prairie Planting**
- Timber Stand Improvement
- Invasive Species Management

d. Alternative Plans. Alternative plans for the Illinois River floodplain and riparian areas are shown in tables 3-34 and 3-35. These plans represent incremental restoration efforts. The assumed distribution of major habitat types is based on the historic land cover distribution. This distribution serves more as a general guide than an absolute definition of what is to be restored; factors influencing the actual distribution of cover types will include availability of restorable land, limiting factors within the navigation pools, site-specific conditions, and cost. Further, suggested restoration levels for each cover type are based on the rate of loss from historical percentages. Due to the varied survey methods employed during the early 1800s, wetlands are significantly underrepresented in the historic data. Therefore, a panel of interagency floodplain experts was tasked with developing a weighting factor that more accurately reflected wetlands on the historical landscape in the main stem and tributary floodplains. As noted in the Forested and Non-Forested Wetlands category in tables 3-34 and 3-35, a percentage of historic forest and grassland was assumed to be wetlands and accounted for here. Finally, it is assumed that, due to the current degraded condition of the ecosystem and the floodplain and riparian components, that any restoration of forested, grassland, and wetlands will provide benefits to the system. Site-specific assessments will have to be conducted in order to optimize benefits vs costs.

Table 3-34. Illinois River Main Stem Floodplain and Riparian Alternatives

Illinois River Main Stem Floodplain Alternatives	Acres Restored	Forest	Grassland	Forested and Non-Forested Wetlands [1]	Total
3MA	0	0	0	0	0
3MB	5,000	1,700	1,200	2,100	5,000
3MC	10,000	3,400	2,400	4,200	10,000
3MD	20,000	6,800	4,800	8,400	15,000
3ME	40,000	13,600	9,600	16,800	40,000
3MF	75,000	25,300	18,000	31,700	75,000
3MG	150,000	50,700	36,000	63,300	150,000

[1] This cover type includes two types of wetlands. It combines an equivalent Forest cover type value with values indicated in the GLO data. This results from the assumption that approximately half of the historical forests cover type could be characterized as wetlands.

Table 3-35. Illinois River Basin Tributary Floodplain and Riparian Alternatives

Illinois River Basin Tributary Floodplain Alternatives	Acres Restored	Forest	Grassland	Forested and Non-Forested Wetlands [1]	Total
3TA	0	0	0	0	0
3TB	5,000	900	900	3,200	5,000
3TC	10,000	1,900	1,800	6,300	10,000
3TD	15,000	2,900	2,700	9,400	15,000
3TE	20,000	3,800	3,600	12,600	20,000
3TF	40,000	7,600	7,200	25,200	40,000
3TG	75,000	13,900	13,500	47,600	75,000
3TH	150,000	27,800	27,000	95,200	150,000

[1] This cover type includes two categories of wetlands. It combines an equivalent Forest and Prairie cover type value with values indicated in the GLO data. This results from the assumption that approximately 25% of the historical forest and prairie cover type could be characterized as wetlands.

Alternative plans for in-stream aquatic habitat restoration were developed on roughly equal intervals of restoration. At this scale and with the level of information available, it is impossible to state with any degree of certainty the specific quantities and types of restoration practices to be implemented. Restoration alternatives were chosen for evaluation based on the desired future condition of 1,000 miles of restored streams. Intervals of miles restored are 25, 50, 100, 250, 500, and 1,000 miles.

3. Evaluation and Comparison of Plans

The plan components developed for the main stem, tributaries, and streams in the basin are listed in table 3-36 with corresponding costs. It is assumed that that benefits can be compared on a per-acre and stream-mile basis; further site-specific analysis will be necessary to optimize project characteristics.

Detailed cost estimates can be found in Appendix E. Further, the Programmatic and Real Estate Cost Estimates for measures used in generating programmatic costs can be found Appendix F. A number of assumptions have gone into the cost estimates found in tables 3-36 through 3-38. For main stem restoration alternatives, costs were generated using the average costs of measures relevant to the major cover type. These costs were $3,900 per acre for forest restoration, $2,000 per acre for grassland, and $8,650 per acre for wetland restoration. Further, it was assumed that while ecosystem improvements would occur on the entire acreage of an alternative, only half of the acreage would be subject to construction activities and associated costs. For example, berm construction and plantings in a portion of the site could benefit the entire site by impacting the hydrology and providing a seed source. The remaining acres would see ecological benefits accrue through natural succession and or restored hydrology. These per-acre costs were multiplied by half of the acreage distributions found in table 3-34. Additionally, its was assumed that at each level of restoration an incremental number of gated levees and rehabilitation of environmental levees would occur. These features range from one set in Alternative 3MB to 16 in Alternative 3MG. The addition of the four measures resulted in a first cost for construction to which a 35 percent contingency was added. Engineering and Design (E&D) during construction was estimated to be 30 percent of adjusted first cost of construction. Supervision and Administration (S&A) for construction contracts was estimated to be 9 percent of first cost for construction. Real Estate estimates assumed fee title acquisition costs of $3,000 per acre. This per acres cost was applied to all of the acres for each restoration alternative. The restoration cost for each alternative is the combination of the first cost of construction, E&D, S&A, and Real Estate costs.

For in-stream aquatic restoration alternatives, costs were generated using the average per-mile costs of riffles and channel remeandering. It was assumed that approximately 75 percent of aquatic restoration would involve riffles while the remaining 25 percent would be dedicated to channel remeander. Estimated costs per mile for riffles are $792,000. Approximately 16.5 percent will be of the larger tributary type shown in the programmatic cost sheet, with the remaining 83.5 percent being of the type constructed on minor tributaries. Depending on the size of the stream, the number of structures required ranges from four per mile for large tributaries to 22 for minor tributaries. Stream remeandering costs are estimated at $2,347,000 per mile. Costs for Real Estate were estimated at $93,200 per mile for riffles and $728,700 per mile for remeandering. Contingency, E&D, S&A and Real Estate contingencies were the same as above. The restoration cost for each alternative is the combination of the first cost of construction, E&D, S&A, and Real Estate costs.

A similar methodology was applied for the estimation of tributary restoration costs shown in table 3-37. Tributary alternative costs are based on average costs per practice distributed according to the acres suggested in table 3-35. No environmental levees or gates are included in this estimate.

Table 3-36. Main Stem Floodplain and Riparian Alternatives Cost Estimate

Illinois River Main Stem Floodplain Alternatives	Acres Restored	First Cost of Construction 35% Contingency	Planning, Engineering and Design 30%	Supervision and Administration 9%	Real Estate Including Contingency [1]	Total First Cost
3MA	0				$0	$0
3MB	5,000	$21,574,000	$6,472,000	$1,942,000	$15,093,000	$45,080,000
3MC	10,000	$43,147,000	$12,944,000	$3,883,000	$30,186,000	$90,161,000
3MD	20,000	$86,295,000	$25,888,000	$7,767,000	$60,372,000	$180,322,000
3ME	40,000	$166,155,000	$49,847,000	$14,954,000	$120,744,000	$351,700,000
3MF	75,000	$301,727,000	$90,518,000	$27,155,000	$226,398,000	$645,799,000
3MG	150,000	$603,133,000	$180,940,000	$54,282,000	$452,797,000	$1,291,152,00

Table 3-37. Tributary Floodplain and Riparian Alternatives Cost Estimate

Illinois River Basin Tributary Floodplain Alternatives	Acres Restored	First Cost of Construction 35% Contingency	Planning, Engineering and Design 30%	Supervision and Administration 9%	Real Estate Including Contingency [1]	Total First Cost
3TA	0	$0	$0	$0	$0	$0
3TB	5,000	$22,268,000	$6,680,000	$2,004,000	$21,910,000	$52,863,000
3TC	10,000	$44,216,000	$13,265,000	$3,979,000	$43,820,000	$105,280,000
3TD	15,000	$66,164,000	$19,849,000	$5,955,000	$65,730,000	$157,697,000
3TE	20,000	$88,432,000	$26,530,000	$7,959,000	$87,640,000	$210,560,000
3TF	40,000	$176,864,000	$53,059,000	$15,918,000	$175,280,000	$421,120,000
3TG	75,000	$332,741,000	$99,822,000	$29,947,000	$328,650,000	$791,160,000
3TH	150,000	$665,483,000	$199,645,000	$59,893,000	$657,300,000	$1,582,321,000

Table 3-38. Aquatic Habitat Restoration Alternatives Cost Estimate

Aquatic Habitat Restoration Alternatives	Stream Miles	First Cost of Construction 35% Contingency	Planning, Engineering and Design 30%	Supervision and Administration 9%	Real Estate Including Contingency [1]	Total First Cost
3SA	0	$0	$0	$0	$0	$0
3SB	25	$40,044,000	$12,013,000	$3,604,000	$6,302,000	$61,964,000
3SC	50	$80,089,000	$24,027,000	$7,208,000	$12,604,000	$123,927,000
3SD	100	$160,178,000	$48,053,000	$14,416,000	$25,207,000	$247,854,000
3SE	250	$400,444,000	$120,133,000	$36,040,000	$63,018,000	$619,635,000
3SF	500	$800,888,000	$240,266,000	$72,080,000	$126,037,000	$1,239,271,000
3SG	1000	$1,601,775,000	$477,495,000	$143,249,000	$252,074,000	$2,478,541,000

[1] Real Estate costs do not include acquisition or appraisal costs.

Annual O&M costs for the alternative plans were estimated and are summarized in table 3-39.

Table 3-39. Annual Operation and Maintenance Costs for Alternative Plans

Illinois River Main Stem Floodplain Alternatives	Acres Restored	Annual O&M
4A	0	
4B	5,000	$162,000
4C	10,000	$324,000
4D	20,000	$648,000
4E	40,000	$1,295,000
4F	75,000	$2,419,000
4G	150,000	$4,843,000

Illinois River Basin Tributary Floodplain Alternatives	Acres Restored	Annual O&M
4A	0	0
4B	5,000	$129,000
4C	10,000	$262,000
4D	15,000	$396,000
4E	20,000	$525,000
4F	40,000	$1,049,000
4G	75,000	$1,951,000
4H	150,000	$3,902,000

Aquatic Habitat Restoration Alternatives	Stream Miles	Annual O&M
4SA	0	
4SB	25	$79,000
4SC	50	$157,000
4SD	100	$314,000
4SE	250	$786,000
4SF	500	$1,572,000
4SG	1000	$3,143,000

4. Plans Recommended for System Evaluation. The alternative plans developed are all recommended for consideration at the system level.

a. Risk and Uncertainties. Reestablishment of large areas of habitat within the floodplains and aquatic systems of the basin will produce significant ecosystem benefit. However, continued water level fluctuations, excessive erosion, and sedimentation will degrade current and future aquatic, floodplain and riparian areas.

Another general consideration for the future is a landscape free of introduced species that can change the look and makeup of an entire system, thereby changing species composition, decreasing rare species, and even changing or degrading the normal functioning of the system. Once the invasive species have been controlled or eliminated and restoration is initiated, ecosystems may see lost components or functions restored.

b. Information and Further Study Needs. At this time, no further investigations other than those identified in the monitoring plan are envisioned.

separately. This was appropriate due to the differences inherent in large floodplain rivers such as the Illinois and its tributaries. Further, many of the physical characteristics and assumptions developed for the formulation of the Illinois main stem do not apply to tributaries.

b. Criteria and Constraints

- **Flood Protection Policies.** No increase in flood elevations as required by Illinois law – Illinois state law specifies that any action in the floodplain that increases flood heights is not allowable or must be accompanied by mitigation of adverse effects. Due to the potential high cost associated with these actions, efforts will be made to avoid this threshold.

- **Landowner Interests.** Opportunities to implement restoration projects on private lands may be limited. Real estate acquisition is the sponsor's responsibility, but several strategies can be employed to increase landowner interest. Approaches to address this constraint are high levels of stakeholder involvement in project development, education regarding the benefits of restoration projects, and sponsor acquisition of voluntary easements and/or fee title to property as opportunities present themselves. No Federal site investigations (such as surveys or geotech investigations) will be conducted without contacting property owners and obtaining permission to access potential project areas.

- **Existing Altered River Hydrology and Water Quality.** Unnatural water level fluctuations throughout the system make it difficult to restore habitats. Efforts undertaken under system Goal 5 will improve conditions for floodplain habitats, and restoration of large areas of floodplain habitats, in particular wetlands, will help improve hydrologic conditions throughout the system. Design of specific project features can be done so that the unnatural effects of water level fluctuations are minimized and the sustainability of the feature is maximized.

- **Impacts on Local Tax Base.** Implementation of large-scale restoration in the Illinois River Basin floodplain, either through acquisition of land or easements, could have an impact upon local taxing authorities if future owners pay less taxes or none at all. Most of the floodplain is rural in nature and in some cases is a significant portion of a county's tax base. Negative impacts to that tax base would potentially generate public opposition to restoration. However, tax base decline could be offset by revenue generated through consumptive and non-consumptive wildlife uses.

c. Measures. Potential measures for implementation cover a wide range of practices designed to improve aquatic, floodplain, and riparian habitats. The following list shows the potential restoration measures that could be implemented under this program, with those in bold being evaluated for direct restoration benefits and costs. Site-specific investigations will be critical for optimization of project measures to be used. These measures correspond with those found in Section 4.

Aquatic, Floodplain, and Riparian Restoration Measures

- **Riffle Structures**
- **Channelization Remeander**
- In-Stream Structures (rock piles, lunkers, etc.)
- Moist Soil Units

- **Gated Levee**
- **Wetland Restoration**
- Lateral Wetlands
- Levee Setback
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- Riparian Forest Buffer
- **Wetland Plantings**
- **Mast Tree Planting**
- **Prairie Planting**
- Timber Stand Improvement
- Invasive Species Management

d. Alternative Plans. Alternative plans for the Illinois River floodplain and riparian areas are shown in tables 3-34 and 3-35. These plans represent incremental restoration efforts. The assumed distribution of major habitat types is based on the historic land cover distribution. This distribution serves more as a general guide than an absolute definition of what is to be restored; factors influencing the actual distribution of cover types will include availability of restorable land, limiting factors within the navigation pools, site-specific conditions, and cost. Further, suggested restoration levels for each cover type are based on the rate of loss from historical percentages. Due to the varied survey methods employed during the early 1800s, wetlands are significantly underrepresented in the historic data. Therefore, a panel of interagency floodplain experts was tasked with developing a weighting factor that more accurately reflected wetlands on the historical landscape in the main stem and tributary floodplains. As noted in the Forested and Non-Forested Wetlands category in tables 3-34 and 3-35, a percentage of historic forest and grassland was assumed to be wetlands and accounted for here. Finally, it is assumed that, due to the current degraded condition of the ecosystem and the floodplain and riparian components, that any restoration of forested, grassland, and wetlands will provide benefits to the system. Site-specific assessments will have to be conducted in order to optimize benefits vs costs.

Table 3-34. Illinois River Main Stem Floodplain and Riparian Alternatives

Illinois River Main Stem Floodplain Alternatives	Acres Restored	Forest	Grassland	Forested and Non-Forested Wetlands [1]	Total
3MA	0	0	0	0	0
3MB	5,000	1,700	1,200	2,100	5,000
3MC	10,000	3,400	2,400	4,200	10,000
3MD	20,000	6,800	4,800	8,400	15,000
3ME	40,000	13,600	9,600	16,800	40,000
3MF	75,000	25,300	18,000	31,700	75,000
3MG	150,000	50,700	36,000	63,300	150,000

[1] This cover type includes two types of wetlands. It combines an equivalent Forest cover type value with values indicated in the GLO data. This results from the assumption that approximately half of the historical forests cover type could be characterized as wetlands.

Table 3-35. Illinois River Basin Tributary Floodplain and Riparian Alternatives

Illinois River Basin Tributary Floodplain Alternatives	Acres Restored	Forest	Grassland	Forested and Non-Forested Wetlands [1]	Total
3TA	0	0	0	0	0
3TB	5,000	900	900	3,200	5,000
3TC	10,000	1,900	1,800	6,300	10,000
3TD	15,000	2,900	2,700	9,400	15,000
3TE	20,000	3,800	3,600	12,600	20,000
3TF	40,000	7,600	7,200	25,200	40,000
3TG	75,000	13,900	13,500	47,600	75,000
3TH	150,000	27,800	27,000	95,200	150,000

[1] This cover type includes two categories of wetlands. It combines an equivalent Forest and Prairie cover type value with values indicated in the GLO data. This results from the assumption that approximately 25% of the historical forest and prairie cover type could be characterized as wetlands.

Alternative plans for in-stream aquatic habitat restoration were developed on roughly equal intervals of restoration. At this scale and with the level of information available, it is impossible to state with any degree of certainty the specific quantities and types of restoration practices to be implemented. Restoration alternatives were chosen for evaluation based on the desired future condition of 1,000 miles of restored streams. Intervals of miles restored are 25, 50, 100, 250, 500, and 1,000 miles.

3. Evaluation and Comparison of Plans

The plan components developed for the main stem, tributaries, and streams in the basin are listed in table 3-36 with corresponding costs. It is assumed that that benefits can be compared on a per-acre and stream-mile basis; further site-specific analysis will be necessary to optimize project characteristics.

Detailed cost estimates can be found in Appendix E. Further, the Programmatic and Real Estate Cost Estimates for measures used in generating programmatic costs can be found Appendix F. A number of assumptions have gone into the cost estimates found in tables 3-36 through 3-38. For main stem restoration alternatives, costs were generated using the average costs of measures relevant to the major cover type. These costs were $3,900 per acre for forest restoration, $2,000 per acre for grassland, and $8,650 per acre for wetland restoration. Further, it was assumed that while ecosystem improvements would occur on the entire acreage of an alternative, only half of the acreage would be subject to construction activities and associated costs. For example, berm construction and plantings in a portion of the site could benefit the entire site by impacting the hydrology and providing a seed source. The remaining acres would see ecological benefits accrue through natural succession and or restored hydrology. These per-acre costs were multiplied by half of the acreage distributions found in table 3-34. Additionally, its was assumed that at each level of restoration an incremental number of gated levees and rehabilitation of environmental levees would occur. These features range from one set in Alternative 3MB to 16 in Alternative 3MG. The addition of the four measures resulted in a first cost for construction to which a 35 percent contingency was added. Engineering and Design (E&D) during construction was estimated to be 30 percent of adjusted first cost of construction. Supervision and Administration (S&A) for construction contracts was estimated to be 9 percent of first cost for construction. Real Estate estimates assumed fee title acquisition costs of $3,000 per acre. This per acres cost was applied to all of the acres for each restoration alternative. The restoration cost for each alternative is the combination of the first cost of construction, E&D, S&A, and Real Estate costs.

For in-stream aquatic restoration alternatives, costs were generated using the average per-mile costs of riffles and channel remeandering. It was assumed that approximately 75 percent of aquatic restoration would involve riffles while the remaining 25 percent would be dedicated to channel remeander. Estimated costs per mile for riffles are $792,000. Approximately 16.5 percent will be of the larger tributary type shown in the programmatic cost sheet, with the remaining 83.5 percent being of the type constructed on minor tributaries. Depending on the size of the stream, the number of structures required ranges from four per mile for large tributaries to 22 for minor tributaries. Stream remeandering costs are estimated at $2,347,000 per mile. Costs for Real Estate were estimated at $93,200 per mile for riffles and $728,700 per mile for remeandering. Contingency, E&D, S&A and Real Estate contingencies were the same as above. The restoration cost for each alternative is the combination of the first cost of construction, E&D, S&A, and Real Estate costs.

A similar methodology was applied for the estimation of tributary restoration costs shown in table 3-37. Tributary alternative costs are based on average costs per practice distributed according to the acres suggested in table 3-35. No environmental levees or gates are included in this estimate.

Table 3-36. Main Stem Floodplain and Riparian Alternatives Cost Estimate

Illinois River Main Stem Floodplain Alternatives	Acres Restored	First Cost of Construction 35% Contingency	Planning, Engineering and Design 30%	Supervision and Administration 9%	Real Estate Including Contingency [1]	Total First Cost
3MA	0				$0	$0
3MB	5,000	$21,574,000	$6,472,000	$1,942,000	$15,093,000	$45,080,000
3MC	10,000	$43,147,000	$12,944,000	$3,883,000	$30,186,000	$90,161,000
3MD	20,000	$86,295,000	$25,888,000	$7,767,000	$60,372,000	$180,322,000
3ME	40,000	$166,155,000	$49,847,000	$14,954,000	$120,744,000	$351,700,000
3MF	75,000	$301,727,000	$90,518,000	$27,155,000	$226,398,000	$645,799,000
3MG	150,000	$603,133,000	$180,940,000	$54,282,000	$452,797,000	$1,291,152,00

Table 3-37. Tributary Floodplain and Riparian Alternatives Cost Estimate

Illinois River Basin Tributary Floodplain Alternatives	Acres Restored	First Cost of Construction 35% Contingency	Planning, Engineering and Design 30%	Supervision and Administration 9%	Real Estate Including Contingency [1]	Total First Cost
3TA	0	$0	$0	$0	$0	$0
3TB	5,000	$22,268,000	$6,680,000	$2,004,000	$21,910,000	$52,863,000
3TC	10,000	$44,216,000	$13,265,000	$3,979,000	$43,820,000	$105,280,000
3TD	15,000	$66,164,000	$19,849,000	$5,955,000	$65,730,000	$157,697,000
3TE	20,000	$88,432,000	$26,530,000	$7,959,000	$87,640,000	$210,560,000
3TF	40,000	$176,864,000	$53,059,000	$15,918,000	$175,280,000	$421,120,000
3TG	75,000	$332,741,000	$99,822,000	$29,947,000	$328,650,000	$791,160,000
3TH	150,000	$665,483,000	$199,645,000	$59,893,000	$657,300,000	$1,582,321,000

Table 3-38. Aquatic Habitat Restoration Alternatives Cost Estimate

Aquatic Habitat Restoration Alternatives	Stream Miles	First Cost of Construction 35% Contingency	Planning, Engineering and Design 30%	Supervision and Administration 9%	Real Estate Including Contingency [1]	Total First Cost
3SA	0	$0	$0	$0	$0	$0
3SB	25	$40,044,000	$12,013,000	$3,604,000	$6,302,000	$61,964,000
3SC	50	$80,089,000	$24,027,000	$7,208,000	$12,604,000	$123,927,000
3SD	100	$160,178,000	$48,053,000	$14,416,000	$25,207,000	$247,854,000
3SE	250	$400,444,000	$120,133,000	$36,040,000	$63,018,000	$619,635,000
3SF	500	$800,888,000	$240,266,000	$72,080,000	$126,037,000	$1,239,271,000
3SG	1000	$1,601,775,000	$477,495,000	$143,249,000	$252,074,000	$2,478,541,000

[1] Real Estate costs do not include acquisition or appraisal costs.

Annual O&M costs for the alternative plans were estimated and are summarized in table 3-39.

Table 3-39. Annual Operation and Maintenance Costs for Alternative Plans

Illinois River Main Stem Floodplain Alternatives	Acres Restored	Annual O&M
4A	0	
4B	5,000	$162,000
4C	10,000	$324,000
4D	20,000	$648,000
4E	40,000	$1,295,000
4F	75,000	$2,419,000
4G	150,000	$4,843,000

Illinois River Basin Tributary Floodplain Alternatives	Acres Restored	Annual O&M
4A	0	0
4B	5,000	$129,000
4C	10,000	$262,000
4D	15,000	$396,000
4E	20,000	$525,000
4F	40,000	$1,049,000
4G	75,000	$1,951,000
4H	150,000	$3,902,000

Aquatic Habitat Restoration Alternatives	Stream Miles	Annual O&M
4SA	0	
4SB	25	$79,000
4SC	50	$157,000
4SD	100	$314,000
4SE	250	$786,000
4SF	500	$1,572,000
4SG	1000	$3,143,000

4. Plans Recommended for System Evaluation. The alternative plans developed are all recommended for consideration at the system level.

a. Risk and Uncertainties. Reestablishment of large areas of habitat within the floodplains and aquatic systems of the basin will produce significant ecosystem benefit. However, continued water level fluctuations, excessive erosion, and sedimentation will degrade current and future aquatic, floodplain and riparian areas.

Another general consideration for the future is a landscape free of introduced species that can change the look and makeup of an entire system, thereby changing species composition, decreasing rare species, and even changing or degrading the normal functioning of the system. Once the invasive species have been controlled or eliminated and restoration is initiated, ecosystems may see lost components or functions restored.

b. Information and Further Study Needs. At this time, no further investigations other than those identified in the monitoring plan are envisioned.

I. GOAL 4: AQUATIC CONNECTIVITY (FISH PASSAGE). Restore aquatic connectivity on the Illinois River and its tributaries, where appropriate, to restore healthy populations of native species

Problem. There is diminished aquatic connectivity (upstream/downstream) on the Illinois River and its tributaries. Aquatic organisms do not have sufficient access to diverse habitat such as backwater and tributary habitats that are necessary at different life stages. Lack of aquatic connectivity slows repopulation of stream reaches following extreme events such as pollution or flooding and reduces genetic diversity of aquatic organisms.

Objectives

- Restore main stem to tributary connectivity, where appropriate, on major tributaries.
- Restore within tributary connectivity.
- Restore passage for large-river fish at Starved Rock, Marseilles, and Dresden Lock and Dams, where appropriate.

Anticipated Outputs

The dams found throughout the Illinois River Basin block fish movement, but most dams are partially passable under some conditions. For native fish species, fish passage must be available during the appropriate times of the year or life stages, which is often not the case. Expected outputs would include improved fish access to spawning, nursery, and overwintering areas at appropriate times. Connectivity also allows for recolonization and improved genetic diversity of populations of native fish and mussels. While virtually all fish species would benefit, species of particular interest including the State listed river redhorse, greater redhorse, Iowa darter, and numerous shiner species. Freshwater mussels would also benefit, due to the life cycle requirements of utilizing fish species as host to colonize and re-colonize areas. The end result would be greater numbers, health, and species diversity for native fish and mussel populations.

1. Inventory Resource Conditions

a. Historic Conditions. Dam construction is a common disturbance in streams nationwide. Throughout the Illinois River Basin, hundreds of dams, ranging in size from very small weirs to large dams, have been constructed since the early 1800s. During the early development period in the 1800's, dams were constructed to power mills and factories located adjacent to streams. On large rivers such as the Illinois, dams were constructed to aid navigation during the 1840s to 1860s and rebuilt by state and the U.S. Army Corps of Engineers for the current 9-foot navigation channel in the 1930s. Later, dams were constructed along major tributaries for water supply, flood control, and recreation. All along, farmers were building ponds to water livestock and raise fish for food, and other landowners were pooling small streams with weirs for aesthetics. Most recently, ponds, dry dams, and water and sediment control basins (WASCOBS) are being constructed through U.S. Department of Agriculture programs to help reduce water and sediment transport to streams. The U.S. Geological Survey has records of about 140 large dams in the Illinois River Basin. There are hundreds more small dams documented by other agencies and many more that are undocumented. Seven dams on the Illinois Waterway and approximately 467 dams within the basin are considered in this report for fish passage.

b. Existing Conditions. There are numerous dams throughout the Illinois River Basin. The navigation dams on the main stem Illinois River/Illinois Waterway are located at La Grange, Peoria, Starved Rock, Marseilles, Dresden, Brandon Road, and Lockport. Table 3-40 and figure 3-16 identify the locations of the main stem dams. The lower two dams at La Grange and Peoria are wicket dams and allow open river conditions 48 percent and 42 percent of the time, respectively. The remaining dams hinder fish movement, although there is some incidental fish passage through the lock chambers at all the dams. Table 3-40 shows the opportunity for fish passage based on the percent of time the dam gates are out of the water and free passage conditions exist. In addition to dams, in 2001, a temporary electrical barrier was installed at Illinois RM 296.3 in the Lockport Pool to discourage movement of non-indigenous species between Lake Michigan and the Upper Mississippi River System. A permanent electrical barrier is currently under construction immediately downstream.

Table 3-40. Illinois River Main Stem Dams

Dam	River Mile	Hydraulic Height	% Year Free Passage Conditions Exist [1]
La Grange Lock and Dam	80	10 [2]	48%
Peoria Lock and Dam	158	11 [2]	42%
Starved Rock Lock and Dam	231	19 [3]	0%
Marseilles Lock and Dam	247	24 [3]	0%
Dresden Lock and Dam	271	22 [2]	0%
Brandon Road Lock and Dam	286	34 [2]	0%
Lockport Lock and Dam	291	40 [3]	0%

[1] Upper Mississippi River and Illinois Waterway Cumulative Effects Study, West Consultants Inc., Bellevue, Washington, June 2000.
[2] GIS data layer, National Inventory of Dams, FEMA, Corps 1995-1996.
[3] www.towboat.org/lock.htm

The number and impact of dams on the major tributaries vary. Figure 3-16 shows the existing stream miles that are connected to the main stem of the Illinois River. There are no dams on the main stems of the La Moine River and Mackinaw River. A few dams are located on the main stems of the Sangamon River (figure 3-17), Spoon River (figure 3-18), Vermilion River (figure 3-19), Aux Sable Creek (figure 3-21), and Kankakee River (figure 3-22). Numerous dams are found on the main stem of the Fox River (figure 3-20), DuPage River (figure 3-23), Des Plaines River (figure 3-24), and North Branch of the Chicago River (figure 3-25). Table 3-41 reports the number of dams on the major tributaries and distance of the first dam from the Illinois River.

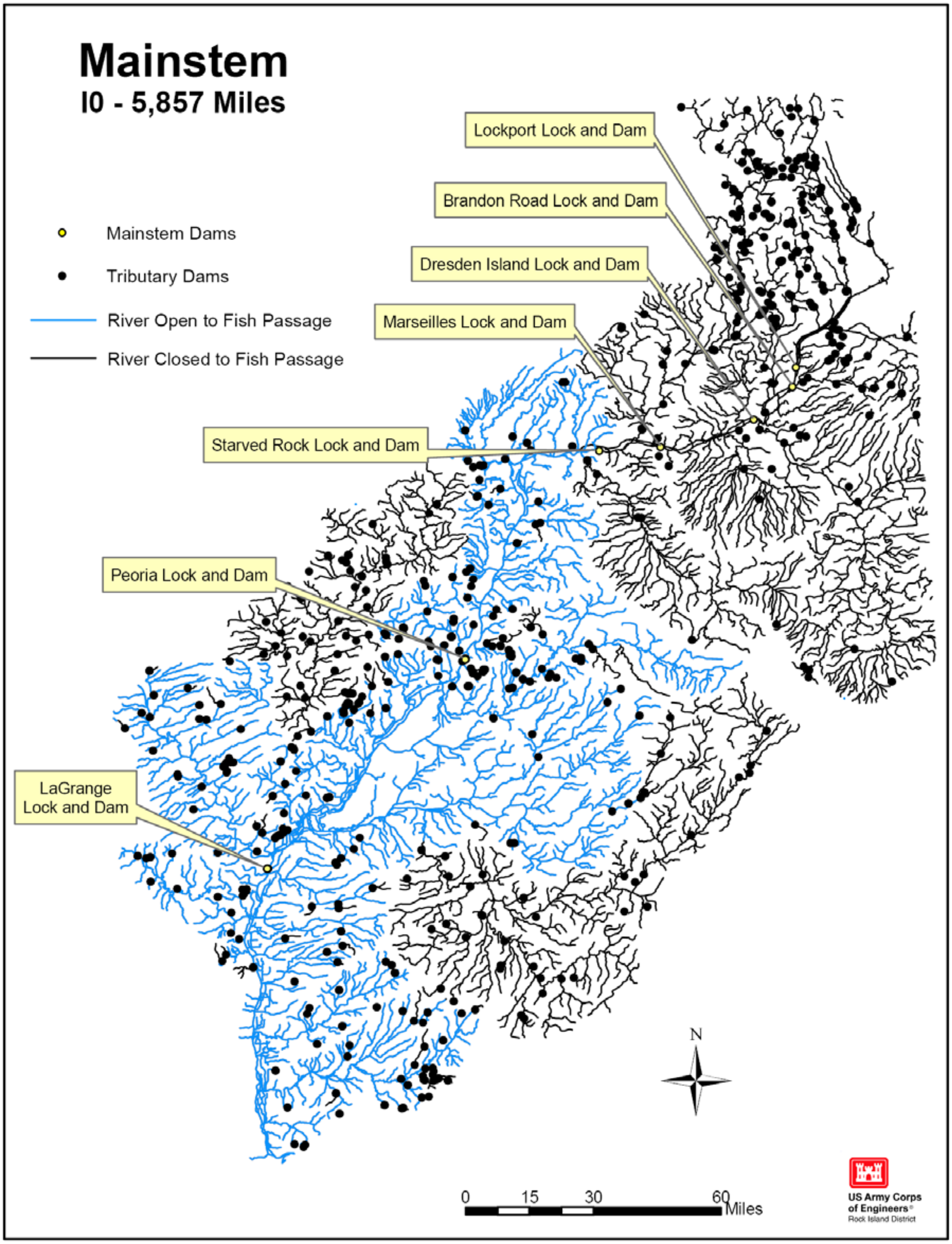


Figure 3-16. Illinois River Existing Connected Stream Segments

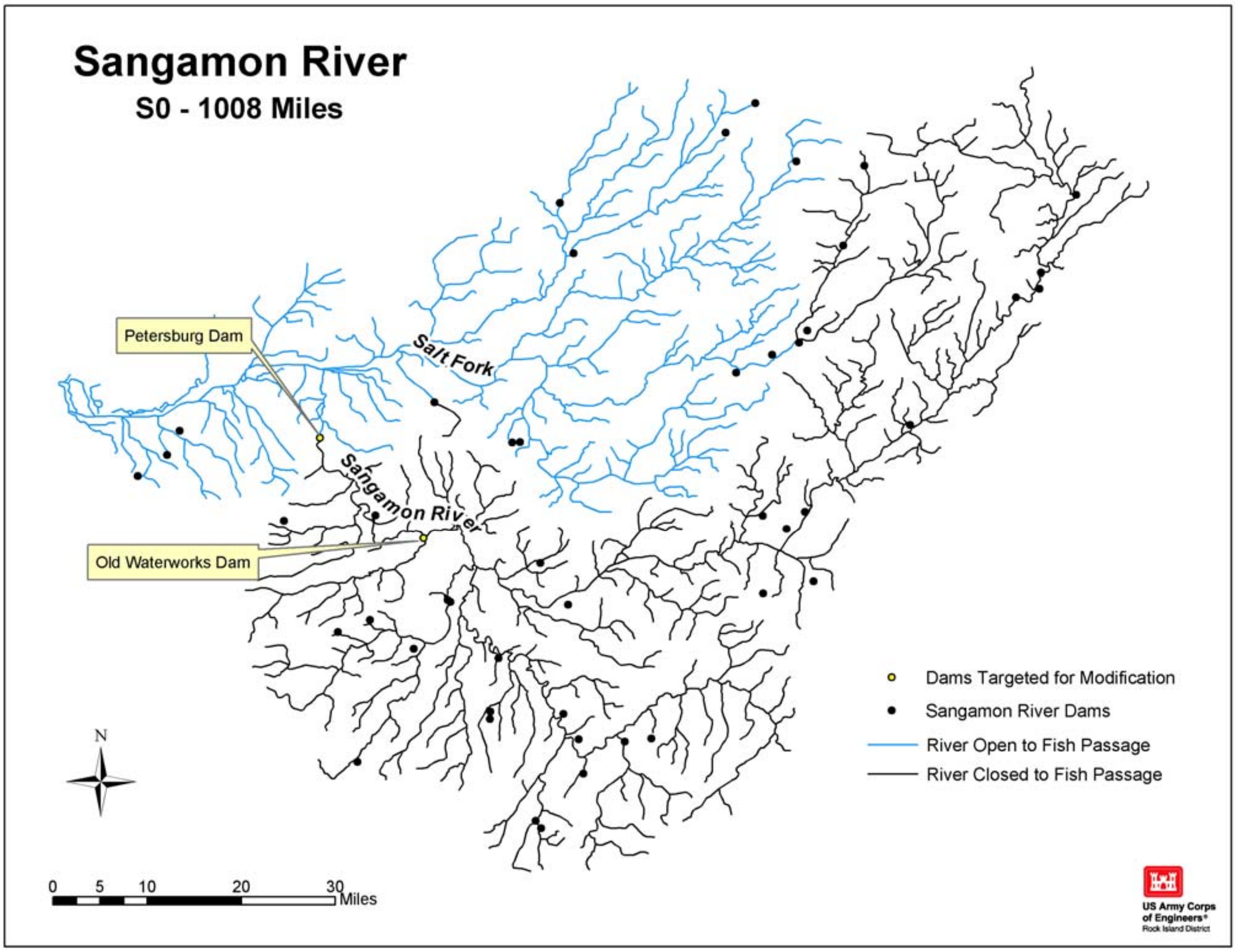


Figure 3-17. Sangamon River Connected Stream Miles

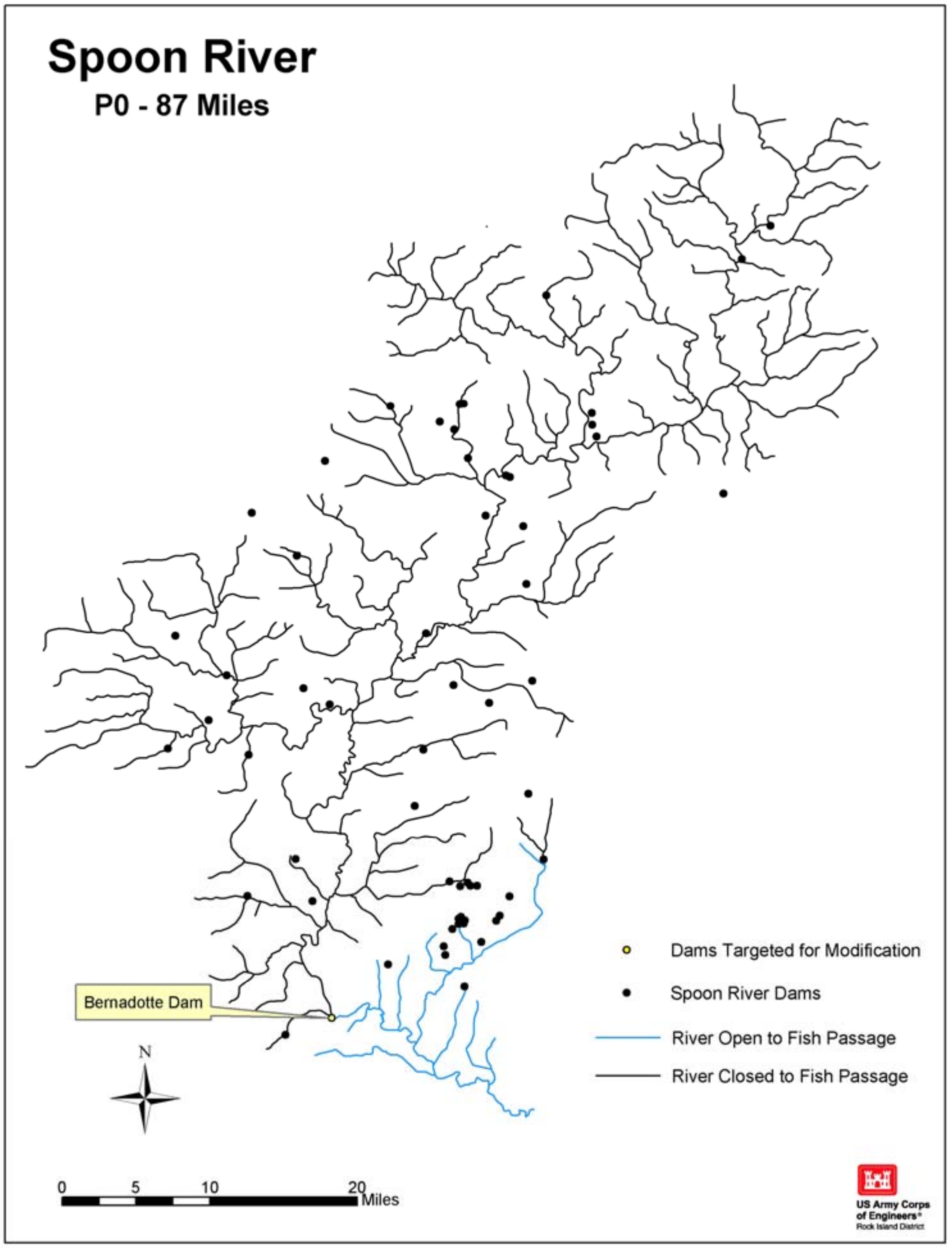


Figure 3-18. Spoon River Connected Stream Miles

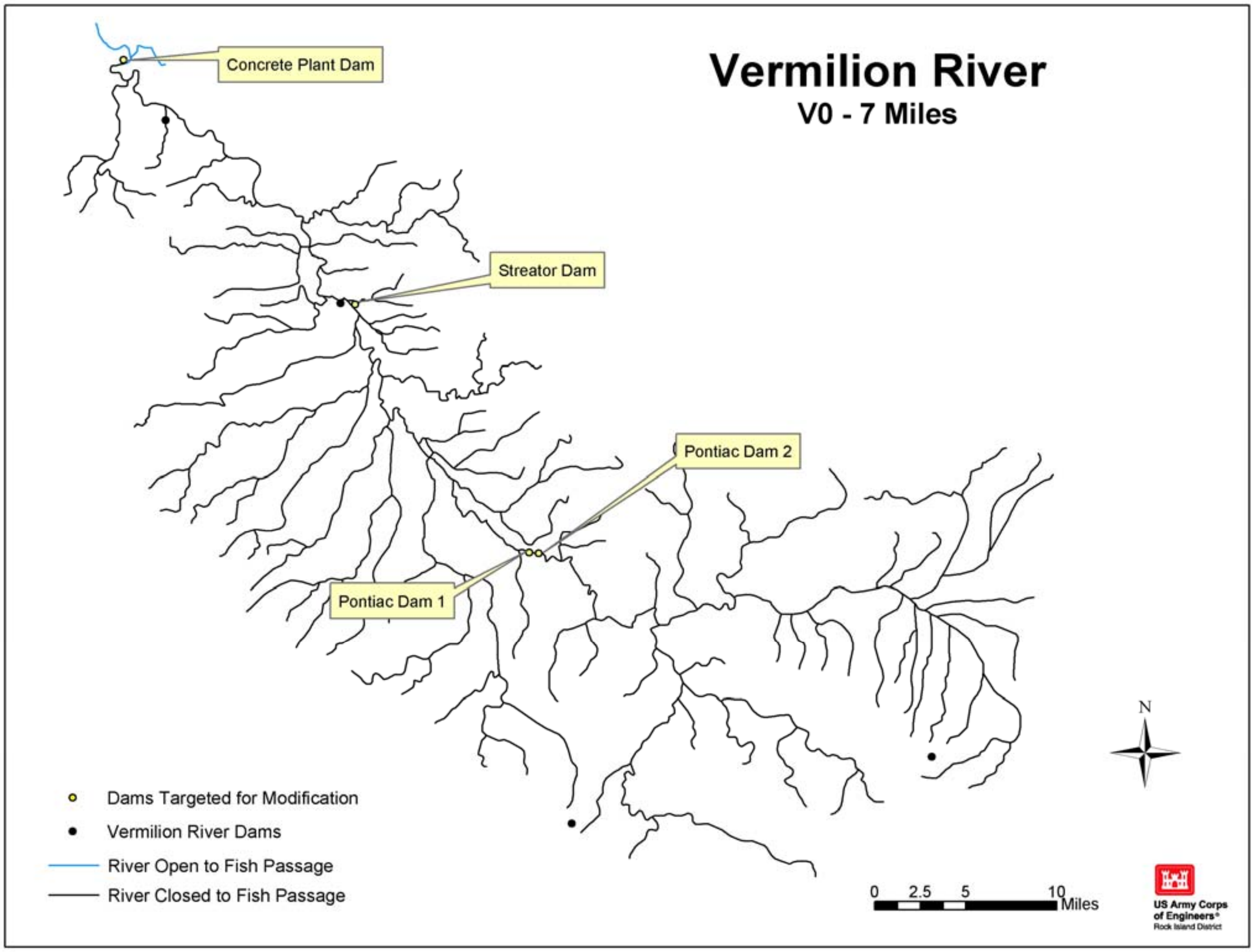


Figure 3-19. Vermilion River Connected Stream Miles

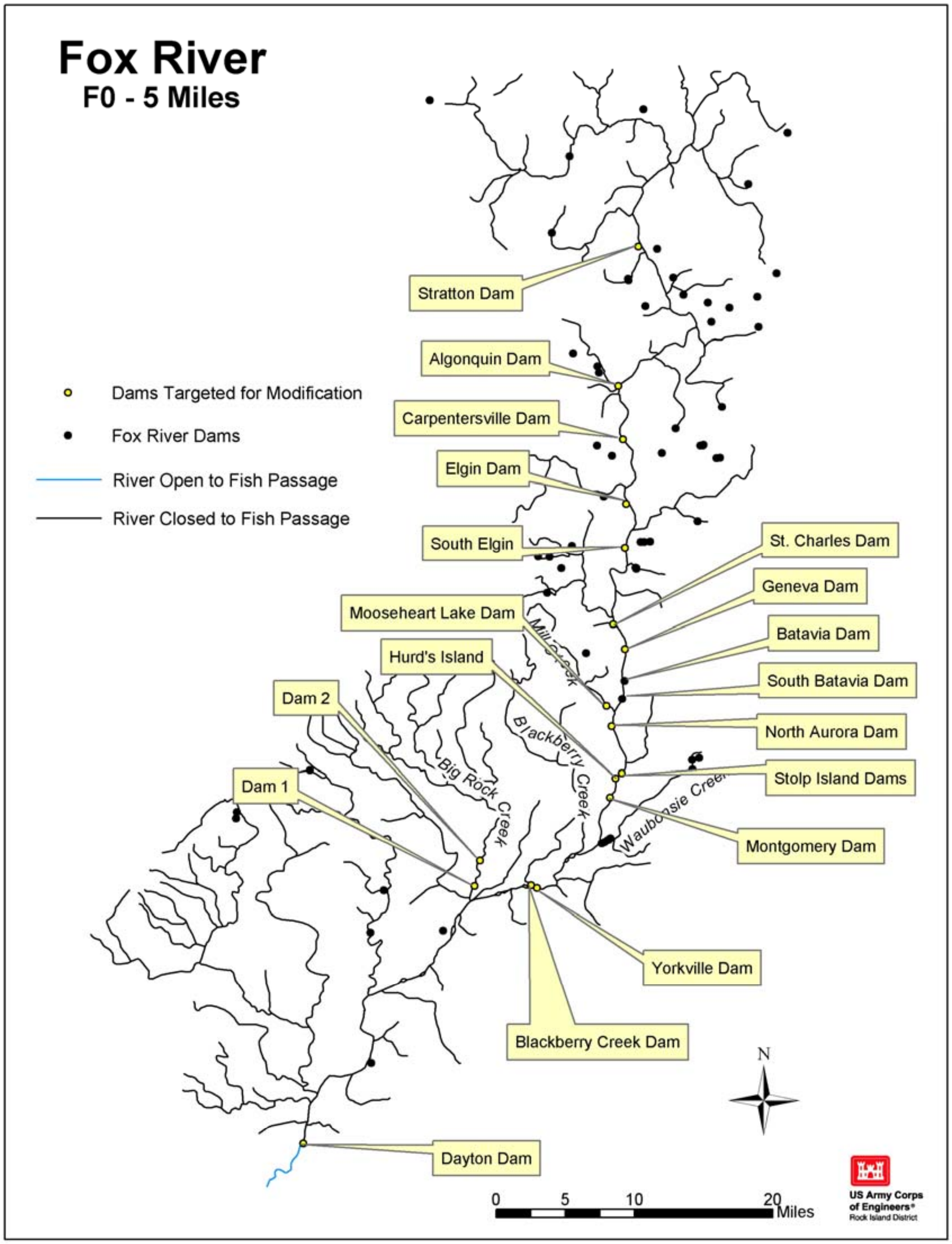


Figure 3-20. Fox River Connected Stream Miles

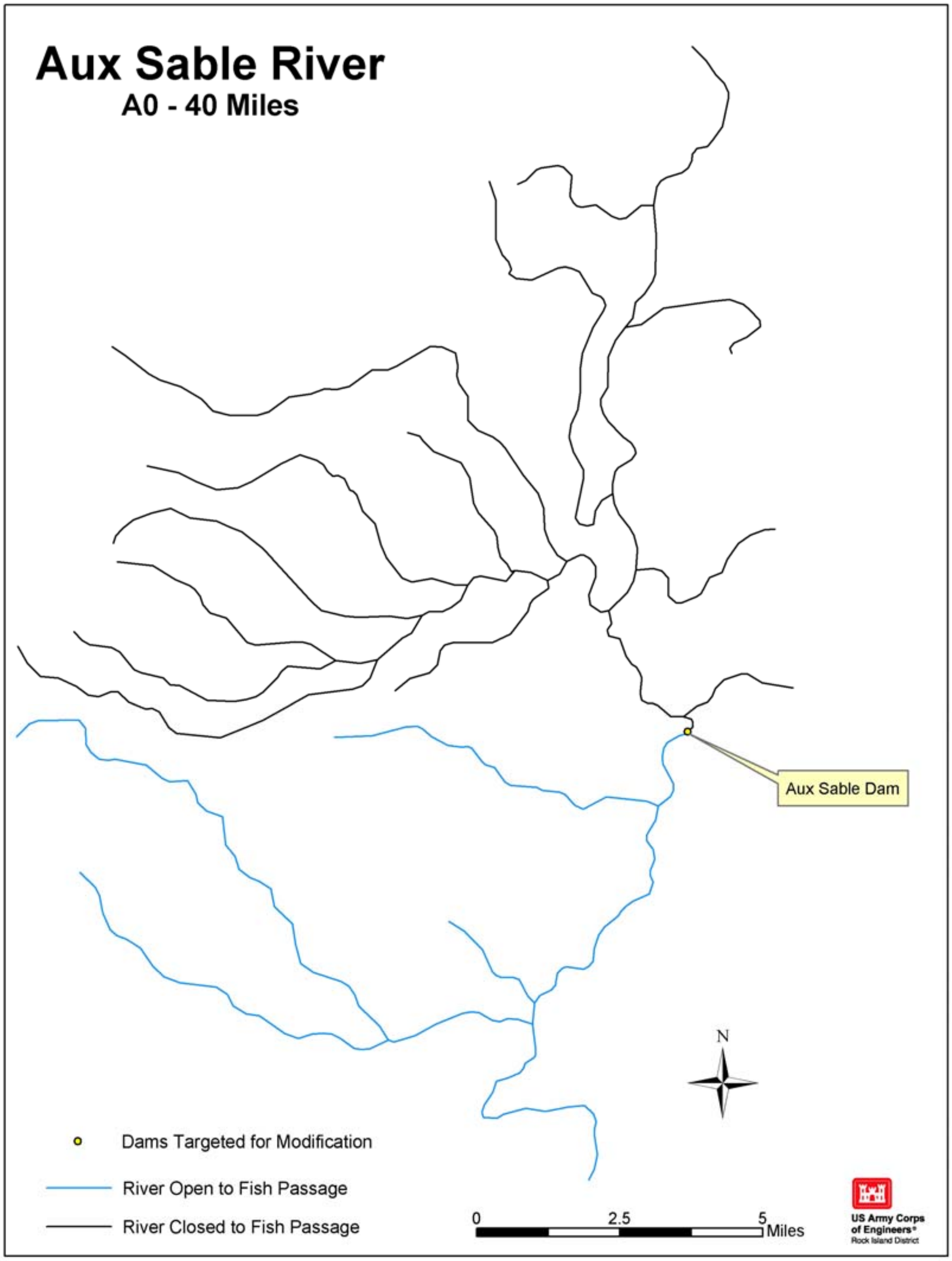


Figure 3-21. Aux Sable Creek Connected Stream Miles

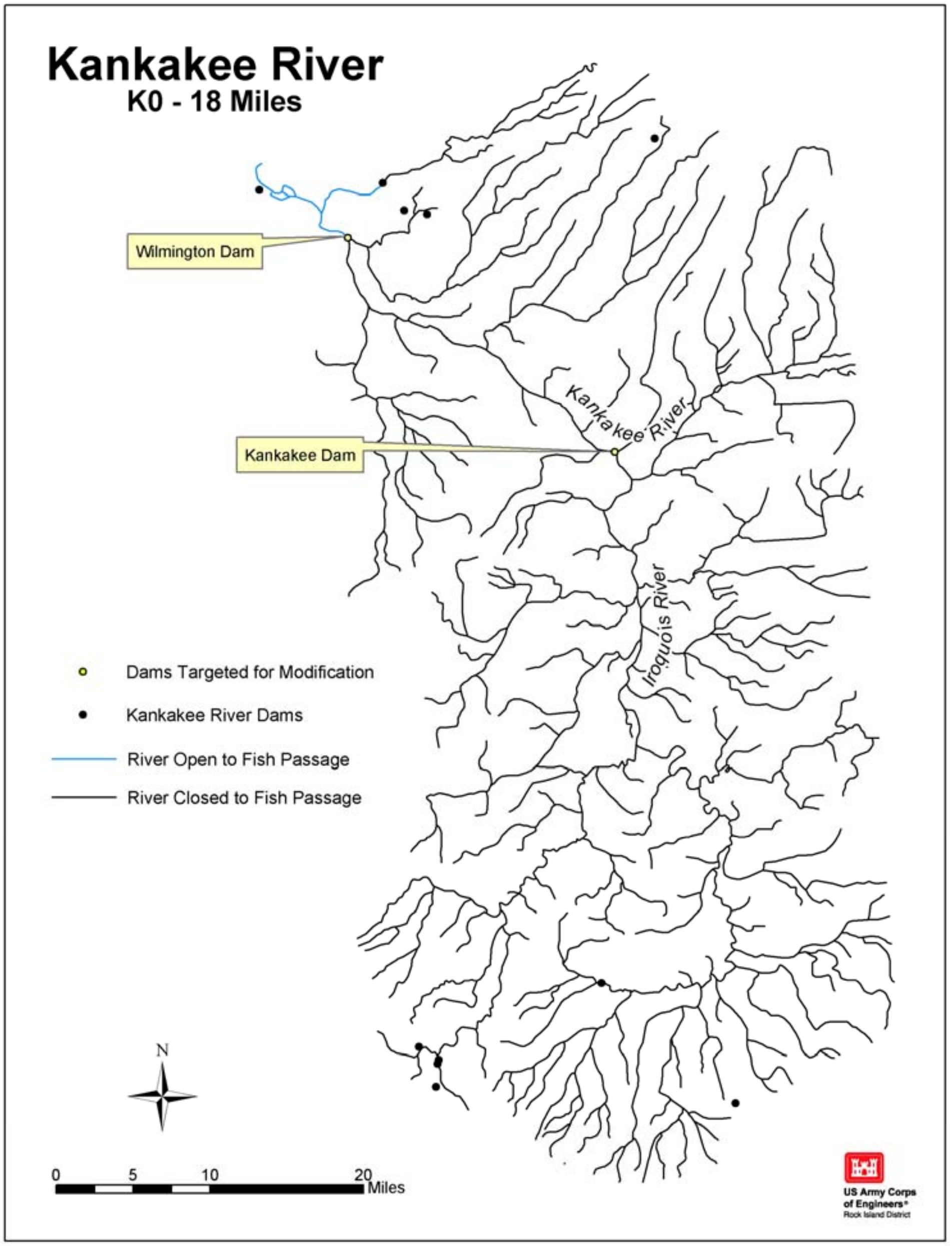


Figure 3-22. Kankakee River Connected Stream Miles

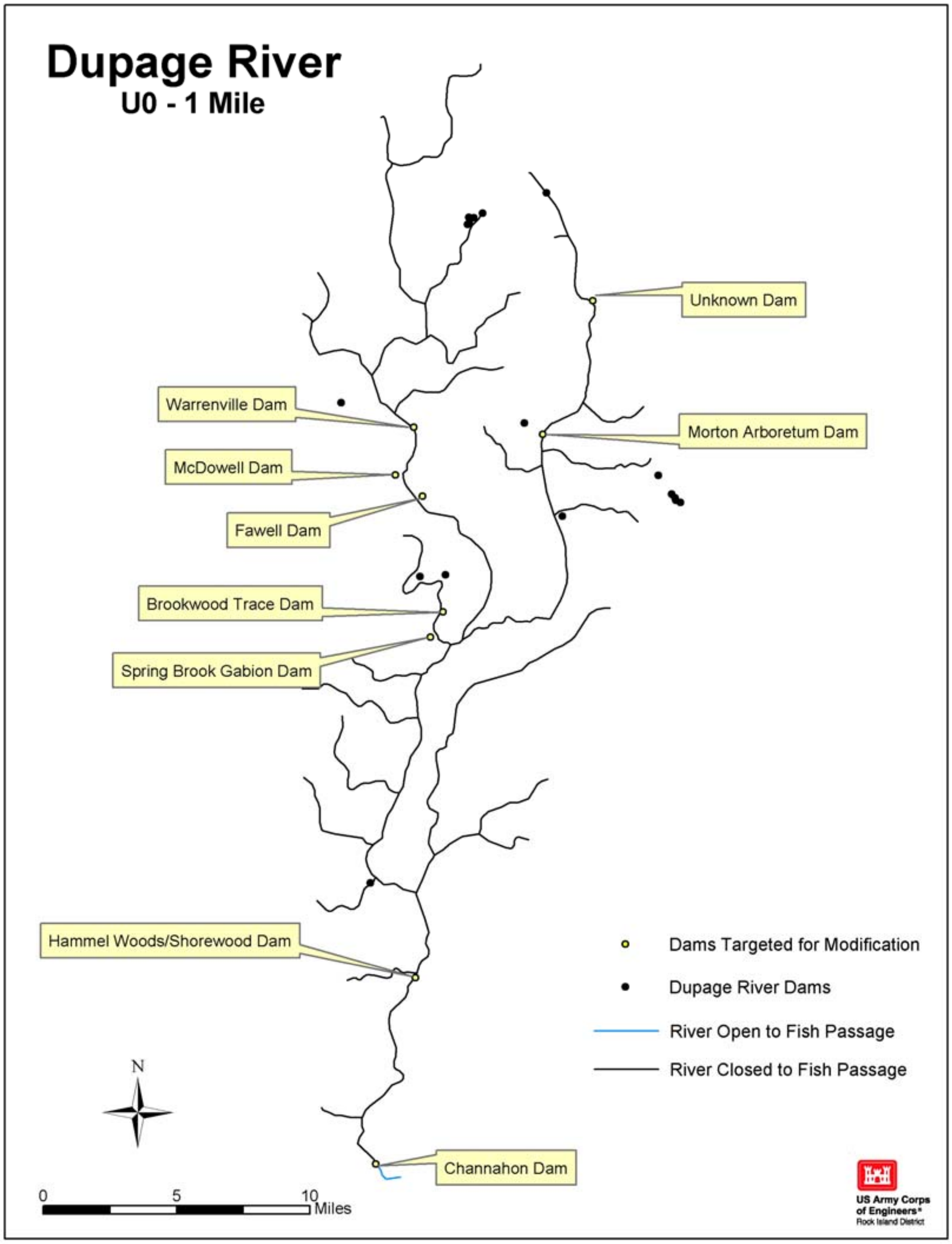


Figure 3-23. DuPage River Connected Stream Miles

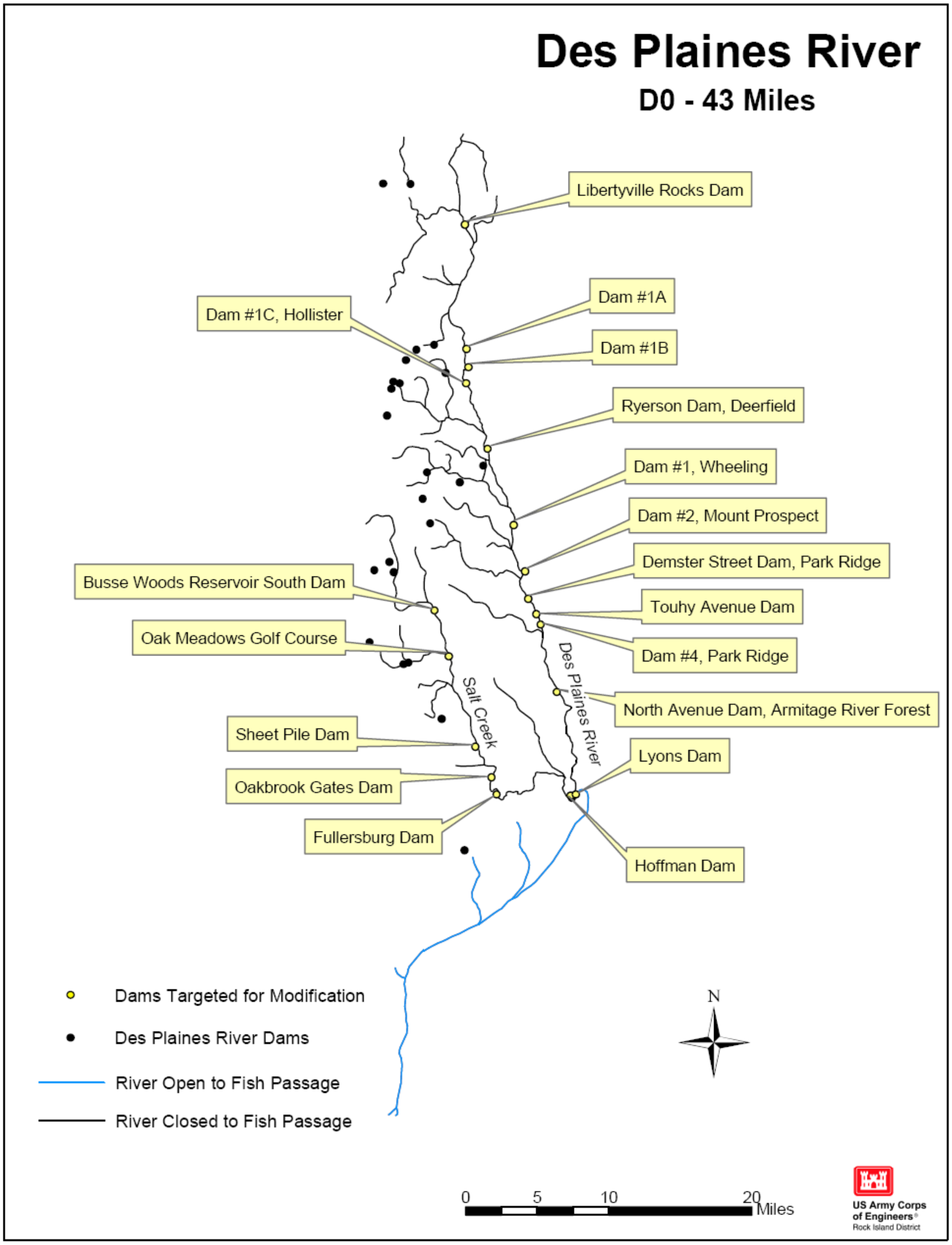


Figure 3-24. Des Plaines River Connected Stream Miles

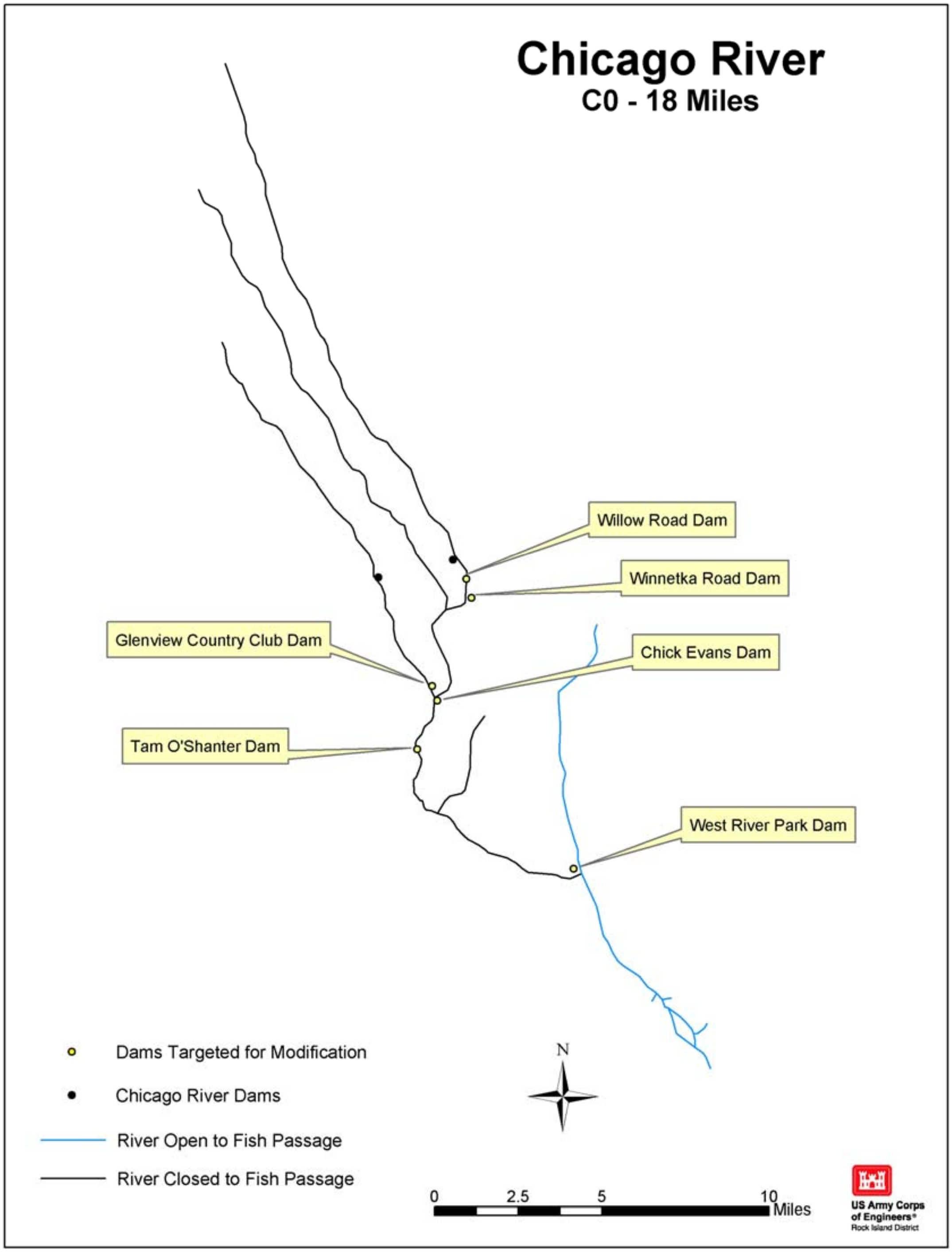


Figure 3-25. Chicago River Connected Stream Miles

Table 3-41. Illinois River Tributaries With First Dam Details

		First Tributary Dam		
Tributary Name	**Dams on Main stem**	**Name**	**Height (ft)**	**RM from Confluence with Illinois River**
Macoupin Creek	N			
Sandy Creek	N			
McKee Creek	N			
La Grange L/D				
LaMoine River	N			
Sangamon River	Y	Petersburg	2-3	42
Salt Fork	Y	Clinton Lake Dam	65	76 [1]
Spoon River	Y	Bernadotte Dam	2-3	27 [1]
Mackinaw River	N			
Peoria L/D				
Vermilion River	Y	Concrete Plan Dam	3-5	6
Starved Rock L/D				
Fox River	Y	Dayton Dam	29.6 [2]	5.7[2]
Marseilles L/D and Dresden L/D				
Kankakee River	Y	Wilmington Dam	5	9.5
DuPage River	Y	Channahon Dam	10	1.5
Brandon Road L/D				
Des Plaines River	Y	Lyons Dam	2	43

Data from National Inventory of Dams - (http://crunch.tec.army.mil/nid/webpages/nid.cfm) – except as noted:
[1] Illinois Streams Information System, Illinois DNR.
[2] Data from Vic Santucci, Max McGraw Wildlife Foundation.

c. Future Without-Project Conditions. Without the project, lack of aquatic connectivity (fish passage) will continue to negatively affect species and populations of aquatic organisms in the Illinois River Basin.

Additional dams may be constructed in the future. The need for potable water for increasing populations in northeastern Illinois may result in construction of dams or modification of existing dams for water supply purposes. It is anticipated that new dams may be constructed to accommodate fish passage; however, any new dams would likely have some impact on connectivity.

It is likely that some of the dams would be removed in the future. Dam removal would be municipality driven and would be related to the costs of continued O&M as well as safety concerns. Municipalities would weigh the benefits and services provided by the dam with the costs of reconstruction, repair, and continued O&M. The Illinois DNR Office of Water Resources is evaluating dam modification or dam removal on State-owned dams.

Fish passage at the Illinois River main stem dams was evaluated under the Upper Mississippi River - Illinois Waterway System Navigation Study, but was not determined to be a high priority on the Illinois River (Wilcox et al. 2004). The low to medium priority ranking was related to the relatively high cost to construct fishways at these sites and the relatively low access to tributary habitat when compared to the Upper Mississippi River dams. Restoration of fish passage at Starved Rock Lock and Dam, Marseilles Lock and Dam, and Dresden Lock and Dam was included in the alternative plan with the maximum amount of ecosystem restoration (USACE 2004b). Restoration of fish passage at Brandon Road Lock and Dam, Lockport Lock and Dam, and T. J. O'Brien Lock and Dam was not considered as this could facilitate dispersal of nonindigenous fish between the Upper Mississippi River System and the Great Lakes.

The success or failure of non-indigenous species barriers will affect connectivity in the future. Construction of a permanent electrical barrier 1,000 feet downstream of the temporary electrical barrier in the Lockport Pool began in 2004.

d. Desired Future Conditions. The desired future condition is a river system that provides connected habitats for native aquatic species, allowing them to utilize critical habitats at critical time periods and recolonize areas after extreme events or disturbance. This connectivity occurs at three scales; major tributary to main stem, within the major tributary basin, and within the main stem of the Illinois River.

The desired future condition is significant connectivity restoration between the main stem and the appropriate major tributaries. The main stem Illinois River would be connected to the majority of its tributaries including the Sangamon, Spoon, Fox, Kankakee, and DuPage Rivers.

The desired future condition is to restore within-tributary connectivity in the major tributary basins. Connectivity along the main stem of the Fox River would be reestablished, and connections would be restored to a few of the Fox River tributaries. Within-tributary connection also would be restored along the main stem of the DuPage, Des Plaines, Kankakee, Vermilion, Sangamon, and Spoon Rivers. Fish passage would be strongly advised for any new dam construction in order to maintain the current degree of connectivity.

The desired future condition is passage of 100 percent of large-river fish on the Illinois River main stem up to RM 286 at Brandon Road Lock and Dam. This would require improved passage at Starved Rock, Marseilles, and Dresden Lock and Dams. The Lockport and Brandon Locks and Dams would continue to block fish movement, thus limiting dispersal of non-indigenous aquatic species between the Upper Mississippi River System and the Great Lakes. Additional study is needed to assess the desirability of facilitating passage at the Brandon Road Lock and Dam. Restored connectivity between the main stem at Brandon Road Lock and Dam and the Des Plaines River is desirable, but this would need to be balanced with the desire to limit dispersal of non-indigenous species.

Restoring aquatic connectivity to aquatic systems restores a measure of ecological integrity to an area. By allowing access to habitats that supply different life requisites for fish species, the future of those species is more likely. In addition, transport of mussel glochidia (freshwater mussel larvae that attach to a vertebrate host for continued life cycle development) by different fish species ensures that mussel communities and species have access to appropriate habitats. Finally, by restoring this component to the ecosystem, some of the building blocks for a healthy and functioning system are restored.

2. Formulation of Alternative Plans

a. Approach/Assumptions. Expert panels and GIS maps were used to formulate and evaluate alternative plans. The GIS maps of dams and stream segments were analyzed to assess relative connectivity within the system. An expert panel of Illinois fisheries biologists from throughout the basin formulated restoration measures for the main stem and each major tributary. The GIS analysis was used to calculate the stream miles connected for each measure. The expert panel then evaluated the relative benefit of restoring connectivity in the various tributaries. The expert panel utilized total stream miles connected and relative benefit information to formulate alternative plans from the measures.

b. Criteria and Constraints. A number of criteria should be considered when formulating plans to restore aquatic connectivity. The magnitude of negative impacts that are caused by the dams was considered. It was assumed that tributaries with high dams, high numbers of dams, or dams close to the confluence with the Illinois River were more negatively impacted. The quality and amount of habitat upstream of the dams was also considered.

Design of site-specific projects to improve connectivity should consider criteria such as swimming speeds and seasonal movement patterns of targeted fish species.

Restoration of connectivity is constrained by the existing use of the dams and their impoundments. Some of the dams provide sufficient water depth for commercial and recreational navigation or hydropower production. This use may also constrain the methods to restore connectivity. Another constraint is the willingness of the dam owners and surrounding communities. Potential contamination of sediments accumulated upstream of the dam may be an issue at some dam locations, constraining potential dam removal.

Restoration of connectivity within tributaries should not increase dispersal of non-indigenous species. Dispersal from the Illinois River to Lake Michigan or from Lake Michigan to the Illinois River is a concern, as well as from the Illinois River to the major tributaries. Non-indigenous species can affect fish and aquatic community diversity by displacing native species and/or modifying their habitat. The Illinois River main stem dams and the electrical barrier currently provide a partial barrier between the Upper Mississippi River System and Lake Michigan. To limit dispersal of non-indigenous species, fish passage should not be restored at Lockport Lock and Dam or the T. J. O'Brien Lock and Dam, which is located on the Calumet-Sag Channel connecting the Illinois River to Calumet Harbor, Lake Michigan. Maintaining these dams does not prevent dispersal of non-indigenous species entirely as they can be transferred to other water bodies through human means such as in bait buckets, live wells, and other accidental means. Non-indigenous species issues should also be considered when reconnecting tributaries to the main stem of the Illinois River.

c. Measures. Fish passage can be accomplished through a variety of techniques. Only the most common methods are discussed here, however, all appropriate techniques should be considered during the site-specific evaluations.

i. Dam Removal. This alternative would consist of the removal of the existing dam (photograph 3-4). This removal would restore 100 percent fish passage at the site. However, many existing dams are highly valued by the surrounding communities, even when there is no longer a specific function for the dam. This measure will be used for ecosystem restoration purposes solely, and should accomplish objectives and produce benefits related to ecological restoration. This measure should not be used to meet regulatory or dam safety requirements. This measure also include significant water quality benefits by removing the often stagnant, shallow pools that form behind dams, thereby increasing dissolved oxygen levels, reducing water temperature, and restoring the flow of gravel, woody debris, and nutrients. This measure would also restore the fish species composition from primarily lacustrine (lake) species back to primarily riverine species.

Photograph 3-4. Before and After Photographs of Dam Removal of Woolen Mills Dam, Wisconsin
www.americanrivers.org

ii. Rock Ramp. Construction of a rock ramp fishway involves placement of stone on the downstream face of the dam to provide a relatively flat 3 to 5 percent gradient (photograph 3-5). Strategic placement of various sized fieldstone would convert the spillway to a more natural looking system of rapids. The roughened chute could be implemented completely across the spillway, converting the entire spillway to a rapids system, or limited to only a portion of the spillway. Pools and eddies would be implemented into the design to slow water velocities and allow resting spots for fish as they travel upstream. Water velocities of 1.5 feet per second or less should be provided throughout the fishway. Besides allowing upstream and downstream fish passage, the rocky bed would create habitat for fish and other aquatic organisms. The mixing action as water passes over and around rocks oxygenates the water, improving water quality. The fishway should be designed to operate under flows equating to the 10- to 90-percent duration range during the months of March, April, and May. During these months, native species such as: walleye, sauger, smallmouth and largemouth bass, northern pike, and channel catfish will be using the fishway to reach suitable upstream spawning grounds. A roughened chute reduces the drowning hazard by eliminating the problem of a downstream hydraulic roller; requires minimal maintenance, minimal real estate acquisition; and is aesthetically pleasing.

Photograph 3-5. Rock Ramp- Otter Tail River, Minnesota

iii. Bypass Channel. The construction of a channel consisting of a series of pool and riffle structures around of the dam is another alternative. A staircased rock and boulder riffle structure would gradually reduce the water level differential between the head and tailwaters of the dam. While this alternative solves the problem of fish passage, the safety risk associated with the hydraulic roller on the downstream face of the dam still exists.

iv. Denil Fishway. Denil Fishways are rectangular chutes or flumes with baffles extending from the sides and bottoms which point upstream (photograph 3-6). The internal roughness created by the baffling controls flow for fish passage. The preferred site would be on the side of the dam where fish tend to congregate. While this alternative solves the problem of fish passage, the safety risk associated with the hydraulic roller on the downstream face of the dam still exists.

Photograph 3-6. Denil Structure at Ipswich Mills Dam, Ipswich, Massachusetts
http://www.mass.gov/dfwele/dmf/publications/tr17_anad_p3_appendix.pdf

d. Alternatives. The study team identified dams throughout the basin that block or inhibit fish migration. Alternatives were developed for the main stem and each tributary basin to increase stream miles of connectivity.

Conditions on the main stem of the Illinois River were evaluated. Because the wicket gates at Peoria and LaGrange Lock and Dams are out of the water 48 percent and 42 percent of the time, respectively, fish passage was not considered necessary at these locations. The main stem dams remaining for consideration as alternatives are Starved Rock, Marseilles, and Dresden Lock and Dams. Adding fish passage at Starved Rock Lock and Dam provides access to the Fox River basin. No major tributaries enter the Marseilles pool; therefore, it was grouped with Dresden Lock and Dam, providing access to the Kankakee and DuPage basins. Finally, the addition of fish passage at Brandon Road Lock and Dam, which provides access to the Des Plaines River, was eliminated at this time in order to continue to block migration of nonindigenous fish between the Upper Mississippi River System and the Great Lakes. The risk associated with and potential benefits of fish passage at this location require further study and may be re-evaluated at a later time.

Tributary restoration alternatives were developed for the Sangamon River, Spoon River, Vermilion River, Fox River, Aux Sable Creek, Kankakee River, DuPage River, Des Plaines River, and North Branch of the Chicago River. Alternatives were developed by grouping specific dams targeted for fish passage. Table 3-42 presents the detailed connectivity alternatives considered. Connected stream miles and incremental gain in stream miles are reported for the various alternatives.

Table 3-42. Detailed Fish Passage Alternatives for the Illinois River Basin

	# of Dams	Stream Miles Connected	Net Increase in Stream Miles Connected
Main Stem		13130[1]	
I0 – No action		5990	
I1 – Fish Passage at Starved Rock	1	6090	100
I2 – Fish Passage at Starved Rock, Marseilles, and Dresden [2]	3	6730	640
Sangamon River		2604[1]	
S0 – No action		1008	
S1 – Fish Passage at Petersburg	1	1808	800
Spoon River		963[1]	
P0 – No action		87	
P1 – Fish passage at the Bernadotte Dam [2]	1	883	796
Vermilion River		715[1]	
V0 – No action		7	
V1 – Fish passage at Concrete Plant	1	144	137
V2 – Fish passage at Concrete Plant and Streator Dams	2	430	286
V3 – Fish passage at Concrete Plant, Streator and Pontiac Dams	4	711	281
Fox River		806[1]	
F0 – No action		5	
F1 – Fish Passage at all main stem dams	12	568	563
F2 – Fish Passage at all main stem dams and 4 tributaries [2]	17	702	134
Aux Sable River		131[1]	
A0 – No action		40	
A1 – Fish passage at Aux Sable Dam [2]	1	131	91
Kankakee River		1308[1]	
K0 – No action		18	
K1 – Fish Passage at Wilmington Dam	1	298	316
K2 – Fish Passage at Wilmington and Kankakee Dams [2]	2	1267	969
DuPage River		170[1]	
U0 – No action			
U1 – Fish passage at all dams on West Branch	5	149	
U2 – Fish passage at all dams on West and East Branch and 1 tributary (Springbrook) [2]	8	168	
Des Plaines River		267[1]	
D0 – No action		43	
D1 – Fish passage at Lyons, Hoffman, and Armitage Dams and 1 tributary (Salt Creek)	7	108	65
D2 – Fish passage at all main stem dams and 1 tributary (Salt Creek) [2]	17	248	140
Chicago River		81[1]	
C0 – No action		18	
C1 – Fish passage at 6 main stem dams	6	55	37

[1] Alternatives do not reconnect all stream miles due to additional dams on tributary systems. Stream miles estimated from GIS coverage (Illinois River Restoration Needs Assessment GIS, Scott A. Tweddale, Construction Engineering Research Laboratory (CERL)).
[2] Denotes system alternative plan

3. Evaluation and Comparison of Plans

Alternatives were evaluated, both qualitatively and quantitatively, and this information was used to formulate the alternative plans.

a. Tributaries. The study team developed the matrix in table 3-43 to qualitatively evaluate and compare potential benefits of restoring fish passage on the major tributaries. The study team used professional judgment based on field experience to estimate the relative negative impacts caused by dams. Biological Stream Characterization (BSC) data for the tributaries was used to estimate stream quality. These two categories were used to assess the relative potential benefits of restoring connectivity on a given tributary and assign a priority for restoring connectivity. Tributaries with low negative fisheries impacts had low to medium priority depending on the stream quality. The Sangamon River was identified as having low impacts due to the single low-head dam that separates two large reaches of river. Tributaries with medium negative fisheries impacts were rated as having medium priority unless stream quality was low. Streams with high negative fisheries impacts were given a high priority. For example, the Fox River has a large number of dams along the main stem and has a high fish species diversity. Restoring connectivity on the Fox, DuPage and Des Plaines Rivers was estimated to have a high potential benefit and was given a high priority. Restoring connectivity on the Spoon, Aux Sable and Kankakee Rivers was estimated to have a medium potential benefit and was assigned a medium priority. Restoring connectivity on the Sangamon, Vermilion, and Chicago Rivers was estimated to have a lower potential benefit and was assigned a low priority.

Table 3-43. Evaluation of Benefits of Fish Passage for the Major Tributaries

River	Negative Fisheries Impacts Caused by Dams	Stream Quality [1]	Priority for Fish Passage
Sangamon	L	M	L
Spoon	M	M-H	M
Vermilion	L	M-H	L
Fox	H	M-H	H
Aux Sable	M-H	H	M
Kankakee	L	H	M
DuPage	H	M	H
Des Plaines	H	M	H
Chicago River	M	L	L

[1] Estimated from Biological Stream Characterization data (Bertrand et al. 1996, ISIS 1999)

The tributaries were grouped by the relative benefits of fish passage to form system connectivity alternatives (table 3-44 and figure 3-26). The cost estimates for tributary passage were based on rock ramp construction. Table 3-44 provides the estimated costs and benefits of the system connectivity alternatives. Benefits are shown in total connected stream miles. The first tributary alternative, 4A, addresses restoring connectivity on the tributaries with a high priority—those tributaries that have been most negatively impacted by dams and with medium to high stream quality. This alternative includes restoring connectivity at all main stem dams and a few tributaries of the Fox River; restoring connectivity at all main stem dams on the DuPage and West Branch of the DuPage River; and restoring connectivity at all main stem dams on the Des Plaines River (figure 3-26). Alternative 4A would reconnect 916 stream miles at an estimated total cost of $52 million.

The second tributary alternative, 4B, includes Alternative 4A with the addition of the dams with medium priority—the main stem dams on the Spoon, Kankakee, and Aux Sable Rivers (figure 3-26). Alternative 4B would reconnect a net 3,052 stream miles.

The third tributary alternative, 4C, includes Alternative 4A+4B, with the addition of restored connectivity on main stem dams of the remaining major tributaries—the Sangamon, Vermilion, and North Branch of the Chicago Rivers (figure 3-26). Alternative 4C would reconnect a net 4,593 stream miles. In spite of the relatively low costs, the study team did not recommend that Alternative 4C be carried forward to the final array of alternatives. Impacts of the Petersburg Dam, on the Sangamon River, are thought to be minimal as the dam is higher up in a large watershed and is passable under some flow conditions. The impacts of the Vermilion River dams are lower as the dams are passable under some flow conditions. Low habitat quality and low water quality on the Chicago River currently limit the potential restoration benefits of fish passage.

b. Main Stem. The main stem alternatives carried forward for evaluation were renamed as follows: I1 and I2 (table 3-42) become 4X and 4Y (table 3-44 and figure 3-26) and reconnect 100 and 740 river miles, respectively. Table 3-44 reports the estimated costs and benefits of the connectivity alternatives.

The study team felt that restoring connectivity *within* tributary basins provided more benefits to the natural resources of the Illinois River Basin than restoring main stem connectivity. The study team did not recommend Alternative 4X that would provide passage only at Starved Rock, which would restore connectivity only to the Fox River. Alternative 4Y, which includes passage at Starved Rock, Marseilles, and Dresden Lock and Dams, was recommended for inclusion in the maximum system alternative plan.

4. Plans Recommended for System Analysis

a. Recommended Alternatives. A cost effectiveness/incremental cost analysis was conducted on the plans outlined in table 3-44 and combinations thereof, resulting in eight possible plans, shown in figure 3-27. Costs for the main stem alternatives were high compared to the amount of connectivity provided, and passage at these dams only became cost effective when combined with tributary connectivity plans. This analysis resulted in four cost effective plans, two of which were also best buys.

Of the two cost effective plans, Alternative 4B+X only provides connectivity to the Starved Rock pool and the Fox River; only 100 tributary steam miles would be reconnected at a cost of approximately $80 million. This alternative was not included into the final array for system alternatives. Alternative 4A, also cost effective, includes streams that are both good quality and highly impacted by dams, therefore given highest priority for fish passage. This alternative plan was recommended as the base plan for system alternatives. Both best buy plans were also recommended for the final array of system alternatives. Table 3-45 shows the final array of alternatives to be carried forward in developing comprehensive system restoration plans.

All system plans would include Blackberry and Waubonsie Creek projects already underway as Critical Restoration Projects. These projects were not included in this analysis.

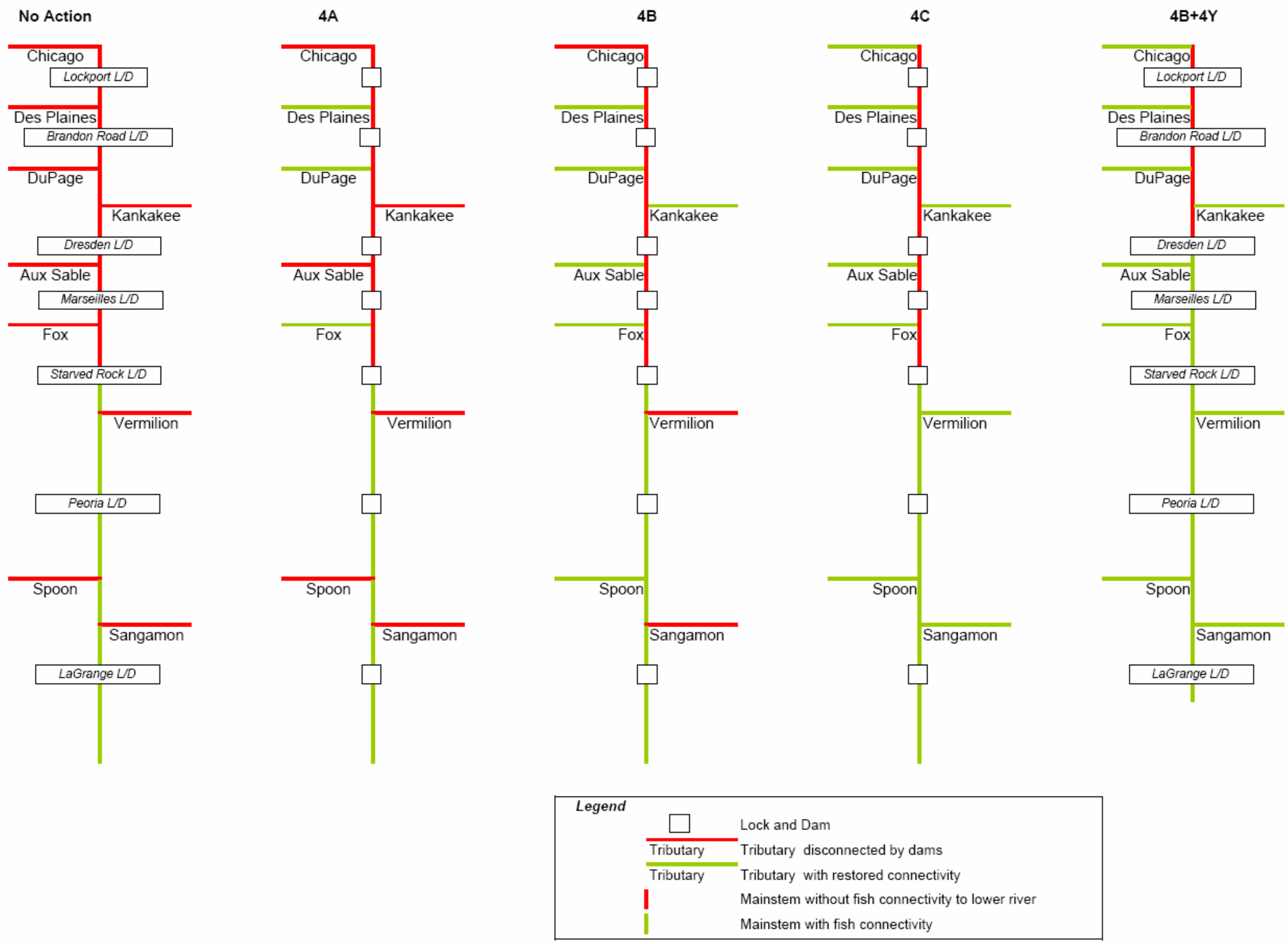


Figure 3-26. Schematic Diagram of Fish Passage Alternatives

Table 3-44. Connectivity Alternatives Evaluated for the Illinois River Basin

	Description	Alternatives From Table 3-42	Number of Dams	Total Connected Stream Miles [1]	Net Connected Stream Miles [2]	Cost [3]	Cost per Connected Stream Mile
Tributary Alternatives							
4A [4]	Fox, DuPage, Des Plaines	F1, U1, D2	34	2,143	916	$52 M	$57,000
4B [4]	Fox, DuPage, Des Plaines, Kankakee, Spoon, Aux Sable	F1, U1, D2, K2, P1, A1	38	4,279	3,052	$55 M	$18,000
4C	Fox, DuPage, Des Plaines, Kankakee, Spoon, Aux Sable, Sangamon, Vermilion, Chicago	F1, U1, D2, K2, P1, A1 S1, V3, C1	49	5,820	4,593	$61 M	$ 13,000
Main Stem Alternatives							
4X	Starved Rock	I1	1	6,090	100	$80 M	$800,000
4Y [4]	Starved Rock, Marseilles, Dresden	I2	3	6,730	740	$235 M	$317,600

[1]Includes total tributary stream miles for Sangamon, Spoon, Vermilion, Fox, Kankakee, DuPage, Des Plaines, and Chicago Rivers. Also used to express beneficial effects from increased connectivity.
[2]Used to express **direct** benefits from increased connectivity.
[3]Includes construction, 35% construction contingency, 30% Planning Engineering and Design, 9% Supervision and Administration, and Real Estate
[4] Denotes system alternative plan

b. Risk and Uncertainty. There are at least 15 introduced fish species in Illinois. Some of these are U.S. natives whose range has been expanded or are species from other parts of the world. There has been a great nationwide increase in the total number of species introduced since 1950, and the proportion on non-U.S. species has also increased significantly (Chick and Pegg 2001). The greatest proportion of non-U.S. species is coming from Asia and South America. The mode of introduction is shifting from intentional releases of food or sport fishes to accidental releases of aquarium fish, aquaculture species, and those carried in international shipping ballast water.

When any fish passage project is proposed, the risk of introducing non-native fish into an area must be considered. The dams found throughout the Illinois River Basin block fish movement, but most dams are partially passable at some time. For native fish species, fish passage must be available during the appropriate times of the year or life stages, which is often not the case. Non-native fish tend to be stronger swimmers than many native species and, because of this, may be able to negotiate sub-optimal passage conditions that would impede more weakly swimming species. Many river fisheries biologists believe that most dams in the basin currently allow non-native species to pass but block native fish species (Sallee, 2004) . Only a very few dams in the basin currently are 100 percent impassable under natural conditions. The risks of introducing non-native species to these areas must be carefully considered. However, even in these areas, people may accidentally release non-native species.

In addition to blocking movement of non-indigenous species, existing dams also retain sediment. While the capacity of many older impoundments to retain sediment has been filled, any dam removal actions may mobilize the stored sediments downstream. For any proposed dam removal, examination of sediment retention benefits, as well as the potential addition of sediment to the system, must be weighed against fish passage benefits. This will be dependent on the volume and nature of the sediment. This issue will be examined on a case by case basis as projects are considered in the future.

c. Information and Further Study Needs

- Tagging studies to better determine movements, timing, habitat use, and design consideration.
- Further discussion, study and consideration of conflicts between restoring connectivity for native fish and mussels and maintaining barriers to limit dispersal of non-indigenous species
- Risk and uncertainty of non-indigenous species
- Community concerns over dam removal

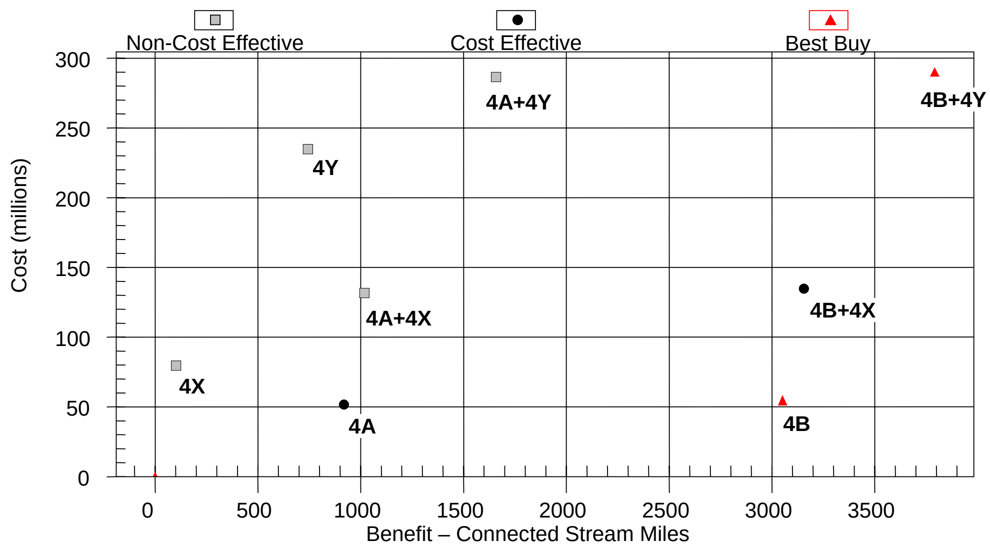


Figure 3-27. Cost Effectiveness of Alternative Plans

Table 3-45. Plans Recommended for System Alternative Plans

Alternative	Tributary	Total Construction Cost [1]	Total Real Estate Cost [2]	Total Estimated Costs	Annual O&M Costs
4A	Fox, DuPage, Des Plaines	$51,147,043	$337,1000	$51,484,143	$152,463
4B	Fox DuPage, Des Plaines, Kankakee, Spoon, Aux Sable	$54,968,125	$372,400	$55,340,525	$156,691
4B + 4Y	Fox DuPage, Des Plaines, Kankakee, Spoon, Aux Sable, Starved Rock, Marseilles, Dresden	$289,733,287	$854,500	$290,587,787	$494,483

[1] Includes 35% construction contingency; 30% Planning, Engineering and Design; and 9% Supervision and Administration.
[2] Includes a contingency, but does not include acquisition or appraisal costs.

J. GOAL 5: HYDROLOGY AND WATER LEVELS. Naturalize Illinois River and tributary hydrologic regimes and conditions to restore aquatic and riparian habitat

Problem. Basin changes and river management have altered the water level regime along the main stem Illinois River, stressing the natural plant and animal communities along the river and its floodplain. Land use changes, the construction of the locks and dams (which create relatively flat navigation pools), and isolation of the river main stem from its floodplain have all impacted the water level regime to varying extents. Two of the most critical results from the basin changes and river management, are the increased frequency and increased magnitude of water level fluctuations, especially during summer and fall low water periods. The lack of the ability to mimic natural hydrologic regimes in areas upstream of the navigation dams is also a problem. Increased flow variability has reduced ecological integrity in tributary areas as well.

Objectives

- Reduce low-water fluctuations along the main stem Illinois River where possible, concentrating on the months of May through October and using pre-1900 water level records as a reference.
- Reduce peak flows from the major Illinois River tributaries by 2 to 3 percent for 2- to 5-year recurrence storm events by 2023. This would help to reduce peak flood stages and reduce high-water fluctuations along the river. Long term, reduce tributary peak flows by at least 20 percent for these events.
- Reduce the incidence of low-water stress throughout the basin by increasing tributary baseflows by 50 percent.
- Reduce the significant water level changes associated with operation of wicket dams at Peoria and La Grange.
- At an appropriate resolution (approximately 1 square mile in urban areas, 10 square miles in rural areas) identify and quantify the land alterations that contribute to unnatural fluctuations and flow regimes.
- Draw down the pools at Peoria and La Grange for at least 30 consecutive days at least once every 5 years.

Anticipated Outputs

Anticipated project outputs for this goal include: naturalizing tributary flow regimes by reducing peak flows and increasing base flows; reducing water level fluctuations on the main stem Illinois River; and exposing main stem areas by pool drawdown. These project outputs would provide a more desirable level of ecosystem function by providing critical habitat and more favorable habitat conditions for aquatic plant and animal (including fish and macroinvertebrates) species.

Pool drawdown would allow for the reestablishment of emergent vegetation (i.e. arrowhead, bulrush, and sedges) in some areas that are currently inundated and/or unable to support aquatic vegetation. Sediment compaction would also result, potentially reducing turbidity. As water levels are raised following the drawdown, these newly vegetated areas would provide food and cover for migratory waterfowl, fish, and macroinvertebrates.

Reducing water fluctuations would allow for the reestablishment of emergent plants (which serves as a food base for fish and waterfowl) in the shallow water areas of the lower three pools. Fewer and smaller fluctuations could reduce the probability that fish using the backwaters and side channels for spawning would become trapped. Fish species anticipated to benefit from reduced water level fluctuations include: largemouth bass, bluegill, gizzard shad, and emerald shiners.

1. Inventory Resource Conditions

Hydrology is a primary driver of aquatic ecosystem processes (Poff and Ward 1989, Poff and Allan 1995). The magnitudes, timing, durations, and rates of change of flows and water levels often regulate the nature of chemical and biological functions in aquatic systems. Hydrologic regimes are largely determined by landscape conditions and subsequently so are the resulting ecosystem characteristics (Sparks 1992). Headwater streams in the Illinois River Basin experience short duration floods nearly every year in response to rainfall; animals in such streams are adapted to either avoid or endure these events by either migrating or finding shelter. These streams also experience extended low flows during the summer and fall. In larger streams and rivers, the average annual hydrologic regime is smoothed somewhat due to larger drainage areas and a greater influence of groundwater on summer low flow, or baseflows, and the relative difference between the flood and low-flow discharge is not so great. This reduced variability in flow conditions allows more organisms to take advantage of the aquatic habitat; the number of fish species, for example, generally increases in downstream areas in large part due to the addition of new species, as opposed to the replacement of species (Horwitz 1978). In the main stem river, a pronounced spring flood generally extends through the early summer and many organisms are able to take advantage of these high water events because they last longer and are more predictable (Sparks et al. 1990). Urban and agricultural development in the Illinois River Basin has altered the basin’s landscape, which has led to changes in the hydrologic regime of the tributaries and main stem. Altered hydrologic regimes can limit ecosystem function in any portion of the landscape when the frequency or magnitude of high or low water conditions vary significantly from those previously experienced and under which native systems have developed (Resh et al. 1988, Poff 1992).

a. Historic Conditions. Prior to 1900, when significant development and hydrologic modification began, much of the Illinois River experienced a cyclical regime in which water levels gradually rose from the late fall through the spring and then fell to stable low levels in the summer (Sparks 1995). This cyclical regime is illustrated in figure 3-28 which shows water levels at four gage locations on the Illinois River for multiple water years. Figure 3-29 shows the locations of the gages referred to in figure 3-28. Both historical (illustrated using black squares) and existing (illustrated using gray lines) water levels are shown in this figure. Existing water levels will be discussed in the next section. Historical observations and measurements of flows from undisturbed areas indicate that stormflows rates from Illinois River watersheds prior to European settlement were probably much lower than current rates. Much of the Illinois River Basin was prairie, savannah, and marshland that effectively retained rainfall. Prairie plants are very effective at transpiring water from the soil into the atmosphere, likely removing large quantities of water from the basin. Many current streams or ditches were historically ephemeral channels, wetland swales, or simply did not exist (Larimore and Smith 1963, Rhoads and Herricks 1996). As urban and agricultural areas developed throughout the watershed, the basin transformed from an infiltration based system, where water enters the soil at the ground surface and flows away from the ground surface, to a runoff based system, where water remains on or flows across the ground surface.

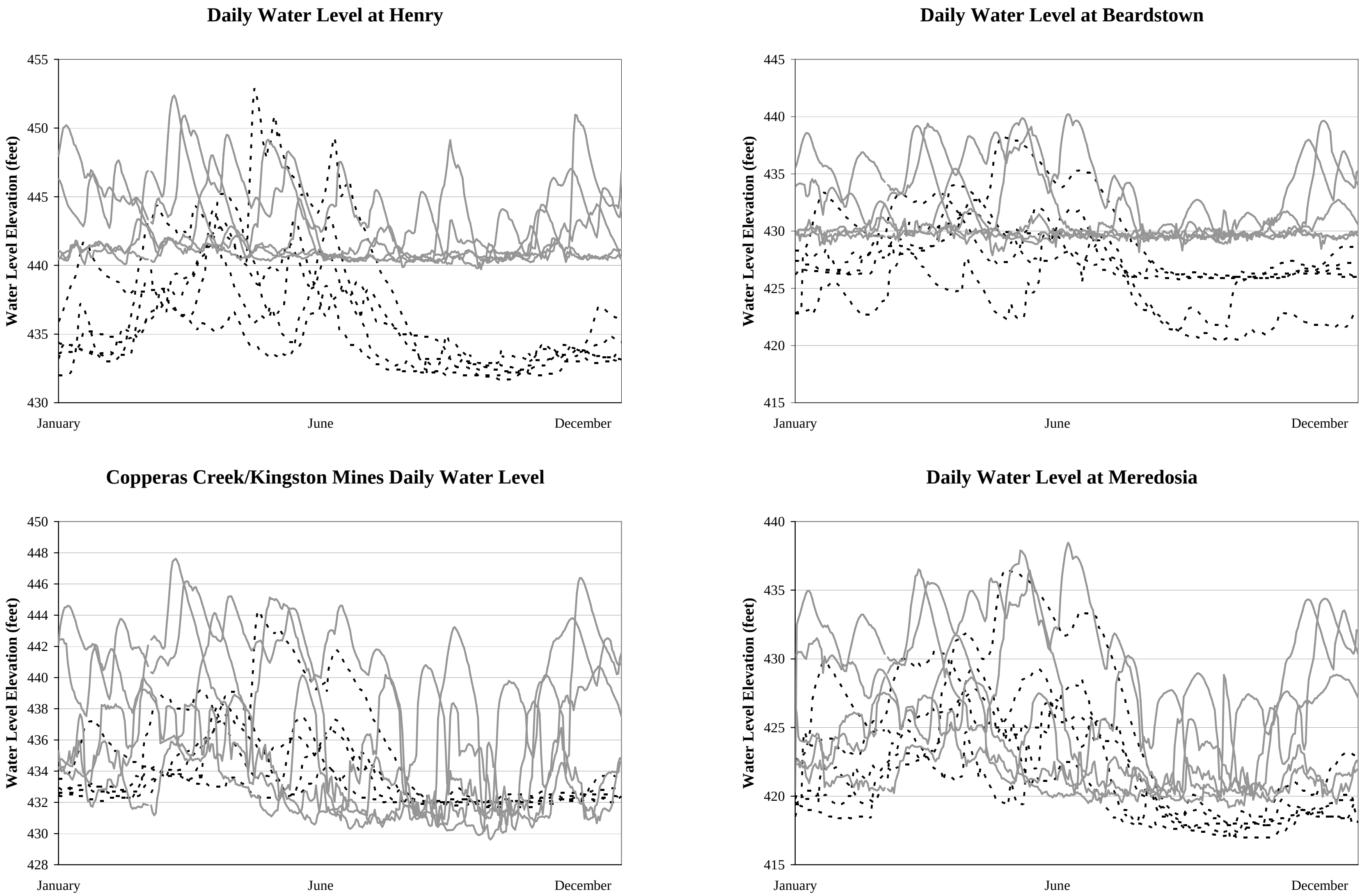


Figure 3-28. Daily Water Levels at Long-term Illinois River Gages, Water Years 1888-1892 (black dashed lines) and 1988-1992 (gray solid lines). Water years run from October 1 through September 30.

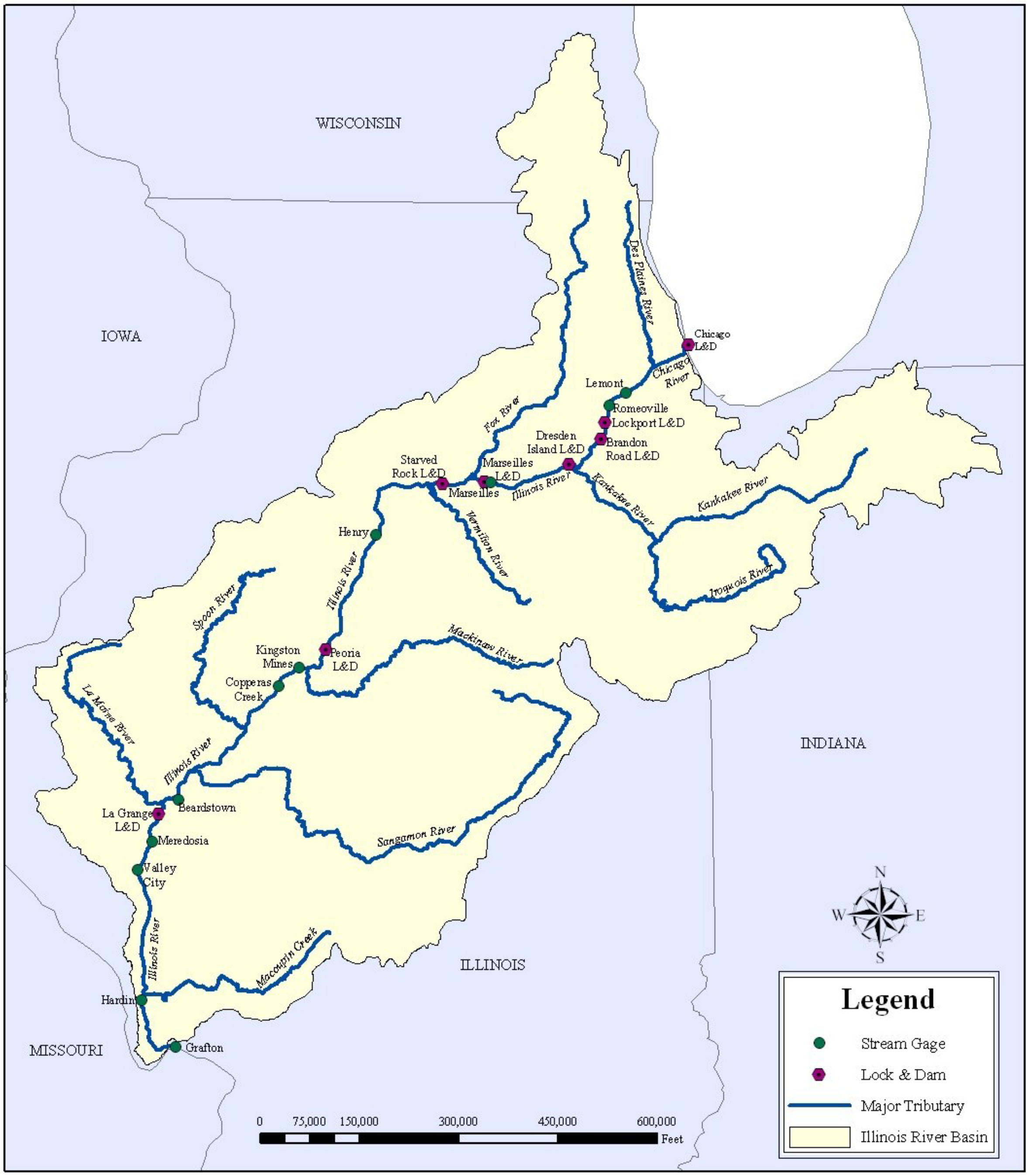


Figure 3-29. Gage Locations

To increase agricultural efficiency, land throughout the Illinois River Basin was cleared and drained. Tilled soil generally tends to create more runoff than vegetated soils (Sartz 1970), so land clearance and drainage in the Midwest increased the movement of water from the land surface and created conditions that resulted in larger storm flows (Knox 2002) and contributed to reduced low flows (Larimore and Smith 1963, Meek 1892, Quick in Menzel et al. 1984, Shriner and Copeland 1904).

Although flows from tile drains have led to sustained low flows at some locations (Rhoads and Herricks 1996), drainage generally reduces low flows by lowering groundwater levels and intercepting through flow, thereby increasing stream flow variability. For example, Larimore and Smith (1963) observed that the Sangamon River at Monticello displays less constant flow than it did before 1928. They noted that land drainage in the watershed led to quicker responses to precipitation and droughts with higher floods and reduced low flows. These changed conditions led to changes in fish distributions, specifically the loss of intolerant species. Smith (1971) noted that reduced summer low flows became more noticeable statewide after 1930 and that these had definite negative effects on headwater and creek fish species.

Hydrologic regime changes also came about due to urbanization and stream channelization. The construction associated with cities and towns leads to increases in impervious area and efficient systems to remove runoff. These led to large increases in the volume of stormwater carried to downstream streams and rivers, especially for small storms that would not cause runoff under more natural conditions, and higher peak flows. Likewise, channelization increases peak flows as it allows flood waves to pass more quickly through the basin (Campbell et al. 1972). The relative effects of hydrologic changes tend to be greatest in small streams, steep basins, and during fairly frequent events (Knox 1977).

The changes in the tributary hydrologic regimes translated downstream into a more uneven delivery of water to the Illinois River, especially for flows associated with storm events. Additionally, the construction of navigation dams and diversion of flows from Lake Michigan increased the river water surface elevation and have altered the nature of the flooding regime along certain reaches of the river. The diversion flows, as well as the possible increase in tributary flow volumes from a reduction in basin-wide annual evapotranspiration rates, lead to the probability that river flow volume increased. Between 1902 and 1928, levees were constructed to increase human use of the floodplain; these levees changed the hydrologic nature of the river system by preventing out-of-bank flows from expanding across significant portions of the floodplain, subsequently changing flood profiles and recession rates along the river (Mulvihill and Cornish 1929 in Havera and Bellrose 1985, Sparks 1995).

It should be noted that changes in rainfall patterns have also contributed to changes in Illinois River Basin hydrologic regimes (Ramamurthy et al. 1989). The CTAP (1994) noted that higher precipitation in the period 1966 to 1991 led to 13 to 20 percent higher average flows and 50 percent higher peak flows at many northern Illinois stream gaging stations. Agricultural landscapes tend to be particularly sensitive to climatic variability (Knox 2001) and so potential climatic shifts must be considered when evaluating hydrologic regime changes.

b. Existing Conditions. Changes in the Illinois River Basin have led to increased variability in most aspects of the hydrologic regimes experienced by the river and its tributaries. In general, stormflows in the basin are currently higher than occurred under pre-development conditions due to land use changes and increased efficiency brought about by channelization, drainage, and urbanization. High flows lead to increased physical stress on organisms, decreased habitat quality, and increased transport of sediment to the river. Low-flow conditions have also become more ecologically stressful, especially in smaller streams. These small streams are often unstable aquatic environments because of extreme water level fluctuations and desiccation during dry periods; for example, stagnant pools in small streams commonly experience temperatures exceeding 90 degrees Fahrenheit (Larimore and Smith 1963, Rhoads and Herricks 1996). Some exceptions occur in streams fed by relatively steady effluent discharges (CTAP 1994) or certain tile drain outlets (Rhoads and Herricks 1996).

The loss of connectivity between the main stem river and its floodplain has also affected the hydrologic regime of the river. Levees were constructed along the river to protect valuable urban and agricultural land from flood, but in doing so, the main stem river has been isolated from its floodplain in certain areas. This isolation, or lack of connectivity, is addressed further under Goal 4. Hydrologic variability on the main stem river is most evident in its water level records. For the purpose of this report, water level fluctuations (or "bumps") are defined as having the following characteristics:

- Elevation differences of 0.5-foot or greater,
- Occur within either 6-hour, 24-hour, or 5-day time periods, and
- Can be characterized as either increases or decreases.

Please note that during our analysis, water level fluctuations were characterized using both 2-hour and daily water level data. The frequency of the source data will be noted in the following discussion.

The ecological impact of these fluctuations is based on the time of year in which the fluctuation occurs; therefore, the fluctuations for any given year are categorized by season. For this analysis, the "summer" occurs from July 1 through November 15 (also referred to as the "growing season"), the "spring" is evaluated from March 1 through May 15, and the remaining portion of the year is referred to as the "winter." Both the "summer" and "winter" time periods encompass a limited amount of time outside of "summer" or "winter." These definitions will be used throughout this section.

The magnitude and frequency of water level fluctuations have notably increased in portions of the river since daily water level monitoring began in the 1880s . This difference is especially pronounced during the growing season (July 1 to November 15) as indicated in figure 3-37. During the pre-1900 growing seasons at all four gages in figure 3-37, there were very few fluctuations larger than 5 feet and the water levels were relatively low compared to the rest of the year. By examining the 1988 to 1992 flow data, it can be seen that large fluctuations occur throughout the year, which indicates that the flow regime has changed throughout the basin. It is possible that some of the changes in water level fluctuations are due to alterations in land cover throughout the basin.

The quantities of historical, observed, and modeled water level fluctuations of 0.5-foot or greater between daily readings, or over periods of up to five consecutive daily readings, during the growing season are compared in table 3-46. Data used in the table are from the Illinois River Ecosystem Restoration Water Level Management Analysis (USACE 2004a). The number of tributary induced fluctuations at each gage was determined using a hydraulic model of the Illinois River main stem with the observed flows but simulating the removal of the influence of the navigation dams. The hydraulic model is discussed in the section *Formulation of Alternative Plans.*

Table 3-46. Comparison of Historical Water Level Fluctuations (Pre-1900) With Observed and "Tributary Induced" Water Level Fluctuations (WY 1990 to 1997) During the Growing Season Using Daily Data

	24-Hour Fluctuations			5-Day Fluctuations		
		Current Conditions			Current Conditions	
Gage Location	**Pre-1900**	**Observed**	**Tributary Induced**	**Pre-1900**	**Observed**	**Tributary Induced**
Marseilles	no data	33	20	no data	34	26
Henry [1]	3	4	4	6	10	12 [2]
Peoria L&D (pool)	no data	8	3	no data	13	11
Copperas Creek/ Kingston Mines	2	19	7	5	21	15
Havana	2	12	5	7	19	13
Beardstown	1	8	3	5	13	9
La Grange L&D (pool)	no data	9	5	no data	13	10
Meredosia	4	15	7	7	22	15

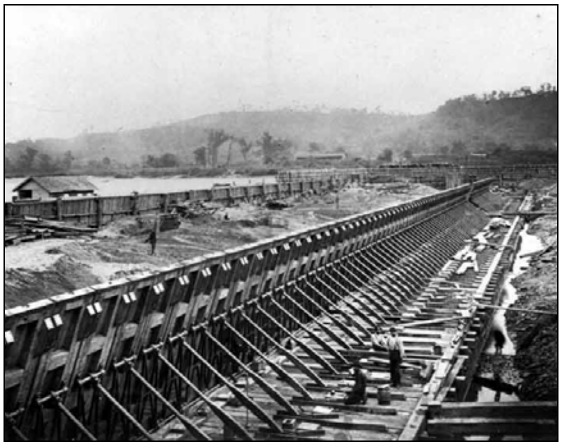
[1] Observed Data for this gage are from water years 1990 to1996.
[2] The number of tributary induced water level fluctuations at the Henry gage is greater than the number of observed water level fluctuations possibly because tributary induced water level fluctuations were obtained using a computer model of the system or our operations are attenuating the natural fluctuations experienced on the main stem.

One source of water level fluctuation on the main stem is the episodic input of stormflows from the drained and developed watersheds of tributary streams feeding the river (Sparks et al. 2000). The altered tributary flow regimes contribute to rapidly rising and falling water levels and more uneven delivery of flows to the Illinois River. Table 3-46 displays a model estimate of the increase in river fluctuations that can be attributed to the altered tributary flow regimes. Flow changes arising out of growing season storm events cause water levels to quickly rise along the main stem river. Once the storm event is over, flow rates decrease and the water levels also fall. Storm water from Chicago has the potential to significantly impact water level fluctuations in the upper areas of the Illinois River.

Another potential fluctuation source is water level management activity (Appendix C). Management-related water level fluctuations are generally most evident in the upper regions of the pool including the tailwater of the upstream dam. These fluctuations are often attributable to gate adjustments at navigation dams (Pegg 2001, Koel and Sparks 2001). While the fluctuations resulting from management activities at all the dams along the main stem are important, the water level fluctuations associated with the wicket dams at the Peoria and La Grange Lock and Dams are distinct.

Photograph 3-7 shows the wicket dam at Peoria and photograph 3-8 shows the construction of a similar wicket dam on the Ohio River. Wicket dams are operated so that during periods of high water levels, the "wickets" lie on the bottom of the river and water flows unimpeded over them (this is referred to as "open pass"). Open pass conditions are purely a function of flow. As water levels decrease, the "wickets" are manually raised and the navigation pool is created. This is done to ensure that the nine-foot depth required for river navigation exists. When wicket dams are raised and lowered, it is possible that significant water level fluctuations may result. The response to wicket dam operations is less noticeable in the pool than it is in the tail water (below the dam). As the wicket dam is raised, the tail water drops significantly. The computed induced fluctuations in the tail water at Peoria and La Grange are 2.3 and 3.0 feet, respectively.

Photograph 3-7. Existing Wicket Dam at Peoria Lock and Dam



Photograph 3-8. Construction of Wicket Dam on the Ohio River

Figure 3-30 shows the pool and tailwater water levels at Peoria for water year 1995. Please note the abrupt changes in water levels during the wicket operations. During Water Years 1979 to 2000, there were approximately 194 wicket operations (either raising or lowering) at Peoria and 168 at LaGrange. This results in an average of 8.4 and 7.3 wicket operations per year at Peoria and LaGrange, respectively. A single tainter gate was installed at each dam in the early 1990s (photograph 3-9). The tainter gates were not designed to affect the frequency of wicket operations; they were installed to make it easier to operate the wicket dam and adjust the flow through the structure, thereby providing better control over the dam releases (USACE, 2005).

Photograph 3-9. Existing Tainter Gate at Peoria Lock and Dam

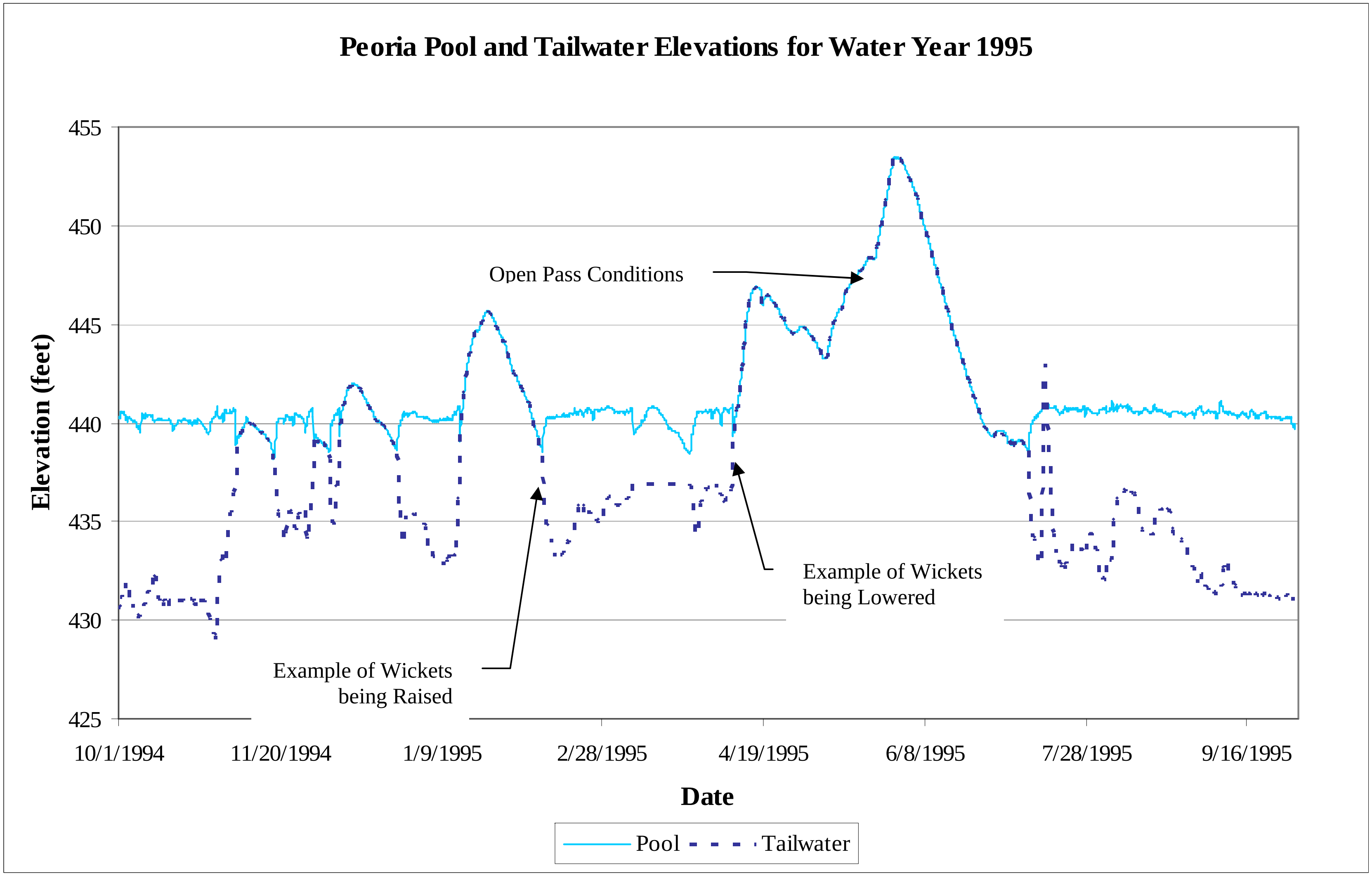


Figure 3-30. Water Level at Peoria Lock and Dam

Water level fluctuations during any part of the year have the potential to strand Illinois River fish or force them to move to avoid stranding (Koel and Sparks 2001, Raibley et al. 1997). Summer water level fluctuations can be especially stressful on aquatic plants (Sparks et al. 1998). Koel and Sparks (2001) found that the increased fluctuation rate seems to favor non-native fish species. Water level fluctuations also have the potential to drown moist soil plants which become established in mid to late June. To serve as a food base and cover for numerous species, these plants must not be inundated for a period long enough to produce seeds (approximately 70 days).

Researchers have noted that more gradual water level rises and falls would benefit a number of organisms. For example, Koel and Sparks (2002) indicate that water level changes should not exceed 0.13 to 0.17 feet per day to minimize fisheries impacts. Also, Atwood et al. (1996) recommend that water level rises not exceed 0.2 feet per day to avoid drowning out emergent vegetation.

Although the increased hydraulic variability has negatively affected the ecological function of some portions of the river, the reduction of hydrologic variability upstream of the dams has had negatively impacts on the ecological function of certain floodplain areas. Each dam keeps the water level in the pool upstream high enough to ensure a 9-foot navigation channel, and, as a result, the floodplains immediately upstream of each dam are far more continuously inundated than they would be under undammed conditions (Sparks 1992). The lack of a flood cycle in these areas acts as a disturbance for the river-floodplain system (Sparks et al. 1990).

These stable water levels limit the consolidation of sediment, leading to higher potential for resuspension, and prevent many native plant species from revegetating. This eliminates the seasonal drying of the sediments that favored the establishment of vegetation in these areas (Sparks et al. 2000). A decrease in the number and regeneration of mast trees has been observed in the areas upstream of the dams. However, the annual flooding regime at the upper end of the pools, where inundation effects are diminished, is often similar to that experienced under undammed conditions (Sparks 1995).

c. Future Without-Project Conditions. Several factors, most notably potential changes in land cover, land use, and climate, play major roles in the future hydrologic regimes throughout the Illinois River Basin. The flows from agricultural lands will be influenced by the extent to which conservation practices are implemented. With the exception of conservation practices, the usage of land in agricultural areas has been fairly constant recently because all suitable areas are being utilized. Tiling projects are expected to continue being implemented in the foreseeable future, while the development of new channelization projects is expected to decrease.

Tributary hydrologic regimes will continue to exhibit high peak flows and low baseflows that stress aquatic biota. These conditions will likely become more stressful in areas that experience increased urbanization. Without site-specific water level manipulation (drawdown), certain backwater and floodplain areas are likely to either continue to degrade or maintain relatively low levels of ecological function.

The current lack of aquatic connectivity between the main stem and its floodplain is likely to remain the same. Some studies are currently underway investigating limited connectivity in several locations. The amount of urbanized land in the basin will continue to increase, and the ecological benefits from stormwater controls are likely to be limited, especially on the main stem, unless efforts are made to control volume by implementing a large number of infiltration practices. While it is impossible to predict changes in climatic conditions, it is possible that some changes may lead to more extreme hydrologic regimes that could drive ecological processes to and over thresholds.

The successful implementation of planned stormwater control projects like the Tunnel and Reservoir Project (TARP) and the Chicago Underflow Project (CUP), may reduce some of the peak flows entering the river from northeastern Illinois, but increased development, even with peak flow control requirements, may increase the volume of storm water entering and the high water fluctuations of the Illinois River Diversions from Lake Michigan are expected to continue.

d. Desired Future Conditions. The desired future conditions would naturalize the water level conditions that would restore ecological function in the Illinois River Basin. This does not necessarily require a return to any particular prior state, but rather creating conditions that allow ecosystem functions to sustain themselves at an acceptable level given the constraints of multiple uses throughout the basin. Rhoads and Herricks (1996) describe this concept as "naturalization."

Regarding tributary flows, the current state of knowledge suggests that flow regimes with reduced peak flows and increased baseflows would provide more desirable levels of ecosystem function than currently occur. The Lieutenant Governor's Task Force (Kustra 1997) identified an initial goal of reducing tributary peak flows by 2 to 3 percent. The reductions necessary to meet this goal are shown in table 3-47.

Table 3-47. Tributary Peak Flows Estimated From USGS Flow Records

			Approximate Flow Recurrence (cfs)					
			Historical Averages		**2.5% Reduction**		**20% Reduction**	
Tributary	**Record**	**Years**	**2-yr**	**5-yr**	**2-yr**	**5-yr**	**2-yr**	**5-yr**
Des Plaines River at Riverside	1914-2001	88	4070	5500	102	138	814	1100
Fox River at Dayton	1915-2001	86	13900	18100	348	453	2780	3620
Kankakee River near Wilmington	1915-2001	87	24600	37500	615	938	4920	7500
Mackinaw River near Green Valley	1922-2001	79	8030	16000	200.8	400	1606	3200
Macoupin River near Kane	1921-2001	74	10200	17500	255	438	2040	3500
Sangamon River near Oakford	1910-2001	84	24100	36300	603	908	4820	7260
Spoon River at Seville	1916-2001	85	12700	20700	318	518	2540	4140
Vermilion River at Lenore	1931-2001	71	13000	20800	325	520	2600	4160

Although the precise relationships between regime components and ecosystem functions have not been fully developed, it was decided that a peak flow reduction exceeding 20 percent would be necessary to sufficiently modify the flow conditions that are currently degrading tributary ecosystems based on expert opinion. Likewise, a significant baseflows increase, 50 percent above the current levels, is desired to reduce low-flow stress to stream organisms. As a basis for project implementation, it is necessary to document and analyze the factors that lead to undesirable hydrologic conditions, and assess these factors basin-wide.

Although there is a significant desire to moderate the rate of rise and fall along the main stem Illinois River, the storage available within the system is very small relative to the flows in the river (USACE 2004a). Although the lack of storage makes it difficult to affect the hydrologic regime of the main stem, the desired future conditions include a reduction in the incidence and speed of water level changes.

Reducing the number of water level fluctuations would likely provide multiple benefits to native biological communities. These benefits would be especially significant during the time of year beginning after the recession of the spring flood in May and extending through the late growing season in October. The objective identified is to reduce the number of daily water level fluctuations exceeding 0.5 feet to levels observed in the 1890s during both growing season and winter time periods. One specific measure that would reduce fluctuations is a reconstruction of the wicket dams so that the dramatic water level changes associated with their operation can be removed. Another specific measure that would reduce the magnitude of water level fluctuations near the lock and dam structures at Peoria and LaGrange is to install an additional tainter gate at each of these locations. Although the addition of a single tainter gate at these structures would probably not decrease the number of fluctuations, it would minimize the effects of raising and lowering the wickets downstream of the dam. Reconnecting the river mainstem to its floodplain may also reduce the number and magnitude of water level fluctuations along the main stem. Future study is required in this area.

Temporarily lowering water levels in the Illinois River navigation pools would provide ecological benefits to areas of the pools that are continually inundated under current conditions, allowing sediments to consolidate and encouraging reestablishment of vegetation. Significant consolidation and benefits to plant growth have been observed in drawdowns in Illinois River and Mississippi River backwaters (Dalrymple 2000, Edwards 1988) and elsewhere (Fox et al. 1977). The desired future condition would be a successful drawdown lasting at least 30 days once every 5 years in the Peoria Pool, and once every five years in the La Grange Pool.

2. Formulation of Alternative Plans

a. Approach/Assumptions. Restoring basin-wide hydrologic regimes requires a systematic approach because of the downstream propagation of flow conditions and impact on sediment transport and channel stability. Illinois River tributaries influence ecosystem characteristics throughout the basin, and tributary flows significantly affect main stem conditions. As such, any attempt to restore the Illinois River hydrology would require a considerable amount of work to improve tributary conditions. At the same time, analysis has indicated that it would be prohibitively expensive, if not impossible, to restore conditions along the Illinois River main stem solely by improving tributary conditions, so improvement along the main stem would require management along the river itself. The final restoration plan; therefore, must include a mix of tributary and main stem measures.

As has been noted elsewhere, this program is being proposed to augment existing efforts and not to replace them. For example, urbanization will continue to increase the instability of tributary and main stem hydrologic regimes if stormwater management strategies that control volumes as well as peak flow levels are not implemented for future development activities. Projects within the Illinois River Basin Restoration program will be developed from ongoing and future watershed planning efforts that identify the suite of practices necessary to benefit hydrologic conditions in each particular watershed. To the extent possible, these projects will be coordinated with work being accomplished under other programs to support the overall basin restoration goal. The alternatives detailed in this report identify the potential measures to be constructed under this program as a part of the overall restoration effort.

Implementing projects to promote more favorable hydrologic regimes would require a number of planning tools developed at the program level (above and beyond the work detailed in these alternatives). Project evaluation will rely on a well-calibrated watershed hydrology model for the entire basin linked to an unsteady-state hydraulic model of the main stem river; this will be used to assess expected benefits and compare the cost effectiveness of various alternative configurations. The basis for the watershed model has already been developed using the USEPA's Better Assessment Science Integrating Point and Nonpoint Sources (BASINS) model, and it is expected that sediment modeling capability would also be incorporated into the model. One of the major components of BASINS that was used in the analysis of various storage and infiltration scenarios is the Hydrological Simulation Program – Fortran (HSPF). A program called One-Dimensional Unsteady Flow Through a Full Network of Open Channels (UNET) was used to develop a basic hydraulic model for the main stem Illinois River. A FORTRAN program was written to calculate the number of water level fluctuations for the observed data and the various alternative scenarios studied.

In some cases, hydrologic changes may have the potential to lead to downstream sedimentation issues, so sediment transport issues must be addressed in the design of all of the measures implemented for this goal. Ongoing flow and water level monitoring at appropriate locations is also necessary to evaluate projects and adapt project objectives based on changing conditions. The need for flow monitoring on small tributaries is crucial to evaluating basin-wide conditions due to the large percentage of the basin that drains directly to low-order streams. Also, implementation would use the computerized inventory and analysis system developed for this project to evaluate potential projects and determine the benefits of constructed projects.

b. Criteria and Constraints There are several constraints that must be considered when formulating plans to influence water levels on the Illinois River, the first of which is that there is very little floodplain storage available on the Illinois River main stem, as was discussed earlier in this goal. Another constraint is that the 9-foot navigation pool must be maintained throughout the entire year. This influences the level to which pool drawdowns may be attempted. Most of the land adjacent to the Illinois River and its tributaries is in private ownership, which can limit where restoration measures are constructed. The levees which exist along the main stem isolate the river from its floodplain and can limit the effect of restoration efforts. The diversion of water from Lake Michigan into the Chicago Sanitary and Ship Canal, which then flows into the Illinois River, is an additional constraint that must be considered. The storm flow from the Metropolitan Water Reclamation District is another constraint.

c. Measures

i. Tributaries. Two systematic approaches were evaluated to meet the tributary objectives of reducing peak flows and increasing base flows. The first approach is to increase the volume of stormwater storage available within each tributary watershed so that runoff from relatively small events, including those expected to occur every 2 five years or more frequently, is temporarily retained before being released downstream. This storage might take various forms, including tile management, detention structures, or expanded riparian areas that provide ecological benefits in addition to flood storage. The second approach is to direct runoff to areas where it can infiltrate into the soil and recharge groundwater. Infiltration requires the proper soil and subsoil conditions; but if conditions are appropriate, it could be incorporated within tile management, conservation practices such as filter strips, or structures consisting of grassed fields enclosed within a berm. Infiltration can also be distributed throughout watersheds using practices that reduce runoff generation or allow runoff to infiltrate close to the point it is generated; the potential for such practices in an urbanizing area is discussed in the Blackberry Creek Watershed Alternative Futures Analysis (2003).

ii. Main Stem. Several measures were evaluated to determine the potential benefits they might provide to main stem water level regimes. Some of the tributary storage and infiltration measures evaluated in the previous section may reduce fluctuations, and other measures implementable on the river itself may also provide benefits. Different river management scenarios were studied, including "optimal" management. Reconfiguring the wicket gates and pool drawdowns at the Peoria and LaGrange lock and dams were also analyzed. This is discussed further in the following section.

d. Alternatives. Alternatives were developed using measures to address five types of hydrologic change: dam management, stormwater storage, infiltration, wicket dam modification, and pool drawdown. Measures that affect stormwater storage and infiltration would take place on the tributaries while measures that affect dam management, wicket dam modification, and pool drawdown would focus on the main stem. The measures were grouped to form plans that met the objectives for this goal to varying degrees. Implementation of these plans would rely on planning tools developed for this program but not budgeted here, specifically the computerized data inventory and analysis system and a fully calibrated hydrology and sediment model for the Illinois River Basin. Successful implementation also requires the continuation of conservation activities being undertaken under existing Federal and State authorities, as well as stormwater controls under the mandate of local authorities; expansion of these other efforts would increase the potential benefits to Illinois River Basin hydrologic regimes.

i. Tributaries. Alternatives that address tributary storage and infiltration are designed to reduce peak flows and increase baseflows. Since relatively common flood events are ecologically significant, it is appropriate to evaluate the change in intensity of 2- and 5-year events, as identified by the Lieutenant Governor's Task Force. Tributary peak flow benefits for this study were quantified as the percent reduction in the 2- and 5-year events attributable to the measures. The benefits for improving tributary baseflows were quantified using the effect of the measures on the 90 percent exceedence flow (the level that average daily flows will meet or exceed over the long-term) expressed as a percent increase.

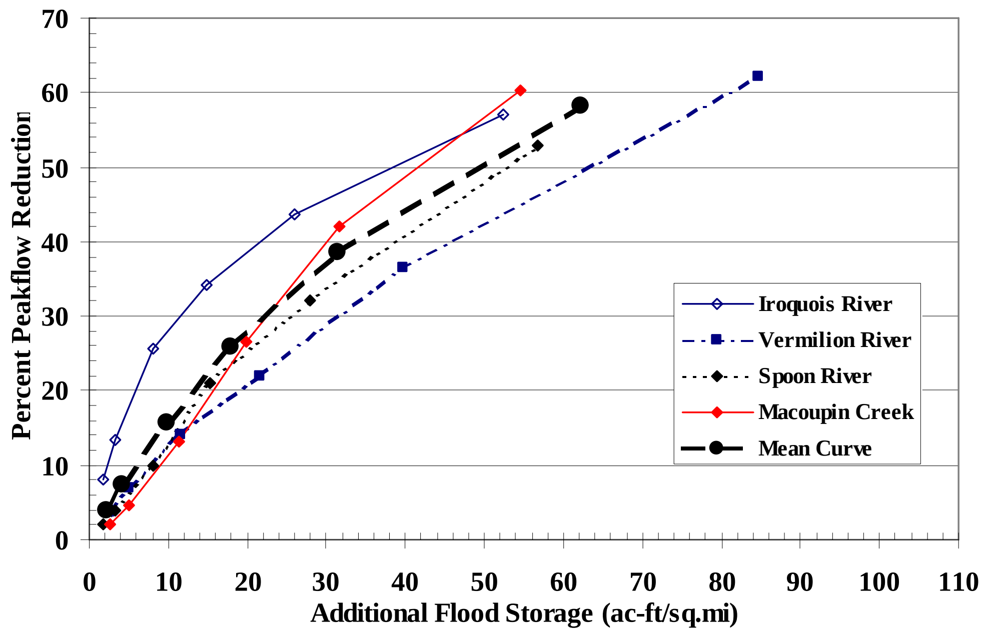
The various levels of storage and infiltration were evaluated by modifying the BASINS model of the Illinois River prepared by the Illinois State Water Survey (ISWS) (Appendix C-3). Model representations of several tributaries were modified to represent the hydrologic effects of either storage or infiltration, and predicted change in hydrologic conditions was evaluated by comparing simulated flows for these tributaries using the meteorological input data from the years 1970 to 1995 with the simulated flows for the same period without added storage or infiltration. The mean response from the selected tributaries was used to estimate the general basin response, and alternatives were generated assuming a similar response if the practices were applied to the approximately 30,000 square miles of the Illinois River Basin. Further model refinement will allow for more meaningful results.

The additional basin storage was simulated within the BASINS model as volume adjacent to basin streams but at an elevation slightly higher than the non-storm water level. Water depths during the range of flow events were used to determine the actual storage volume utilized during those events. This floodplain-like storage is expected to be a relatively efficient way to reduce peak flows, and so the storage-flow reduction relationships obtained represent a condition of fairly optimal storage distribution throughout the watershed; more volume may be required to meet the flow reduction goals if storage is distributed in a different manner. The infiltration scenarios were modeled, using the

BASINS model, by routing the runoff from a portion of the land area to special land segments that soaked in most of their inflow and discharged primarily through groundwater. This type of approach would not discriminate between infiltration methods (constructed facilities, filter strips, etc.) For modeling purposes, each acre of infiltration area received runoff from 19 acres of basin area, in addition to the precipitation falling on the infiltration area itself. There was no attempt to verify that appropriate areas were available either for the floodplain-like storage or for infiltration. Because of the setup of the ISWS BASINS model, changes in the Des Plaines watershed were modeled for neither storage nor infiltration. Also, because of difficulties with the model, the infiltration alternatives were not modeled in the Kankakee-Iroquois watershed.

The effectiveness of storage on reducing 2- and 5-year peak flows is shown in figure 3-31, and the effectiveness of infiltration is shown in figure 3-32. The mean curves in figure 3-32 represent the average peak flow reductions, in percent, for storage within the Iroquois River, Vermilion River, Spoon River, and Macoupin Creek watersheds. Although there is some variation, with the largest benefits in the Iroquois watershed, the mean curve indicates that an additional 3.0 acre-feet of storage per square mile of basin area would reduce 5-year peak flows by approximately 5 percent. This relatively small amount of storage is effective largely because it does not take a large volume of storage to shave the peaks off relatively frequent events. Figure 3-32 demonstrates that the percent reduction of peak flows would be nearly proportional to, but slightly less than, the percent of area treated by infiltration. The model results for the Vermilion, Spoon, and LaMoine River watersheds show very similar peak flow reductions.

(a) Reduction of 2-year flows



(b) Reduction of 5-year flows

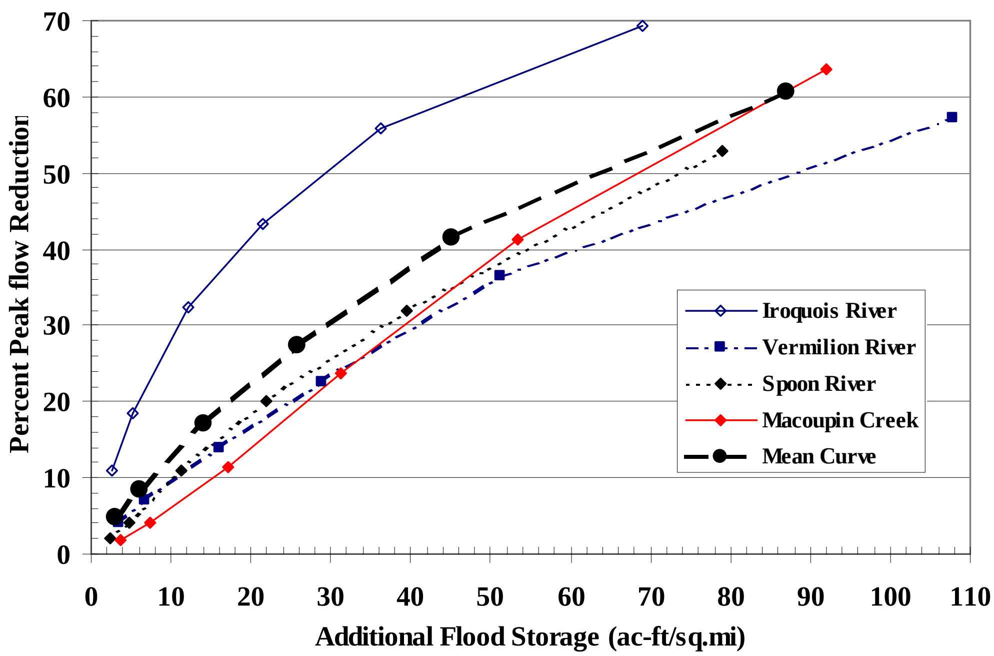
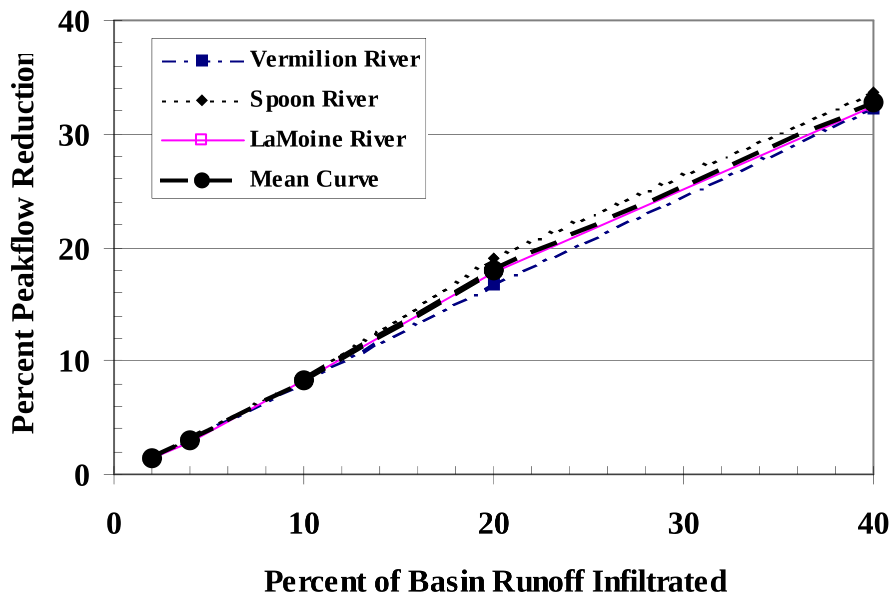


Figure 3-31. Potential Tributary Peak Flow Reduction for the (a) 2-Year and (b) 5-Year Flow Events With Additional Flood Storage Within Their Watersheds

(a) Reduction of 2-year flows



(b) Reduction of 5-year flows

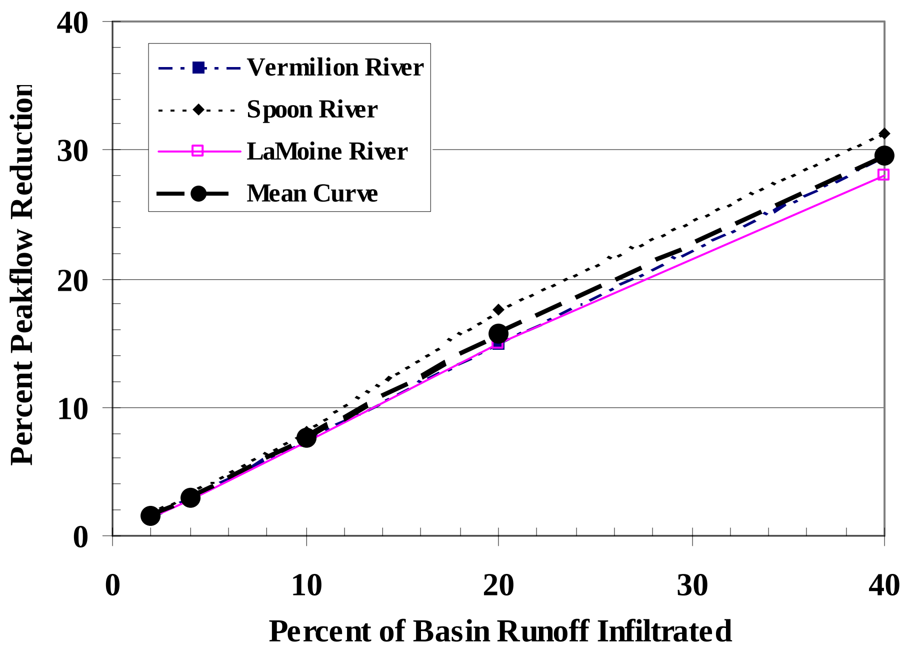


Figure 3-32. Potential Tributary Peak Flow Reduction for the (a) 2-Year and (b) 5-Year Flow Events With Additional Infiltration Within Their Watersheds

The values for the mean curves in figures 3-31 and 3-32 were used to calculate the benefits for various levels of program, implementation; figure 3-41 compares the relative effectiveness of infiltration and storage at reducing peak runoff flows. Using the assumptions that the infiltration facilities would be approximately 5 percent of their contributing areas and the floodplain wetlands are inundated to a depth of 1.5 feet during the 5-year event, the mean curves from figures 3-31 and 3-32 were adjusted to reflect the area required for each practice. Figure 3-33 shows that both practices are effective but that on a project footprint basis infiltration would provide a somewhat greater benefit per unit area than would flood storage. It should be noted that the relative effectiveness of each practice may change if designed under different assumptions, say infiltration facilities at 10 percent of their contributing basin or inundation depths of 2 feet. However, figure 3-33 is adequate to provide a basis for planning-level analysis. The two treatments should not be considered interchangeable because they may not be equally applicable in a given area; infiltration would not be available in basins with inappropriate soil conditions, and available land may limit the application of floodplain storage projects.

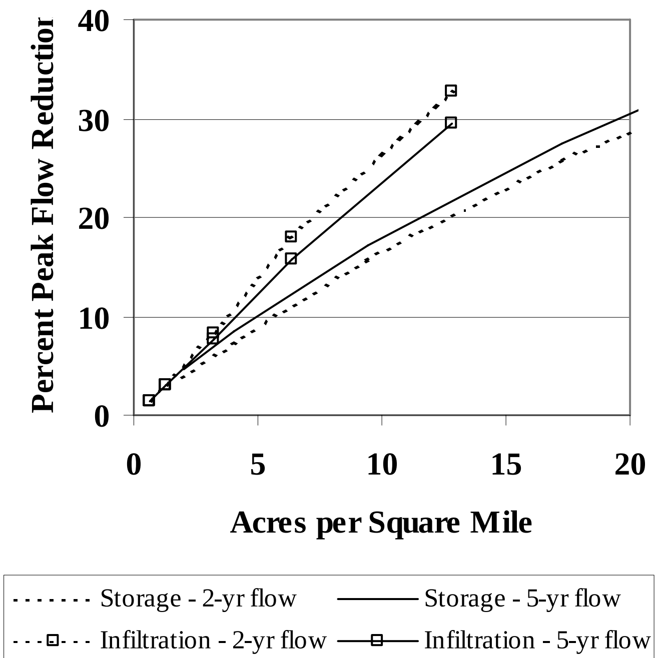


Figure 3-33. Comparison of Relative Peak Flow Reduction Effectiveness of Infiltration and Floodplain Storage Assumes storage depth of 1.5 feet during 5-year event and contributing area ratio of 20:1 for infiltration measures.

Figures 3-34, 3-35, and 3-36 illustrate the degree to which storage volume and infiltration lead to increased baseflows. Infiltration tends to be much more effective than storage at baseflows support. The per unit benefits of infiltration tend to decrease for scenarios exceeding 10 percent of basin runoff infiltrated. It should be noted that the Iroquois River, which showed the greatest baseflows benefits from storage, was not modeled for the infiltration scenarios due to problems representing infiltration areas in the model. It is likely that if benefits from that system were included, the mean curve in figure 3-43 and the infiltration curve in figure 3-44 would be somewhat higher.

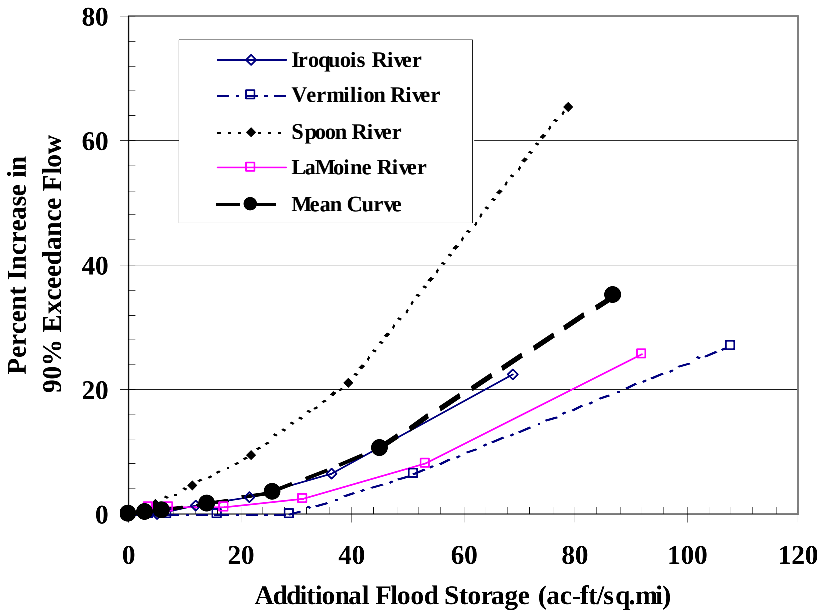


Figure 3-34. Potential Tributary Baseflow Increases With Additional Flood Storage Within Their Watersheds

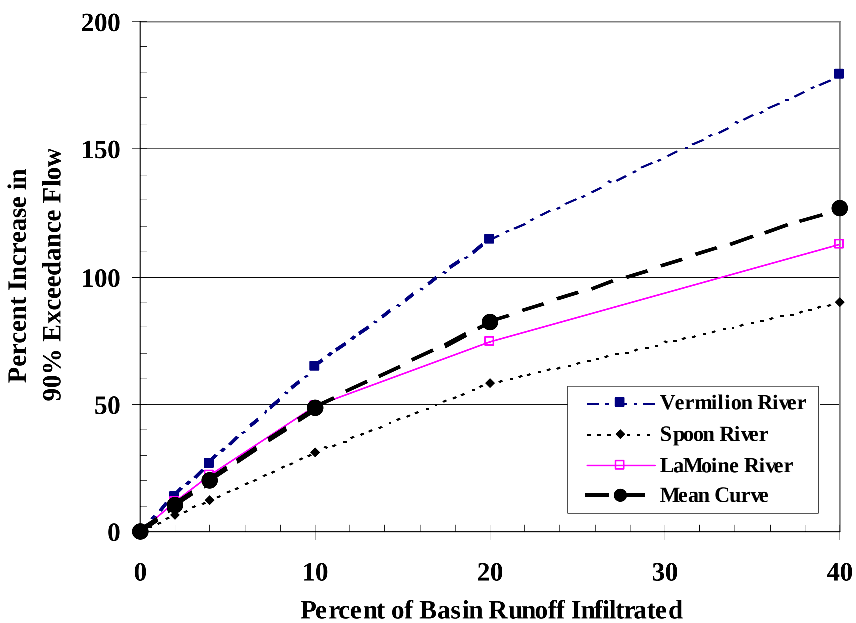


Figure 3-35. Potential Tributary Baseflow Increases With Additional Infiltration Within Their Watersheds

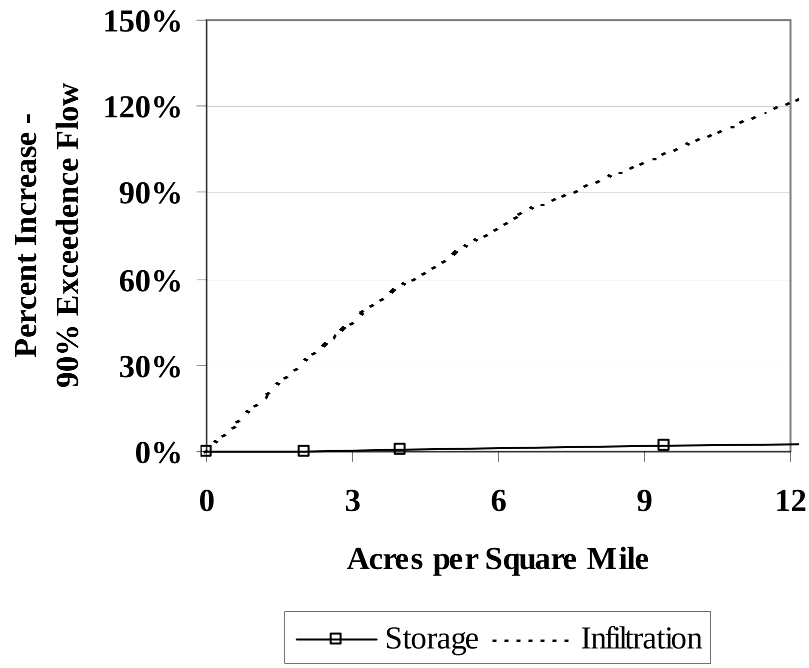


Figure 3-36. Comparison of Relative Tributary Baseflow Support Effectiveness of Infiltration and Floodplain Storage Assumes storage depth of 1.5 feet during 5-year event and contributing area ratio of 20:1 for infiltration measures.

Alternatives employing various levels of stormwater storage and infiltration area were developed using the above analysis.

ii. Stormwater Storage. Increasing the area available to retain peak flows along the tributaries would reduce the flashiness of tributary water regimes and may also provide benefits to the main stem. Five levels of basin-wide stormwater storage creation were considered for this program and are identified in table 3-48 (Plan R0 is the No-Action Alternative). The watershed model developed by the ISWS for the Illinois River Restoration Study was modified to represent storage areas adjacent to channels that capture low-level overflows. Figures 3-39 and 3-42 were used to determine the tributary peak flow reduction and the base flow increase, respectively, for each alternative.

iii. Infiltration. Infiltration represents another means to affect tributary hydrologic regimes, and in addition to proving effective at peak flow reduction, infiltration provides the additional benefit of augmenting low flows in the tributaries. Five levels of basin-wide implementation were considered for this program and are identified in table 3-49 (Plan I0 is the No-Action Alternative). Figures 3-40 and 3-43 were used to determine the extent to which the various alternatives would reduce the tributary 5-year peak flows and increase the tributary base flows, respectively.

Table 3-48. Stormwater Storage Alternatives

Plan ID	Additional Storage Created [1] (acre-feet)	Storage Area[2] (acres)	Storage Area[2] (miles)	Tributary Peak Flow Rate Reduction (%)	Tributary Base Flow Increase (%)
R0	NA	NA	NA	NA	NA
R1	27000	18000	28	1.5	0.1
R2	45000	30000	47	2.5	0.1
R3	90000	60000	94	5	0.3
R4	160000	107000	167	8	0.6
R5	375000	250000	391	16	1.6

[1] During a storm event with a 5-year recurrence interval.
[2] Assuming an average depth of 1.5 feet

Table 3-49. Infiltration Area Alternatives [1]

Plan ID	Area From Which Runoff Is Infiltrated ($miles^2$)	% of Basin From Which Runoff Is Infiltrated	Infiltration Area Required [3] (acres)	Infiltration Area Required [3] ($miles^2$)	Tributary Peak Flow Rate Reduction (%)	Tributary Base Flow Increase (%)
I0	NA	NA	NA	NA	NA	NA
I1	300	1	9600	15	0.8	5.2
I2	600	2	19200	30	1.5	10.4
I3	1200	4	38400	60	3.0	20.4
I4	3000	10	96000	150	7.6	48.5
I5	6000	20	192000	300	15.8	82.4

[1] During a storm event with a 5-year recurrence interval.
[2] Assuming an average depth of 1.5 feet.
[3] Assuming that infiltration facilities are developed with a 1:20 ratio of facility area to drainage area.

3. Main Stem. On the main stem Illinois River, alternatives were formulated to address dam management, wicket dam modification, and pool drawdown. Alternatives will be analyzed in terms of the following benefits: reduced fluctuations and area exposed by drawdown.

a. Fluctuations. The water level fluctuation effects of the alternative measures proposed for this goal were summarized in terms of fluctuations that occur in the three different portions of the year under the Existing Conditions section (please refer to that section for the characteristics of "water level fluctuations" as used here). For each time period, fluctuations that occur within 6-hours, 1-day, and 5-days were evaluated. Although for some measures, the water level changes may occur over a longer period of time than 1-day, thereby reducing the number of changes within 6-hour or 1-day time windows, the consensus of the study team is that such a "reduction" may not be very meaningful if the change still occurs within a 5-day period.

i. River and Dam Management. The current dam management strategy in place on the Illinois River is to control the navigation pools within a set band. The Water Level Management Analysis identified that a large percentage of small fluctuations downstream of dams arise because the current management strategy does not prevent significant flow changes at the locks and dams. This translates into water level fluctuations in the Illinois River. Improvements to allow lockmasters to monitor flows entering and within their pools, coupled with an ability to make smaller gate setting changes at more frequent intervals, would allow an increased degree of water level management. This was found to significantly reduce small water level fluctuations within the river. Once such an increased management strategy is in place, additional benefits may accrue from coordinated storm response.

Hydraulic modeling for the Illinois River Ecosystem Restoration Water Level Management Analysis (Appendix C-2) suggests that a number of management changes could reduce the number of short-term fluctuations occurring along the Illinois Waterway. Model results for a "optimal" management scenario indicated that the total number of fluctuations observed along the river would significantly decline. In many locations, such a management strategy would remove nearly all of the fluctuations not induced by inflows from the watershed. "Optimal" management includes increasing the frequency of dam gate changes (every two hours) and ideal knowledge of flows within and inflows to the river. Although ideal knowledge of flows and inflows is not feasible at this point in time and gate changes every two hours is impractical, "optimal" management has been used in this analysis as a planning tool while they system is being studied.

The reduction of water level fluctuations under "optimal" management would accrue almost entirely during low-water periods. Fluctuations due to higher flows or storm events would generally not be affected by this measure. Using the UNET model results (Appendix C-1), it is possible to develop quantitative estimates of potential benefits for this measure. Costs to implement include extra gaging, equipment upgrades to allow more frequent changes of gate settings, and the development of new regulation manuals.

"Optimal" management is used in this analysis even though it is an idealized situation and it is unlikely that it could be completely realized using today's technology. There are several limitations of the computer models that were used to analyze water level fluctuations under "optimal" management. These limitations include the inability to replicate the effects of wind and tow boats and the use of lockage water (the water required to transport water craft through the lock chamber at a lock and dam site). Tow boats can produce a localized wave of up to 1.08 feet and drawdown of up to 0.69 feet (Bhowmik et al, 1982). A 50-year wind with a 6-hour duration can produce a wave of up to 1.6 feet on the Illinois River (Bhowmik et al, 1982).

The Water Level Management Analysis investigated the potential to use available storage within the system to reduce fluctuations. Such a management measure would require the measures described for “optimal” management, such as ideal knowledge of inflows and gate changes every two hours, as well as centralized control of the locks and dams along the river and a computerized system to optimize storage on a real-time basis. At this time, the software routines required for the complex system optimization at real-time have not been developed, and only Peoria Pool has a large enough volume-to-flow ratio to provide the required storage area to significantly affect fluctuations. Using the small amount of storage available in Peoria Pool to reduce fluctuations in the Illinois River system may increase local fluctuations within Peoria Pool, which may not be desirable. As the technology becomes available to conduct real-time optimization, this management strategy may be able to provide some downstream benefits.

Stormwater control may have the potential to reduce the larger fluctuations associated with storm events in the reaches immediately downstream of the stormwater facilities. The Tunnel and Reservoir Project (TARP) and the Chicago Underflow Project (CUP), currently under construction in the upper parts of the basin, will likely provide stormwater benefits downstream, with the magnitude and timing of these benefits depending on the specifics of project operations. Preliminary modeling indicates that the TARP/CUP operations will likely reduce fluctuations to some degree as far downstream as Starved Rock. To be fully successful, stormwater controls would have to be implemented throughout the basin, as rapidly fluctuating downstream inflows can mask upstream improvements. Also, the flat slope of the river from Henry downstream reduces the effectiveness of stormwater control practices because it increases the time that stormflows have to be held back to eliminate fluctuations.

Figures 3-37 and 3-38 show the average number of water level fluctuations for historical, existing, and modeled scenarios for both the growing season (figure 3-45) and the winter (figure 3-46). Winter effects are analyzed for the following two time periods: November 16 through February 28 and May 16 through June 30. Systemic averages were determined from daily (pre-1900 data) and two-hour gage records and synthetic (UNET) gage records for Peoria Pool (the pre-1900 data uses the gage at Henry instead of Peoria Pool), Kingston Mines, and Meredosia. Daily pre-1900 records were divided by 0.7 to account for resolution effects when comparing to two-hour gage records. Changes to tributary inflows for each of the modeled scenarios were developed using the BASINS hydrologic model for water years 1990 to 1995 which were then used as input to the UNET hydraulic model of the main stem Illinois River. The unmanaged scenario represents the effects of current tributary flows independent of main stem water level management activities. “Optimal” management implies gate setting changes every two hours and ideal knowledge of flows within and inflows to the river. As discussed earlier, it is improbable that “optimal” management could be realized using today’s technology, nonetheless, it is useful as a planning tool. “Optimal” management is a part of every management scenario because the UNET model uses that management strategy to predict the hydraulic effects of changes in basin conditions. High storage represents an additional 423,000 acre-feet of basin storage, while moderate storage represents an additional 90,000 acre-feet of basin storage. High infiltration represents infiltration of 20 percent of basin runoff, and moderate infiltration represents infiltration of 4 percent of basin runoff.

"Optimal" management would eliminate most of the fluctuations generated by water level management activities and reduce fluctuation levels to those caused by basin inflows alone. Increased tributary storage at levels of 10 acre-feet or more per square mile of watershed area would result in some reduction in fluctuations along the river, but even the highest levels proposed for this project are not sufficient to reduce fluctuations to pre-1900 levels. Infiltration at the proposed levels does not significantly reduce 5-day fluctuations along the main stem beyond the potential reduction due to water level management changes. In some cases, the number of water level fluctuations increase when infiltration areas are added to the system. This may be due to the way infiltration areas tend to extend the time period in which stormwater flows are released from the basin, which could influence the number of water level fluctuations resulting from consecutive storm events. Although increasing tributary storage volume and infiltration areas shows little or no effect in reducing short-term, minor water level fluctuations on the main stem, it is believed that local tributary benefits would result from both measures. Further study is required in this area.

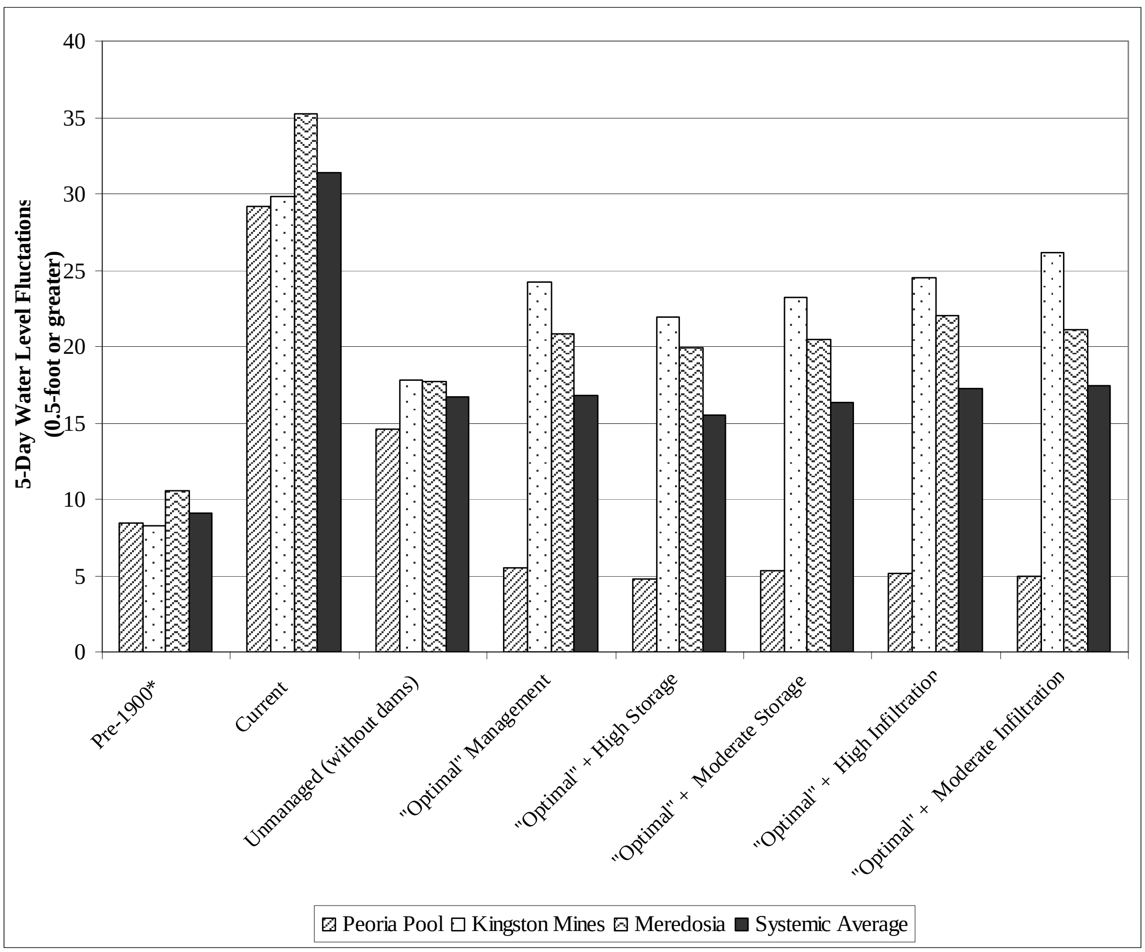


Figure 3-37. Growing Season Fluctuations Over 5-Day Windows Under Various Modeled Scenarios

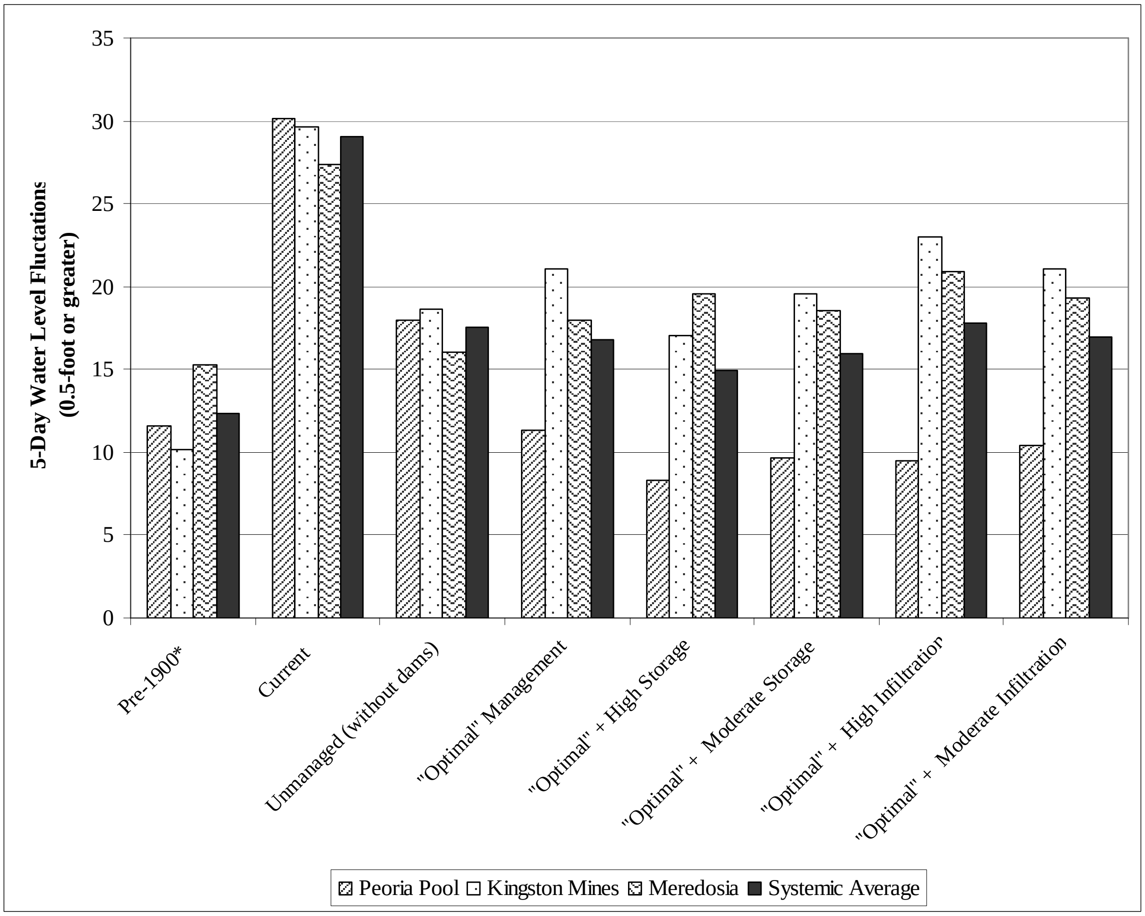


Figure 3-38. Winter Fluctuations Over 5-Day Windows Under Various Modeled Scenarios

The benefits shown in figures 3-37 and 3-38 are to some extent affected by the chosen benefit metric. The storage and infiltration measures are more effective at reducing the number of fluctuations within 24-hour time periods and at reducing the number of large fluctuations (one foot and greater), but the incidence of 5-day fluctuations of 0.5 foot or greater was felt to be a more stringent and accurate estimate of ecological benefit. These results strongly suggest that the landscape changes have changed the nature (and possibly the volumes) of the flows to the river to the extent that the hydraulic effects cannot be completely addressed by feasible watershed projects. The Illinois River is especially susceptible to such changes because its low slope accentuates water level changes under changing inflows. Therefore, under the levels considered here, the primary benefits from the infiltration and storage measures would accrue in the tributaries, not along the main stem. It is important to note that the “optimal” management scenarios represent a potential benefit, but it is likely that the actual benefit will be somewhat less because of the limitations imposed by real-world conditions. It is also likely that under somewhat less than “optimal” conditions there would be fluctuation benefits derived from infiltration or storage measures that would offset the non-optimal management conditions but cannot be recognized in this analysis due to the modeling limitations.

Three alternatives for dam management were considered for this program and are identified below:

- M0 – No action
- M1 – Increase frequency of dam gate changes with the aim of reducing low-water fluctuations; requires new regulation manuals, improved gage network (10) and increased capacity of operators to make gate changes (i.e. "Optimal" management)
- M2 – M1 + enact coordinated water control with the aim of minimizing fluctuations induced by storm events (i.e. centralize water control)

ii. Wicket Dam Modification. The operation of the wicket dams at Peoria and LaGrange induce significant water level fluctuations, both when the wickets are raised and when they are lowered. Totally eliminating these large fluctuations would likely require replacing the wickets with permanent structures, which would eliminate the ability to have open pass during periods of high water levels. Altering the method of wicket operation is not likely to significantly reduce the occurrence of these fluctuations. Although adding another tainter gate at either Peoria and LaGrange would probably not decrease the frequency of wicket operations at the dams, it would most likely reduce the magnitude of water level fluctuations that result from wicket operations. The computed induced water level fluctuations at Peoria and La Grange Lock and Dams with the addition of a single tainter gate at each dam are 0.5 and 1.1 feet, respectively (USACE, 2005). This represents a computed reduction in the magnitude of the water level fluctuations of 1.8 and 1.9 feet at Peoria and La Grange, respectively. Reconstruction of the dams, and replacement of all the wickets with tainter gates, could further smooth the fluctuations that currently occur during wicket operations and so would accrue benefits in the upper portions of the La Grange and Alton Pools.

The potential benefits from adding tainter gates would be a reduced intensity of the water level drops associated with gate raises because of the reduced need to hold back flows to build pool. Although adding a single tainter gate at Peoria and La Grange would not reduce the number of water level fluctuations (consequently the benefits in terms of water level fluctuations do not change), the reduction in magnitude of water level changes is significant and beneficial. Reconstructing the dams as permanent structures (i.e. replacing the wicket gates with tainter gates) may provide the opportunity to smooth water level changes enough to eliminate the fluctuations that would have occurred due to raising wicket gates. The benefits would occur at Kingston Mines and Meredosia, with maximum average reductions of 1.5 and 1.7 fluctuations per growing season, respectively, and 0.7 and 0.5 fluctuations per winter season, respectively. Effects due to the pulses from wicket lowering would be attenuated as well, but the benefits are not likely to be observable in the fluctuation metric because the rising water levels would generally induce fluctuations during a 5-day time window regardless.

The following six alternatives for wicket dam modification were considered for this program:

- WP0 – No action at Peoria dam
- WP1 – Add additional tainter gate at Peoria
- WP2 – Reconstruct wicket dam at Peoria to allow continuous dam operations
- WL0 – No action at La Grange dam
- WL1 – Add additional tainter gate at La Grange
- WL2 – Reconstruct wicket dam at La Grange to allow continuous dam operations

iii. Floodplain Storage. Potential fluctuation reduction benefits were investigated for floodplain management activities in the Peoria and La Grange Pools (please see Appendix C-4). Because of the historical loss of connected floodplain area, changes in flow are more restricted and these likely lead to a less stable water level regime than would occur if the additional area were available. Floodplain elevation is a key determinant of the nature of the benefits expected; to affect the water level changes occurring during low water, it is necessary for the available floodplain to be at or near flat pool elevations. Because of the interest in mitigating such low water fluctuations, the floodplain management analyses concentrated on scenarios that focused on making area available when the water level was relatively low.

The Hennepin Drainage & Levee District at RM 206 is the only significant contiguous area of disconnected floodplain within the Peoria Pool. That area is 2,900 acres protected from the river by an agricultural levee system. The UNET modeling indicated that making use of the leveed area to attenuate high flows could reduce maximum water levels at Henry, approximately 7 miles downstream, by as much as 0.5 foot, although all benefits depend on the design of the structure that would be used to divert flows into the district. Hydraulic modeling indicates that the area would be most effective at reducing fluctuations if its inlet weir is set just above level pool elevation (440 feet NGVD). With this design, the HDLD would reduce 5-day fluctuations downstream to the Peoria Lock and Dam (RM 158) by approximately 5 percent. Upstream reductions would be less (2 percent at Starved Rock Tail, RM 231), and downstream of the Peoria Lock and Dam the river would display 1 percent reductions or less. These benefits would be roughly additive when combined with work to restore tributary hydrologic regimes; if storage is added in the basin at levels of 10 acre-feet per square mile or greater, additional fluctuation benefits can be expected, but combinations with infiltration alternatives or low levels of storage are unlikely to display additional benefits beyond those attributable to the HDLD alone.

Modeling of floodplain storage in the La Grange Pool indicates somewhat smaller reductions in water level fluctuations from added storage area than the modeling of the HDLD. For this report, the Illinois State Water Survey used the UNET model to simulate a number of scenarios wherein different combinations of floodplain areas in the La Grange Pool were made available to attenuate low-level fluctuations, in the same way that the HDLD was modeled in Peoria Pool. Changes in the water level fluctuation regime were quantified at Kingston Mines, Copperas Creek, Havana, and Beardstown. The results of this effort suggest that although location-specific effects are significant, the fluctuation reductions due to the storage areas are roughly additive. The effects also diminish quickly with distance, and are much greater downstream from the added storage than upstream. Figure 3-39 summarizes the relationships developed from this analysis. Please note that the percent reduction in 5-day fluctuations is based on the average reduction under “optimal management” conditions based on UNET hydraulic modeling conducted by the Illinois State Water Survey.

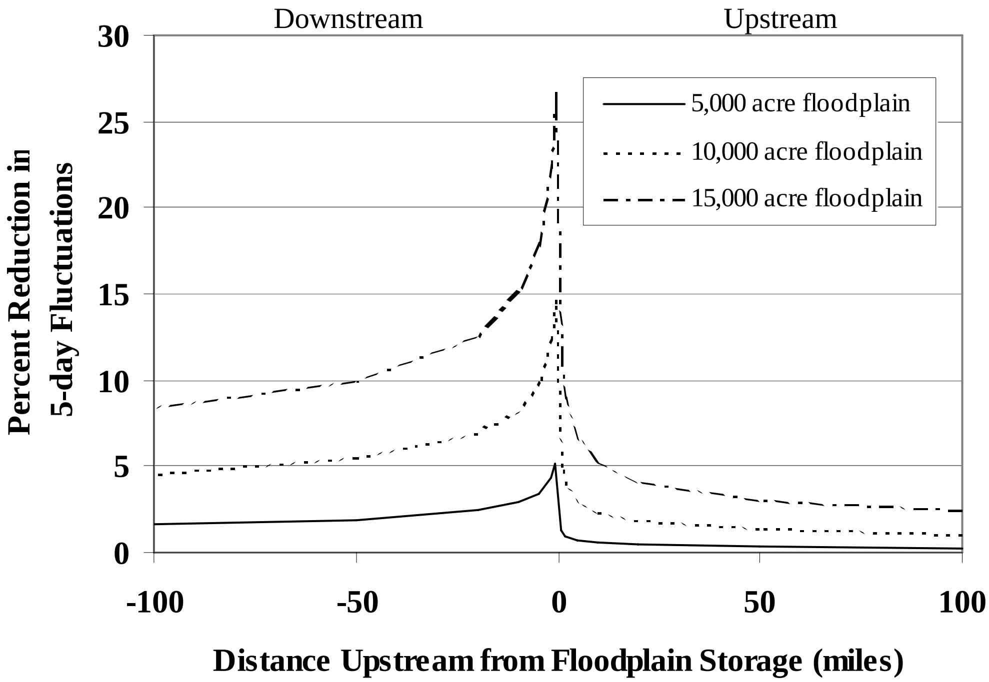


Figure 3-39. Expected Reduction in La Grange Pool Water Level Fluctuations Upstream and Downstream of Added Floodplain Storage

As figure 3-39 indicates, the incremental addition of floodplain storage areas in the La Grange Pool can have a large effect on local water level conditions, and there is sustained benefit downstream but benefits do not transmit a long distance upstream. For example, the addition of 15,000 acres at pool level would reduce fluctuations by 10 percent or more, under modeled conditions, for 50 miles downstream, but the fluctuation 10 miles upstream would be less than 5 percent. Locations with 5,000 acres or less would not be expected to reduce fluctuations anywhere by more than 5 percent. Large benefits can be expected only in the immediate vicinity of the floodplain projects, and to some degree downstream, and only if the total area exposed at low water is greater than about 10,000 acres.

No floodplain projects are recommended as part of this Goal for two reasons, (1) they are already addressed in Goal 3 and (2) the benefits realized from floodplain projects tend to influence only the local area. Some ancillary hydrologic benefits will be attained when floodplain projects are implemented to meet Goal 3. Some floodplain management activities may be considered as part of the effort to improve local conditions in the vicinity of other projects. For example, open areas of the floodplain could be created across the river from a habitat restoration project in an attempt to attenuate fluctuations. As part of a systematic effort, these results suggest that floodplain areas in the upper reaches of the pool may provide the most benefits; downstream areas would have little upstream benefits and it is likely that most of the fluctuation benefits do not pass downstream of the dams, when they are in operation. The Corps of Engineers has done some analysis of the effects of levee removal on the Mississippi and Illinois Rivers as part of the *Upper Mississippi River Comprehensive Plan for Systematic Flood Damage Reduction and Associated Environmental Sustainability* report which is still under review. Early results have shown that completely removing agricultural levees from the system could provide some reduction in water levels on the Illinois River in some locations. No analysis on water level fluctuations was performed as part of this study. Further study is required in this area.

b. Pool Drawdown. Several factors combine to determine the effects of a drawdown event, including:

- the duration of the event,
- the depth to which the water level is drawn down,
- the area of sediment exposed, and
- the month or season of drawdown.

Increased drawdown depth and implementation of added dewatering measures can increase sediment consolidation. It has been noted that 70 consecutive days with sustained low water conditions between July 10 and October 1 are required for optimal growth and establishment of moist soil plants (Bellrose et al. 1983), but benefits have been observed with drawdowns of lesser duration (Atwood et al. 1996). Seasonality is critical to the benefits achieved; drawdown during the winter may provide the benefit of sediment compaction, although it would not permit vegetation to establish.

Analyses for the UMR Navigation Study evaluated the potential for pool-wide drawdowns along the Illinois River. In that analysis, very little benefit was found in drawing down the river at points upstream of Starved Rock. Benefits were found at Peoria and La Grange, but a low probability of success was assigned to attempted drawdowns in those pools because flow conditions would prevent maintenance of a 2-foot drawdown for 60 continuous days between May and August in more than 50 percent of years. The Water Level Management Analysis conducted additional analyses of the potential for drawdown in the Peoria and La Grange Pools. Flow conditions during 30-day and 70-day time windows throughout the year were analyzed to determine the probability of maintaining drawdown during the entire window or for 30 consecutive days within each 70-day window. The values determined from this analysis are given in tables 3-48 and 3-49 as the "Full Success Rate" for the attempted drawdowns.

Main stem benefit analysis concentrated on the Illinois River from Henry to Meredosia. This reach contains most of the ecologically significant areas on the main stem, and downstream of Meredosia the river hydrologic regime becomes dominated by the backwater effects of the Mississippi River. Fluctuation benefits were generated for each pool, with the percent reduction at the Peoria Pool, Meredosia, and Kingston Mines gages representing Peoria Pool, Alton Pool, and La Grange Pool, respectively. The benefits at the three pools were averaged to develop a measure of systemic benefit.

Drawdown benefits were determined based on expected acres of exposure (the sum of the area exposed multiplied by the probability of success). Timing is crucial to ecological benefits of drawdowns, so a seasonal factor was used to adjust the benefits based on time of year. Drawdowns occurring between June 1 and September 1 were accorded a value of "1.0," with the value of drawdown decreasing linearly to "0.2" on December 1 (figure 3-40). This factor is referred to as the "suitability" of the drawdown season.

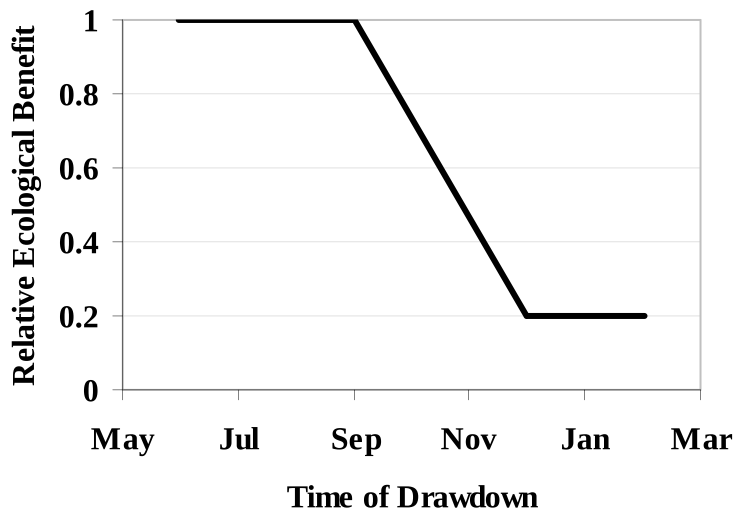


Figure 3-40. Assumed Seasonal Value of Drawdown Along Main Stem Illinois River

The probability of success combined with the suitability of the drawdown season and length of sustained drawdown provides a quality-weighted expected benefit factor of the drawdown. These values were calculated for the most favorable times of the year (tables 3-50 and 3-51). Combining these values with the average area of exposure, calculated using hydraulic modeling, provides the total expected benefits for the various drawdown scenarios (figures 3-41 and 3-42). Note that the uncontrolled scenario refers to the hypothetical situation in which main stem water level management activities have been removed from the system (i.e. no dams). The benefits quantified for the Peoria Pool used modeled exposed area: 3,000 acres for 1-foot drawdown, 8,000 for 2-foot drawdown, and 24,000 for uncontrolled drawdown. The values for La Grange use the modeled area exposed in the vicinity of the channel plus additional contiguous off-channel aquatic area identified for the Navigation Study totaling 4,300 acres for 1-foot drawdown, 8,600 for 2-foot drawdown, and 15,200 for uncontrolled drawdown.

The following formulas further explain this process:

Expected Benefit Per Acre = Suitability * Full Success Rate * Duration of Drawdown

Expected Drawdown Benefits = Expected Benefit Per Acre * Area Exposed by Drawdown

Table 3-50. Benefit Calculations for Peoria Pool Drawdowns

Starting Date		**Jun 1**	**Jul 1**	**Aug 1**	**Sep 1**	**Oct 1**	**Nov 1**	**Dec 1**
Suitability (30-day)		1.0	1.0	1.0	0.8	0.6	0.4	0.2
Suitability (70-day)		1.0	0.97	0.86	0.66	0.46	0.29	0.2
30-day attempt	Full success rate	0.15	0.3	0.6	0.65	0.65	0.55	0.4
	Expected benefit (per	**4.5**	**9**	**18**	**15.6**	**11.7**	**6.6**	**2.4**
70-day attempt	Full success rate	0.1	0.2	0.45	0.45	0.4	0.3	0.2
	Expected benefit (per	**7**	**13.6**	**27.1**	**20.8**	**12.9**	**6.1**	**2.8**
	30-day but not 70-day rate	0.4	0.6	0.4	0.4	0.4	0.4	0.55
	Expected benefit (per	**12**	**18**	**12**	**9.6**	**7.2**	**4.8**	**3.3**

Table 3-51. Benefit Calculations for La Grange Pool Drawdowns

Starting Date		**Jun 1**	**Jul 1**	**Aug 1**	**Sep 1**	**Oct 1**	**Nov 1**	**Dec 1**
Suitability (30-day)		1.0	1.0	1.0	0.8	0.6	0.4	0.2
Suitability (70-day)		1.0	0.97	0.86	0.66	0.46	0.29	0.2
30-day attempt	Full success rate	0.1	0.25	0.4	0.65	0.6	0.55	0.4
	Expected benefit (per	**3**	**7.5**	**12**	**15.6**	**10.8**	**6.6**	**2.4**
70-day attempt	Full success rate	0.0	0.15	0.3	0.45	0.4	0.25	0.2
	Expected benefit (per	**0**	**10.2**	**18.1**	**20.8**	**12.9**	**5.1**	**2.8**
	30-day but not 70-day rate	0.4	0.55	0.55	0.35	0.35	0.3	0.35
	Expected benefit (per	**12**	**16.5**	**16.5**	**8.4**	**6.3**	**3.6**	**2.1**

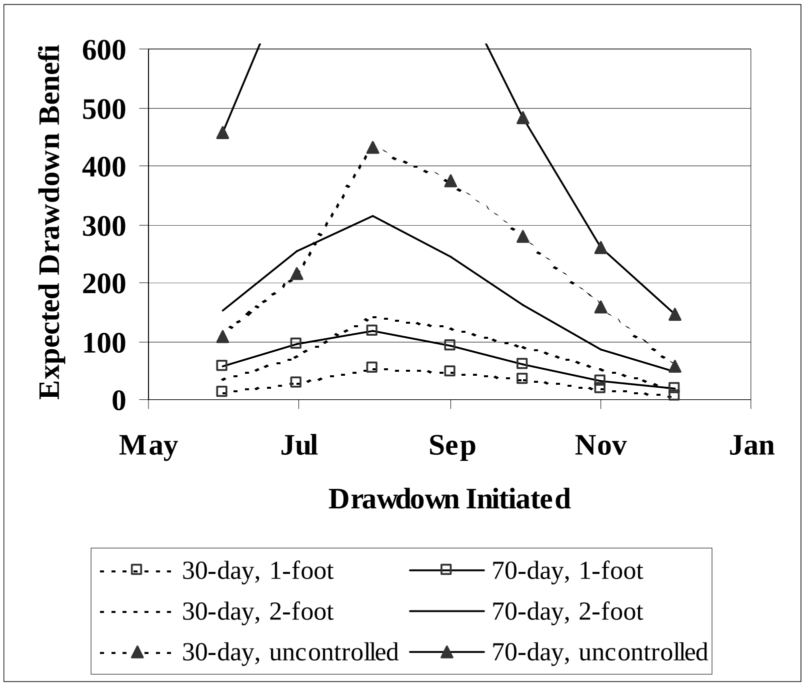


Figure 3-41. Expected Drawdown Benefits in Peoria Pool. Units are thousand quality acre-days.

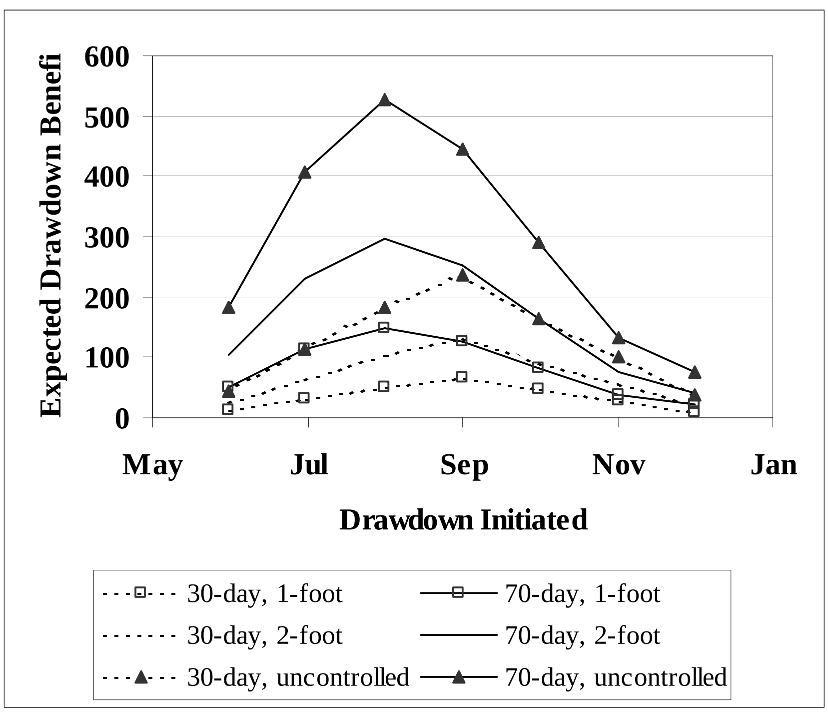


Figure 3-42. Expected Drawdown Benefits in La Grange Pool. Units are thousand quality acre-days.

Since the cost of drawdown is estimated using the long-term dredging requirements to maintain navigation with lower water levels, there is no incremental cost per drawdown attempt. For Peoria Pool, 2-foot drawdowns were chosen, but because of the likelihood of high dredging requirements, only a 1-foot drawdown was chosen for La Grange Pool. The individual measures were chosen based on the number of attempts to maintain at least 30 consecutive days of drawdown 10 times over 50 years.

Five alternatives for pool drawdown were considered for Peoria Pool (P) and seven alternatives for pool drawdown were considered for La Grange Pool (L). These alternatives are identified below:

- P0 – No Peoria Pool drawdown
- P1 – Attempt a 2-foot drawdown of Peoria Pool 2 years out of every 3 from Jul 1-30
- P2 – Attempt a 2-foot drawdown of Peoria Pool every 3 years from Aug 1-30
- P3 – Attempt a 2-foot drawdown of Peoria Pool 2 years out of every 5 from Jun 1- Aug 9
- P4 – Attempt a 2-foot drawdown of Peoria Pool every 4 years from Aug 1- October 9

- L0 – No La Grange Pool drawdown
- L1 – Attempt a 1-foot drawdown of La Grange Pool 4 years out of every 5 from Jul 1- 30
- L2 – Attempt a 1-foot drawdown of La Grange Pool every other year from Aug 1- 30
- L3 – Attempt a 1-foot drawdown of La Grange Pool 3 times every 10 years from Sep 1- 30
- L4 – Attempt a 1-foot drawdown of La Grange Pool every other year from Jun 1- Jul 9
- L5 – Attempt a 1-foot drawdown of La Grange Pool 2 years out of every 7 from Jul 1- Sep 9
- L6 – Attempt a 1-foot drawdown of La Grange Pool 6 times every 25 years from Aug 1- Oct 9

3. Evaluation and Comparison of Plans

A range of plans was developed by combining alternatives developed for dam management, stormwater storage, infiltration, wicket dam modification, and pool drawdown. The costs and benefits for these plans were estimated to allow evaluation of how well these plans meet the objectives of this goal and their relative cost-effectiveness. Based on this analysis, effective plans of different levels of effort were chosen for inclusion in the proposed system-level plans.

a. Costs. Costs for each of the alternatives were developed assuming a 50-year project life. Where possible, these costs were estimated using previously constructed projects or from other planning efforts, such as the Restructured Upper Mississippi-Illinois Waterway System Navigation Study. All construction costs include a 35 percent contingency, 30 percent for planning, engineering, and design, 9 percent for contract supervision and administration, and estimated real estate costs. Costs shown are in 2003 dollars.

Dam Management

M1 – Management improvements require three upgrades – initial cost $3.7M

- Place remote controls on rest of Illinois River dams (Marseilles already installed) – $5,629,500.
- Revise regulation manuals (7 total) - $108,000 each, for a total of $756,000.
- Install and maintain additional gages (10 total) - USGS initial cost $20,250 each, for a total of $202,500.

M2 – Navigation Study estimates $7,000,000 over 50 years. Assume initial cost of $1,000,000.

Storage (R1-R5)

Assume that each storage area would be on the order of 5 acres or more and a depth (during the design event) of 1.5 feet. Based on the cost estimate of a similar project, the construction cost for a floodplain pond was estimated to be approximately $6300 per acre-foot. Operation and Maintenance (O&M) Cost is estimated to be $5.00 per acre-foot per year.

Infiltration (I1-I5)

There are a variety of potential ways to develop infiltration facilities – assume half upland structures, half filter strip. Assume that each upland infiltration structure would be on the order of 5 acres or more. An upland structure/ filter strip project was estimated to cost $13,825 per acre, with annual O&M Cost of $6.75 per acre.

Wicket Dam Modification

Wicket dam modification would consist of replacing either 26 of the wickets with one tainter gate or all of the wickets (108 at Peoria and 109 at La Grange) with 4 tainter gates. One tainter gate was estimated to cost $26 million, with an annual estimated O&M cost of $30,000. Replacing the entire wicket structure with four tainter gates was estimated to cost a total of $300 million. The Navigation Study estimates that installing an additional tainter gate at either Peoria or La Grange (without removing any of the wickets) would cost approximately $13.9 million (USACE, 2005).

Drawdown

The Navigation Study estimated the cost to conduct drawdowns as the cost to dredge to maintain minimum channel conditions and access to facilities. This management would allow any number of drawdowns over the course of the project life. Preliminary estimates for Peoria Pool and La Grange Pool indicated that an additional 47,000 and 204,000 cubic yards of dredging would be required every 10 years to maintain navigation during 1.5-foot drawdowns of these two pools, respectively.

Because dredging needs were not determined for 2-foot drawdowns of Peoria Pool, it was assumed that such a drawdown would require twice as much dredging as the 1.5-foot drawdown. Likewise, it was assumed that the quantities required for a 1-foot drawdown of La Grange Pool would be the same as the dredging for a 1.5-foot drawdown. These assumptions lead to added channel maintenance dredging requirements of 470,000 cubic yards of material in Peoria Pool and 1,021,000 cubic yards in La Grange Pool over a 50-year time period.

Additional dredging would also be required to maintain facility access. USACE 2004a identified 12 marinas and 20 industrial facilities that would be affected by a drawdown in Peoria Pool and so would have to be dredged an additional 5 times over 50 years. The final cost estimate is $14.6 million to maintain 2-foot drawdown conditions in Peoria Pool and $22.9 million to maintain 1-foot drawdown conditions in La Grange Pool.

It should be noted that these costs do not reflect additional economic costs such as loss of recreation due to lower water levels. Also not quantified is the potential benefit from reduced future maintenance dredging. These issues will be addressed further in the project design phase.

b. Benefits. Quantifying hydrologic benefits under this goal requires consideration of multiple independent factors. Although the current understanding of Illinois River Basin ecosystem processes allows identification of several important aspects of the hydrologic regime, this understanding is not sufficient to determine many critical thresholds that are known to influence ecosystem integrity. In the absence of knowledge regarding thresholds, benefits are generally assumed to be directly associated with reduction of unfavorable conditions or increase of favorable conditions; that is, a 10 percent reduction in an unfavorable condition is interpreted as a 10 percent improvement in that aspect of the hydrologic regime. This is not altogether consistent with the importance of thresholds; for example, reducing unfavorable conditions may or may not achieve a proportional benefit because the reduced level may still be too unfavorable for ecosystem response. However, in the absence of a more detailed understanding, the assumption of a linear response is the best available. Where possible, it is better to compare the hydrologic regime to conditions that maintained a more desirable state.

One of the most important considerations in evaluating hydrologic benefits is that all of the significant aspects of the altered regime must be captured. Many of these aspects are independent and not directly comparable, so dissimilar benefits should not be lumped together before evaluation. In other words, providing additional benefits to one aspect of the hydrologic regime (e.g., peak flows) would not necessarily offset the effects of a different aspect (e.g., low flows). Because there is currently no accepted index that combines the aspects of the Illinois River Basin hydrologic regime into a single value for comparison, it is not possible to develop a single estimate of regime "quality." Therefore, in this section the different alternatives were compared by individually accounting for the various relevant hydrologic regime benefits.

i. Tributary Benefits. Tributary benefits were quantified as reduced 2- to 5-year peak flows and increased baseflows. These two aspects of the hydrologic regime are generally acknowledged to provide independent benefits to stream and river communities. Reduced peak flows for these relatively common events are assumed to correlate with less extreme conditions during runoff events and so are related to other beneficial improvements during high water conditions. Baseflow levels are commonly directly related to ecosystem support during drought conditions.

The benefits for these two aspects were expressed directly as the modeled improvements shown in Figures 3-39 through 3-44, and are shown in table 3-50. This formulation assumes the proportional relationship between hydrologic improvements and ecosystem benefits described previously and does not identify any benefit thresholds. Where both storage and infiltration measures were used in an alternative, the benefits were assumed to be additive.

ii. Main Stem Benefits. Two types of benefits were identified that would independently improve main stem Illinois River hydrologic regimes: reduced fluctuations and bottom area exposed during sustained drawdown. Using the main stem fluctuation index defined as the average annual number of 5-day fluctuations exceeding 0.5 foot at the Peoria Pool, Kingston Mines, and Meredosia gages, main stem fluctuation benefits have been defined using:

$$\text{Benefit} = (\text{Current-Alternative})/(\text{Current} - \text{pre-1900})$$

The values for the fluctuation index for Water Years 1990 - 1997 ("Current") are 31.4 for the growing season and 29.0 for the winter. Pre-1900, this index is estimated to be 9.0 for the growing season, 12.3 for the winter. Using these values, fluctuation benefits can be estimated using the following formulas:

$$\text{Growing Season Benefit} = (31.4 - \text{Alternative})/22.4, \text{ and}$$
$$\text{Winter Benefit} = (29.0 - \text{Alternative})/16.7$$

The assumptions for this benefit calculation are that the fluctuations of 0.5 foot or more occurring over 5 days or less and measured using 2-hour data correlate with the conditions that are adversely affecting ecosystem function in the main stem Illinois River; that the average of these three locations accurately reflects overall river conditions; that the conditions observed in the 1890's are near-optimal for the current system; and that there is a proportional improvement in condition with each change that moves total fluctuation numbers closer to pre-1900 levels. The assumed fluctuation benefits for the various alternatives are shown in table 3-52.

Table 3-52. Tributary and Main Stem Alternative Hydrologic Regime Benefits

	Initial Cost ($M)			Tributaries		Reduced Main Stem Fluctuations	
Alternative	**Construction**	**Real Estate**	**Total**	**Reduced Peak Flow**	**Increased Baseflow**	**Growing Season**	**Winter**
R0, I0, M0, WP0, WL0	0	0	0	0	0	0%	0%
M1	6.6	0	6.6	0	0	65%	73%
M2	7.6	0	7.6	0	0	65%	73%
R1	**108**	**62**	**170**	**1.50%**	**0.1%**	**0%**	**0%**
R2	180	104	284	2.50%	0.1%	0%	0%
M1, R2	187	104	291	2.50%	0.1%	65%	73%
M1, R3	367	207	574	5%	0.3%	65%	73%
M1, R4	647	368	1015	8%	0.6%	66%	73%
M1, R5	1508	863	2371	16%	1.6%	67%	78%
I1	100	33	133	0.80%	5%	0%	0%
M1, I2	207	65	272	1.50%	10%	67%	73%
M1, I3	407	131	538	3%	20%	65%	73%
M1, I4	1008	326	1334	7.60%	50%	65%	73%
M1, I5	2009	653	2662	16%	80%	65%	73%
R1, I1	**208**	**95**	**303**	**2.30%**	**5%**	**0%**	**0%**
M1, R1, I1	**215**	**95**	**310**	**2.30%**	**5%**	**65%**	**73%**
M1, R3, I3	**767**	**338**	**1105**	**8%**	**20%**	**65%**	**73%**
M1, R4, I3, P4, L6	**1047**	**499**	**1546**	**11%**	**20%**	**66%**	**73%**
M1, R5, I4	2509	1189	3698	23%	50%	67%	78%
M1, R5, I4, WP2	2809	1189	3998	23%	50%	70%	79%
M1, R5, I4, WL2	2809	1189	3998	23%	50%	70%	79%
M1, R5, I4, WP2, WL2, P4, L6	**3109**	**1189**	**4298**	**23%**	**50%**	**72%**	**80%**

Key:
(R) - storage in tributary areas
(I) - infiltration in tributary areas
(M) - dam management
(WP) - modification of Peoria wicket dams
(WL) – modification of La Grange wicket dams
Bold type - alternative combinations that were used as system plans

Drawdown benefits were calculated using

$$\text{Expected benefit per attempt} = n * P * Q * A$$

as described above, where n is the desired length of drawdown, P is the probability of n consecutive days with appropriate flow conditions (Appendix C), Q is the quality factor that relates to the benefits accrued from the season the drawdown is taking place (figure 3-38) and A is the bottom area exposed by drawdown. This formulation assumes that there is no benefit unless the drawdown is maintained for at least n days. Expected benefits were formulated for n = 30 and 70 days, and expected benefits for the 70-day drawdown attempts included both the benefits from a 70-day drawdown and the benefits from drawdowns that last at least 30 days but not the full 70 days within that time period (tables 3-48 and 3-49). Total benefits are the expected benefits per attempt multiplied by the number of attempts over the course of the project (table 3-53). Alternatives were developed with the intent of one successful drawdown every 5 years, so drawdowns in less favorable seasons would be expected to require some attempts in additional years to attain the desired number of successes. For this reason, Table 3-53 lists the expected benefits based on the number of days that the pool is expected to be drawn down over the 50-year project life. Drawdown benefits are quantified as quality acre-days, representing the area exposed for at least 30 consecutive days, with quality reflecting seasonal benefits as shown in figure 3-38. Expected number of days drawn down are 30 and 70 for fully successful 30- and 70-day drawdowns, respectively, and 15 and 35 for drawdown attempts that are not fully successful.

4. Plans Recommended for System Analysis

a. Restoration Alternatives. The alternatives described above were combined to represent plans with different levels of effort, each adding increments onto the previous plans and with benefits corresponding to the various system-level alternatives. It is assumed that each is cost-effective because the most cost-effective measures will be used in the implementation of each plan. Characteristics of each plan are summarized in table 3-54.

5A – R1. Create an additional 27,000 acre-feet of storage during 5-year event. Reduces tributary peak flows by 1.5 percent and provides an initial level of benefit to tributary areas.

5B – R1, I1. Create an additional 27,000 acre-feet of storage during 5-year event and infiltrate runoff from 300 square miles. Provides tributary benefits by reducing peak flows by 2.3 percent, thereby meeting Lt. Governor’s goal and increasing low flows by 5 percent.

5C – M1, R1, I1. Create an additional 27,000 acre-feet of storage during 5-year event, infiltrate runoff from 300 square miles, and increase intensity of water level management at Illinois Waterway locks and dams. Provides tributary benefits by reducing peak flows by 2.3 percent, thereby meeting Lt. Governor’s goal and increasing low flows by 5 percent. Also provides significant reduction in low-flow water level fluctuations on main stem river.

5D – M1, R3, I3. Create an additional 90,000 acre-feet of storage during 5-year event, infiltrate runoff from 1,200 square miles, and increase intensity of water level management at Illinois Waterway locks and dams. Provides significant tributary benefits by reducing peak flows by 8 percent, thereby exceeding Lt. Governor’s goal and increasing low flows by 20 percent. Also provides significant reduction in low-flow water level fluctuations on main stem river..

Table 3-53. Drawdown Alternative Benefits

Alternative	Cost ($M)	Number of Attempts (50 yr)	Expected Benefit per Attempt (acre-days)	Expected Days Drawn Down	Total Benefit (acre-days)	Benefit per Day Drawn Down
P0, L0	0	0	0	0	0	
P1	14.6	33	72	495	2376	4.8
P2	14.6	17	144	405	2448	6
P3	14.6	20	152	1040	3040	2.9
P4	14.6	13	313	665	4069	6.1
L1	22.9	40	32.25	750	1290	1.7
L2	22.9	25	51.6	525	1290	2.5
L3	22.9	15	67.1	375	1007	2.7
L4	22.9	25	51.6	875	1290	1.5
L5	22.9	14	114.8	560	1607	2.9
L6	22.9	12	148.8	560	1786	3.2

Key:
P - Peoria Pool drawdowns
L - La Grange Pool drawdown

Table 3-54. Characteristics of Alternative Plans Selected As Part of System Plans

		Tributary Benefits		Main Stem Benefits			Initial Cost ($M)			
System Plan	Alt. Plan	Peak Flow Reduction	Base Flow Increase	Growing Season Reduced Fluctuation	Winter Reduced Fluctuation	Expected Drawdown (Peoria/La Grange)	Construction	Real Estate	Total	O&M ($K/yr)
1	5A	1.50%	0%	0%	0%	no/no	108	62	170	135
2	5B	2.30%	5%	0%	0%	no/no	208	95	303	200
3	5C	2.30%	5%	66%	75%	no/no	215	95	310	325
4,5	5D	8%	20%	66%	75%	no/no	767	338	1105	835
6	5E	11%	20%	66%	75%	yes/yes	1085	499	1584	1185
7	5F	23%	50%	73%	81%	yes/yes	3147	1189	4336	2650

5E – M1, R4, I3, P4, L6, WP1, WL1. Create an additional 160,000 acre-feet of storage during 5-year event, infiltrate runoff from 1,200 square miles and increase intensity of water level management at Illinois Waterway locks and dams, and reconstruct portions of the Peoria and La Grange dams to include an additional tainter gate at each dam. Provides significant tributary benefits by reducing peak flows by 11 percent, thereby exceeding Lt. Governor's goal and increasing low flows by 20 percent. Also provides significant reduction in low-flow water level fluctuations on main stem river. Provides additional infiltration and storage on the tributaries which would influence the tributary flow regime and provide associated benefits. Drawdowns of Peoria and La Grange Pools would expose bottom areas for at least 30 consecutive days during 1 year out of 5, with potential exposure for up to 70 consecutive days, consolidating sediment and encouraging plant growth during the late growing season. The additional tainter gates would decrease the magnitude of water level fluctuations associated with wicket operations

5F – M1, R5, I4, P4, L6, WP2, WL2. Create an additional 375,000 acre-feet of storage during 5-year event, infiltrate runoff from 3,000 square miles, increase intensity of water level management at Illinois Waterway locks and dams, and reconstruct Peoria and La Grange dams to remove effects of wicket operations. Considerably improves tributary hydrologic regimes, reducing peak flows by 23 percent, thereby exceeding Lt. Governor's goal and increasing low flows by 50 percent. Also provides significant reduction in water level fluctuations on main stem river, increased management, wicket removal and tributary basin improvements contributing to more stable water levels. Provides additional infiltration and storage on the tributaries which would influence the tributary flow regime and provide associated benefits. Drawdowns of Peoria and La Grange Pools would expose bottom areas for at least 30 consecutive days during 1 year out of 5, with potential exposure for up to 70 consecutive days, consolidating sediment and encouraging plant growth during the late growing season.

b. Risk and Uncertainty. Because of the likely sensitivity of the Illinois River Basin hydrologic regime to climate impacts (Knox 2001), it is necessary to develop alternatives that are robust to the range of potential climate variation likely to be expected over the life of the project. Extreme events and climatic cycles are also significant aspects of the hydrologic regime. In the last century, the Illinois River Basin has experienced both extreme drought and extreme floods. Temporal changes in climatic or hydrologic conditions will be reflected as changes in the hydrologic regimes of the streams and rivers within the Illinois River Basin. The design of individual projects should be robust enough to function under potential hydrologic regime and sediment delivery conditions.

The measures selected for this goal, when correctly designed and applied, would improve the hydrologic regime characteristics of rivers and streams in the Illinois River Basin. The extent and degree of improvements for each individual project would depend on project design and watershed conditions, but sophisticated hydrologic and hydraulic modeling provides confidence that the benefits for the proposed levels of project implementation are reasonable. The model results have uncertainty associated with them, and the achieved benefits may be somewhat more or less than the current modeling suggests. In addition, there is uncertainty in the realizable benefits from the proposed management improvements; hydraulic modeling indicates a potential level of benefit under a certain management scheme, but it is yet to be seen how closely "real-world" management can come to the optimal level.

One item of significant uncertainty is the net effect of outside influences on the hydrologic regime of the Illinois River in the future. Factors that will affect future hydrologic conditions are climate, land use and land cover conditions. Changes in any of these factors could mask some of the change, brought about by project implementation. The uncertainty regarding this item can be addressed by incorporating monitoring results into evaluations of program effectiveness; by separating project effects from those of outside influences it will be possible to correctly assess project benefits and adapt to changing conditions.

Finally, an additional item of uncertainty is the ecological response from the proposed level of hydrologic regime change. The team is confidant that the proposed objectives would provide significant and measurable benefits, and that these changes would have significant ecological benefits. However, in the absence of a complete model to relate ecosystem integrity and hydrologic regime, it cannot be confidently assumed that all of the hydrologic characteristics required to maintain a specific level of integrity have been addressed. Further work is necessary to move beyond the qualitative understanding of system function so that quantitative predictions of ecosystem response are possible, and that the initial objectives may be revised if necessary.

c. Additional Benefit Quantification. Originally, the benefits for Goal 5 were quantified for each alternative in terms of: percent reduction in tributary peak flow (TPF) for the 5-year event, percent increase in tributary base flow (TBF), percent decrease in main stem fluctuations (MSF), and whether pool drawdowns and wicket dam reconstruction would be attempted. The benefits for Goal 5 have been further quantified in terms of stream miles and acres, as to the length of stream and the watershed area that would be affected by the measures included in a particular alternative. Table 3-55(a) show the main stem areas with direct benefits (the area adjacent to the sites with proposed management changes).

Table 3-55 (a). Additional Benefit Quantification for Goal 5

		Main Stem Area with Benefits Resulting from the Proposed Measures (acres)			
System Plan	**Alternative Plan**	**Main Stem Water Level Management Changes**	**Navigation Pool Drawdown**	**Wicket Dam Modification**	**Total Acres**
1	5A	0	0	0	0
2	5B	0	0	0	0
3	5C	8,600	0	0	8,600
4,5	5D	8,600	0	0	8,600
6	5E	8,600	12,300	0[1]	20,900[1]
7	5F	8,600	12,300	2,800	23,700

[1] System Plan 6 /5E - Further analysis is required to more completely quantify the benefits from the addition of a tainter gate at Peoria and La Grange dams.

Tables 3-55(b) and 3-55(c) show the watershed and stream length influenced (the reach or area that potentially experiences benefits from the proposed management changes or construction activities) for each alternative.

The direct benefits and the watershed area and length of stream influenced from the proposed measures for each of the alternatives were calculated based on engineering expertise. There are approximately 11,000 perennial stream miles (approximately 33,000 total stream miles in the basin)

and 300 sub-watersheds in the Illinois River Basin. It is assumed that a proportional percentage of stream miles lie in specified percentage of sub-watersheds (i.e. 50 percent of the stream miles (5,500 miles) lie in 50 percent of the sub-watersheds (150 sub-watersheds).
It is assumed that the Main Stem Water Level Management Changes proposed for Alternatives 3 through 7 will provide benefits to approximately one-fourth of the pool area downstream of the dams based on consideration of the geography of the downstream pools. For this analysis, the average water surface area in Brandon Road, Dresden Island, Marseilles, Starved Rock, Peoria, and La Grange pools was assumed to be approximately 270 acres, 1,510 acres, 2,170 acres, 2,660 acres, 20,050 acres, and 7,840 acres, respectively, based on information obtained from the HEC-RAS models of the Illinois River developed by the Rock Island District. The total potential area benefited from water level management changes (i.e. "optimization") is approximately 8,600 acres [table 3-55(a)].

The potential direct benefits resulting from the proposed Navigation Pool Drawdown were calculated by watershed modeling described in earlier in this report. The potential area benefited from a 2-foot drawdown at Peoria Pool is 8,000 acres and the potential area benefited from a 1-foot drawdown at La Grange is 4,300 acres.

It is assumed that the Wicket Dam Modification (total reconstruction of the dams at Peoria and La Grange – alternative 7) will benefit approximately one-tenth of the pools downstream of Peoria and La Grange dams based on consideration of the geography of the downstream pool. The total area that will potentially be benefited from the wicket dam reconstruction is approximately 2,800 acres. The addition of a tainter gate at Peoria and La Grange dams (Alt 6 / 5E) will benefit the area downstream by reducing the magnitude of water level changes. Further analysis is required to more completely quantify the benefits that will result from the addition of tainter gates at Peoria and La Grange.

The main stem area with beneficial effects from main stem water level management, navigation pool drawdown, and wicket dam modification proposed under Goal 5 have been added because the main stem area will be benefited in different ways for the three measures.

Stormwater storage volume (SV) and infiltration area (IA) measures will be implemented in half of the watersheds in the Illinois River Watershed for Alternative 6/5E; therefore, half of the perennial stream miles (5,500 stream miles) and sub-watersheds (150) will realize beneficial effects [table 3-55(b)].

Table 3-55 (b). Additional Benefit Quantification for Goal 5

			Number of Sub-Watersheds With:		Percentage of the Illinois River Watershed With:		Potential Number of Stream Miles Benefited from (miles)	
Alternative Plan	**Proposed Add'l Storage Volume (acre-feet)**	**Proposed Add'l Infiltration Area (acres)**	**Add'l Storage Volume**	**Add'l Infiltration Area**	**Add'l Storage Volume**	**Add'l Infiltration Area**	**Add'l Storage Volume**	**Add'l Infiltration Area**
5A	27,000	0	25	0	8%	0%	920	0
5B	27,000	9,600	25	38	8%	13%	920	1,390
5C	27,000	9,600	25	38	8%	13%	920	1,390
5D	90,000	38,400	84	150	28%	50%	3,080	5,500
5E	160,000	38,400	150	150	50%	50%	5,500	5,500
5F	375,000	96,000	300[1]	300[1]	100%	100%	11,000	11,000

[1] Alternative 5F would include restoration measures in all watersheds.

For Alternative 6, 160,000 acre-feet of additional SV and 38,400 acres of IA would be created. The amount of SV and IA created in each sub-watershed are given below:

SV_s = stormwater storage volume per sub-watershed
$SV_{Alternative\ 6}$ / 150 sub-watersheds = 160,000 acre-feet / 150 watersheds
= 1067 acre-feet per watershed

IA_s = infiltration area per sub-watershed
$IA_{Alternative\ 6}$ / 150 sub-watersheds = 38,400 acres / 150 watersheds
256 acres per watershed

The stream miles with beneficial effects from additional stormwater SV and IA for Alternatives 1 through 5 are based on the following assumptions: (1) there are approximately 300 sub-watersheds in the Illinois River Basin, (2) the additional SV developed for each sub-watershed (SV_s) is 1,067 acre-feet, (3) the additional IA developed for each sub-watershed (IA_s) is 256 acres.

The additional SV and IA proposed for Alternatives 1 through 5 was divided by SV_s and IA_s, respectively, to obtain the number of sub-watersheds affected. The number of subwatersheds with additional SV and IA were divided by 300 to determine the approximate percentage of the Illinois River Basin with additional SV and IA (and the potential length of stream with beneficial effects for each), respectively. The percentage of the Illinois River Basin with additional SV and IA was multiplied by the total number of perennial stream miles in the Illinois River Basin to obtain the number of stream miles benefited for each alternative. It is assumed that the stormwater storage and infiltration measures proposed for Alternative 7 will indirectly benefit the entire Illinois River Watershed and all the perennial streams within the Illinois River Watershed. The stream lengths with beneficial effects from the increased stormwater storage volume and infiltration area proposed under Goal 5 have been added because the streams will be benefited in different ways for the two measures [table 3-55(c)].

Table 3-55 (c). Additional Benefit Quantification for Goal 5

		Stream Length Influenced by the Proposed Measures (miles)		
System Plan	**Alternative Plan**	**Stormwater Storage**	**Increasing Infiltration**	**Total Miles**
1	5A	920	0	920
2	5B	920	1,390	2,310
3	5C	920	1,390	2,310
4,5	5D	3,080	5,500	8,580
6	5E	5,500	5,500	11,000
7	5F	11,000	11,000	22,000

d. Ancillary Benefits. Additional hydrologic regime benefits are likely to accrue from projects undertaken for other goals. These include:

- Reduced fluctuations and additional hydrologic benefits from floodplain and riparian restoration projects (Goal 3)
- Flow attenuation due to stream restoration, especially re-meandering projects (Campbell et al. 1972, Goal 3)
- Some flow attenuation as water passes through water quality facilities (Goal 5) and sediment control facilities (Goal 5)

In addition, the projects enacted under this goal are likely to have ancillary benefits for other goals.

- Some floodplain benefits to support Goal 3, including habitat, would be provided by the constructed storage areas
- Sediment delivery would be reduced due to trapping in storage areas and pretreatment for infiltration areas (Goal 1)
- Reduced stream power due to hydrologic benefits would reduce streambank and bed erosion in tributary areas (Goal 1), and reduce overall sediment transport (figure 3-43) subsequently reducing the transport of nutrients (Goal 6)
- Nutrients would be trapped and transformed in storage areas (Goal 6).

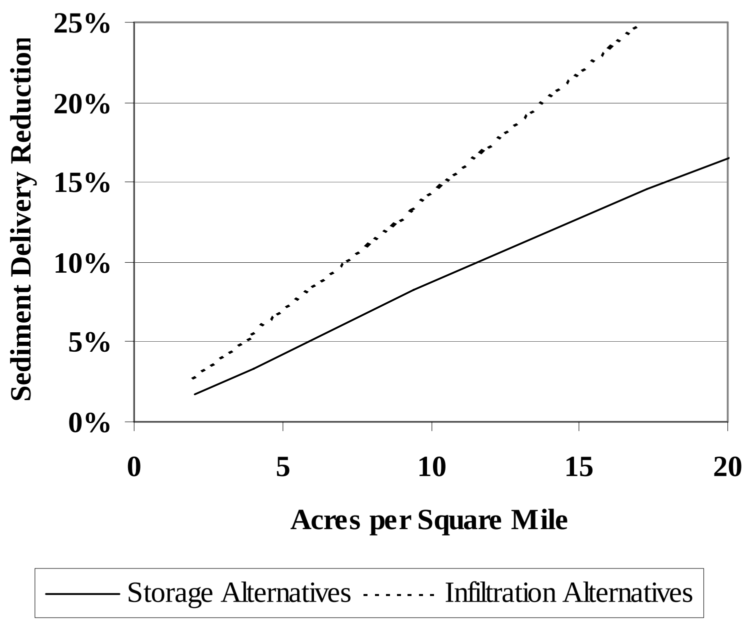


Figure 3-43. Estimated Sediment Delivery Reduction Due to Hydrologic Regime Improvements.

Hydrologic benefits estimated using BASINS model developed by Demissie et al. (2003a) as described in Measures, Tributary section of Goal 5. Relationships between daily flow and daily sediment load for Iroquois, LaMoine, Spoon and Vermillion Rivers in Demissie et al. (2003b). Sediment delivery reduction estimated by comparing loads for each alternative calculated using modeled daily flows for Water Years 1972-1995 and computing average reduction for the four modeled tributaries.

Non-ecosystem benefits that can also be attributed to hydrologic regime projects are reduced maintenance dredging costs and beneficial use of the sediment removed from the pools in preparation for pool drawdowns. These benefits were not quantified for this study.

Finally, there would be the potential to incorporate additional features into the hydrologic regime projects to support other goals. For example, the design of storage areas can be modified to more efficiently trap sediment (Goal 1). There is also the potential to incorporate water quality features into storage facilities (Goal 6). These types of added benefits would generally require additional costs as they require features that would not otherwise be included in the hydrologic regime projects.

e. Information and Further Study Needs. There are several additional study needs related to Goal 5, which could take place in the form of special studies. Further studies need to be performed on:

- effects of implementing infiltration and storage together on the tributaries and the main stem,
- reduction of the magnitude of water level fluctuations due to storm events,
- effects of additional tainter gates at Peoria and La Grange,
- effects of reconnecting the main stem to its floodplain (i.e. levee removal, etc.) on various flow regimes, including, during small floods during the summer growing season,
- effects of model refinement, and
- response of the entire system to the combined effect of all restoration measures related to Goal 5.

K. GOAL 6: WATER AND SEDIMENT QUALITY. Improve water and sediment quality in the Illinois River and its watershed.

Problem. Water resources in the Illinois River Basin are impaired due to a combination of point and non-point sources of chemical pollution as well as physical, structural and hydrological changes within the basin. Although effective regulatory efforts have reduced contributions from point sources, non-point sources of water quality impairment, such as sediments and nutrients, continue to degrade the surface waters.

Objectives

- Achieve full use support for aquatic life on all surface waters of the Illinois River Basin by 2025.
- Achieve full use support for all uses on all surface waters of the Illinois River Basin in 2055.
- Remediate sites with contaminant issues that affect habitat.
- Achieve Illinois EPA nutrient standards by 2025, following standards to be established by 2008. Until then (2008), work to minimize sedimentation as a cause of impairment as defined by 305(b).
- Work to minimize sedimentation as a cause of impairment as defined by 305(b) by 2035.
- Maintain waters that currently support full use or can be considered pristine waters.

1. Inventory Resource Conditions

a. Historic Conditions. Many changes have occurred within the Illinois River Basin that have significantly impacted upon the river. During the 1850-1965 period, the number of people living in the basin increased from 500,000 to over 10,500,000. This rapid growth resulted in vast quantities of industrial wastes and human sewage being produced. Communities along the Illinois River released untreated sewage directly into the river.

By 1908, fish production of the Illinois River began to decline sharply as its waters could no longer assimilate the tremendous volume of sewage it received. As increased quantities of sewage entered the Illinois River, the effect was devastating. Upper stretches of the river were depleted of oxygen and became toxic. Mayflies, which are indicators of clean water and are an important food of many species of fish, and fingernail clams virtually disappeared from the river above Beardstown after 1950.

In addition, the increased production of row crops has resulted in a greater use of herbicides, insecticides, and fertilizers. Eroded soil also contributes to water quality impairments by transporting adsorbed compounds, such as the nutrient phosphorus, in addition to impairments from increased sediment. The upper basin has the highest yield of total phosphorus (190.5 $kg/km^2/yr$); the primarily agricultural lower Illinois River Basin has an estimated yield of 69 $kg/km^2/yr$. David and Gentry (2000) estimated that 70 percent of the phosphorus in the Illinois River was from sewage effluent. Within tributary basins without significant point source contributions, the primary source of phosphorus is cropland runoff. Phosphorus is transported in both the particulate form (adsorbed to eroded soil) and dissolved in runoff water. Recent research indicates that, if soil phosphorus concentrations are excessively high, phosphorus may also leach through soils and be transported by tile-drainage systems (Xue et al. 1998). In the Iroquois River, particulate phosphorus concentrations have decreased in the last 15 years, probably because of adoption of conservation tillage systems (used on approximately 45 percent of cropland in the Illinois River Basin). However, during the same period, dissolved phosphorus concentrations have increased.
During this same time period, the landscape was being altered significantly. In many parts of the state, wetlands were being drained or filled. The loss of wetlands has adversely impacted the rate at which water was delivered to rivers and creeks. This resulted in higher velocities of these streams, thus increasing channel erosion and allowing greater quantities of sediment to be carried. Nutrient concentrations also increased with the loss of wetlands due to the loss of wetland plants being available to use the nutrients and hold the water for longer periods of time.

In the Illinois River Basin, the primary form of nitrogen found in streams is nitrate. Nitrate does not tend to come from fields as surface runoff, but leaches through the soil and reaches high levels in outflow from tile-drainage systems. Although nitrogen is not usually the limiting nutrient for algal production and eutrophication of streams and lakes in Illinois, it has been identified as one of the principal causes of the hypoxic zone in the northern Gulf of Mexico. The U.S. Geological Survey has estimated the average annual total nitrogen flux from the Illinois River Basin, during the period 1980-1996, at 144,320 metric tons per year. The upper part of the basin, above Marseilles, which includes the metropolitan Chicago area, was estimated to have the highest total nitrogen yield in the Mississippi River basin (3,120 $kg/km^2/yr$).

Many of the agricultural chemicals used are persistent in nature and toxic to fish. Over the past 30 years, numerous agricultural chemical-caused fish kills have been documented within the Illinois

River Basin and its tributary streams. Fish kills have also been caused by numerous discharges from industrial and manufacturing operations, which discharge toxic heavy metals, inorganic and organic chemicals, and oxygen demanding organic waste such as wood pulp fibers, canning, and dairy and food processing wastes.

Oxygen depletion has become a problem in the backwater areas of the lower river as wind-generated waves resuspend materials from the shallow lake bottoms, exerting an oxygen demand and removing dissolved oxygen from the water. Elimination of the summer low water periods prohibits compaction of sediments. Therefore, suspended sediments settle only loosely to the lakebed, creating a soft bottom in which aquatic plants cannot take root. During periods of high turbidity, aquatic plant growth is limited, since suspended sediments interfere with light penetration into the water.

b. Existing Conditions. One of the most noticeable improvements in the environmental conditions within the Illinois River system has been improved water quality associated with national and regional efforts to meet the goals of the Clean Water Act (CWA). It is expected that water quality will continue to improve in the future because of implementation of CWA Combined Sewer Overflow and Stormwater Management requirements, and local conservation efforts, and that improved water quality will translate into improvements in other ecosystem components. For example, fish and freshwater mussel populations in the main river channel have recently shown improvements that can be attributed to better water quality.

Improvements in chemical water quality, however, have not resulted in recovery of physical and biological health of the river system. Due to several factors including the combination of water level fluctuations, loss of floodplain areas, and increased sedimentation and turbidity, aquatic vegetation has not returned to the Illinois River. Excessive amounts of sediment continue to fill backwater and side channel habitats, and fish and aquatic populations have not improved markedly in these areas as they have in the upper reaches of the main stem of the river. Resources for migratory waterfowl will continue to be degraded through a combination of problems, including sedimentation, water level fluctuations, urbanization, and industrial, agricultural, and domestic pollution.

Water Supply. The Illinois River also serves as one of the sources for the public water supply system serving Peoria, which also uses three well fields. The cities of Aurora, Elgin, Kankakee, Pontiac, Streator, Decatur, Taylorville, Springfield, Jacksonville, and Canton use water from tributaries of the Illinois River. Moreover, the Commonwealth Edison Company uses Illinois River water for cooling purposes.

Wastewater Disposal. The Illinois River is a major conduit for the transport of treated wastewater throughout Illinois. It is estimated that 2,109 outfalls are located in the Illinois River Basin today. Illinois has taken significant steps to obtain compliance for effluent limitations by dischargers in the basin. From the municipal facility perspective, approximately $5.6 billion in Federal grant dollars has been expended for treatment facility construction in the Illinois River Basin through the Construction Grants Program. It can be safely estimated that several hundred million dollars have also been expended by industrial dischargers. Although the Illinois River ranks among Illinois' top recreational resources, it has also been a primary channel for the transport of human, animal, industrial, and agricultural wastes.

Assessing the Quality of the State's Waters and Prioritizing Improvements: Clean Water Act 305(b) and 303 (d) List. As required by the Federal Clean Water Act, the Illinois EPA assesses the conditions of the State's surface and groundwater resources when new data or information regarding the waterbody status is attained. Monitoring and assessments are scheduled for each waterbody, based on its designated use(s). The assessments are reported biennially in the "Illinois Water Quality Report" (also referred to as the 305(b) report). For rivers, streams, and lakes, the Illinois EPA utilizes biological, chemical, and habitat data collected as part of several monitoring programs. Additional water quality data are obtained through agreements and contracts with other agencies and organizations.

Water quality conditions are described in terms of the level of attainment for designated use categories including aquatic life, wildlife, primary contact (swimming, water skiing), secondary contact (boating, fishing), agricultural, industrial, food processing, and drinking water uses. Each designated use category has established water quality standards for protecting these uses. Individual use assessments are then aggregated into an overall use attainment category. In addition, the Illinois EPA identifies causes (toxics, nutrients, sedimentation, etc.) for those water bodies not fully attaining designated uses and sources (point and non-point) of pollutants contributing to the problem. For purposes of this document, water quality stresses are considered to be those causes resulting in less than full support of overall use as identified in the "Illinois Water Quality Report, 2000-2001."

Water Quality Assessment for the Illinois Basin. The Illinois drainage basin is comprised of the Illinois, Sangamon, Des Plaines, Kankakee, Lamoine, Spoon, Vermillion, Mackinaw and Fox River basins. As part of the "Illinois Water Quality Report, 1990-1991," overall use support was assessed for 5,670.7 stream miles and 257 lakes within the Illinois Drainage Basin. Of the 5670.7 stream miles assessed, 44.3 percent fully support overall use (no water quality impairments). Streams with less than full support include: 44.4 percent partial support with minor impairments; 9.3 percent partial support with moderate impairments; and 2.0 percent not supporting overall use. Of the 257 lakes assessed, 11.3 percent fully supported overall use. Lakes with less than full support include: 26.5 percent partial support with minor impairments; 26.5 percent partial support with moderate impairments; and 35.7 percent not supporting overall use.

Causes (stresses) and sources of identified water quality impairments for the Illinois drainage basin are depicted in table 3-53. Major causes of impairment for streams and lakes include nutrients, siltation, suspended solids, bacteria, dissolved oxygen, metals, and changes in the hydrology of rivers and streams.

Sources of impairment are predominately from non-point sources, or pollution from diffuse, intermittent runoff. Non-point sources include agricultural runoff, urban runoff, silviculture, construction , resource extraction, land disposal, hydrologic modification, habitat modification, marinas, and recreational boating. Table 3-56 provides a detailed summary of the sources contributing to water quality impairments for lakes and streams.

Table 3-56. Summary of Sources Contributing to Water Quality Impairments in the Illinois Drainage Basin

Stream Category	Miles Major Impairment	Miles Moderate/Minor Impairment
Industrial Point Source	3.8	378.2
Municipal Point Source	198.4	1,220.6
Combined Sewer Overflows	37.4	398.0
Unspecified Agriculture	572.8	1,090.2
Non-irrigated Crop Production	23.5	852.4
Irrigated Crop Production	2.0	0.2
Pasture Land	35.1	590.4
Feedlots - All Types	1.7	4.5
Animal Holding Areas	0	7.3
Urban Runoff/Storm Sewers	24.6	734.5
Resource Extraction	0	173.2
Unspecified Hydrologic/Habitat Modification	0	147.7
Channelization	104.4	972.1
Flow Regulation/Modification	0.6	267.9
Removal of Riparian Vegetation	0	319.5
Streambank Modification	0	356.0
Dredging	0	14.2
Dam Construction	0	157.2
Highway/Road Construction	0	49.6
Land Development	0	424.7
Highway Runoff	0	91.3

Lake Category	Acres Major Impairment	Acres Moderate/Minor Impairment
Industrial Point Source	524	10,762
Municipal Point Source	256	11,224
Unspecified Non-point Source	4,442	23,178
Agriculture	159,392	4,811
Construction	1,325	12,793
Urban Runoff/Storm Sewers	2,708	28,819
Resource Extraction	155	708
Land Disposal	5,887	16,611
Hydrologic Modifications	1,339	58,999
In-Place Contaminants	42,638	27,963
Recreational Activities	5,974	12,987
Atmospheric Deposition	0	4,040
Waterfowl	200	2,995
Highway Runoff	15	614
Upstream Impoundment	202	1,231
Unknown	0	5,011
Combined Sewer Overflows	0	225
Waste Storage Tank Leaks	0	10

The Illinois drainage basin is a very diverse system, which includes highly urbanized areas in the Des Plaines River basin, to intensive agricultural uses in the Sangamon River Basin. Causes of water quality impairment (stresses) and sources vary considerably within the river basins comprising the Illinois drainage basin

Total Maximum Daily Load Program (TMDLs). The Clean Water Act Section 303(d) provides a coordinated framework between states and the U.S. EPA to systematically track and address impaired waters throughout the state and nationwide. Although much success has been achieved through the NPDES permitting program in reducing pollutants discharged to waterways by municipal treatment works and industrial discharges, some impaired waterways are not expected to recover through the application of technology-based effluent treatment alone.

States are required to list impaired waters every 2 years and to prioritize each water body for an in-depth analysis of pollutant sources and the reductions necessary so that they attain all of the uses that they are assigned (or "designated" in CWA terminology). The in-depth analysis is called a Total Maximum Daily Load or "TMDL." A stream can have many different segments within a stretch and numerous impairments representing a variety of needed improvements in its chemical, physical, and biological state.

The most recent TMDL list for the State of Illinois was approved in November 2004. The list can be found at Illinois EPA's website, http://www.epa.state.il.us/. Information for this list is in the process of geospatial referencing, therefore, a summary for the Illinois River for the 2004 list is not available as of this printing; however, the 2002 summary is available.

On the Illinois 1998 TMDL list, there were 342 segments in the Illinois River basin listed for siltation and suspended solids. Another 269 segments were listed as being impaired by excess nutrients. [1]

The five basins in the Illinois River having more than 100 total impairments are listed below.

Basin	Total Impairments	Largest Number of Segments Impaired for:	Second Largest Number of Segments Impaired for:
Des Plaines	266	Nutrients	Sediments
Upper & Lower Illinois Main stem	219	Sediments	Nutrients
Sangamon	171	Sediments	Nutrients
Chicago Calumet	129	Dissolved Oxygen	Nutrients
Fox River	117	Sediments	Dissolved Oxygen

The pollutant reductions called for in TMDLs may require voluntary actions and the cooperation of many programs such as the CWA 319 program, CREP program, and ecosystem restoration actions recommended in this document in order to realize the water quality improvements called for in the TMDL and realize the water quality goals of the Clean Water Act.

[1] In some cases, more than one listing occurred in a segment, and actual listings occur for a sub-segment. New Illinois 303(d) list was finalized in November 2004.

Other Water Quality Programs. Under the authority of the Water Quality Act of 1987, Illinois operates a coordinated program of regulation and technical assistance for the effective management of urban stormwater. Section 405 of the Act requires some Illinois industries and municipalities to apply for stormwater NPDES permits. Municipalities with populations greater than 100,000 must apply for permits for their storm sewer systems. NPDES permits are also required from a wide variety of industrial activities defined in the regulations that could result in stormwater runoff. Some construction site activities are included in this definition, and permits are required for such stormwater dischargers.

The December 8, 1999, Storm Water Phase II Rule expanded the number of municipalities located in urban areas that are required to obtain NPDES permit coverage for discharges from their municipal separate storm sewer systems (MS4s). Municipalities located outside of urbanized areas may need to comply with some requirements as determined by the delegated NPDES Permitting Authority.

In addition, beginning on March 10, 2003, municipalities with a population under 100,000 were no longer exempt from the construction site storm water requirements and the industrial storm water requirements. Waste Water Treatment Plants with a discharge of 1.0 million gallons per day (mgd) or more need a General Storm Water Permit for Industrial Activities.

Industrial Activity General Permits require a pollution prevention plan, considered to be one of the most important requirements of the General Permit. A list of the 11 categories is found at: http://cfpub.epa.gov/npdes/stormwater/swcats.cfm**.** Each facility covered by this permit is required to develop a plan, tailored to the specific conditions and with the primary goal of controlling pollutants that may be discharged into storm water runoff.

Each storm water plan must include a site map and a description of the measures and controls that will be used to prevent and/or minimize pollution of storm water. Among other things, the plan must contain storm water management controls and measures to remove significant pollutants from stormwater as well as identify areas that have high potential for erosion of soil and the methods to be employed to reduce such erosion.

Complementing the NPDES stormwater permit program, Illinois offers various forms of technical and financial assistance for water quality protection through the proper management of urban runoff. Under Section 319 of the Act, grants are made available to fund projects that effectively demonstrate non-point source pollution control techniques. In addition to directly improving water quality, such projects promote wider application of urban stormwater management practices. Together with Section 319, Section 208 establishes a comprehensive State strategy for controlling urban runoff.

c. Future Without-Project Conditions. Water resources in the Illinois River Basin are impaired due to a combination of point and non-point sources of pollution. Although effective regulatory efforts have reduced contributions from point sources, non-point sources of water quality impairment (such as sediments and nutrients) continue to degrade the surface waters. Continued improvement in chemical water quality will be insufficient to prevent further degradation of many aspects of the Illinois River ecosystem. Without further reduction of sediment entering the system from degraded tributaries and management of sediment already within the system, backwater areas will continue to rapidly fill and aquatic vegetation beds will not recover.

In addition to turbidity, the quality of the sediments, particularly in the main stem, may limit macroinvertebrates such as fingernail clams. Ammonia, an agricultural fertilizer, is found in the upper layers of the sediments, sometimes in toxic amounts. Minor improvements in water quality may be made due to regulation and improvements in best management practices (BMPs). The EPA's programs to reduce nonpoint source pollution and its Targeted Watersheds Grant Program will continue to provide some improvements in general water quality and provide information on the management of physical impacts of tile drainage.

d. Desired Future Conditions. The desired future for water quality would include all of the following: achieve full use support for aquatic life on all surface waters of the Illinois River Basin by 2025; achieve full use support for all uses on all surface waters of the Illinois River Basin in 2055; remediate sites with contaminant issues that affect habitat; achieve Illinois EPA nutrient standards by 2025, following standards to be established by 2008; work to minimize sedimentation as a cause of impairment as defined by 305(b) by 2035; and maintain waters that currently support full use or can be considered pristine waters.

2. Formulation of Alternative Plans

No specific measures or alternatives were formulated for this goal specifically. However, alternatives that address or benefit water and sediment quality are discussed in previous goals for this study. It is believed that proposed actions to reduce sedimentation and nutrient loads to the basin and to attenuate the flow extremes will help to return impaired segments to their designated uses.

Constraints

- Several limiting factors to improved water quality exist such as ammonia, dissolved oxygen levels, or nitrates. An improved understanding of these factors in impaired waters is required in designing projects and measuring success.
- Expense and technical feasibility of addressing (legacy) contaminated sediments.
- Changes to the hydrology within the Illinois River drainage basin.
- Practices that address water quality may negatively impact sediments and vice versa.
- Funding availability.
- Adequate monitoring to make determination of needs/improvements.
- Permit review process.

Criteria for Prioritization

- It is believed that water quality improvements will be realized throughout the basin through implementation of many of the types of projects being proposed at the programmatic level. Future watershed assessments should consider basin water quality information at small watershed level. Those waters that do not achieve full use support will be considered an important criterion in the watershed prioritization process.
- Water bodies that meet standards, but are declining/under threat, should be given greater focus.
- Waters that are better than their designated use need to be protected to assure that they do not degrade below current conditions.

Considerations and Assumptions

- Implementation will require coordination with the Illinois EPA and US EPA, as well as other State and Federal agencies and non-governmental organizations.
- Goals and objectives with metric(s), and water quality assessment and tracking systems that support the CWA 305(b) water quality report to Congress already exist for some EPA programs and could be considered and used to reinforce project tracking and measurement of success.
- State prioritization and scheduling of TMDL development and implementation. prioritization and process.
- Load reduction targets developed and implementation of plans for federally approved TMDLs.
- U.S. EPA and the Upper Mississippi River States are developing monitoring and assessment methodologies for biological standards and criteria.
- Results of tile drain management research from EPA Targeted Watershed Project in the Sangamon River watershed

Information Needs

- Assemble and review Illinois (and other Upper Mississippi River States) EPA guidelines and available research on sediments/phosphorus/turbidity. (e.g., greater than 35 percent fine sediments in transect, turbidity TSS 116 mg/l in 1 sample in 3 years, or other appropriate number developed in future). (Info on website under 305(b).
- Information on sedimentation rates/transects.
- Base flows need to be established for all streams in the Illinois River.
- Quantification of pollutant and nutrient removal efficiencies, and changes in hydrology resulting from large-scale riparian wetland restoration.
- Assemble information on vulnerability of specific areas to sedimentation and pollutants transport to water bodies and analyze potential to ensure that correct BMP and restoration measures are being used to mitigate.
- More information is needed about the endpoints or targets for physical habitat parameters to correct biological impairments.

L. SYSTEM EVALUATIONS

1. Formulation of Alternative Plans

The system team developed various alternatives to restore systemic ecological integrity and fish and wildlife habitat. This portion of the report discusses the alternatives formulation.

The Comprehensive Plan is guided by the overarching goal of restoring ecological integrity, including habitats, communities, and populations of native species, and the processes that sustain them. This overarching goal directed the formulation of alternative plans for each of the six goals, specifically formulated to address the system limiting factors in the basin. Each of these goals contains specific, measurable objectives which have been developed to optimize the ecological integrity of the basin. These objectives were developed by the interagency System Team, resource managers, and stakeholders, and represent a desired future condition or virtual reference condition for the Illinois River Basin.

The System Team formed subgroups to formulate goals, measures and alternatives plans to address the identified problems for each goal. This process was described in each of the goals presented in the previous portion of this section. The subgroups studied the existing conditions and developed scenarios for the future without project conditions. Each of these subgroups then developed lists of measures to address these problems. For each of the measures, the relative cost and system benefits were identified. This information was then used to develop various alternative plans for each goal (i.e., combining benefits and costs for a certain amount of bed and bank stabilization, water and sediment retention basins, etc., in developing a plan for sediment reduction). At this level of analysis, the various measures were evaluated, comparing their costs and benefits. The screening resulted in the alternatives being developed from cost-effective measures. These cost effective restoration measures were then combined into several alternative plans, representing a range of levels of effort and varying degrees of achieving the desired future condition for each goal over the 50-year planning horizon.

In total, eight alternative plans (including the No Action alternative) were formulated to provide a range of restoration options for consideration. These were generally assembled by increasing levels of effort and cost, with some plans representing relatively equal amounts of work under each of the goals and some alternatives emphasizing various goals more heavily. In particular, a number of the alternatives were formulated to provide specific frames of reference relating to the restoration of habitat (acres of various habitat types, etc.) and ecological integrity (structural and functional elements that support and maintain a balanced, integrated, adaptive community). Figure 3-44 was developed for illustrative purposes only, but shows conceptually the estimated benefits of the various plans relative to restoration objectives (desired future) for system ecological integrity. All alternatives, with the exception of the No Action alternative, provide regional habitat and ecological integrity benefits by slowing, stabilizing, or reversing the current decline of ecological integrity over the 50-year planning horizon.

The Illinois River Basin has been significantly altered over the course of the past 150 years. The combined effects of habitat losses through changes in land use, human exploitation, habitat degradation and fragmentation, water quality degradation, and competition from aggressive non-indigenous species have significantly reduced the abundance and distribution of many native plant and animal species in the Illinois River Basin. In addition, human alterations of Illinois River Basin landscapes have altered the timing, magnitude, duration, and frequency of habitat forming and seasonal disturbance regimes. The cumulative results of these complex, systemic changes are now severely limiting both the habitats and species composition and abundance in the Illinois River Basin. Because of the magnitude of these past changes to the basin and the continuing landscape alteration, the levels of restoration provided by Alternatives 1-4 do not reverse the decline in systemic ecological integrity throughout the life of the project. However, these alternatives represent improvements in ecological integrity to the Illinois River Basin, primarily at the local or regional scale . It is not until the level of restoration associated with Alternative 5 that system-wide ecological integrity is predicted to stabilize or improve. Alternatives 6 and 7 represent the only alternatives to significantly reverse the current system decline of ecological integrity, increasing ecological integrity toward the desired future condition throughout the 50-year project life, by prescribing sufficient levels of ecosystem restoration to restore the system, both habitats and processes, to a more naturalized and sustainable state.

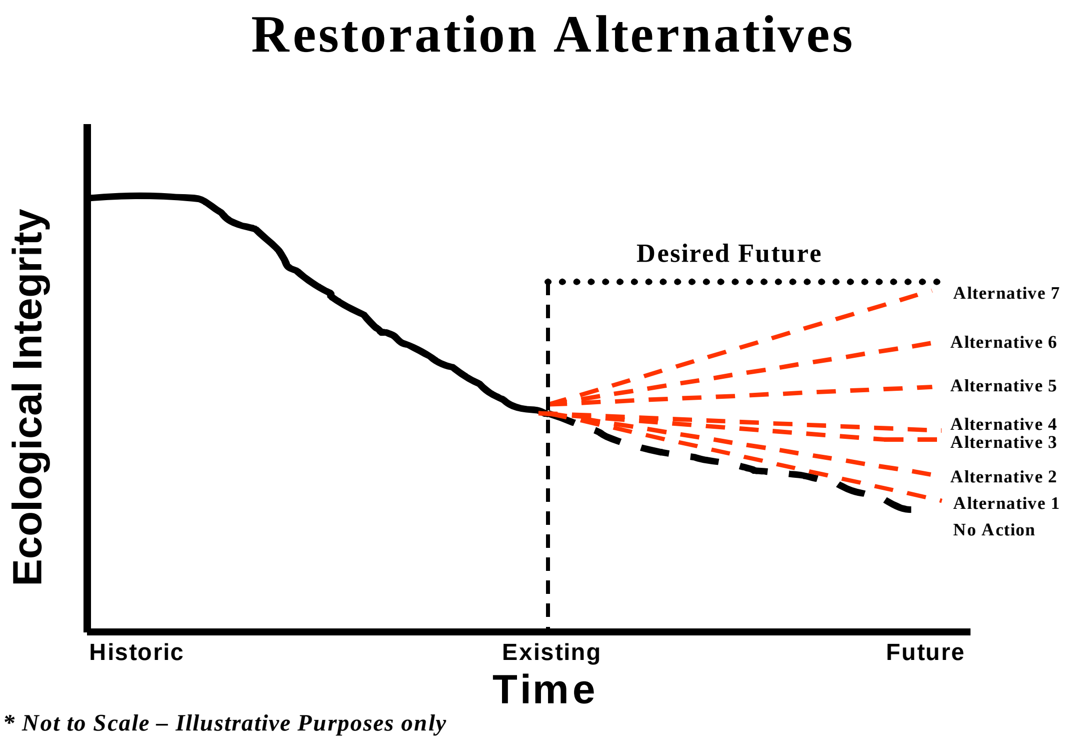


Figure 3-44. Conceptual Restoration Benefits of Alternatives

The eight system alternative plans are listed below; describing the predicted response to restoration by goal and the resulting response in ecological integrity over the 50–year planning horizon. A summary matrix of the system benefits is included as table 3-57. In addition, table 3-58 shows a similar matrix of total first costs. Finally, annual O&M costs are described in table 3-59 for a fully implemented program. All restoration projects would be cost-shared 65 percent Federal and 35 percent non-Federal sponsor. The cost estimates are based on unit costs for construction of various restoration measures. In addition, costs for program management, monitoring, adaptive management, and further special studies have been included. These additional program components are described more fully in Section 6, *Plan Implementation*.

a. Description of System Alternatives. The following descriptions explain the system alternatives by describing the benefits associated with each goal.

No Action –Anticipated future condition, assuming no new efforts are undertaken as a result of this study.

- **Ecological Integrity.** Continue the decline in system ecological integrity and populations of native species, resulting from the continuation of habitat loss and fragmentation, the altering of natural disturbance regimes, and the continuation of non-indigenous species colonization.
- **Sediment Delivery.** Some increase in sediment delivery due to the continuation of landscape alterations, increases in impervious surfaces and resulting runoff, and the continuation of channel instability due to prior alterations.
- **Backwaters and Side Channels.** Continue to lose backwaters at an annual rate of approximately 1 percent of volume and surface area, or a 40 percent loss of backwaters over 50 years. Further degradation of side channels due to island erosion and channel sedimentation.
- **Floodplain, Riparian, and Aquatic.** Relatively minor changes in floodplain areas with some increase in the degradation of riparian and aquatic habitats due to urbanization and land-use changes.
- **Connectivity.** No significant change in the number of dams blocking fish and aquatic species migration. Some local fish passage initiatives are currently underway.
- **Water Level.** Small increase in the number of fluctuations in tributary and main stem water level regimes due to continued land-use changes.
- **Water Quality.** Minor improvements in water quality due to regulation and improvements in best management practices (BMPs).

Alternative 1

- **Ecological Integrity.** Continue the decline in system ecological integrity and populations of native species. However, in areas of focused restoration efforts, there would be regional improvements to both habitat and regional ecological integrity.
- **Sediment Delivery.** Reduction in the delivery from direct Peoria Lakes tributaries exclusively. Sediment delivery would be reduced by approximately 20 percent from these watersheds. System benefits include reduced delivery of 6.3 percent to Peoria Lakes and 2.3 percent system wide.
- **Backwaters and Side Channels.** Restoration of 3,600 acres in 40 of the approximate 100 backwaters. Dredging of 10-200 acres per backwater, with 10 backwaters dredged to the optimal level (40 percent of backwater area). This would create overwintering habitat spaced approximately every 7 miles along the system and optimal areas every 28 miles. Restoration of 10 side channels and protection of 10 islands. In total, these efforts would benefit an estimated 14,300 acres.
- **Floodplain, Riparian, and Aquatic.** Restoration of 5,000 acres of main stem floodplain (approximately 1 percent of total main stem floodplain area) including approximately 2,100 acres of wetlands, 1,700 acres of forest, and 1,200 acres of prairie; tributary restoration of 5,000 acres (approximately 0.6 percent of total tributary floodplain area), approximately 3,200 acres of wetlands, 900 acres of forest, and 900 acres of prairie; and aquatic restoration including 25 miles of tributary streams (0.8 percent of the approximately 3,000 miles of channelized streams) with a mix of improved in-stream

aquatic habitat structure and channel remeandering. Indirect benefits would extend to an additional 25 miles of stream.

- **Connectivity.** No change; same as without project.
- **Water Level.** Reduction in the fluctuations in tributary areas due to the creation of 18,000 acres of storage area at an average depth of 1.5 feet. Reduces the 5-year peak flows in tributaries by 1.5 percent but does not discernibly reduce fluctuations along the main stem Illinois River. Providing benefits to an estimated 920 miles of tributary streams.
- **Water Quality.** Local improvements in water quality due to the implementation of measures to reduce sediment delivery. Sediment and nutrient inputs to the river, such as phosphorus and nitrogen, will not measurably decline at the system level.

Alternative 2

- **Ecological Integrity.** Current habitat conditions will be maintained. However, some decline in system ecological integrity would continue to occur, especially for populations of native species that are currently declining or sensitive to continued habitat fragmentation, such as area-sensitive species.
- **Sediment Delivery.** Reduction in the delivery from direct Peoria Lakes tributaries with some efforts on tributaries downstream. On average, sediment contributions decline by 40 percent from the Peoria Lakes tributaries and 0.5 percent in the downstream tributaries. System benefits include a reduction in the delivery of 12.5 percent to Peoria Lakes and 5 percent system wide.
- **Backwaters and Side Channels.** Restoration of 6,100 acres in 60 of the approximate 100 backwaters on the system. Dredging of 10-200 acres per backwater, with 20 backwaters dredged to the optimal level (40 percent of backwater area). This would create overwintering habitat spaced approximately every 5 miles along the system and optimal areas every 14 miles. Restoration of 20 side channels and protection of 15 islands. In total, these efforts would benefit an estimated 30,950 acres.
- **Floodplain, Riparian, and Aquatic.** Restoration of 5,000 acres of main stem floodplain (approximately 1 percent of total main stem floodplain area) including approximately 2,100 acres of wetlands, 1,700 acres of forest, and 1,200 acres of prairie; tributary restoration of 10,000 acres (approximately 1.2 percent of total tributary floodplain area) including approximately 6,300 acres of wetlands, 1,900 acres of forest, and 1,800 acres of prairie; and aquatic restoration including 50 miles of tributary streams (1.6 percent of the approximately 3,000 miles of channelized streams) with a mix of improved in-stream aquatic habitat structure and channel remeandering. Indirect benefits would extend to an additional 50 miles of stream.
- **Connectivity.** No change; same as without project.
- **Water Level.** Reduction in the fluctuations in tributary areas due to the creation of 18,000 acres of storage area at an average depth of 1.5 feet and 10,000 acres of infiltration area. Results include a 2.3 percent reduction in the 5-year peak flows in tributaries, an overall average of 5 percent increase in tributary base flows, but no discernable reduction

in fluctuations along the main stem Illinois River. Providing benefits to an estimated 2,310 miles of tributary streams.

- **Water Quality.** Some additional improvements in water quality at the local or regional level due to a reduction in sediment and phosphorus delivery resulting from sediment delivery reduction measures.

Alternative 3

- **Ecological Integrity.** Improvements in habitat conditions at the system level, with a focus on system ecological integrity, particularly in impacts of excessive sedimentation. This plan would increase backwater habitat, reduce sediment delivery, and restore additional main stem and tributary floodplain areas.

- **Sediment Delivery.** Reduction in sediment delivery from direct Peoria Lakes tributaries by 40 percent, other tributaries upstream of Peoria Lakes by 11 percent, and tributaries downstream of Peoria Lakes by 4 percent. System benefits include reduced delivery of 20 percent to Peoria Lakes and 10 percent system wide.

- **Backwaters and Side Channels.** Restoration of 8,600 acres in 60 of the approximate 100 backwaters on the system. Dredging of 10-200 acres per backwater, with 40 backwaters dredged to the optimal level (40 percent of backwater area). This would create overwintering habitat spaced approximately every 5 miles along the system and optimal areas every 7 miles. Restoration of 30 side channels and protection of 15 islands. In total, these efforts would benefit a total of 42,240 acres.

- **Floodplain, Riparian, and Aquatic.** Restoration of 20,000 acres of main stem floodplain (approximately 7.9 percent of total main stem floodplain area) including approximately 8,400 acres of wetlands, 6,800 acres of forest, and 4,800 acres of prairie; tributary restoration of 20,000 acres (approximately 2.3 percent of total tributary floodplain area) including approximately 12,600 acres of wetlands, 3,800 acres of forest, and 3,600 acres of prairie; and aquatic restoration including 100 miles of tributary streams (3.3 percent of the approximately 3,000 miles of channelized streams) with a mix of improved in-stream aquatic habitat structure and channel remeandering. Indirect benefits would extend to an additional 100 miles of stream.

- **Connectivity.** Restore fish passage at all main stem dams on the Fox River (12 dams), all dams on the West Branch of the DuPage River (5 dams), and all main stem dams and one tributary (Salt Creek) of the Des Plaines River (17 dams).

- **Water Level.** Reduction in fluctuations in tributary areas due to the creation of 18,000 acres of storage area at an average depth of 1.5 feet and 10,000 acres of infiltration area. Also, a reduction in fluctuations on the main stem due to increasing intensity of water level management at navigation dams using electronic controls and increased flow gaging. Results include a 2.3 percent reduction in the 5-year peak flows in tributaries, an overall average 5 percent increase in tributary base flows, and up to 65 percent reduction in the occurrence of half foot or greater fluctuations during the growing season in the main stem Illinois River. Providing benefits to an estimated 2,310 miles of tributary streams.

- **Water Quality.** Some additional improvements in water quality due to reduced sediment, phosphorus, and nitrogen delivery. These improvements would primarily result from sediment delivery reduction measures, with some benefits from water level management measures.

Alternative 4

- **Ecological Integrity.** Improvements in habitat conditions at the system level, with a focus on tributary ecological integrity and secondary effects to main stem habitats. This plan would result in sediment delivery reduction, tributary floodplain and stream restoration, increased fish passage, and more naturalized water levels.
- **Sediment Delivery.** Reduction in sediment delivery from direct Peoria Lakes tributaries by 40 percent, other tributaries upstream of Peoria Lakes by 11 percent, and tributaries downstream of Peoria Lakes by 4 percent. System benefits include reduced delivery of 20 percent to Peoria Lakes and 10 percent system wide.
- **Backwaters and Side Channels.** Restoration of 6,100 acres in 60 of the approximate 100 backwaters on the system. Dredging of 10-200 acres per backwater, with 20 backwaters dredged to the optimal level (40 percent of backwater area). This would create overwintering habitat spaced approximately every 5 miles along the system and optimal areas every 14 miles. Restoration of 20 side channels and protection of 15 islands. In total, these efforts would benefit a total of 30,950 acres.
- **Floodplain, Riparian, and Aquatic.** Restoration of 5,000 acres of main stem floodplain (approximately 1 percent of total main stem floodplain area) including approximately 2,100 acres of wetlands, 1,700 acres of forest, and 1,200 acres of prairie; tributary restoration of 20,000 acres (approximately 2.3 percent of total tributary floodplain area) including approximately 12,600 acres of wetlands, 3,800 acres of forest, and 3,600 acres of prairie; and aquatic restoration including 100 miles of tributary streams (3.3 percent of the approximately 3,000 miles of channelized streams) with a mix of improved in-stream aquatic habitat structure and channel remeandering. Indirect benefits would extend to an additional 100 miles of stream.
- **Connectivity.** Restore fish passage at all main stem dams on the Fox River (12 dams), all dams on the West Branch of the DuPage River (5 dams), all main stem dams and one tributary (Salt Creek) of the Des Plaines River (17 dams), Wilmington and Kankakee Dams on the Kankakee River, Bernadotte Dam on the Spoon River, and the Aux Sable Dam.
- **Water Level.** Create 60,000 acres of storage area at an average depth of 1.5 feet and 38,400 acres of infiltration area. Increase intensity of water level management at navigation dams using electronic controls and increased flow gaging. Results include an 8 percent reduction in the 5-year peak flows in tributaries, an overall average 20 percent increase in tributary base flows, and up to a 65 percent reduction in the occurrence of half-foot or greater fluctuations during the growing season in the main stem Illinois River. Providing benefits to an estimated 8,580 miles of tributary streams.
- **Water Quality.** Anticipate improvements in water quality due to reduced sediment, phosphorus, and nitrogen delivery. These improvements would result from sediment delivery reduction measures and water level management measures.

Alternative 5

- **Ecological Integrity.** Improves the amount of current habitats and their functions at the system level. No further declines in system ecological integrity are foreseen at this level of restoration. System health and ecological integrity are stable or improving.
- **Sediment Delivery.** Reduction in sediment delivery from direct Peoria Lakes tributaries by 40 percent, other tributaries upstream of Peoria Lakes by 11 percent, and tributaries downstream of Peoria Lakes by 4 percent. System benefits include reduced delivery of 20 percent to Peoria Lakes and 10 percent system wide.
- **Backwaters and Side Channels.** Restoration of 8,600 acres in 60 of the approximate 100 backwaters on the system. Dredging of 10-200 acres per backwater, with 40 backwaters dredged to the optimal level (40 percent of backwater area). This would create overwintering habitat spaced approximately every 5 miles along the system and optimal areas every 7 miles. Restoration of 30 side channels and protection of 15 islands. In total, these efforts would benefit a total of 42,240 acres.
- **Floodplain, Riparian, and Aquatic.** Restoration of 40,000 acres of main stem floodplain (approximately 7.9 percent of total main stem floodplain area) including approximately 16,800 acres of wetlands, 9,600 acres of forest, and 13,600 acres of prairie; tributary restoration of 40,000 acres (approximately 4.6 percent of total tributary floodplain area) including approximately 25,200 acres of wetlands, 7,200 acres of forest, and 7,600 acres of prairie; and aquatic restoration including 250 miles of tributary streams (8.3 percent of the approximately 3,000 miles of channelized streams) with a mix of improved in-stream aquatic habitat structure and channel remeandering. Indirect benefits would extend to an additional 250 miles of stream.
- **Connectivity.** Restore fish passage at all main stem dams on the Fox River (12 dams), all dams on the West Branch of the DuPage River (5 dams), all main stem dams and one tributary (Salt Creek) of the Des Plaines River (17 dams), Wilmington and Kankakee Dams on the Kankakee River, Bernadotte Dam on the Spoon River, and the Aux Sable Dam.
- **Water Level.** Create 60,000 acres of storage area at an average depth of 1.5 feet and 38,400 acres of infiltration. Increase water level management at navigation dams using electronic controls and increased flow gaging. Results include an 8 percent reduction in the 5-year peak flows in tributaries, an overall average 20 percent increase in tributary base flows, and up to a 65 percent reduction in the occurrence of half-foot or greater fluctuations during the growing season in the main stem Illinois River. Providing benefits to an estimated 8,580 miles of tributary streams.
- **Water Quality.** Anticipate improvements in water quality due to reduced sediment, phosphorus, and nitrogen delivery. These improvements would result from sediment delivery reduction measures and water level management measures.

Alternative 6

- **Ecological Integrity.** Restoration would provide a measurable increase in level of habitat and ecological integrity at the system level.

- **Sediment Delivery.** Reduction in sediment delivery from direct Peoria Lakes tributaries by 40 percent, other tributaries upstream of Peoria Lakes by 11 percent, and tributaries downstream of Peoria Lakes by 20 percent. System benefits include reduced delivery of 20 percent to Peoria Lakes and 20 percent system wide.
- **Backwaters and Side Channels.** Restoration of 12,000 acres in 60 of the approximate 100 backwaters on the system. Dredging an average of 200 acres per backwater, the optimal level of 40 percent of the approximate 500-acre average backwater area. This would create optimal backwater and over-wintering habitat spaced approximately every 5 miles along the system. Restoration of 35 side channels and protection of 15 islands. In total, these efforts would benefit a total of 56,020 acres.
- **Floodplain, Riparian, and Aquatic.** Restoration of 75,000 acres of main stem floodplain (approximately 14.9 percent of total main stem floodplain area) including approximately 31,700 acres of wetlands, 25,300 acres of forest, and 18,000 acres of prairie; tributary restoration of 75,000 acres (approximately 8.8 percent of total tributary floodplain area) including approximately 47,600 acres of wetlands, 13,900 acres of forest, and 13,500 acres of prairie; and aquatic restoration including 500 miles of tributary streams (16.6 percent of the approximately 3,000 miles of channelized streams) with a mix of improved in-stream aquatic habitat structure and channel remeandering. Indirect benefits would extend to an additional 500 miles of stream.
- **Connectivity.** Restore fish passage at all main stem dams on the Fox River (12 dams), all dams on the West Branch of the DuPage River (5 dams), all main stem dams and one tributary (Salt Creek) of the Des Plaines River (17 dams), Wilmington and Kankakee Dams on the Kankakee River, Bernadotte Dam on the Spoon River, and the Aux Sable Dam.
- **Water Level.** Create 107,000 acres of storage area at an average depth of 1.5 feet and 38,400 acres of infiltration. Increase water level management at navigation dams using electronic controls and increased flow gaging. Results include an 11 percent reduction in the 5-year peak flows in tributaries, an overall average 20 percent increase in tributary base flows, and up to 65 percent reduction in the occurrence of half-foot or greater fluctuations during the growing season in the main stem Illinois River. This alternative also would see benefits accrue from drawdowns in La Grange or Peoria Pools. Providing benefits to an estimated 11,000 miles of tributary streams.
- **Water Quality.** Anticipate improvements in water quality due to reduced sediment, phosphorus, and nitrogen delivery. These improvements would result from sediment delivery reduction measures and water level management measures.

Alternative 7

- **Ecological Integrity.** Restoration would provide a measurable increase in level of habitat and ecological integrity at the system level, at or near the vision for the Illinois River Basin. This level of effort was developed to provide an upper limit of potential restoration (or desired future condition) considering current political, social, and fiscal constraints.
- **Sediment Delivery.** Reduction in sediment delivery from direct Peoria Lakes tributaries by 40 percent, other tributaries upstream of Peoria Lakes by 11 percent, and tributaries

downstream of Peoria Lakes by 20 percent. System benefits include reduced delivery of 20 percent to Peoria Lakes and 20 percent system wide.

- **Backwaters and Side Channels.** Restoration of 18,000 acres in 60-90 of the approximate 100 backwaters on the system. Dredging of 200-300 acres per backwater. This would create backwater and overwintering habitat spaced approximately every 3 to 5 miles along the system. Restoration of 40 side channels and protection of 15. In total, these efforts would benefit a total of 66,580 acres.
- **Floodplain, Riparian, and Aquatic.** Restoration of 150,000 acres of main stem floodplain (approximately 29.9 percent of total main stem floodplain area) including approximately 63,300 acres of wetlands, 50,700 acres of forest, and 36,000 acres of prairie; tributary restoration of 150,000 acres (approximately 17.6 percent of total tributary floodplain area) including approximately 95,200 acres of wetlands, 27,800 acres of forest, and 27,000 acres of prairie; and aquatic restoration including 1,000 miles of tributary streams (33.3 percent of the approximately 3,000 miles of channelized streams) with a mix of improved in-stream aquatic habitat structure and channel remeandering. Indirect benefits would extend to an additional 1000 miles of stream.
- **Connectivity.** Restore fish passage at all main stem dams on the Fox River (12 dams), all dams on the West Branch of the DuPage River (5 dams), all main stem dams and one tributary (Salt Creek) of the Des Plaines River (17 dams), Wilmington and Kankakee Dams on the Kankakee River, Bernadotte Dam on the Spoon River, Aux Sable Dam, and Starved Rock, Marseilles, and Dresden Locks and Dams on the Illinois River main stem (3 dams).
- **Water Level.** Create 250,000 acres of storage area at an average depth of 1.5 feet and 96,000 acres of infiltration area. Increase water level management at navigation dams using electronic controls and increased flow gaging. Results include a 23 percent reduction in the 5-year peak flows in tributaries, an overall average increase of 50 percent in tributary base flows, and up to a 73 percent reduction in the occurrence of half-foot or greater fluctuations during the growing season in the main stem Illinois River. This alternative also would see benefits accrue from drawdowns in La Grange or Peoria Pools and replacement of wickets at Peoria and La Grange with automatic gate dams to eliminate wicket-related fluctuations. Providing benefits to an estimated 22,000 miles of tributary streams.
- **Water Quality.** Anticipate improvements in water quality due to reduced sediment, phosphorus, and nitrogen delivery. These improvements would result from sediment delivery reduction measures and water level management measures.

b. Alternative Costs. The following tables summarize the system alternative costs, if fully implemented, over the full 50 year time horizon. The first cost estimates are based on unit costs for construction of various restoration measures. In addition, costs for program administration, monitoring, adaptive management, and further special studies have been included. All restoration would be cost-shared 65 percent Federal and 35 percent non-Federal sponsor. The costs of attaining the Overarching Goal Ecological Integrity and Goal 6 Water Quality will be addressed through the activities undertaken associated with the other goals and through the prioritization process and restoration specifications.

The costs of construction were calculated first, based on attaining the desired level of ecological benefits. The construction cost estimates include all costs related to the implementation of restoration projects including a 35 percent contingency; 30 percent for planning, engineering, and design; 9 percent construction oversight; and real estate estimates. However, total program costs require the inclusion of administration, monitoring, etc. Average system management costs are estimated to range from $600,000 to $1.25 million per year based on level of effort associated with each alternative plan. These funds are anticipated to cover both the Corps on Engineers staff time as well as the in-kind services of the sponsor. A technologies and innovative approaches component addressing items called for in the legislation, was estimated to require funding of approximately 6 percent of the construction costs. The program also seeks to utilize an adaptive management framework and, as such, includes 3 percent of the construction costs for this purpose. Special studies are anticipated to further define watershed issues and address specific questions regarding various resource issues; the various plans allow from $500,000 to $1 million per year for these activities based on the level of effort associated with the overall plans.

The systemic O&M Cost is the responsibility of the non-Federal sponsor. Estimates of O&M were developed based on the specific practices recommended under each category and developed into a single system-wide cost. Table 3-59 summarizes the anticipated annual O&M cost associated with each of the alternatives assuming full implementation. This level of O&M, ranging from $613,271 to $16,179,318 annually, would be associated with the fully implemented plan. The actual annual O&M costs in years leading up to full implementation would be proportional to the percent of the restoration activities undertaken.

Table 3-57. System Plan – Benefits Summary

	Overarching Goal	Goal 1	Goal 2	Goal 3	Goal 4	Goal 5	Goal 6
Alternative	**Ecological Integrity**	**Sediment Delivery**	**Backwaters and Side Channels**	**Floodplain, Riparian, and Aquatic**	**Connectivity**	**Water Level Management**	**Water Quality**
No Action	decline	some increase delivery	decline 1%/ yr	No Change	potential improvement	more fluctuations	minor improvement
1	regional improvements	0% upper Tribs 20% Peoria Tribs 0% lower Tribs	3,600 BW acres 10 side channel 10 island protect	5,000 acres MS 5,000 acres Trib 25 stream miles		-1.5% TPF 0% TBF 0% MSF	minor regional improvements
2	maintain current habitat at system level	0% upper Tribs 40% Peoria Tribs 0.5% lower Tribs	6,100 BW acres 20 side channel 15 island protect	5,000 acres MS 10,000 acres Trib 50 stream miles		-2.3% TPF +5% TBF 0% MSF	regional improvement
3	begin system improvements - sediment focus	11% upper Tribs 40% Peoria Tribs 4% lower Tribs	8,600 BW acres 30 side channel 15 island protect	20,000 acres MS 20,000 acres Trib 100 stream miles	Fox, DuPage, Des Plaines	-2.3% TPF +5% TBF 66% MSF	some system improvement
4	begin system improvements - tributary focus	11% upper Tribs 40% Peoria Tribs 4% lower Tribs	6,100 BW acres 20 side channel 15 island protect	5,000 acres MS 20,000 acres Trib 100 stream miles	Fox, DuPage, Des Plaines, Kankakee, Spoon, Aux Sable	-8% TPF +20% TBF 66% MSF	some system improvement
5	ecosystem integrity stable	11% upper Tribs 40% Peoria Tribs 4% lower Tribs	8,600 BW acres 30 side channel 15 island protect	40,000 acres MS 40,000 acres Trib 250 stream miles	Fox, DuPage, Des Plaines, Kankakee, Spoon, Aux Sable	-8% TPF +20% TBF -66% MSF	some system improvement
6	measurable increase at system level	11% upper Tribs 40% Peoria Tribs 20% lower Tribs	12,000 BW acres 35 side channel 15 island protect	75,000 acres MS 75,000 acres Trib 500 stream miles	Fox, DuPage, Des Plaines, Kankakee, Spoon, Aux Sable	-11% TPF +20% TBF -66% MSF	some system improvement
7	reasonable upper bound to system improvements	11% upper Tribs 40% Peoria Tribs 20% lower Tribs	18,000 BW acres 40 side channel 15 island protect	150,000 acres MS 150,000 acres Trib 1000 stream miles	Fox, DuPage, Des Plaines, Kankakee, Spoon, Aux Sable, 3 Main Stem Dams	-23% TPF +50% TBF -73% MSF	some system improvement

Overarching Goal – Ecological Integrity will be addressed by the other goals through prioritization and specifications on restoration measures.
Goal 1 - Sediment delivery benefits are expressed in percentage reductions in tributary delivery resulting from in-channel stabilization and upland practices.
Goal 2 - Backwater (BW) Benefits are expressed in acres dredged, but will benefit larger reaches. Side Channel benefits associated with increased structure and some dredging.
Goal 3 - Main stem (MS) floodplain and riparian (trib) areas are expressed as acreages. Aquatic areas are expressed in stream miles.
Goal 4 - Connectivity (Fish Passage) lists reaches to be addressed. Main stem passage is at Starved Rock, Marseilles, and Dresden Island.
Goal 5 - TPF and TBF are tributary peak flow and base flow, respectively. MSF is the change in the main stem fluctuation regime, representing an average of 5-day windows in the lower river fluctuations over the course of the average growing season. Auto gates allow increased management to smooth flow releases and are included in Alternatives 6 and 7. Wicket dam replacements are considered for the Peoria and La Grange pools in Alternative 7.
Goal 6 - Water quality issues will be addressed through other goals. Greatest benefits likely associated with Goals 1 and 3.

Only rough benefits estimations are included in table; see write-up for additional details.

Table 3-58. First Costs by Goal Category Over 50-Year Implementation

	Overarching Goal	Goal 1	Goal 2	Goal 3	Goal 4	Goal 5	Goal 6	Cost ($ Millions)	
Alternative	**Ecological Integrity**	**Sediment Delivery**	**Backwaters and Side Channels**	**Floodplain, Riparian, and Aquatic**	**Connectivity**	**Water Level Management**	**Water Quality**	**Construction Total [1]**	**Total Program [2]**
No Action	–	–	–	–	–	–	–		
1	Achieved through other goals	$95	$365	$160	–	$135	Achieved through other goals	$790	$945
2	Achieved through other goals	$210	$620	$275	–	$305	Achieved through other goals	$1,410	$1,660
3	Achieved through other goals	$560	$870	$640	$50	$310	Achieved through other goals	$2,430	$2,905
4	Achieved through other goals	$560	$620	$505	$55	$1,105	Achieved through other goals	$2,845	$3,355
5	Achieved through other goals	$560	$870	$1,390	$55	$1,105	Achieved through other goals	$3,980	$4,605
6	Achieved through other goals	$1,040	$1,205	$2,675	$55	$1,625	Achieved through other goals	$6,600	$7,440
7	Achieved through other goals	$1,040	$1805	$5,350	$290	$4,325	Achieved through other goals	$12,810	$14,155

Note: Overarching Goal Ecological Integrity and Goal 6 Water Quality will be addressed under other goals through prioritization and practice specifications.
[1] Construction cost estimates include: 35% contingency, 30% planning, engineering, & design, and 9% construction oversight. Real Estate estimates are included.
[2] Total program calculations include:
Management = $600k to $1.25 million/year based on level of effort (approx 2/3 Corps 1/3 in-kind services)
Technologies and Innovative Approach components costs are approximately 8% of construction total
Adaptive Management costs are approximately 3% of construction total
Special Studies and Watershed Studies ($500k to $1 million based on level of effort)
Excludes O&M Costs - which are shown separately

Table 3-59. Annual O&M Costs Assuming Full Implementation

	Overarching Goal	Goal 1	Goal 2	Goal 3	Goal 4	Goal 5	Goal 6	
Alternative	**Ecological Integrity**	**Sediment Delivery**	**Backwaters and Side Channels**	**Floodplain, Riparian, and Aquatic**	**Connectivity**	**Water Level Management**	**Water Quality**	**Annual O&M Costs**
No Action	–	–	–	–	–	–	–	
1	Achieved through other goals	$97,000	$11,990	$369,281	$0	$135,000	Achieved through other goals	$613,271
2	Achieved through other goals	$212,000	$18,805	$581,363	$0	$200,000	Achieved through other goals	$1,012,168
3	Achieved through other goals	$645,000	$20,445	$1,486,525	$152,463	$325,000	Achieved through other goals	$2,629,433
4	Achieved through other goals	$645,000	$18,805	$1,000,825	$156,691	$835,000	Achieved through other goals	$2,656,321
5	Achieved through other goals	$645,000	$20,445	$3,130,213	$156,691	$835,000	Achieved through other goals	$4,787,329
6	Achieved through other goals	$1,125,000	$21,265	$5,941,525	$156,691	$1,185,000	Achieved through other goals	$8,429,481
7	Achieved through other goals	$1,125,000	$22,085	$11,887,750	$494,483	$2,650,000	Achieved through other goals	$16,179,318

2. Evaluation and Comparison of Plans

Description of the Evaluation and Comparison Process

The purpose of the evaluation and comparison steps is to determine to what extent the various plans achieve ecosystem goals and objectives and reasonably maximize ecosystem benefits to the Nation. The evaluation of each alternative consists of measuring or estimating the ecosystem benefits (acres of habitat, stream miles restored, tons of sediment not delivered to the system, etc.) and the resulting effect on ecological integrity, costs, and determining the difference between the without- and with-project conditions. In particular, each alternative is formulated and evaluated in relationship to five criteria: completeness, effectiveness, efficiency, acceptability, and risk and uncertainty. The effectiveness and efficiency of each alternative is determined based on percent attainment of the desired future (represented by Alternative 7) and area benefited (acres or stream miles).

- **Completeness** is the extent to which the alternative plans provide and account for all necessary investments of other actions to ensure the realization of the planning objectives, including actions by other Federal and non-Federal entities.
- **Effectiveness** is the extent to which the alternative plans contribute to achieve the planning objectives.
- **Efficiency** is the extent to which an alternative plan is the most cost-effective means of achieving the objectives.
- **Acceptability** is the extent to which the alternative plans are acceptable in terms of applicable laws, regulations, and public policies.
- **Risk and uncertainty** is the identification of the areas of sensitivity where actual outcomes are uncertain due to unpredictable biological or economic elements.

The selection of a preferred comprehensive plan alternative requires that individual alternative plans be compared against the without-project condition and against one another. Alternative plan comparisons were largely driven by the evaluation of information generated during the formulation of the alternatives (e.g., costs, ecosystem benefits, extent of achieving objectives, etc.). Additional information regarding alternative completeness, sustainability and level of risk and uncertainty also were assessed.

The primary criteria used by the Corps of Engineers for ecosystem restoration projects is cost effectiveness and incremental analysis. The National Ecosystem Restoration (NER) plan is selected from the cost-effective plans as the alternative that reasonably maximizes ecosystem restoration benefits compared to costs. The selected plan is chosen after considering the cost-effectiveness and incremental costs of other plans.

a. Completeness. All of the plans formulated provide relatively equal levels of completeness. All plans could be fully attained through an expanded authorization under this authority; however, considerable opportunities exist for partnerships with other Federal and State agencies. The extent of these partnerships will depend on future authorizations and appropriations for the various partner agencies.

b. Effectiveness. The effectiveness of alternative plans is related to the extent to which they achieve the planning objectives or desired future conditions. Ecosystem restoration project benefits are typically non-monetary outputs expressed in terms of increased quality and quantity of habitat. These outputs are typically measured as annualized habitat units (combination of acreage and habitat suitability). However, it was not feasible to quantify annualized habitat benefits using a formal Habitat Evaluation Procedures (HEP) approach over the 30,000-square-mile project area given the range of habitat types and limiting factors being addressed by the system alternatives. The defined outputs varied by goal category and included acres, stream miles, reductions in sediment delivery, and improved hydrologic regimes. As a result, a complete cost effectiveness and incremental cost effectiveness analysis based on habitat units could not be conducted.

Early on in the study process, detailed objectives were identified for each goal category by the system team, resource managers, and stakeholders. These objectives represent a desired future condition of ecological condition for the Illinois River Basin.

The best quantifiable measure of system output that provides comparability across all goal categories was the percentage attainment of restoration objectives (desired future). However, the benefit area was also able to be quantified in terms of acres and stream miles. These measures of benefits allow for the completion of a cost effectiveness-incremental cost analysis for five of the seven goal categories (Goals 1 through 5). The outputs for the Overarching Goal and Goal 6 could not be fully quantified and, as a result, were assessed qualitatively.

As part of future site-specific restoration projects, detailed and complete cost effectiveness and incremental cost analysis will be conducted.

The remainder of this section highlights the values identified for effectiveness. By examining the number, type, and potential results of restoration alternatives, the effectiveness of ecosystem alternatives was quantitatively and qualitatively assessed. This process included identifying the extent to which the alternative plan:

- Maintains or exceeds the existing condition
- Accounts for planning objectives (desired future conditions)
- Affects ecosystem integrity (EOPs, sustainability).

Overarching Goal: Ecosystem Integrity

The goal of ecosystem restoration is to restore and sustain ecosystem integrity by protecting native biodiversity and the ecological and evolutionary processes that create and maintain that diversity. Ecological integrity is the overarching goal for this restoration program and should drive the identification, development, and selection of all restoration measures and alternatives; all alternatives and objectives formulated under all of the other program goals would contribute toward restoring the ecological integrity of the Illinois River Basin.

Ecological integrity is defined as a system's wholeness or "health," including presence of all appropriate elements, biotic and abiotic, and occurrence of all processes that generate and maintain those elements at the appropriate rates (Angermeier and Karr 1994). The environmental quality of the restoration alternatives was evaluated by examining how they contribute to the Illinois River Basin ecosystem integrity. The parameters, compared to the existing conditions at both the regional and system scale, were:

1) Maintain or exceed the existing condition,
2) Increase the amount of quality habitat and,
3) Improve the ecological integrity (habitat, biodiversity, function, and sustainability).

The proposed ecosystem restoration alternatives address increasing amounts of quality habitat through restoration and preservation. Some alternatives address restoration of ecosystem function, and thus increasing levels of sustainability. In this evaluation, all of the alternatives, except no action, were presumed to positively affect the habitat and ecological integrity, either at the regional or system level or both, with varying degrees of effectiveness. A summary of the effectiveness of the alternatives on ecosystem integrity is shown in table 3-57. Ecosystem integrity can be achieved at the regional scale or system scale and is a function of the level of restoration and project placement (i.e., concentration in a watershed). As ecological integrity is improved, particularly through sediment reduction and water level management, habitats and projects become more sustainable.

No Action (anticipated future condition without project). Continue the decline in system ecological integrity and populations of native species, resulting from the continuation of habitat loss and fragmentation, the altering of natural disturbance regimes, and the continuation of non-indigenous species colonization.

Alternative 1. Continue the decline in system ecological integrity and populations of native species. However, in areas of focused restoration efforts, there would be regional improvements to both habitat and regional ecological integrity.

Alternative 2. Current habitat conditions will be maintained. However, some decline in system ecological integrity would continue to occur, especially for populations of native species that are currently declining or sensitive to continued habitat fragmentation, such as area-sensitive species.

Alternative 3. Improvements in habitat conditions at the system level, with a focus on system ecological integrity, particularly in impacts of excessive sedimentation. This plan would increase backwater habitat, reduce sediment delivery, and restore additional main stem and tributary floodplain areas.

Alternative 4. Improvements in habitat conditions at the system level, with a focus on tributary ecological integrity and secondary effects to main stem habitats. This plan would result in sediment delivery reduction, tributary floodplain and stream restoration, increased fish passage, and more naturalized water levels.

Alternative 5. Improves the amount of current habitats and their functions at the system level. No further declines in system ecological integrity are foreseen at this level of restoration. System health and ecological integrity are stable or improving.

Alternative 6. Restoration would provide a measurable increase in level of habitat and ecological integrity at the system level.

Alternative 7 (desired future condition). Restoration would provide a measurable increase in level of habitat and ecological integrity at the system level, at or near the vision for the Illinois River

Basin. This level of effort was developed to provide an upper limit of potential restoration considering current political, social, and fiscal constraints.

Sustainability is the ability of the ecosystem to maintain its structure and function and to remain resilient in order to continue to give and support life. The sustainability of the various plans was measured as a way to address the extent to which the various alternatives address the system ecological integrity. In general, it will take extensive work to reach an increased level of sustainability of ecological processes and functions. Significant increases in sustainability are anticipated with Goals 6 and 7.

Goals 1 through 5

For Goals 1 through 5, the effectiveness of the various alternatives in attaining the study objectives could be expressed in two ways: (1) percentage of the desired future condition and (2) area benefited (acres or stream miles).

1. **Percent Attainment of the Desired Future Condition.** Benefits were first quantified as a percentage of the desired future condition established as part of the study and expressed in Alternative 7. The following paragraphs and table 3-61 briefly summarize the reference for each goal category in terms of the benefit measures shown and percent attainment. The various percentages were averaged (e.g. given equal weighting) in order to provide some understanding of the system level of attainment of the study objectives. Across all categories, the range of effectiveness in attaining the system objectives ranged from a low of 7 percent for Alternative 1 to a high of 97 percent for Alternative 7.

Goal 1. The sediment delivery restoration objective calls for a 20 percent reduction system-wide. Each of the alternatives has an estimated reduction, (i.e., Alternative 1 - 2.3 percent system reduction) which can be converted to a percentage of the objective (12 percent of the system goal of 20 percent). This is only a summary since the regional benefits associated with some of the smaller plans are lost, because only the overall system reduction was calculated.

Goal 2. Backwater and Side Channel restoration alternatives were evaluated under three different criteria. These included backwater restoration measures against the system objective of 19,000 acres and side channel restoration measures against the system objective of 40 areas (established by the UMR-IWW System Navigation Study objectives database). The formulation also included island protection projects, but because the levels are nearly the same for all alternatives and the affected area is very small, this measure was not included in the effectiveness matrix.

Goal 3. The effectiveness was best measured by looking at the performance by alternative against the three separate restoration objectives. The actual numbers were calculated by again looking at each alternatives percentage attainment of the objectives: main stem floodplain with an objective of 150,000 acres, tributary floodplain with an objective of 150,000 acres, and aquatic stream restoration with an objective of 1,000 miles.

Goal 4. Connectivity (fish passage) was not as easily converted to a percentage basis, since no single system stream mile objective was developed. The total stream miles connected by alternative was divided by the maximum number of stream miles—3,792—connected under Alternative 7. This does not clearly reflect the total value of various individual projects, since the extent to which various dams block migrations varies considerably by dam site. However, it does provide a sense of the relative magnitude. It was also noted by those working directly on the fish passage issues that given Midwest fish communities, in many cases addressing long stretches separated by only a single dam may not represent as great of benefits as addressing more closely spaced dams that are more completely limiting habitat in a tributary or stream reach. This was the basis for addressing the Fox, Des Plaines, and DuPage in the first increment of passage.

Goal 5. The naturalization of water levels to more closely match ecosystem needs is one of the most complex areas of study. The actual physical processes are complex and the biological responses are not precisely understood. However, the outputs of the various alternative plans were able to be measured in three different fashions to address progress toward the study objectives. Main stem benefits were measured in terms of percent reductions in 1-foot fluctuations, tributary benefits measured in terms of increases in base flow (based on a maximum of 50 percent reduction shown as 100 percent attainment of the objective), and peak flow reductions (based on a maximum of 23 percent again shown as 100 percent attainment of the objective).

Table 3-60. Alternative Effect on Ecosystem Integrity

	No Action	Alternative. 1	Alternative. 2	Alternative. 3	Alternative. 4	Alternative. 5	Alternative. 6	Alternative. 7
Quality Habitat Improvement	decline	regional only	maintain current	minor	minor	minor	major	major
Ecosystem Integrity Regional Scale	decline	improve	improve	improve	improve	improve	improve	improve
Ecosystem Integrity System Scale	decline	decline	decline	sediment improve	tributary improve	improve	improve	improve
Sustainability	no	low	low	low/mod	low/mod	moderate	high	high

Table 3-61. Summary of the Effectiveness of Alternatives as Percent of Desired Future Conditions

Effectiveness	No Action	Alt 1	Alt 2	Alt 3	Alt 4	Alt 5	Alt 6	Alt 7
Goal 1 - Sediment Reduction (20% reduction)	0%	12%	25%	50%	50%	50%	100%	100%
Goal 2 - Backwaters (19,000 acres)	0%	19%	32%	45%	32%	45%	63%	95%
Goal 2 - Side Channels (40 no.)	0%	25%	50%	75%	50%	75%	88%	100%
Goal 3 - Main Stem Floodplain (150k acres)	0%	3%	3%	13%	3%	27%	50%	100%
Goal 3 -Tributary Floodplain (150k acres)	0%	3%	7%	13%	13%	27%	50%	100%
Goal 3 - Aquatic Restoration (1k miles)	0%	3%	5%	10%	10%	20%	50%	100%
Goal 4 - Fish Passage (miles)	0%	0%	0%	23%	78%	78%	78%	100%
Goal 5 - Water Level - Main Stem % reduction 1-foot fluctuations)	0%	0%	0%	65%	65%	65%	65%	73%
Goal 5 - Water Level – Tributary (% increase in base flow) (max 50%)	0%	0%	10%	10%	40%	40%	40%	100%
Goal 5 - Water Level - Tributary (% reduction in peak flow) (max 25%)	0%	7%	10%	10%	35%	35%	48%	100%
Combined Goals (equal weighting)	0%	7%	14%	31%	38%	46%	63%	97%

2. Area Benefited (acres or stream miles). In addition to the percent attainment quantification, the system team also determined the area of beneficial influence in terms of stream miles and acres. Some individual goals produce benefits in one category or both while system alternative plans produce a mixture of both benefit categories (table 3-62).

Goal 6. Water and Sediment Quality

Similar to the Overarching Goal, no specific restoration was planned to directly address Goal 6 Water and Sediment Quality. However, benefits are anticipated to result from the practices included under the other goals (table 3-63). In particular, the reduction of sediment will address one of the key impairment to many reaches. The nutrient phosphorus is adsorbed to sediment, and reductions are anticipated associated with any sediment reductions. Similarly, reductions in nitrogen are anticipated as a result of wetland restoration and improved riverine corridors and buffers. The benefits are not likely to be more than regional with Alternatives 1 and 2. The levels associated with Alternatives 3 through 5 should provide some system improvements. However, more significant system improvements are anticipated with the levels associated with Alternatives 6 and 7, which more fully address sediment delivery and floodplain and riparian restoration.

c. Efficiency. For ecosystem restoration studies, efficiency is measured in terms of cost effectiveness. The National Ecosystem Restoration (NER) plan is the plan that reasonably maximizes ecosystem restoration benefits compared to costs, considering the cost effectiveness and incremental cost of implementing other restoration options. Corps of Engineers guidance requires the use of incremental cost analyses to select the NER plan. Two analytical processes are conducted to meet these requirements. First, a cost-effectiveness analysis is conducted to ensure that the least cost solution is identified for each possible level of ecosystem output. Cost effectiveness means that no plan can provide the same benefits for less cost or more benefits for the same cost. Then, incremental cost analysis of the least cost solutions is conducted to reveal changes in costs for increasing levels of environmental outputs. Plans that provide the greatest increase in benefits for the least increase in costs are identified as “best buy” plans. In the absence of a common measurement unit for comparing the non-monetary benefits with the monetary costs of ecosystem restoration plans, cost effectiveness and incremental analysis are valuable tools to assist in decision making.

1. Percent Attainment of the Desired Future Condition. The traditional Corps of Engineers ecosystem restoration project evaluations include an assessment of increases in ecosystem quality and quantity (often habitat), as well as a cost effectiveness-incremental cost analysis (CE/ICA). For a project that encompasses more than 30,000 square miles and multiple habitat types, it was not feasible to conduct habitat evaluation procedures. In addition, the benefits differed across the goals and were not directly comparable. The percent attainment measure of benefits allowed for the completion of a cost effectiveness-incremental cost analysis for five of the seven goal categories (Goals 1 through 5). Table 3-64 shows the combined percent attainment of the system objectives using an equal weighting of the various outputs. The outputs for the Overarching Goal and Goal 6 could not be fully quantified and, as a result, were separately assessed qualitatively.

Table 3-62. Acreage and Stream Mile Benefits of System Alternatives

	Goal 1 Sediment Delivery (Miles)	Goal 2 Backwaters and Side Channels (Acres)	Goal 3 Floodplain, Riparian and Aquatic (Acres)	Goal 3 Floodplain, Riparian and Aquatic (Miles)	Goal 4 Connectivity (Miles)	Goal 5 Water Level Mgmt (Acres)	Goal 5 Water Level Mgmt (Miles)
No Action	0	0	0	0	0	0	0
Alt 1	1,700	14,300	10,000	50	0	0	920
Alt 2	3,220	30,950	15,000	100	0	0	2,310
Alt 3	9,570	42,240	40,000	200	2,140	8,600	2,310
Alt 4	9,570	30,950	25,000	200	4,280	8,600	8,580
Alt 5	9,570	42,240	80,000	500	4,280	8,600	8,580
Alt 6	16,750	56,020	150,000	1,000	4,280	20,900	11,000
Alt 7	16,750	66,580	300,000	2,000	6,730	23,700	22,000

Table 3-63. Alternative Effect on Water and Sediment Quality

Effectiveness	No Action	Alt 1	Alt 2	Alt 3	Alt 4	Alt 5	Alt 6	Alt 7
Goal 6 - Water Quality	None	Low	Low	Moderate	Moderate	Moderate	Mod/High	Mod/High

Table 3-64. Cost Effectiveness - System Benefits (Percent of Desired Future) and System Costs

Efficiency	No Action	Alt 1	Alt 2	Alt 3	Alt 4	Alt 5	Alt 6	Alt 7
Combined Goals 1 through 5 (equal weighting)	0%	7%	14%	31%	38%	46%	63%	97%
Total First Cost ($ million)	-	$945	$1,660	$2,905	$3,355	$4,605	$7,440	$14,155
Cost Effectiveness. - Goals 1 through 5 (cost per % improvement, $ million)	-	$135	$119	$94	$88	$100	$118	$146

Figures 3-45 and 3-46 and table 3-65 show the output of the cost effectiveness-incremental cost analysis using the percentage attainment of the desired future condition and total first cost. As figure 3-45 illustrates, all plans formulated for the study were cost effective and were built only from cost effective measures. Four plans in addition to the No Action Alternative were identified as best buys: Alternatives 4, 5, 6, and 7. These plans provide the greatest increase in benefits for the least increase in cost (lowest incremental costs).

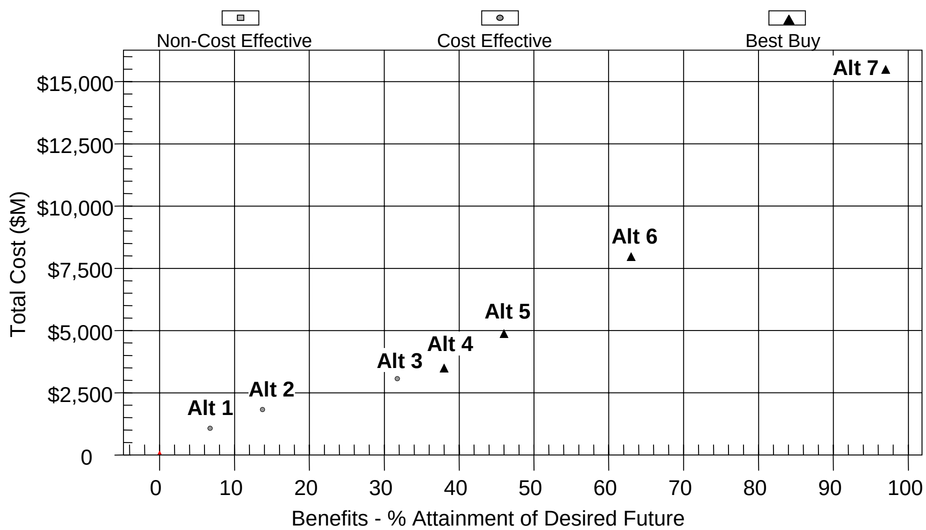


Figure 3-45. Cost Effectiveness of Plans

Table 3-66 and figure 3-46 highlight the results of the incremental cost analysis of the best buy plans. As the figures show, Alternative 4 provides restoration at a cost effectiveness of $88 million per percent of the desired future attained for the first 38 percent. Alternative 5 provides a gain of an additional 8 percent attainment of objectives for an additional $1.25 billion investment, at an incremental cost of $156 million per percent. A similar incremental cost of $166 million per percent is incurred in moving from Alternative 5 to Alternative 6. However, in order to attain the final 34 percent increase in objective benefits, an additional, $6.7 billion would be required at an incremental cost of $198 million per percent.

Table 3-65. Summary of Incremental Cost Analysis

Alternative	Cost ($ Millions)	% Attainment of Desired Future	Incremental Cost	Incremental Benefit	Incremental Cost Per Output
Alternative 0	$0	0	$0	0	$0
Alternative 4	$3,355	38	$3,355	38	$88
Alternative 5	$4,605	46	$1,250	8	$156
Alternative 6	$7,440	63	$2,835	17	$166
Alternative 7	$14,155	97	$6,715	34	$198

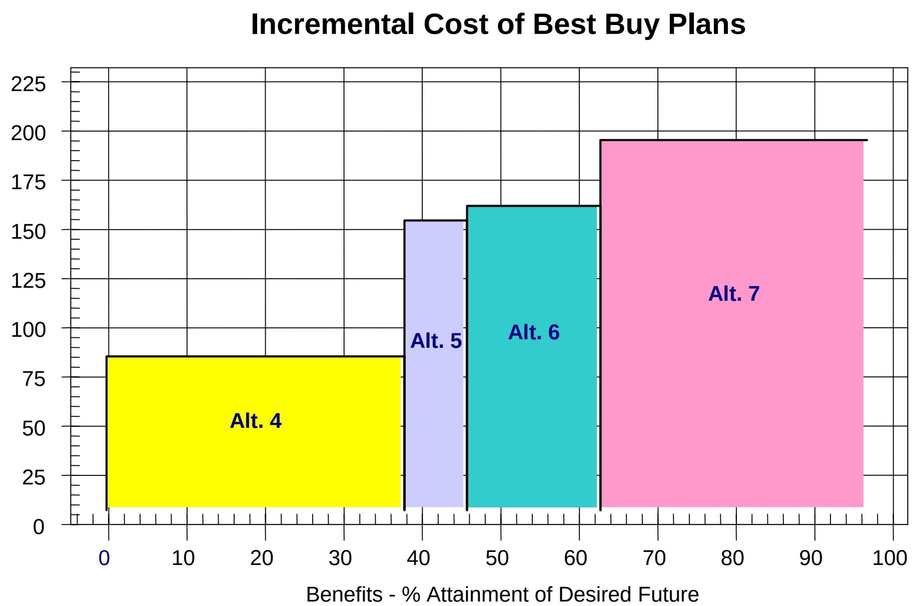


Figure 3-46. Incremental Cost of Best Buy Plans

2. Acres Benefited (acres or stream miles). In addition to the percent of goal attainment analysis, cost effectiveness and incremental costs analysis (CE/ICA) was also conducted to evaluate the area of influence benefits, in acres and stream miles. The CE/ICA looks separately at the benefits produced by each alternative plan in terms of acres and stream miles. The result is an analysis that identified the most efficient or “best buy” system alternatives for each benefit category at the goal and system level.

The alternatives developed and analyzed by goal were built from cost effective practices and therefore the range of alternatives within each Goal category were all considered cost effective. The purpose of this analysis is to show which system alternatives have the largest share of best buy components across the goal categories. Those system alternatives composed of “best buy” levels of restoration for acres, stream miles, and percent of goal attainment are considered to be more effective system restoration alternatives.

Table 3-66 summarizes the acres and stream mile benefits of the proposed system alternatives by goal and alternative. All alternatives are cost effective; in addition, figures in bold indicate “best buy” alternatives.

The results of the cost effectiveness analysis for the system alternative plans showed that all alternative plans were cost-effective plans. Cost effectiveness means that no plan can provide the same benefits for less cost or more benefits for the same cost. Alternative 6 exhibited the lowest cost per unit of all alternatives, $683 per acre of benefit (table 3-67). Alternative 3 exhibited the lowest cost per unit of all cost effective alternatives, $5,080 per stream mile of benefit.

For both acres and stream mile benefit categories, “best buy” plans were identified. Table 3-68 and figure 3-47 show the best buy plans based on acres. These plans provide the greatest increase in benefits for the least increase in costs. For system alternatives producing acres of habitat benefits, Alternative 6 provides 226,920 acres of habitat benefit to the Basin at an annualized incremental cost of $683 per acre of habitat benefit. Alternative 7 provides an additional 163,360 acres of habitat benefit at an annualized incremental cost of $935 per acre of habitat benefit.

Table 3-66. Cost Effective Summary of Acreage and Stream Mile Benefits

System Alternative	Goal 1 Sediment Delivery (miles)	Goal 2 Backwaters & Side Channels (acres)	Goal 3 Floodplain, Riparian & Aquatic (acres)	Goal 3 Floodplain, Riparian & Aquatic (miles)	Goal 4 Connectivity (miles)	Goal 5 Water Level Management (acres)	Goal 5 Water Level Management miles)
No Action	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Alt 1	**1,700**	14,300	10,000	50	**0**	**0**	920
Alt 2	3,220	**30,950**	15,000	100	**0**	**0**	2,310
Alt 3	9,570	**42,240**	40,000	200	2,140	**8,600**	2,310
Alt 4	9,570	**30,950**	25,000	200	**4,280**	**8,600**	**8,580**
Alt 5	9,570	**42,240**	80,000	500	**4,280**	**8,600**	**8,580**
Alt 6	**16,750**	**56,020**	150,000	**1,000**	**4,280**	**20,900**	**11,000**
Alt 7	**16,750**	**66,580**	**300,000**	**2,000**	**6,730**	**23,700**	**22,000**

All alternatives are cost effective; figures in bold indicate "best buy" alternatives.

Table 3-67. System Alternative Plans Evaluation

Alternative	Plan Total Benefit (acres)	Plan Total Benefit (miles)	Acres – Total First Cost of Construction ($millions)	Miles – Total First Cost of Construction ($ millions)	Acres – Annualized Cost ($ 1,000s)	Miles - Annualized Cost ($ 1,000s)	Annualized Cost/System Acre ($ dollars)	Annualized Cost/System Mile ($ dollars)
No Action	0	0	$0	$0	$0	$0	$0	$0
Alt 1	24,300	2,670	$463	$328	$26,845	$19,015	$1,104	$7,122
Alt 2	45,950	5,630	$770	$638	$44,645	$36,990	$971	$6,570
Alt 3	90,840	14,220	$1,268	$1,246	$73,520	$72,245	$809	$5,080
Alt 4	64,550	22,630	$883	$2,046	$51,195	$118,630	$793	$5,242
Alt 5	130,840	22,930	$1,650	$2,418	$95,670	$140,195	$731	$6,114
Alt 6	226,920	33,030	$2,676	$3,958	$155,155	$229,485	$683	$6,947
Alt 7	390,280	47,480	$5,312	$7,585	$307,995	$439,780	$789	$9,262

Note: Some acres and stream mile benefits may be double counted within a particular alternative if some of the same areas would be addressed by more than one goal.

Table 3-68. Incremental Cost Analysis of Best Buy System Alternative Plans (Acres of Benefit)

Alternative Plan	Acre Output [1]	Annualized Cost [2]	Incremental Cost	Incremental Output Acres	Incremental Cost/Acre of Benefit
No Action	0	$0	$0	0	$0
Alternative 6	226,920	$155,156,124	$155,156,100	226,920	$683
Alternative 7	390,280	$307,993,023	$152,836,900	163,360	$935

[1]Outputs are calculated as Acre of Benefit.
[2]Annualized cost is initial construction cost, based on a 50-year period of analysis, .05375% interest rate.

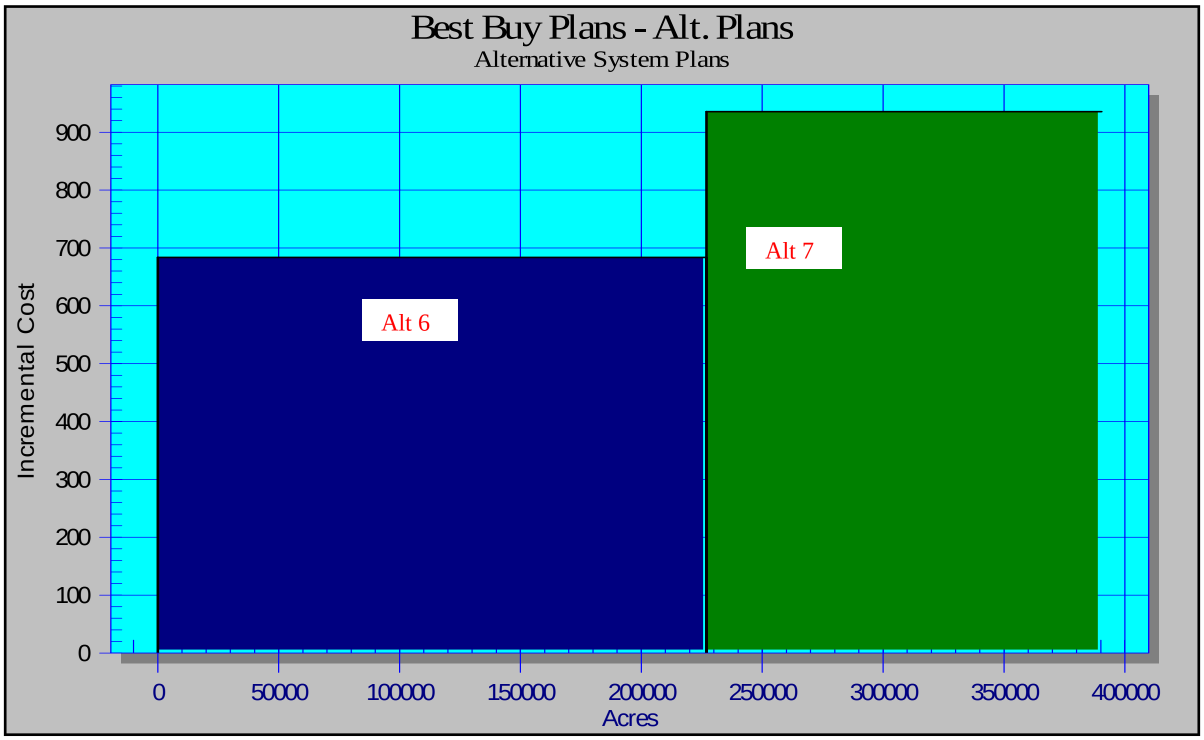


Figure 3-47. Incremental Analysis of Best Buy Plans (Acres of Benefit)

For system alternative producing stream miles of habitat benefits, there were four best buys; Alt 3, 4, 6, and 7 (table 3-69 and figure 3-48). Alternative 3 provides 14,220 miles of habitat benefit to the Basin at an annualized incremental cost of $5,080 per mile of habitat benefit. Alternative 4 provides an additional 8,410 miles of habitat benefit at an annualized incremental cost of $5,515 per mile of habitat benefit. Alternative 6 provides an additional 10,400 miles of habitat benefit at an annualized incremental cost of $10,659 per mile of habitat benefit. Finally, Alternative 7 provides an additional 14,450 miles of habitat benefit at an annualized incremental cost of $14,553 per mile of habitat benefit. While incremental costs increase significantly between Alt 4 and Alt 6, Alternative 6 adds considerably more benefits by addressing sediment delivery along the lower Illinois River and adding 800 miles of instream aquatic habitat restoration. The major addition in moving from Alt 6 to Alt 7 is an additional 1,000 miles of instream aquatic habitat restoration and providing fish passage on the main stem Illinois River.

Table 3-69. Incremental Cost Analysis of Best Buy System Alternative Plans (Miles of Benefit)

Alternative Plans	Miles Output [1]	Annualized Cost [2]	Incremental Cost	Incremental Output Miles	Incremental Cost/Mile of Benefit
No Action	0	$0	$0	0	$0
Alternative 3	14,220	$72,243,845	$72,243,850	14,220	$5,080
Alternative 4	22,630	$118,628,337	$46,384,490	8,410	$5,515
Alternative 6	33,030	$229,487,271	$110,858,900	10,400	$10,659
Alternative 7	47,480	$439,782,959	$210,295,700	14,450	$14,553

[1]Outputs are calculated as Acre of Benefit.
[2]Annualized cost is initial construction cost, based on a 50-year period of analysis, .05375% interest rate.

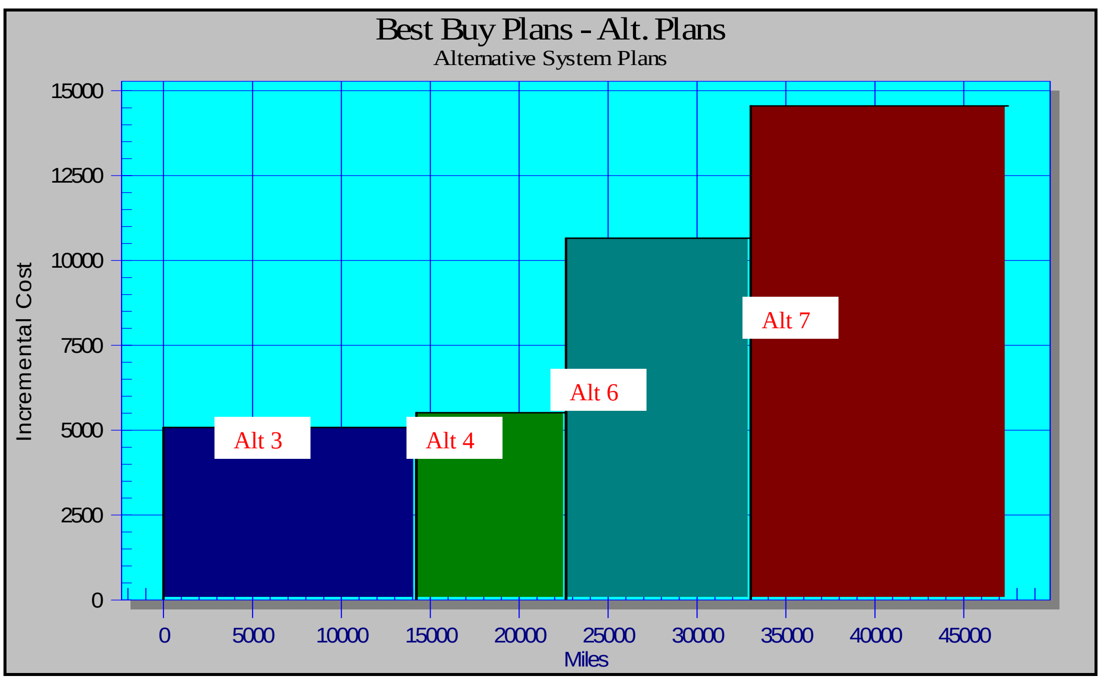


Figure 3-48. Incremental Analysis of Best Buy Plans (Miles of Benefit)

The most efficient alternatives, or best buy plans, varied somewhat by analysis acres, stream miles, and percent attainment. In total, they included the No Action and Alternatives 3, 4, 5, 6, and 7 (table 3-70). Alternative 3 was a best buy only in terms per cost per stream mile at $5,080 per stream mile. Alternative 4 was a best buy in terms of stream miles and percent attainment of goals. It provides restoration at a cost effectiveness of $5,515 per mile and $88 million per percent of the desired future condition attained for the first 38 percent. Alternative 5 was a best buy only for percent of goal attainment, providing a gain of an additional 8 percent, at an incremental cost of $156 million per percent. Only, Alternative 6 and 7 were best buy plans under all three forms of system analysis.

Table 3-70. Best Buy Plans from All System Analysis Methods

Alternative	Incremental Annual Cost/Acre	Incremental Annual Cost/Mile	Incremental Cost Per % Goal Attained (Millions)
No Action	**$0**	**$0**	**$0**
Alternative 1	$1,104	$7,122	$135
Alternative 2	$971	$6,920	$119
Alternative 3	$809	**$5,080**	$94
Alternative 4	$793	**$5,515**	**$88**
Alternative 5	$731	$71,883	**$156**
Alternative 6	**$683**	**$10,659**	**$166**
Alternative 7	**$935**	**$14,553**	**$198**

Note: Best Buy Plans are shaded. Incremental costs are shown from previous best buy plan.

d. Acceptability. Acceptability is the workability and viability of the alternative plan with respect to acceptance by Federal, State, and local entities; the general public; and compatibility with existing laws regulations and public policies [*Principles and Guidelines for Water and Related Land Resources,* Section VI.1.6.2(c)(4)]. To be acceptable, a plan has to have a perceived value, cost effectiveness, and a high probability of success. Many factors can render a plan infeasible in the minds of individuals. These factors can generally be categorized as technical (engineering or natural world limitations), economic, financial, environmental, social, political, legal and institutional.

While a wide range of comments was recorded during the study public meetings in December 2003, many comments supported plans that provide measurable system improvements in habitat and ecosystem integrity. These comments would be consistent with Alternatives 3 through 7 in considering habitat, but more specifically Alternatives 5 through 7 when considering ecological integrity.

e. Risk and Uncertainty. Risk and uncertainty are inherent in water resources planning and ecosystem restoration. Planners, resource managers, and decision makers rarely have all the information needed to make necessary public investment decisions. They often do not know how much confidence to place in the information they have; and must make decisions in an uncertain political, social, and economic environment. In addition, human intervention in natural processes involves unpredictable economic and biological elements.

Principles and Guidelines for Water and Related Land Resources, dated March 10, 1983, states that "the planner's primary role in dealing with risk and uncertainty is to identify the areas of sensitivity and describe them clearly so that decisions can be made with knowledge of the degree of reliability of available information." The alternatives and their effects should be examined to determine the uncertainty inherent in the data or various assumptions of future economic, demographic, social, public, environmental, and technological trends.

Risk and uncertainty was addressed as part of the formulation of measures and alternatives under each goal category. While there are uncertainties associated with some of the practices and approaches proposed in the Comprehensive Plan, the measures used to develop alternatives have been implemented at a number of locations and demonstrated to provide the desired benefits. Based on the approach of building all alternatives from similar measures, there are similar levels of risk and uncertainty associated with each alternative. As a result, risk and uncertainty does not represent a direct selection criterion in choosing among alternatives.

At the system level, however, risk and uncertainty is inherent in a study of a large basin, particularly in regard to ecological thresholds. Of concern is determining the thresholds associated with reductions in sediment delivery and reductions in water level fluctuations that will produce desired biological responses, such as increased aquatic plant growth and increased populations of macroinvertebrates. Since these thresholds cannot be known with certainty, the proposed approach is to implement restoration actions using sound site-specific project planning, adaptive management, long-term systemic monitoring, project-specific monitoring, and additional studies to address the uncertainties present during the implementation of the project components.

As a result, these elements have been included as part of the implementation framework for this restoration project and are described in greater detail in the following sections. Further specific studies will be developed to provide additional information needed for detailed design and refinement of specific components of the Comprehensive Plan.

The data collected and experiences learned through executing the restoration activities are recommended to be periodically reviewed and summarized for decision makers. This evaluation would provide the basis for potential identification of improved techniques or approaches; revised sediment reduction targets; improved hydrologic modifications; new restoration approaches; and modifications to the monitoring and adaptive management framework. It is likely that new technologies and techniques will emerge during the implementation process. New technologies and techniques for ecosystem restoration offer the possibility of improving the Comprehensive Plan over and above the measures identified to date. The implementation process will allow flexibility to consider and include new technologies as they become available.

3. Selection of the Preferred Comprehensive Plan Alternative

By reviewing the various alternative plan qualitative and quantitative outputs in comparison to the criteria of completeness, effectiveness, efficiency, acceptability (and risk and uncertainty), the relative benefits of the various alternative plans become clearer. Table 3-71 and the following sections provide additional explanation of the selection of the preferred comprehensive plan alternative in regards to completeness; effectiveness in achieving objectives; and efficiency - Cost Effectiveness (NER).

In terms of completeness, all plans were essentially equal. In terms of effectiveness in addressing the overarching goal of restoring ecological integrity and Goal 6, Alternatives 3, 4, 5, 6, and 7 provide improvements in terms of improving system habitats compared to existing conditions. However, only Alternatives 5, 6, and 7 fully address the study vision for a system sustainable by natural processes and the overarching goal of restoring and maintaining ecological integrity. Evaluation of the ecosystem alternative contribution to the planning objectives determined that Alternatives 6 and 7 most directly achieve the planning goals and objectives. Therefore, they received the highest ranking. While less defined, water and sediment quality improvements are also anticipated to be the greatest with Alternatives 6 and 7.

Table 3-71. Summary of Evaluation Criteria of Best Buy Plans

Completeness						
	No Action	**Alt 3**	**Alt 4**	**Alt 5**	**Alt 6**	**Alt 7**
	-	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**

Effectiveness						
	No Action	**Alt 3**	**Alt 4**	**Alt 5**	**Alt 6**	**Alt 7**
Overarching Goal - Habitat	decline	minor	minor	minor	major	Major
Overarching Goal – Ecosystem Integrity Region	decline	improve	improve	improve	improve	Improve
Overarching Goal – Ecosystem Integrity System	decline	sediment improve	tributary improve	improve	improve	Improve
Overarching Goal - Sustainability	no	low/mod	low/mod	mod	high	High
Goal 6 - Water Quality	-	mod	mod	mod	mod/high	mod/high
Combined Goals (equal weighting)	0%	31%	38%	46%	63%	97%
Acres Benefited	-	90,840	64,550	130,840	226,920	390,280
Stream Miles Benefited	-	14,220	22,630	22,930	33,030	47,480

Efficiency						
	No Action	**Alt 3**	**Alt 4**	**Alt 5**	**Alt 6**	**Alt 7**
Project Cost ($ in millions)	-	$2,905	$3,355	$4,605	$7,440	$14,155
Best Buy Plans Percent Attainment	Yes	-	Yes	Yes	Yes	Yes
Best Buy Plans Acres Restored	Yes	-	-	-	Yes	Yes
Best Buy Plans Stream Miles Restored	Yes	Yes	Yes	-	Yes	Yes

The most efficient alternatives, or best buy plans, varied somewhat by analysis (acres), stream miles, and percent attainment. In total, they included the No Action and Alternatives 3, 4, 5, 6, and 7. Alternative 3 was a best buy only in terms per cost per stream mile at $5,080 per stream mile. Alternative 4 was a best buy in terms of stream miles and percent attainment of goals. It provides restoration at a cost effectiveness of $5,515 per mile and $88 million per percent of the desired future condition attained for the first 38 percent. Alternative 5 was a best buy only for percent of goal attainment, providing a gain of an additional 8 percent, at an incremental cost of $156 million per percent. Only Alternatives 6 and 7 were both best buy plans under all three forms of system analysis.

Acceptability also points to the strong desire to see plans that result in significant system improvements (i.e. Alternatives 5, 6, and 7). Since all plans have similar levels of risk and uncertainty, it did not provide a basis for selecting a particular plan.

Based on an assessment of all evaluation criteria, Alternative 6 was selected as the preferred comprehensive plan alternative. Alternative 3 and 4 were not selected since they do not provide enough restoration to make systemic ecological integrity improvements over current conditions, especially in relation to system ecological thresholds. Alternative 6 was selected over Alternative 5, since it was a best buy in terms of both cost per acre and stream miles, while Alternative 5 was not. Alternative 6 also provides a higher level of attainment of the desired future (63 percent) than Alternative 5 (46 percent) with similar incremental costs. Alternative 6 is anticipated to result in achievement of desired system outputs including restoration above threshold levels required for the return of aquatic plants and diving ducks and addressing system limiting factors allowing for improvements in fish, waterfowl, and threatened and endangered species populations.

As shown in the summary table of the best buy plans (table 3-71), only Alternatives 6 and 7 achieved significant improvements to ecosystem integrity over current conditions and high levels of sustainability. Alternative 7, while also a best buy under all three benefit evaluations and attaining near 100 percent achievement of the desired future, was also not preferred due to the relatively large increase in incremental and total cost per stream mile, acre, and percent attainment, with fewer benefits per dollar than the components in Alternative 6. Alternative 7 is not anticipated to reach new thresholds, but would increase the likelihood that the desired levels would be reached and maintained, and would provide greater areas of high quality habitat outputs. Alternative 6 includes 63 percent of the quantifiable desired future condition at roughly 51 percent of the cost of Alternative 7. The interagency System Team believes that the level of restoration achieved by Alternative 6 best meets the Federal objective of contributing to increases in the net quantity and quality of desired ecosystem restoration.

Alternative 6, if fully implemented over the next 50 years, would provide a measurable increase in system ecological integrity. Specifically, this alternative would reduce systemic sediment delivery by 20 percent, restore 12,000 acres of backwaters, restore 35 side channels, protect 15 islands, restore 75,000 acres of main stem floodplain, restore 75,000 acres of tributary floodplain, restore 1,000 stream miles of aquatic habitat, provide fish passage along the Fox, DuPage, Des Plaines, Kankakee, Spoon, and Aux Sable Rivers, produce an 11 percent reduction in the 5-year peak flows in tributaries, increase tributary base flows by 20 percent, produce a 66 percent reduction in half-foot or greater water level fluctuations along the main stem during the growing season, and provide system level improvements in water quality.

In total, this plan would provide benefits to approximately 225,000 acres and 33,000 stream miles. In addition to direct restoration activities, the plan includes components for system management and a technologies and innovative approaches component that includes (monitoring, computerized inventory and analysis, innovative dredging and beneficial use technologies, and special studies). Sections 6 and 7 describe these aspects of the plan in greater detail.

Due to the scope of the preferred comprehensive plan alternative and the long time period for implementation, a tiered implementation approach is recommended. Corps of Engineers cost-shared restoration efforts would begin with $131,200,000 ($85,300,000 Federal funds) in restoration funds through 2011 (Tier I), with the potential to expand to $345,600,000 ($224,600,000 Federal funds) in restoration efforts through 2015 (Tier II). The funding and activities would begin significant restoration consistent with eventual implementation of Alternative 6. These initial phases are proposed to demonstrate the benefits of the various practices and project components prior to seeking additional funding.

Tier I efforts would be cost shared 65 percent Federal ($85.3 million) and 35 percent non-Federal ($45.9 million). This funding level would provide approximately $122.3 million for planning, design, construction and adaptive management of restoration projects; $6.1 million for the technologies and innovative approaches component; and $2.75 million for system management. The estimated annual O&M Cost when all projects constructed under Tier 1 features are in place is $125,000. If funding is available, a report to Congress will be submitted in the 2011 timeframe, documenting the project successes and the results from Tier I restoration efforts. The implementation of this plan is more fully described in Section 6 of the report.

4. DESCRIPTION OF THE PREFERRED COMPREHENSIVE PLAN ALTERNATIVE

Part A of this section summarizes the preferred comprehensive plan alternative, provides some basic descriptions of measures that would be used to achieve the desired goals, and provides a summary of costs and operations and maintenance considerations for individual measures. The preferred comprehensive plan alternative, Alternative 6, was selected because it achieves a balance between increasing system-wide benefits and cost effectiveness. Part B summarizes costs associated with the recommended implementation of Tier I through 2011 and Tier II through 2015. and includes the technologies and innovative approaches component of the preferred comprehensive plan alternative.

Goals of Alternative 6 include:

1. **Ecological Integrity.** Restoration would provide a measurable increase in level of habitat and ecological integrity at the system level. Implementation of Alternative 6 would provide benefits to approximately 225,000 acres and 33,000 stream miles.

2. **Sediment Delivery.** Reduce sediment delivery from direct Peoria Lake tributaries by 40 percent, other tributaries upstream of Peoria Lake by 11 percent, and tributaries downstream of Peoria Lake by 20 percent. System benefits include reduced delivery of 20 percent to Peoria Lake and 20 percent system wide. A reduction in sediment would benefit approximately 16,750 stream miles.

3. **Backwaters and Side Channels.** Restore 12,000 acres in 60 of the approximate 100 backwaters on the system. Dredging an average of 200 acres per backwater, the optimal level of 40 percent of the approximate 500-acre average backwater area. This would create optimal backwater and over-wintering habitat spaced approximately every 5 miles along the system. Restoration of 35 side channels and protection of 15 islands. Restoration measures would benefit approximately 56,020 acres.

4. **Floodplain, Riparian, and Aquatic Restoration.** Restore 75,000 acres of main stem floodplain (approximately 14.9 percent of total main stem floodplain area) including approximately 31,700 acres of wetlands, 25,300 acres of forest, and 18,000 acres of prairie; tributary restoration of 75,000 acres (approximately 8.8 percent of total tributary floodplain area) including approximately 47,600 acres of wetlands, 13,900 acres of forest, and 13,500 acres of prairie; and aquatic restoration including 500 miles of tributary streams (16.6 percent of the approximately 3,000 miles of channelized streams) with a mix of improved instream aquatic habitat structure and channel remeandering. Restoration measures would benefit approximately 150,000 acres and 1,000 stream miles.

5. **Connectivity.** Restore fish passage at all main stem dams on the Fox River (12 dams), all dams on the West Branch of the DuPage River (5 dams), all main stem dams and one tributary (Salt Creek) of the Des Plaines River (17 dams), Wilmington and Kankakee Dams on the Kankakee River, Bernadotte Dam on the Spoon River, and the Aux Sable Dam. Restoration measures would result in benefits to approximately 4,280 stream miles.

6. **Water Level.** Create 107,000 acres of storage area at an average depth of 1.5 feet and 38,400 acres of infiltration. Increase water level management at navigation dams by using electronic controls, increased flow gaging, and installing new tainter gates at Peoria and LaGrange Dams. Results include an 11 percent reduction in the 5-year peak flows in tributaries, an overall average 20 percent increase in tributary base flows, and up to 66 percent reduction in the occurrence of half-foot or greater fluctuations during the growing season in the main stem Illinois River. This alternative also would see benefits accrue from drawdowns in La Grange or Peoria Pools. Water level management would result in benefits to approximately 20,900 acres and 11,000 stream miles.

7. **Water Quality.** Anticipate improvements in water quality due to reduced sediment, phosphorus, and nitrogen delivery. These improvements would result from sediment delivery reduction measures and water level management measures.

A. COMPONENT MEASURES IN RESTORATION PROJECTS

The following summarizes the types of measures planned for each goal as part of restoration projects. The measures described could be used in conjunction with other measures, or singly, to achieve critical restoration project goals. These projects fall under each of the goal categories. Projects and measures would be selected to optimize ecosystem integrity benefits. Project selection criteria would be developed to optimize ecosystem integrity within the framework of project objectives (Section 3, *Plan Formulation*). Costs were developed based on data from previous Rock Island District projects, other Corps projects, and, where no Corps data were available, other agencies. A detailed cost breakdown to achieve 50-year program goals is presented in Appendix E. All estimated construction costs assume a 35 percent contingency. Additionally, planning engineering and design costs were assumed to be 30 percent of construction costs, while contract supervision and administration costs were assumed to be 9 percent of construction cost. Estimated costs to acquire real estate were also included in the construction cost.

Many of the measures would address multiple goals but some are specific to individual goals. While the measures described are not an exhaustive list, they represent proven and common techniques that could be used to achieve the desired restoration goals. The restoration measures listed reflect the suggestions and input received from other Corps Districts and partnering agencies. Refinement and location of measures would occur during site-specific planning activities, adhering to the implementation framework.

1. Overarching Goal - Ecological Integrity. The overarching goal of restoration efforts is to increase the ecological integrity of the Illinois River Basin. Projects formulated under all of the other program goals would contribute towards this goal; therefore, no specific projects or alternatives were formulated for this goal.

2. Goal 1 - Sediment Delivery. Reducing sediment delivery to the Illinois River and its tributaries would be achieved through implementation of in-stream and upland measures. This part of the preferred comprehensive plan alternative would reduce sediment delivery in the Illinois River to Valley City by 20 percent. The major focus of the sediment reduction plan would be on direct tributaries to Peoria Lake, reducing sediment delivery by 40 percent. Implementation of the plan would also result in a sediment delivery reduction of 11 percent from the remainder of the basin upstream of Peoria Lake to Peoria Lake and a reduction of 20 percent from the rest of the basin downstream of Peoria Lake to Valley City. Sediment control through in-channel measures is expected to account for 75 percent of the reduction obtained. Local site conditions and project objectives will dictate specific measures to be implemented and detailed analyses of the geomorphic impacts of the sediment control measures would be conducted during project design. As indicated in Section 3 of this report, in-channel measures are likely to be most cost-effective in the southern and western portions of the watershed. For this reason, project costs were estimated based on the assumption that 75 percent of the work in the western and southern regions would consist of in-stream measures (e.g., grade control and bank stability), while the other 25 percent would consist of upland measures. In the eastern portion of the watershed, an even mix of upstream versus upland measures to control sediment delivery was assumed.

a. Grade Control. Grade control refers to any alteration that produces a more stable streambed. There are two basic types of grade control structures. The first is essentially a bed control structure, using a hard point in the stream or river for protection against the water's erosive forces. The second type is designed to reduce the energy slope in the area of concern such that the water is no longer capable of scouring the bed. The type, location, spacing of structures, and size of structures all are important considerations when designing a grade control structure(s). Rock riffles are the preferred method of grade control (photograph 4-1).

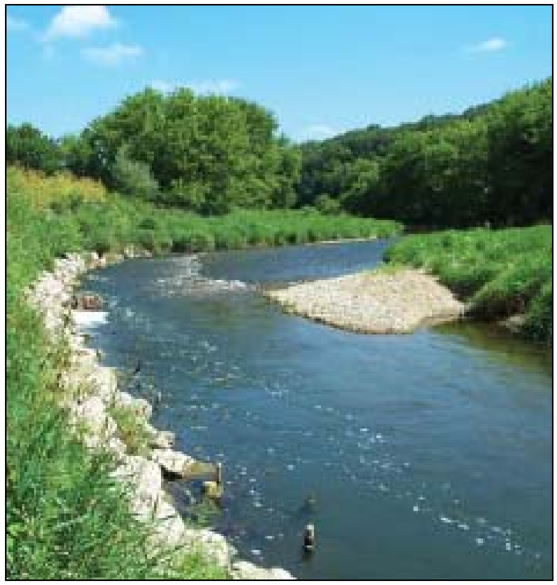
Photograph 4-1. Riffle Structure for Grade Stabilization

Rock riffles act as bed control elements, provide habitat benefits, and require little, or relatively inexpensive, operation and maintenance. Pool and riffle units provide a diverse range of hydraulic and biological niches that are critical to sustaining thriving river habitats. An assessment of channel stability should be conducted such that causes of current instability can be identified (e.g., land use changes leading to increased discharge) and remedial measures and their location can be identified. Upstream and downstream hydraulic and sediment regimes may be impacted through addition of riffle structures; therefore, careful planning should be undertaken to consider these potential ramifications. Priority would be given to areas exhibiting highly degraded habitat in the form of excessive bank erosion and head cutting with no existing pool and riffle habitats. Riffle structure design should accommodate habitat and migration needs of aquatic species.

The cost of riffle structures was estimated based on similar projects performed by the Rock Island District and then adapted to typical dimensions encountered in Illinois River tributaries. The estimated construction cost for a rock riffle structure on a major tributary was estimated to be $210,500, while the estimate for a small tributary was estimated to be $45,500. The main factor affecting the cost difference was the assumed stream width (200 feet for a major tributary, 41 feet for a minor tributary). Operations and maintenance (O&M) costs were developed based on the assumption of 5 percent replacement over a 50-year project life, which would amount to $150 per year on a major tributary and $30 per year on a minor tributary.

b. Bank Stabilization. A range of measures may be implemented to increase river or stream bank stability. Direct (e.g., riprap revetment, photograph 4-2) or indirect (e.g., barbs, bendway weirs) structural measures, generally constructed of riprap, may be used alone or in conjunction with plants, such as willow post plantings. This combination is often referred to as a bioengineered or biotechnical measure (photograph 4-3).

Photograph 4-2. Rock Revetment Used for Bank Stabilization



Photograph 4-3. Bioengineered Stone Toe Protection and Vegetation Used for Bank Stabilization (Univ. of Illinois- Urbana Champaign Water Quality Department: www.wq.uiuc.edu/Pubs/Streambank.pdf

When stream banks are directly exposed to high-velocity flows, directly placing riprap on banks can be used to prevent erosion. Another direct bank protection measure that is likely to be utilized is stone toe protection. One of the advantages of stone toe protection is that it can be placed without grading the bank line, while minimizing tree loss and construction impacts and cost. The upper portion of the bank normally revegetates on its own (resulting in further cost savings). Bendway weirs and stone toe protection can be placed riverward of the existing bank to encourage deposition and floodplain formation (also acting to trap sediment). Stream barbs are low rock sills that project out from a stream bank to redirect flow away from the bank and towards the channel centerline. Geomorphic analysis of the site conditions should be conducted prior to design and construction.

Bioengineered measures are often used in conjunction with other structural measures. As the plants grow, their roots strengthen the soil matrix. The result of using bioengineered methods often provides greater erosion protection than using plants or a structural practice alone and is generally more aesthetically pleasing than a structural practice. Costs associated with each bank stabilization measure are presented in table 4-1. The costs are separated based upon whether the measure would be applied to the main stem or a major or minor tributary. Sediment reduction benefits assume that each practice would perform at design levels. Biedenharn et al. (1997) provided a comprehensive review of stream stabilization practices and design considerations.

Table 4-1. Estimated Construction and O&M Cost for 100 Feet of Streambank Stabilization

Measure	USACE Construction Cost [1]	Estimated Annual O&M Cost
Live Planting (willow posts)		
Main stem	$21,400	$208
Major	$17,700	$171
Minor	$14,000	$134
Stone armor		

Main stem	$39,300	$ 25
Major	$32,400	$ 21
Minor	$25,400	$ 16
In-stream barb/groin/spur [2]		
Main stem	$62,100	$ 80
Major	$18,100	$ 23
Minor	$ 9,800	$ 12
Longitudinal stone toe		
Main stem	$19,900	$ 12
Major	$16,400	$ 10
Minor	$12,900	$ 8

[1] Assumes an additional 35% construction contingency, 30% Planning, Engineering, and Design, 9% Supervision and Administration, and estimated Real Estate costs
[2] Measure applied at 1 per 100 feet

No single technique or streambank restoration measure is applicable in all situations. Selection of appropriate measures would be determined based on evaluation of the engineering, economic, and environmental factors at each site.

c. Sediment Retention Structure. Sediment retention structures store runoff that is transporting suspended sediment and bed material (photograph 4-4). These structures may be designed to be self-dewatering or permanent pond.

Photograph 4-4. Sediment Retention Structure

The major factors controlling the degree of sediment retention include: physical characteristics of the transported sediment; hydraulic characteristics of the basin; inflow time distribution of sediment and water; basin geometry; and water and sediment chemistry. The cost of sediment retention structures was based on the anticipated size of the basin. The basin size is dictated by factors affecting the required storage volume, including drainage area, soils, hydrology, and topography. Design guidance can be found in the Natural Resources Conservation Service's (NRCS) National Engineering Handbook. Costs for small (1 acre), medium (5 acres), and large (150 acres) sediment retention structures were estimated to be $59,200, $195,000, and $6,616,000, respectively. Anticipated O&M costs would be associated with inspection, mowing, potential riprap replacement, and debris and sediment removal. Constructed wetlands can also be used to treat runoff water, though not as a primary settling system, since operation and maintenance require periodic clean out which would severely degrade biological functions.

d. Filter Strips. Though not used for cost estimating purposes, filter strips could serve as an important plan component. It is recommended that the use of filter strips be expanded to applicable areas by other agencies. Filter strips reduce sediment delivery by reducing overland flow velocity, which permits deposition of entrained sediment (photograph 4-5).

Photograph 4-5. Filter Strips Trap Sediment and Pollutants Before Entering a Body of Water

Solids are removed by three primary mechanisms. First, bed material load is deposited as decreased flow velocities reduce transport capacity of the flow. Second, suspended solids become trapped in the litter of the filter strip. Suspended solids trapped in the litter at the soil surface would not as readily become resuspended. However, trapping efficiency would decrease as the litter becomes inundated with sediment and may require maintenance to perform at design levels. Finally, suspended material that moves into the soil matrix along with infiltrating water can become trapped. This is the primary means by which suspended colloidal particles are trapped. Along with the sediment itself, sediment-bound nutrients and chemicals would also be deposited, resulting in better water quality for receiving bodies of water. The cost per acre of filter strips was estimated to be 50 percent of the cost of prairie plantings, as less specialized seed would be required, for a cost of $1,350 per acre. Operations and maintenance costs were estimated to be $5 per acre per year, primarily for inspection.

3. Goal 2 - Backwaters and Side Channels. Backwater and side channel restoration would be accomplished through dredging to restore and maintain deepwater aquatic habitat; island protection to maintain current islands; and measures to improve habitat diversity and depths in side-channels.

a. Dredging. The preferred comprehensive plan alternative calls for dredging 60 of the approximate 100 backwaters in the system. Currently, most backwaters on the system have very shallow depths and an average surface area of approximately 500 acres per backwater. Of the 500 acres in a typical backwater, 5 percent of the area would be dredged to a depth of at least 9 feet; 10 percent to between 6 and 9 feet; 25 percent to between 3 and 6 feet; and 60 percent would require no dredging, resulting in a total dredged area of 200 acres, or 40 percent of a typical backwater. The cost of this dredging configuration would be $19.6 million per backwater. No operations and maintenance costs would be associated with this practice as the backwater would be overdredged to account for sedimentation. Conventional dredging techniques, such as mechanical and hydraulic dredging, in addition to innovative dredging technologies would be used to achieve project goals. Design guidance for traditional dredging techniques is provided in Engineering Manual (EM) 1110-2-5025 (USACE 1983); EM 1110-2-5026 (USACE 1987a); and EM 1110-2-5027 (USACE 1987b). In addition to these standard methods, opportunities to use high-solids dredging and the use of geotechnical tubes (geotubes) would also be considered, as site conditions warrant.

Traditional hydraulic dredging and mechanical dredging with clamshells (photograph 4-6) or draglines have several limitations. These include resuspension of sediments at the point of excavation and free water entrainment in sediments, which require extensive, and potentially expensive, dewatering and return water treatment (Duke et al. 2000).

Photograph 4-6. Island Creation Utilizing a Clamshell Bucket To Mechanically Dredge Sediment

A high-solids dredging technology (photograph 4-7) could be used in place of, or in addition to, more traditional dredging technologies. This type of dredge incorporates a sealed clamshell, which removes sediment at its *in situ* moisture content. The material is then fed into a hopper of a positive displacement pump where it is pumped through a pipe to its discharge location. The discharge has the consistency of toothpaste.

Photograph 4-7. High-Solids Dredging Technology Used Where Fine-grained Sediments Are Prevalent

Specific site conditions as well as defined project objectives would dictate placement sites of dredged material. Where conditions and project objectives permit, dredged material may be used to create islands that would be of habitat value. Other potential uses of dredged sediment are placement on nearby agricultural fields, building up existing islands, or restoration of brownfields, former mined lands, gravel pits, etc. Islands create off-channel areas that are sheltered from river currents and waves. These characteristics create conditions in backwaters that are ideal for a variety of aquatic plants and animals. In addition, islands can serve as either upland or wetland habitat.

The Peoria Lake Rehabilitation and Enhancement project, part of the Environmental Management Program, was a successful project constructed in the mid-1990s (photograph 4-8). Since construction, the barrier island has reduced wave action on a portion of the lake, thereby reducing sediment resuspension and turbidity. While the improved water quality has not stimulated the growth of submergent and emergent aquatic vegetation on the lee side of the island because of undesirable water level fluctuations, the site is utilized by migratory waterfowl and the dredged channel has benefited native fish.

Photograph 4-8. Aerial View of Peoria Lake Habitat Rehabilitation and Enhancement Project

It was assumed that any design involving island creation would incorporate measures to prevent erosion of the island; therefore, there were no O&M costs directly associated with island creation.

b. Island Protection. The preferred comprehensive plan alternative calls for adding protection to 15 of the 56 existing islands on the Illinois River. For cost estimating purposes, it was assumed that each island was 1-mile long and 100-foot wide. Twenty percent of the island perimeter would be protected. Three different measures and methods—off-bank revetments, bankline revetments, and timber piles (photograph 4-9)—were evaluated to provide the 20 percent perimeter protection. Based on this assumed distribution, a representative cost for each island protection was estimated to be

$1,150,000. Annual O&M costs associated with island protection were estimated to be $1,035, under the assumption that 15 percent of the off-bank and 8 percent of the bank revetment would need to be replaced over the 50-year project life. No O&M costs would be associated with timber piles.

Photograph 4-9. Timber Piles Used to Provide Structural Depth Diversity and Island Protection

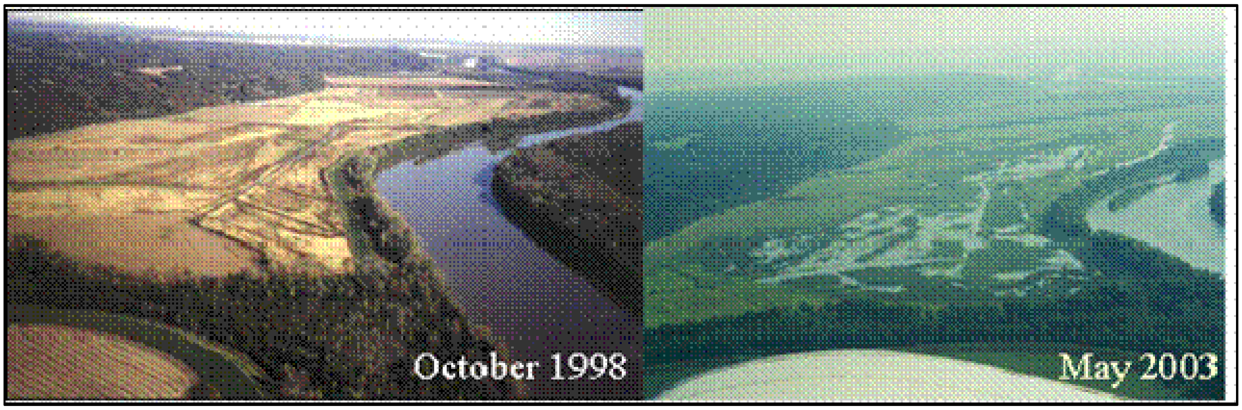
Island protection is a measure utilized to protect an existing or newly created island. Protecting islands from the effects of accelerated erosion, caused by commercial and recreational navigation and wind-fetch, is important where important habitat, private property, or archeological resources are adversely impacted. Protection of the upstream ends and banks of existing islands to maintain, and potentially restore, their historic length would be accomplished through the use of off-bank revetments (photograph 4-10) (rock or timber), bank armoring (riprap, articulating concrete blocks, A-Jacks), or groins. The advantage of articulating concrete blocks or A-Jacks is that not all of the treated surface area is covered with material, permitting vegetation to grow amongst the protection, which can offer additional stabilization and is more aesthetically pleasing. The opportunity to utilize bioengineered island protection measures where they meet project goals and objectives will be pursued.

c. Side Channel Restoration. Under the preferred comprehensive plan alternative, 35 of the 56 side channels in the Illinois River would be restored. Each side channel would be restored through a combination of off-bank structures and dredging. For purposes of cost estimation, it was assumed that stub dikes would be used to create structural depth diversity and to promote suitable hydraulic conditions in the side channel. Stub dikes are constructed of rock built nearly perpendicular to the shoreline, and extending from the shoreline approximately 30 to 40 feet. Seven stub dikes for each mile-long side channel would be used. The cost for adding stub dikes to an individual side channel was estimated to be $127,000. Operations and maintenance costs were estimated to be $164 per year, based on the assumption that 15 percent of the rock would need to be replaced over the 50-year life of the project. Creation of depth diversity could be accomplished through the use of stub dikes, wing dams, log piles, or pile dikes. Wing dams are submerged structures that are constructed perpendicular to an island or bank. Their historic purpose was to reduce flow velocity in the area of the wing dam, inducing deposition, which lead to channelization of the main channel. These flow regulating structures could be modified to increase connectivity between the main channel and off-channel areas.

Photograph 4-10. Off-Bank Revetments Used To Provide Erosion Protection on Islands

4. Goal 3 - Floodplain, Riparian, and Aquatic. The preferred comprehensive plan alternative includes the restoration of 75,000 acres of mainstem and 75,000 acres of tributary floodplain and riparian habitats and 500 miles of aquatic stream restoration. The 75,000 acres of floodplain to be restored on the main stem would be distributed according to approximate historical cover types as follows: 31,700 acres of wetlands, 25,300 acres of forest, and 18,000 acres of prairie. The distribution of the restored floodplain in the tributary areas would be 47,600 acres of wetlands, 13,900 acres of forest, and 13,500 acres of prairie. Five hundred miles of the approximately 3,000 miles of channelized streams of tributary streams would be restored.

a. Floodplain. A total of 150,000 acres of floodplain (75,000 acres mainstem, 75,000 acres tributary), would be restored under the preferred comprehensive plan alternative. Measures that were considered to improve floodplain ecological function were divided among forest, grassland (prairie), and wetland, based on historical cover type. Forest restoration would be achieved through timber stand improvement and planting mast trees. Timber stand improvement costs an estimated $8,200 per acre, with an associated annual O&M cost of $2 per acre. Tree planting would be accomplished at a tree density of 50 trees per acre at a cost of $6,100 per acre, with an associated annual O&M cost of $65 per acre. Prairie or grassland restoration would be accomplished through improvement of site conditions to benefit targeted plant species and planting desirable vegetation. The estimated cost of prairie restoration is $5,500 per acre, with an estimated annual O&M cost of $5 per acre. Wetland habitat would be created or rehabilitated through the creation of Moist Soil Management Units (MSMUs), wetland planting, and/or reconnection of floodplain areas to backwater areas. An example of a floodplain restoration project is shown in photograph 4-11.



Photograph 4-11. Before and After Photographs of Floodplain Restoration at Spunky Bottoms on the Illinois River, a Project Sponsored by the Nature Conservancy

Moist soil management units are shallow-water impoundments created by low-height levees. They incorporate water control structures to flood the impoundment during the fall and winter while reducing water levels and limiting fluctuations in the impoundment during the late spring and summer. Inundated conditions provide suitable habitat for migrating waterfowl and other animals. Summer drawdown promotes germination and growth of plants suited to moist or somewhat flooded conditions. Location of the MSMU relative to the waterfowl flyway, water source, soil type, topography, impoundment size, number of units, levee design, and design of the water control structure are important considerations in MSMU design. The estimated cost per acre of MSMU is $15,000. Estimated annual O&M costs are $20 per acre. More information on the design details of MSMUs can be found in Olin et al. (2000) and Lane and Jensen (1999). Wetland plantings would cost an estimated $8,800 per acre, with O&M costs of $7 per acre per year.

Riparian buffer strips provide much of the same functions as upland grass filter strips (see discussion of Goal 1, page IV-2). When buffer strips are created using mast trees, the strips can provide shade, which reduces water temperature; provide riparian wildlife habitat; protect fish habitat; maintain aquatic species diversity; and provide wildlife movement corridors. Photograph 4-12 shows a typical forest riparian buffer. In addition, vegetation nearest the stream or water body provides litter fall and large woody debris important to aquatic organisms. Woody roots increase the resistance of streambanks to erosion caused by high water flows and waves. The estimated cost of riparian forest buffers was estimated to be $6,100 per acre, the same as planting mast trees.

b. Aquatic Restoration. To accomplish the goal of 500 miles of stream restoration, a combination of riffle structures and stream re-meandering would be used. A brief description of riffle structures can be found in this section under Goal 2, page IV-7. The construction and O&M costs for riffle structures can also be found under Goal 2. Approximately 20 percent of the riffle structure would be constructed in major tributaries with the remainder in minor tributaries. The density (number per mile) of riffle structure partly depends on stream width. For this reason it was assumed that four structures per mile would be required for major tributaries, while minor tributaries would require 22 structures per mile.

Photograph 4-12. Forest Riparian Buffer

Channel re-meandering is a complex subject. Historic and present land use, geology, hydrology, hydraulics, and sediment transport must be considered. Restoring meander planform geometry can be accomplished by analyzing historical maps or meander scars left on the floodplain (Soar and Thorne 2001). However, this method is applicable only if historic hydrologic and sediment regimes are deemed to be representative of the restored channel. Changes in land use may have altered the hydrologic and sediment regimes such that they no longer support a historic meander planform. Soar and Thorne (2001) detail the considerations and design procedure for channel restoration. The cost of channel re-meandering depends greatly on channel dimensions. For major tributaries, it was estimated to cost $177,000 per 100 feet of channel, or $9,350,000 per mile. For minor tributaries, the cost was estimated to be $97,000 per 100 feet of channel, or $5,125,000 per mile. Operations and maintenance costs were estimated to be $713 and $365 for major and minor tributaries, respectively.

5. Goal 4 – Connectivity. Connectivity would be restored by providing fish passage at all dams on the Fox River, all dams on the west branch of the DuPage River, all dams on the Des Plaines River, at Salt Creek (a tributary of the Des Plaines River), the Wilmington and Kankakee Dams on the Kankakee River, the Bernadotte Dam on the Spoon River, and the Aux Sable Dam on the Aux Sable River. These locations were selected because they would provide significant benefit. However, should opportunities to restore connectivity at other locations arise, they would be explored. This portion of the preferred comprehensive plan alternative is estimated to cost $35 million. The total cost was estimated by adding a rock ramp for fish passage. Any decision regarding dam removal would require considerable planning, not only to account for physical impacts, but also cultural impacts.

Dams may be removed for several reasons. They may be structurally or economically obsolete or pose an unnecessary safety concern. In addition, a dam may be removed for ecological restoration (Heinz Center 2002). Under this program, the primary reason for dam removal would be for ecosystem restoration. Dam removal carries with it potential physical, chemical, ecological, economic, and social considerations. Physical effects on the system are hydrology, sediment, and geomorphology; because of the importance of sediment delivery in this system, geomorphological changes and sediment stabilization must be addressed in the design of potential dam removal projects. Negative chemical effects could occur downstream of a removed dam if contaminated sediments are located at the site. Dam removal generally has a positive ecological effect, as fish and other aquatic organisms are able to access more areas of a river; however, invasive species may also become more widespread. Social and economic effects include aesthetics of the dam site and surrounding areas that are impacted by dam removal, potential changes in property values, loss a of culturally significant site, and other economic factors depending on the use and state of the dam.

Several types of fish passage are available and can be classified into vertical slot, Denil, weir, and culvert fishways (Katopodis 1992). Excavated bypass channels backfilled with rock and formed into sills or weirs are also utilized to pass fish and other aquatic organisms around a dam. A rock ramp (photograph 4-13) from the face of a dam to the downstream channel bottom can be used as an alternative to an excavated channel bypass. The most important factors to be considered in fishway design are the hydraulic characteristics of the fishway and the swimming ability and behavior of the fish species to be passed. Fishway efficiency depends on attracting fish to the fishway and providing adequate passage conditions through the fishway and at its exit. Entrance conditions at fishways are critical for attracting fish. Most fish swim in a burst and rest pattern (Katopodis 1992); therefore, it is important to ensure that any fishway is designed such that it has suitable resting spots, as in a pool and riffle design, and that velocities and the lengths over which the velocities occur, do not exceed the targeted species capabilities.

Photograph 4-13. Rock Ramp on the Otter Tail River, Minnesota

6. Goal 5 - Water Levels

a. Stormwater Storage. The preferred comprehensive plan alternative calls for the addition of 160,000 acre-feet of stormwater storage. Tributary hydrologic regimes would be modified by increasing the volume of stormwater storage available within each tributary watershed so that runoff from relatively small events, including those expected to occur every 2 years or more frequently, would be temporarily held back before being released downstream. This storage might take various forms including tile management, detention structures or expanded riparian areas that provide ecological benefits in addition to flood storage. The estimated cost for stormwater storage was based on the assumption of an impoundment constructed to hold water at a depth of 1.5 ft. This cost was estimated at $2,880 per acre-feet with an O&M cost of $5 per acre-feet per year. Since these will be designed to address small events they may have little or no effect on large events; this study does not claim any flood damage reduction benefits from this storage.

b. Increasing Infiltration. This portion of the preferred comprehensive plan alternative would create 38,400 acres of infiltration area. Another approach to improve tributary hydrologic conditions is directing runoff to areas where it can infiltrate into the soil. Infiltration requires the proper soil and subsoil conditions, but if conditions are appropriate, infiltration could be accomplished using tile management or conservation practices, such as filter strips or structures consisting of grassed fields enclosed within a berm. Infiltration can also be increased throughout watersheds using practices that reduce runoff generation or allow runoff to infiltrate close to the point it is generated. Conservation practices on agricultural land that result in more infiltration are conservation tillage and no-till farming. The cost per acre of infiltration practice was estimated to be $7,500, which represents an average of $14,500 per acre of upland pond and $500 per acre of grass filter strip. Average O&M costs are estimated to be $7 per acre.

c. Main Stem Water Level Management. Components of this part of the preferred comprehensive plan alternative would upgrade the controls on dams, revise seven dam regulation manuals, and install 10 flow gages. More intense water level management at the main stem locks and dams, that is, more frequent small gate changes based on a more complete knowledge of pool inflows, would reduce the number of water level fluctuations along the river, especially immediately downstream of the dams. Additional management changes may further reduce fluctuations. To enable this more intense management, dam gate equipment will be upgraded to allow changes to be made more frequently without increasing manpower requirements. These estimated costs are $3,000,000 for new equipment and $756,000 for revision of dam regulation manuals. Tainter gates would be constructed at Peoria and LaGrange Locks and Dams at an estimated cost of $26.6 million each. Also, additional gages would be maintained along the river and significant tributaries to support real-time management decisions, at a cost of $20,250 per gage, with annual O&M costs of $12,500 per gage.

d. Navigation Pool Drawdown. The Upper Mississippi River- Illinois Waterway Navigation Study estimated the cost to conduct drawdowns as the cost to dredge to maintain minimum channel conditions and access to facilities. This cost would create conditions to allow multiple drawdowns over the course of the project life. Preliminary estimates for Peoria Pool and La Grange Pool indicated that an additional 47,000 and 204,000 cubic yards, respectively, of dredging would be required every 10 years to maintain navigation during 1.5 foot drawdowns of these two pools. Assuming that drawing down Peoria Pool by 2 feet would require twice this amount and that the quantities required for a one-foot drawdown of La Grange Pool would be the same, this leads to additional maintenance dredging of 470,000 cubic yards of material in Peoria Pool and 1,020,000 cubic yards in La Grange Pool. Additional dredging would be required to maintain facility access: Appendix C identifies 12 marinas and 20 industrial facilities that would be affected by a drawdown in Peoria Pool and would have to be dredged an additional five times over 50 years.

Using $8 per cubic yard dredging and placement costs (and assuming that placement areas are available), and $25,000 per facility dredging event (from Navigation Study), the added cost to maintain these conditions in Peoria Pool is approximately $14.6 million. Assuming that a similar number of facilities would be impacted in the La Grange Pool, the preliminary cost for maintaining drawdown conditions in that pool can be estimated as $22.9 million. It should be noted that these costs do not reflect additional economic costs such as loss of recreation due to lower water levels. Occasional temporary pool drawdowns would allow sediment to compact and would encourage aquatic plant growth in areas that are currently inundated continuously. During moderate to low-flow periods water levels can be maintained at lower levels at the Peoria and La Grange Locks and Dams but the successful drawdown requires that higher flow conditions, such as due to extensive thunderstorms in the basin, do not occur during the drawdown period. Drawdowns are most likely to be successful in the late summer or fall but would be most beneficial in late spring or early summer, so timing is a key consideration. Also, lower water levels have the potential to adversely affect recreational navigation and water supply uses.

7. Goal 6 - Water and Sediment Quality. Measures to address water quality are described in the previous goals. Those measures targeting sediment reduction would also have a positive impact on increased water clarity. Additionally, a reduction in sediment-bound nutrients and chemicals would be expected, contributing to enhanced water quality.

8. Adaptive Management. An active adaptive management program is recommended in conjunction with construction and monitoring programs to ensure the attainment of restoration outputs and seek opportunities to reduce overall project costs below the current estimates. The systematic process of modeling, experimentation, and monitoring would compare the outcomes of alternative restoration or management actions. Based on the large study area, the complexity of the ecosystem restoration, and the opportunities for increased cost effectiveness, Illinois River Basin Restoration projects should include funding for adaptive management of up to 3 percent of the construction implementation costs. If, over time, less adaptive management funding is needed, these funds would be applied to implementing other restoration projects. The adaptive management component is described in more detail in Section 6 of this report, *Plan Implementation.*

9. Technologies and Innovative Approaches. A Technologies and Innovative Approaches component would address the other three components called for in Sec 519 (b)(3)—a long-term resource monitoring program; a computerized inventory and analysis system; and a program to encourage innovative dredging technology and beneficial use of sediments. One of the most critical aspects assessing ecosystem responses is that a scientifically rigorous long term monitoring program should be implemented from the onset of any restoration process (Likens 1992). These long term data provide the foundation for evaluating accomplishment of program goals. This information feeds back into the adaptive management process as more knowledge is gained on how a given ecosystem works. This feedback will work specifically towards measuring accomplishments made towards restoration goals and objectives, and will also identity areas where additional work may be needed. Long term data are also essential in providing information that will assist in understanding the underlying processes that define an ecosystem’s structure and function, which can also be useful in implementation of restoration projects (Thomas 1999). All of these aspects highlight the fact that dedication and support of long term study of an ecosystem is a fundamental requirement for restoration. The information gained will provide invaluable insight for managers, scientists, and policy makers to make decisions in the future. The over-riding mechanism for this process is such that as long term information is fed into the iterative, adaptive management process, to provide a direct means to gauge the efficiency and efficacy of restoration work. The outputs of all monitoring efforts would be closely coordinated with project teams and adaptive management efforts to maximize the effectiveness of restoration activities.

a. **System-Level & Goal Level Monitoring.** System-level monitoring would be designed to develop a snapshot of the overall system health using system indicators. Goal-level monitoring would integrate and build on existing monitoring data to evaluate the progress in each of the supporting goals, thereby indicating progress for each particular system-limiting factor identified by the project team (reducing sediment delivery, improving backwater habitats, etc.). This plan acknowledges that a certain degree of systemic risk and uncertainty exist in a large, dynamic system such as the Illinois River Basin. Long term resource monitoring is an effective means of reducing risk and uncertainty inherent in project planning in this environment. Long term resource monitoring will result in better projects that return higher benefits for less cost.

b. **Project Level Monitoring.** Project-specific monitoring is critical to validating and refining the approach to system restoration. Monitoring results provide information on the need for adaptive management and help direct future restoration efforts to the most cost effective techniques helping to guide design improvements to better meet ecosystem goals.

c. **Computerized Inventory and Analysis (CIA) System.** A CIA would be developed to inventory and analyze monitoring information. All monitoring data will be posted to a CIA.

d. **Special Studies.** These efforts would be directed at efforts to improve the understanding of the condition of the system and improve the analysis techniques available.

e. **Innovative Sediment Removal and Beneficial Use Technologies.** Technologies would be evaluated and tested to evaluate more ecologically sound, cost effective, and beneficial ways to dredge and place material. These efforts would be closely coordinated with ongoing Corps activities related to dredging and regional sediment management. Potential efforts include demonstrations of various methods to build islands and utilize sediments on farmland as a soil amendment. Funding would be drawn from special studies or incorporated in construction activities.

B. IMPLEMENTATION THROUGH 2011 AND 2015

The Comprehensive Plan recommendations call for continuing restoration efforts under the existing authority of Section 519. Corps of Engineers cost shared restoration efforts would begin with $131.2 million in funding through 2011 (Tier I), increasing to $345.6 million in restoration efforts through 2015 (Tier II).

Implementation of the Comprehensive Plan would include three major elements:

1) System Management
2) Critical Restoration Projects
3) Technologies and Innovative Approaches
    a. System-Level, Goal Level, and Site-Specific Monitoring
    b. Computerized Inventory and Analysis (CIA) System
    c. Special Studies
    d. Innovative Sediment Removal and Beneficial Use Technologies

Each of these components is described in more detail in Section 6 of this report

The recommendation for the 7-year authorization, or Tier I, (table 4-2) includes extending the current authorization through 2011 and increasing the total funding authorization to $131.2 million. This funding level would provide approximately $122.3 million for restoration projects; $6.1 million for developing technologies and innovative approaches (includes $2.6 million for system monitoring, $3.5 million for site-specific monitoring, $0 for a computerized inventory and analysis system, and $0 for special studies); and $2.75 million for system management. Restoration efforts would be cost shared 65 percent Federal, or $85.3 million, and 35 percent non-Federal, or $45.9 million. The annual O&M costs for features constructed through Tier 1 (2011) are estimated to be $125,000.

Table 4-2. Program First Costs Through Implementation of Tier I
(October 2003 Price Levels)

Lands and Damages	$ 18,000,000
Fish and Wildlife Facilities	$ 71,950,000
Planning, Engineering, and Design	$ 27,680,000
Construction Management	$ 4,680,000
Technologies and Innovative Approaches	$ 6,140,000
System Management	$ 2,750,000
Total Program Costs	**$131,200,000**

The recommendation for the 11-year authorization, or Tier II, (table 4-3) includes extending the current authorization through 2015 and increasing the total funding authorization to $345.6 million. This funding level would provide approximately $309.1 million for restoration projects, $30.8 million for developing technologies and innovative approaches (includes $18.6 million for system monitoring, $9.0 million for site-specific monitoring, $1.2 million for a computerized inventory and analysis system, and $2 million for special studies), and $5.75 million for system management. Restoration efforts would be cost shared 65 percent Federal, $224.6 million, and 35 percent non-Federal, $121 million. The annual O&M costs for features constructed through Tier II (2015) are estimated to be $201,000.

The following sections highlight the types of efforts to be accomplished under each of the three major elements—System Management, Critical Restoration Projects, and Technologies and Innovative Approaches. Cumulative component costs for both Tier I and Tier II are presented in table 4-3, and annual component costs are presented in table 4-4. Section 6, *Plan Implementation*, includes additional detailed information about implementation of the selected plan.

1. System Management. Considerable management and coordination efforts would be required to manage the comprehensive ecosystem restoration program. Efforts associated with management include direct costs for Corps of Engineers Project Management and Illinois DNR staff. Management costs would correspond with the size of the program, and are estimated to be approximately $750,000 in 2011 and 2015.

2. Critical Restoration Projects. The majority of the funding, roughly 93 percent or $122.3 million (including $3.1 million in adaptive management if required) of the initial $131.2 million would be targeted to address component 3.B of Section 519 (WRDA 2000) calling for the development and implementation of a program to plan, design, and construct restoration projects. By 2015, approximately 89 percent , or $309 million, of the $345.6 million program would be used to construct restoration projects. While all goal categories are important and would be addressed to some extent in efforts through 2015, initial activities will emphasize the most critical restoration issues: reduce sediment delivery (Goal 1), restore side channels and backwaters (Goal 2), and reduce water level fluctuations (Goal 5). The following priority areas will be addressed initially, with potential for more depending on actual costs. The descriptions below describe restoration efforts through 2011 and 2015.

a. Small Watersheds. Specific projects would address sediment delivery, riparian restoration, and water level fluctuations. Activities would seek 20 to40 percent reductions in sediment delivery from these areas, 11 percent decreases in 5-year peak flow, and 20 percent increase in base flow on the assumption of a continuation of 1970-2000 climatic conditions. Roughly one third of these tributaries would be direct tributaries to the Peoria Pool and two thirds spread throughout the basin.

  i. Tier I (2011). Complete restoration activities in eight small watersheds with drainage areas of roughly 100 square miles each. The Illinois River Basin contains approximately 300 areas of this size. Start or complete feasibility investigation for an additional five small watersheds. Estimated costs through 2011: $59.54 million.

  ii. Tier II (2015). Complete or start restoration of 20 small watershed projects and completed feasibility investigations for four additional small watersheds. Estimated costs through 2015: $171.9 million.

b. Major Tributaries. Focuses would include sediment reduction; floodplain, riparian, and aquatic restoration; and fish passage.

  i. Tier I (2011). Restore two reaches of the eight major tributaries and start restoration of one additional reach. Estimated costs through 2011: $12.1 million.

  ii. Tier II (2015). Restore three reaches and start restoration of one additional reach. Estimated costs through 2015: $23.2 million.

c. Mainstem. Efforts would address backwater and side channel degradation and restore system limiting aquatic and floodplain habitat. Projects would be divided approximately equally among the three lower pools (Peoria, LaGrange, and Alton).

  i. Tier I (2011)- Complete restoration of two backwater, start construction on one additional backwater, and complete feasibility investigation on one additional backwater- $29.8 million. Start construction of four side channel/ island restoration projects in two pools- $8.73 million. Restore one floodplain area and start feasibility one additional floodplain area - $7.2 million. Complete feasibility investigation for one pool drawdown in one mainstem pool- $1.8 million. Estimated total costs through 2011: $47.53 million.

  ii. Tier II (2015). Complete restoration of four backwaters and complete planning and design of two additional backwaters- $59.7 million. Complete construction of four side channel/ island restoration projects in two pools and start construction of four additional projects- $13.7 million. Restore two floodplain areas- $11.6 million. Complete pool drawdown in one mainstem pool- $20.5 million. Estimated total costs through 2015: $105.5 million.

3. Technologies and Innovative Approaches. Approximately 5 percent, or $6.1 million, of the $131.2 million authority would be utilized to conduct a Technologies and Innovative Approaches component. By 2015, approximately 9 percent, or $30.7 million of the $345.6 million dollar program would be used for technologies and innovative approaches.

- **a. System-Level & Goal Level Monitoring.** Estimated costs through 2011: $2.625 million. Estimated costs through 2015: $18.625 million.
- **b. Project Level Monitoring.** Estimated costs through 2011: $3.5 million. Estimated costs through 2015: $9 million.
- **c. Computerized Inventory and Analysis (CIA) System.** Estimated costs through 2011: $0. Estimated costs through 2015: $1.2 million.
- **d. Special Studies.** Estimated costs through 2011: $0. Estimated costs through 2015: $2 million.
- **e. Innovative Sediment Removal and Beneficial Use Technologies.** Funding would be drawn from special studies or incorporated in construction activities.

Table 4-3. Comprehensive Plan Cumulative Component Costs

Illinois River Basin Restoration Comprehensive Plan													
Cumulative Component Costs (in 000's of Dollars)													
							TIER 1					**TIER 2**	
Component	**Year 1**	**Year 2**	**Year 3**	**Year 4**	**Year 5**	**Year 6**	**Year 7**		**Year 8**	**Year 9**	**Year 10**	**Year 11**	
Technologies and Innovative Approaches	**$0**	**$75**	**$767**	**$1,626**	**$2,924**	**$4,624**	**$6,143**	**4.7%**	**$12,297**	**$18,262**	**$24,430**	**$30,784**	**8.9%**
System Monitoring	$0	$0	$350	$775	$1,275	$1,875	$2,625	2.0%	$6,625	$10,625	$14,625	$18,625	5.4%
Site-Specific Monitoring	$0	$75	$417	$851	$1,649	$2,749	$3,518	2.7%	$4,872	$6,037	$7,405	$8,959	2.6%
Computerized Inventory and Analysis System	$0	$0	$0	$0	$0	$0	$0	0.0%	$300	$600	$900	$1,200	0.3%
Special Studies	$0	$0	$0	$0	$0	$0	$0	0.0%	$500	$1,000	$1,500	$2,000	0.6%
System Management	**$0**	**$100**	**$200**	**$800**	**$1,400**	**$2,000**	**$2,750**	**2.1%**	**$3,500**	**$4,250**	**$5,000**	**$5,750**	**1.7%**
Critical Restoration Projects	**$711**	**$4,426**	**$15,833**	**$30,717**	**$58,128**	**$95,891**	**$122,305**	**93.2%**	**$168,765**	**$208,774**	**$255,740**	**$309,109**	**89.4%**
Sub Watershed (Minor Tributary)	$73	$1,062	$3,670	$7,704	$23,774	$51,515	$59,540	45.4%	$78,406	$96,675	$125,423	$171,948	49.7%
Major Tributary	$433	$867	$1,614	$2,398	$6,509	$8,872	$12,096	9.2%	$16,040	$16,599	$18,806	$23,183	6.7%
Floodplain Restoration (Main Stem)	$16	$37	$1,788	$5,232	$6,975	$7,093	$7,211	5.5%	$7,446	$8,180	$11,589	$11,595	3.4%
Pool Drawdown (LaGrange Pool)	$0	$0	$0	$0	$435	$870	$1,816	1.4%	$10,386	$19,732	$20,511	$20,511	5.9%
Backwater Restoration (Dredging)	$189	$2,269	$8,316	$13,960	$17,795	$20,141	$29,812	22.7%	$39,693	$49,367	$59,266	$59,680	17.3%
Side Channel Restoration/ Island Protection	$0	$191	$445	$990	$1,408	$5,068	$8,728	6.7%	$12,339	$12,600	$13,157	$13,650	3.9%
Adaptive Management	$0	$0	$0	$434	$1,232	$2,332	$3,101	2.4%	$4,454	$5,620	$6,988	$8,542	2.5%
TOTAL	**$711**	**$4,601**	**$16,801**	**$33,143**	**$62,452**	**$102,515**	**$131,198**	**100.0%**	**$184,561**	**$231,286**	**$285,170**	**$345,643**	**100.0%**
Federal Share of Total	$462	$2,991	$10,920	$21,543	$40,594	$66,634	**$85,279**		$119,965	$150,336	$185,360	**$224,668**	
Operations and Maintenance	$0	$0	$0	$0	$1	$28	**$93**		$218	$344	$493	**$694**	

Table 4-4. Comprehensive Plan Annual Component Costs

Illinois River Basin Restoration Comprehensive Plan													
Annual Component Costs (in 000's of Dollars)													
							TIER 1				**TIER 2**	**TOTAL**	
Component	**Year 1**	**Year 2**	**Year 3**	**Year 4**	**Year 5**	**Year 6**	**Year 7**	**Year 8**	**Year 9**	**Year 10**	**Year 11**	**Years 1-11**	**% of Total**
Technologies and Innovative Approaches	**$0**	**$75**	**$692**	**$859**	**$1,298**	**$1,700**	**$1,519**	**$6,153**	**$5,965**	**$6,168**	**$6,354**	**$30,784**	**8.9**
System Monitoring	$0	$0	$350	$425	$500	$600	$750	$4,000	$4,000	$4,000	$4,000	$18,625	5.4
Site-Specific Monitoring	$0	$75	$342	$434	$798	$1,100	$769	$1,353	$1,165	$1,368	$1,554	$8,959	2.6
Computerized Inventory and Analysis System	$0	$0	$0	$0	$0	$0	$0	$300	$300	$300	$300	$1,200	0.3
Special Studies	$0	$0	$0	$0	$0	$0	$0	$500	$500	$500	$500	$2,000	0.6
System Management	**$0**	**$100**	**$100**	**$600**	**$600**	**$600**	**$750**	**$750**	**$750**	**$750**	**$750**	**$5,750**	**1.7**
Critical Restoration Projects	**$711**	**$3,715**	**$11,407**	**$14,884**	**$27,410**	**$37,763**	**$26,414**	**$46,460**	**$40,010**	**$46,966**	**$53,369**	**$309,109**	**89.4**
Adaptive Management	$0	$0	$0	$434	$798	$1,100	$769	$1,353	$1,165	$1,368	$1,554	$8,542	2.5
Sub Watershed (Minor Tributary)	$73	$990	$2,608	$4,034	$16,070	$27,741	$8,026	$18,865	$18,269	$28,748	$46,525	$171,948	49.7
Major Tributary	$433	$433	$747	$784	$4,112	$2,362	$3,224	$3,945	$559	$2,207	$4,377	$23,183	6.7
Floodplain Restoration (Main Stem)	$16	$22	$1,751	$3,444	$1,743	$118	$118	$235	$735	$3,408	$6	$11,595	3.4
Pool Drawdown (LaGrange Pool)	$0	$0	$0	$0	$435	$435	$946	$8,570	$9,347	$779	$0	$20,511	5.9
Backwater Restoration (Dredging)	$189	$2,080	$6,047	$5,644	$3,835	$2,346	$9,671	$9,881	$9,674	$9,898	$415	$59,680	17.3
Side Channel Restoration/ Island Protection	$0	$191	$254	$545	$418	$3,660	$3,660	$3,611	$261	$557	$493	$13,650	3.9
TOTAL	**$711**	**$3,890**	**$12,199**	**$16,343**	**$29,309**	**$40,063**	**$28,683**	**$53,363**	**$46,725**	**$53,884**	**$60,474**	**$345,643**	**100**
Federal Share of Total	$462	$2,529	$7,930	$10,623	$19,051	$26,041	$18,644	$34,686	$30,371	$35,024	$39,308	**$224,668**	**65**
Operations and Maintenance	$0	$0	$0	$0	$1	$27	**$65**	$125	$126	$149	**$201**	**$694**	

5. ENVIRONMENTAL IMPACTS/EFFECTS

Section 519 of Water Resources Development Act (WRDA) 2000 defines the Illinois River Basin as the Illinois River, Illinois, its backwaters, its side channels, and all tributaries, including their watersheds, draining into the Illinois River. Small portions of this program area are located outside the Illinois State boundaries, and include an area in extreme southeastern Wisconsin and the northeastern corner of Indiana. The original coordination efforts for this project did not include any area outside the boundaries of Illinois. In the event that future projects associated with this Comprehensive Plan are proposed for these two areas outside Illinois, individual coordination with appropriate Federal and State agencies would be required for compliance with National Environmental Policy Act (NEPA) and other Federal laws and policies applicable to all plans recommended for implementation.

The NEPA documentation and required coordination for this systemic program are documented in the integrated Environmental Assessment (EA) within this report. Subsequent NEPA documentation and coordination, whether the project occurs within or outside the State of Illinois, will be represented by individual, site-specific EAs and will be compiled for all future ecosystem restoration projects after they have been identified.

This systemic ecosystem restoration program would result in positive impacts to numerous aspects/components of the environment.

SYSTEM RECOMMENDATIONS

A. Environmental Impacts of the Selected Alternative

1. Natural Resources. Basic to all ecosystem restoration projects is the premise that ecological integrity would improve if the project(s) were to be implemented. In some cases, this improvement could be represented by simply slowing the rate of ecological decline. Implementation of the recommended alternative for this program (Alternative 6) represents a level of restoration that would provide a measurable increase in the level of ecological integrity at the system level, moving towards the desired future condition, in the most cost-effective manner.

All types of projects, including ecosystem restoration, result in the alteration or conversion of one habitat type to another. When this happens, invariably, some organisms benefit to the detriment of others. This trade-off is inevitable whether this conversion is the result of natural processes or human induced ones, such as this program. Such a trade-off could be illustrated by an example where a historically deep backwater lake has filled in over the years and become a willow thicket with only a very small, shallow, ephemeral open water portion. Beavers and shore birds could be negatively impacted if the backwater was deepened. These two species could be replaced by fish and waterfowl. The inevitable trade-offs that would result from implementation of this program is considered to be beneficial over-all to restoring and maintaining ecological integrity and the processes that maintain them.

Because of the tiered nature of this systemic program and the associated, somewhat generic analysis, there is not enough detailed information available at this time to fully evaluate site-specific impacts to natural resources resulting from implementation and construction of management measures specific to each future project. Important, sensitive resources that may be adversely affected by construction include, but are not limited to, fisheries, mussel assemblages, Federal and State endangered and threatened species, bottomland forests, wetlands, rookeries, fish spawning areas, and recreational use areas. Despite this potential adverse impact from construction activities, the overall impact to ecological components, both biotic and abiotic, would improve through time.

This Comprehensive Plan describes preliminary assessments for natural resources that may be impacted by this systemic program. Impacts to resources will be investigated in greater detail when EAs are conducted for each site prior to construction. Additional habitat analysis, hydraulic modeling, endangered and/or threatened species evaluations, mussel surveys, fishery impact assessments, recreation impact assessments, and contaminant risk assessments will be needed to fill data gaps. Interagency coordination and cooperation will be required during completion of each EA so that impacts of concern can be properly recognized and evaluated and appropriate measures to reduce potential impacts can be identified and implemented, if warranted.

The intent of any ecosystem restoration program and project is to improve the environment compared to the future without project condition. Implementation of the preferred alternative for this program would accomplish that. This is illustrated in figure 5-1 as a line graph depicting trends in ecological integrity in the Illinois River Basin through time, including a prediction of the trend if Alternative 6 were to be implemented to the full funding level recommended. Alternative 6 is the first alternative where significant increases in sustainability of ecological processes and functions are anticipated.

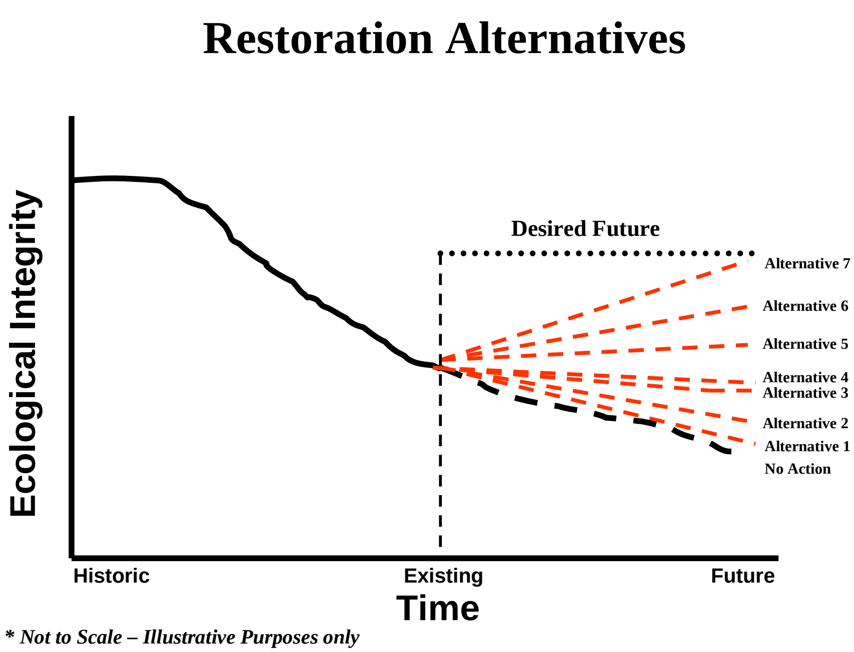


Figure 5-1. Conceptual Restoration Benefits of Alternatives

As discussed earlier in this Comprehensive Plan, Section 3, *Plan Formulation,* subsections E through K, the individual goal write-ups list species or groups of organisms that would benefit from implementation of the great variety of management measures intended to achieve each goal. These are the types of natural resource components that would be impacted (positively) from implementation of Alternative 6.

2. Threatened and Endangered Species. Only when future site-specific ecosystem restoration projects and their associated EAs are identified by specific location, magnitude, and objectives, with details on the management measures proposed to meet the objectives, will it be possible to identify which sensitive resource (e.g., wetlands, backwater lakes, threatened and endangered species, natural areas, high quality woodlands, mussel populations, bat roost trees, etc.) may be impacted and how to avoid or minimize impacts to those resources. This systemic ecosystem restoration program should lead to improved conditions for sensitive resources.

The U. S. Fish and Wildlife Service (USFWS) responded to the District's NEPA coordination letter by listing the current distribution of federally-listed threatened and endangered species in Illinois. This initial coordination response did not provide information on federally-listed species in Indiana or Wisconsin that occur within the Illinois River Basin. From that information on Illinois, the following subset of species could occur in the Illinois River Basin: bald eagle, gray bat, Indiana bat, Higgins' eye pearly mussel, clubshell mussel, prairie bush clover, leafy prairie clover, lakeside daisy, Mead's milkweed, decurrent false aster, eastern prairie fringed orchid, Pitcher's thistle, Hine's emerald dragonfly, Karner blue butterfly, and eastern massasauga rattlesnake. Some of these species would have a low to nonexistent likelihood of being impacted by any future site-specific ecosystem restoration project under this systemic program (e.g., Pitcher's thistle, Karner blue butterfly, Higgins' eye pearly mussel, Mead's milkweed). Direct actions/activities of this program are not likely to negatively impact any federally-listed threatened or endangered species.

In the Final Coordination Act Report (CAR) dated May 2004, the USFWS states the District must complete a programmatic Biological Assessment (BA) to comply with the Endangered Species Act (ESA). The CAR states the District has chosen to fulfill ESA Section 7 consultation with a programmatic BA at some point following authorization of the Illinois River Ecosystem Restoration Study (IRERS). Following extensive discussion within the District, and following the receipt of a letter from the USFWS, dated August 10, 2005 (see Section 7.B.), on this subject, the District has decided, with USFWS concurrence that completion of a programmatic BA would not be the most efficient way to satisfy ESA Section 7 compliance for this project.

Biological Assessments are intended to help Action Agencies (in this case the Rock Island, Chicago, Detroit, and St. Louis Districts) if a formal consultation with the USFWS is necessary. Biological Assessments also help to determine if a proposed action is likely to adversely affect a listed species or critical habitat. Formal consultations determine whether a project is likely to jeopardize the continued existence of a listed species or destroy or adversely modify critical habitat. Biological Assessments are required for early consultations on prospective projects that are major construction activities, which are defined as construction projects which are major Federal actions significantly affecting the quality of the human environment.

The general investigation Comprehensive Plan for the Illinois River Basin Restoration cannot yet identify future specific restoration project locations; specific restoration project goals, the nature and extent of the specific restoration activity. The District believes this lack of site specific project details makes the completion of a programmatic BA of limited utility. Because of this inability, at this time, to package specific suites of activities, the District believes the most effective and efficient way to accomplish compliance with the ESA for the IRERS is to complete site specific and species specific BAs when enough information on specific ecosystem restoration project locations and restoration measures have been finalized. These species specific BAs would be completed before any contract for construction is entered into and before construction is begun. These BAs would accompany future site specific Environmental Assessments.

The Coordination Act Report from the USFWS for this project can be seen in appendix G of this report and the conclusions and recommendations are reproduced here:

Conclusions

- The Illinois River ecosystem has been so severely degraded by human activities during the last 100 years that its ecological integrity and ability to recover from disturbance have been greatly diminished. Sedimentation problems continue to pose serious threats to backwater areas in the lower pools that currently provide habitat for a number of fish and wildlife species. A collaborative and adaptive management strategy involving implementation of conservation measures, rehabilitation projects, and long-term monitoring is needed to improve the condition of this ecosystem. Management decisions and actions at both the watershed and more localized levels will ultimately determine the future fate of this once highly productive river resource.

- In cooperation with the Illinois Department of Natural Resources (DNR), we believe that the Corps has done a good job of identifying system-wide environmental needs and establishing an implementation process to address many of these issues. However, significant coordination is still needed to establish the appropriate level of government, non-government, and private cooperation to successfully restore the Illinois River Basin.

- Because of sedimentation and human-induced alterations to the floodplain ecosystem, aquatic and terrestrial habitats throughout the Illinois River will continue to decline at spatially variable and largely unquantified rates. Prioritization schemes should be implemented at the project fact sheet level to insure that limited dollars are applied most efficiently.

- The main channel of the Illinois River will remain stable, but backwaters will continue to decline from sedimentation. In coordination with the Navigation Study and EMP restoration efforts, critical backwater areas within each pool should be identified and restored as expeditiously as possible.

- Main channel fish populations are expected to remain healthy, but fish species requiring backwater habitats for any life requirements will likely decline. An anticipated rapid response to backwater restoration efforts will likely be seen among fish guilds requiring backwater habitat.

- During the fall, State natural resource agencies, the USFWS national wildlife refuges, and many privately-owned duck clubs artificially manipulate water levels in several management areas along the Illinois River. These moist soil units enhance growth of aquatic vegetation and supplement natural sources of food. Unmanaged backwater areas that currently provide dabbling duck food resources are likely to decline in future years as backwaters diminish. There may be opportunities to work with private landowners and establish partnerships to enhance the management of these areas and potentially the integrity of the Illinois River.

- The quality of bottomland hardwood forest habitat will decline. Associated species that depend upon mast and mature/over-mature stands will decline due to lack of regeneration.

- As they are currently funded or structured, we do not believe that the current ecosystem restoration efforts within the basin can reverse the system-wide decline in fish and wildlife habitat without a more intense coordination among agencies. Future IL 519, EMP, Navigation Study, etc., habitat projects must be able to address the systemic driving variables as well as the localized symptoms of habitat decline.

Recommendations

- All management actions (both Federal and State) such as those implemented under EMP, IL 519, Navigation Study, USDA, USFWS and other restoration efforts along the main stem of the Illinois River and the main stem floodplain need to be coordinated with one another to ensure efficient and successful management of the Illinois River Basin. This coordination may be best met through specific institutional arrangements and the formation of a management triad consisting of: (1) River Council, (2) Science Team, and (3) Regional Management Team.

- Several similar recommendations have become apparent during the coordination of this project and in light of strides made by the Upper Mississippi River-Illinois Waterway (UMR-IWW) System Navigation Study to implement environmental restoration as a key component of that study's alternative matrix. It is strongly recommended that the IL 519 and the Navigation Study be more closely coordinated with one another and potentially integrated as part of each another. Much like the Mississippi River, the Illinois River has paid a significant environmental price for structures that allow and improve navigation. Environmental alternatives that mitigate navigation impacts on the Illinois River need to be coordinated with projects funded through the IL 519 authorization.

- As the primary regulator of Section 404 permits, the Regulatory Branch of the Rock Island District plays an important role in the success of this restoration initiative. It appears that many beneficial projects could be targeted through contacts made by the Regulatory Branch through Section 404 permit applications. Interested and willing landowners could be directed to contact key members of regional teams for assistance in projects such as stream restoration (as opposed to channelization) or wetland protection (as opposed to draining). Wetland, stream, and forest mitigation as outlined in the Corps recent "draft mitigation guidelines" could be emphasized for the most important areas within each tributary watershed of the Illinois River Basin.

- We encourage the Corps to investigate opportunities to assist in the funding of specific U.S. Department of Agriculture-type programs where landowner contacts have been made and prime project sites are identified to address one or more of the seven environmental restoration goals. In addition to government-led efforts, there may also be opportunities to work with various non-government organizations to accomplish many of the basin goals as well. These types of partnerships could reduce planning efforts and present more efficient "on the ground" projects.

- Alternative features, predominantly regarding sediment reduction techniques, which are untested for their ecological integrity function (i.e., riffle structures, bendway weirs, etc.) should be implemented through a cautious and scientific approach to identify ecological reactions. Opportunities should be sought to collaborate with state and/or private universities to study the biological interactions of these features.

- Adaptive management techniques should be established that would allow the Corps and the Illinois DNR to redirect focus of the IL 519 authority if future conditions of the Illinois River turn out to be less desirable than predicted, especially regarding sediment delivery assumptions into the Illinois River Basin.

3. Historic Properties. Archeological site and survey geographic information systems (GIS) data were queried in order to summarize the study area within the State of Illinois by county (table 5-1). GIS historic properties by county for the States of Wisconsin and Indiana were not available for this Comprehensive Plan. Therefore, site location data for historic properties within these states will be provided on a case-by-case, site-specific project basis.

As of May 2004, there were 24,808 previously recorded archeological sites within the study area in Illinois. Approximately 4,800 separate surveys have been conducted over an area covering approximately 984,000 acres or roughly 6.2 percent of the study area. Data concerning cultural affiliation and archeological site types are available for more than 23,000 of the recorded sites. Cultural components span the entire known occupation of North America including Paleo Indian through Historic Native American and Euro American traditions. A brief cultural history for the Illinois River Basin, focusing on the Illinois River Valley, can be found in appendix I, *Cultural History*. Documented archeological site types include prehistoric mounds and rock shelters, prehistoric/historic period habitations, cemeteries, and burials, and historic period farmsteads, industrial/commercial complexes, schools, and churches.

Since 6.2 percent of the study area contains 24,808 previously recorded archeological sites, the potential for undocumented archeological sites in the unsurveyed portion of the study area is expected to be relatively high, although it varies considerably according to landscape position and associated landform sediment assemblage (LSA) unit. Research conducted for the Corps in support of the operation and maintenance of the Illinois Waterway project has defined and mapped LSA units covering approximately 787,000 acres of the current study area (table 5-2). LSA units are geologic features that define Late Wisconsinan and Holocene alluvial fills. Each LSA unit has an ordered structure of development with predictable ages that have proven effective in determining the likelihood for near-surface and/or deeply buried archeological sites.

In general, approximately one archeological site has been documented for every 76 acres of land that has been surveyed within the LSA subset of the study area. The totals differ somewhat between landscape categories and component LSA units. Table 5-2 illustrates this range of variability.

Clearly greater site frequencies are documented for LSAs like alluvial fans (1 site per 43 acres), colluvial slopes (1 site per 22 acres), and Bath terraces (1 site per 50 ac) over other LSAs such as crevasse splays (1 site per 142 acres) or paleochannels (1 site per 151 acres). Likewise landscape site frequencies suggest a settlement preference for eolian (1 site per 31 acres), valley margin (1 site per 41 acres), and catastrophic flood landscapes (1 site per 57 acres) over floodplain landscapes (1 site per 205 acres). These numbers most likely reflect a settlement preference for certain higher, drier landforms, although this may be misleading. The higher numbers may have been augmented by the fact that these landforms have limited deposits of recent alluvium so that sites are more easily discovered near the present ground surface using traditional archeological surface survey techniques.

Conversely, the lower site frequencies for other landforms may be due in part to improper surface surveys conducted over deep recent alluvial deposits. The LSA model underscores the fact that geomorphological analysis is necessary both to assess the archeological potential of a given landform within the study area and to identify the proper field investigation technique for archeological site discovery.

Table 5-1. Summary Archeological Survey and Site Frequency Data Identified by All Counties Within the Study Area (2004 data)

Illinois County	County Acreage in Study Area	Archeological Surveys*	Acreage Surveyed	Percentage Surveyed	Recorded Archeological Sites**
Adams	163469	44	4783	2.9%	98
Brown	196647	58	18197	9.3%	441
Bureau	389658	39	11648	3.0%	184
Calhoun	81394	29	3488	4.3%	319
Cass	246027	91	9920	4.0%	912
Champion	146558	26	1202	0.8%	95
Christian	444382	68	15443	3.5%	456
Cook	587244	541	52060	8.9%	957
Dekalb	149203	11	400	0.3%	32
Dewitt	259766	33	1159	0.4%	382
Dupage	215998	393	31014	14.4%	479
Ford	192947	4	366	0.2%	26
Fulton	565307	241	40080	7.1%	2984
Greene	350228	105	69898	20.0%	617
Grundy	276326	129	36809	13.3%	260
Hancock	232347	44	7626	3.3%	518
Henderson	9855	0	0	0.0%	1
Henry	35521	6	576	1.6%	7
Iroquois	701838	18	1124	0.2%	208
Jersey	174168	50	11037	6.3%	368
Kane	243448	422	45657	18.8%	654
Kankakee	434009	103	14737	3.4%	550
Kendall	206861	210	56558	27.3%	469
Knoz	378563	20	877	0.2%	217
Lake	264366	649	48596	18.4%	605
Lasalle	736359	176	22145	3.0%	979
Lee	57876	0	0	0.0%	4
Livingston	661688	30	2166	0.3%	165
Logan	395386	42	1132	0.3%	452
Macon	363417	67	5879	1.6%	222
Macoupin	424162	66	31998	7.5%	247
Marshall	255688	40	5693	2.2%	173
Mason	360456	41	5611	1.6%	244
Mcdonough	377668	130	18928	5.0%	1163
Mchenry	195639	225	23298	11.9%	231
Mclean	760918	134	14387	1.9%	440
Menard	202651	50	4305	2.1%	181
Montgomery	86452	12	548	0.6%	37
Morgan	366877	124	23759	6.5%	377
Moultrie	44	0	0	0.0%	0
Peoria	403627	132	27898	6.9%	570
Piatt	170578	20	1124	0.7%	209
Pike	173998	57	18084	10.4%	666
Putnam	110353	17	1606	1.5%	65
Sangamon	562459	278	32161	5.7%	1292
Schuyler	282539	103	29959	10.6%	1111
Scott	161846	32	65145	40.3%	438
Shelby	56361	13	530	0.9%	23
Stark	184786	1	4	0.0%	32
Tazewell	421704	95	7252	1.7%	430
Vermillion	34350	1	20	0.1%	1
Warren	147808	5	71	0.0%	86
Will	542776	1096	146805	27.0%	2761
Woodford	347963	35	10578	3.0%	370
Total	15792558	6356*	984339	6.2%	24808**

* Some surveys include multiple counties, so only the individual survey counts by county are accurate.
** Archeological site totals include all sites recorded in the study area, many of which fall outside of the surveyed areas represented in this table.

Table 5-2. Summary Archeological Site Frequency Data Identified by Landscape Category and Landform Sediment Assemblage Unit Within the Illinois Waterway Portion of the Study Area (based on Hajic, 2000)

LANDFORM SEDIMENT ASSEMBLAGE (LSA) UNITS	ILLINOIS WATERWAY LANDSCAPE CATEGORIES: CATASTROPHIC FLOOD		DISTURBED AREAS		EOLIAN		FLOODPLAIN		VALLEY MARGIN		TRIBUTARY		VALLEY TERRACE		GRAND TOTAL BY LSA UNIT		AVERAGE SURVEYED ACREAGE PER ARCHEOLOGICAL SITE BY LSA UNIT
	Sites	Acreage Surveyed	Sites	Acreage Surveyed	Sites	Acreage Surveyed	Sites	Acreage Surveyed	Sites	Acreage Surveyed	Sites	Acreage Surveyed	Sites	Acreage Surveyed	Sites	Acreage Surveyed	
Alluvial Fan	0	0	0	0	0	0	0	0	212	8932	0	111	0	0	212	9043	43
Bar	32	3359	0	0	0	0	5	240	0	0	0	0	0	0	37	3599	97
Colluvial Slope	0	0	0	0	0	0	0	0	12	268	0	0	1	12	13	280	22
Channel Belt	0	0	0	0	0	0	0	0	0	0	68	4800	0	0	68	4800	71
Crevasse Splay	0	0	0	0	0	0	3	409	0	0	0	17	0	0	3	426	142
Dune	0	0	0	0	7	215	0	20	0	0	0	152			7	387	55
Erosional Residual	92	3861	0	0	0	0	0	0	0	0	0	0	0	0	92	3861	42
Floodplain Undifferentiated	0	0	0	0	0	0	8	594	0	0	20	1378	0	0	28	1972	70
Floodplain, Type B	0	0	0	0	0	0	1	325	0	0	0	0	0	0	1	325	325
Floodplain, Type C	0	0	0	0	0	0	5	546	0	0	0	0	0	0	5	546	109
Floodplain, Type D	0	0	0	0	0	0	9	1689	0	0	0	0	0	0	9	1689	188
Floodplain, Type E	0	0	0	0	0	0	12	1644	0	0	0	0	0	0	12	1644	137
Floodplain, Type S	0	0	0	0	0	0	6	391	0	0	0	0	0	0	6	391	65
Island	0	0	0	0	0	0	0	38	0	0	0	0	0	0	0	38	#DIV/0!
Floodplain Lake	0	47	0	106	0	0	2	6804	0	0	0	55	0	2	2	7014	3507
Marginal Channel	133	7525	0	0	0	0	0	0	0	0	0	0	0	0	133	7525	57
Natural Levee	0	0	0	0	0	0	35	4639	0	0	0	34	0	0	35	4674	134
Overbank Belt	0	0	0	0	0	0	0	0	0	0	12	1307	0	0	12	1307	109
Paleochannel	2	575	0	0	0	0	1	36	0	0	5	578	0	24	8	1212	151
Active River Channel	0	0	0	0	0	0	5	1477	0	0	0	0	0	0	5	1477	295
Strath Terrace	27	2129	0	0	0	0	0	0	0	0	3	51	0	0	30	2180	73
Bath Terrace (Youngest)	138	6816	0	0	0	0	0	0	0	0	21	682	5	690	164	8188	50
Manito Terrace (Next Youngest)	10	539	0	0	0	0	0	0	0	0	0	0	3	74	13	613	47
Unknown	0	0	6	5286	0	0	0	0	0	0	0	0	0	0	6	5286	881
GRAND TOTAL BY LANDSCAPE CATEGORY	434	24852	6	5392	7	215	92	18853	224	9200	129	9165	9	802	901	68479	76
AVERAGE SURVEYED ACREAGE PER ARCHEOLOGICAL SITE BY LANDSCAPE CATEGORY	57		899		31		205		41		71		89		76		

Architectural sites (exposed "above ground" superstructures or components versus "buried" archeological sites) within the Illinois River Basin are extremely common, varied, and important in the cultural history representing the occupation of the program area (appendix I). Architectural sites are predominately European or Euro-American and consist of buildings, structures, complexes, and districts.

Architectural historic properties can also exist as remnants of water retention dams and other early hydropower structures. The Illinois Waterway (IWW), as well as many of its tributaries, exhibit navigational and hydroelectric structures important to 19th and 20th century commerce. The present IWW system 9-foot Navigation System was initiated when Congress passed the River and Harbor Act of 1927 that authorized funds for its improvement from Utica, Illinois to St. Louis, Missouri. This legislation was modified in 1930 to include the State of Illinois initiated project from Utica to Lockport, and further modified in 1935 to increase the lower portion to its present 300-foot width. Extending for approximately 333 miles, the IWW links Lake Michigan with the Mississippi River and connects with the Atlantic Ocean via the Great Lake Region, St. Lawrence Seaway, and Inland Coastal Waterway. The IWW extends from the mouth of the Chicago River on Lake Michigan, then proceeds through the Chicago Sanitary and Ship Canal, the lower Des Plaines River, and the Illinois River to the Mississippi River at Grafton, Illinois. The Chicago Sanitary and Ship Canal, with a depth of 22 feet, was completed in 1900. Cal Sag Channel was completed in 1922 and later modified, including widening in 1960. Its Calumet channel branches southeast from the waterway and provides an important link with the Calumet industrial region along the Illinois-Indiana border. Principal cargoes carried by barges are coal, petroleum, and grain products. The IWW system has long been identified as a significant system relative to the historical, engineering, and economical development of the State of Illinois and City of Chicago, as well as to the nation.

Adjacent to the IWW, the Illinois and Michigan Canal was designated as a National Historic Landmark in January 1964 and listed on the National Register of Historic Places in October 1966. The Illinois and Michigan Canal was designated the Illinois and Michigan Heritage Canal Corridor in 1984. T. J. O'Brien Lock, the Chicago Sanitary and Ship Canal, Lockport Lock, Brandon Road Lock and Dam, Dresden Island Lock and Dam, Marseilles Lock, Dam, and Canal, and Starved Rock Lock and Dam are within the canal corridor boundaries.

In July 1993, the Illinois Historic Preservation Agency (IHPA) and the Rock Island District Corps of Engineers (Rock Island District) determined that portions of the IWW Navigation Channel, from mile 80.2 to 327.0, were eligible for listing on the National Register of Historic Places. In October 1996, the Rock Island District surveyed 331 buildings and structures and identified eight historic districts, eligible to the National Register of Historic Places (NRHP) as the "Multiple Property Chicago to Grafton, Illinois, Navigable Water Link, 1839-1945." The Corps' *Architectural and Engineering Resources of the Illinois Waterway Between 130th Street in Chicago and La Grange, Volumes I and II,* documents the 72 contributing resources within the 8 historic districts, consisting of the seven lock and dam facilities and the Illinois Waterway Project Office.

As part of the recently completed Navigation Study, the final NRHP Nomination Registration Form was accepted by the Illinois Historic Preservation Agency in January 2002. The significant portions of the IWW are formally designated as the "Historic Resources of the Illinois Waterway Navigation System, 1808-1951." With the endorsement of Corps Washington Headquarters, the Historic Resources of the Illinois Waterway Navigation System, 1808-1951 nomination forms have been formally submitted to the National Park Service for evaluation and listing.

Submerged historic properties are completely or partially inundated during most of the year. These can include structures, boats and other water vessels, water retention dams, prehistoric and historic occupations, and other sites typically found at terrestrial, archeology sites. Typically, the submerged historic properties cannot always be accurately located within the IWW by documentation alone, but often require remote sensing methods and underwater testing. For a list of documented submerged shipwrecks, see table 5-3.

The Corps and the Illinois DNR have determined that implementation of the Illinois River Basin Restoration may have an effect upon archeological, architectural and/or submerged properties listed on, or eligible for listing on, the NRHP, and consulted with the Advisory Council on Historic Preservation (ACHP), the State Historic Preservation Officer (SHPO), and other consulting parties, as required by Section 106 and Section 110 of the NHPA. The Corps and the Illinois DNR have previously invited the SHPO, ACHP, Tribal Historic Preservation Officers (THPOs), and any other interested parties to participate in the consultation process and in the development of a Programmatic Agreement (PA) for the Illinois River Basin Restoration. There is the potential for adverse effects to significant historic properties and cultural resources. Such effects would be mitigated under the stipulations of the executed *Programmatic Agreement Among the Chicago, Rock Island, and St. Louis Districts of the U.S. Army Corps of Engineers, the State of Illinois Department of Natural Resources, the Illinois State Historic Preservation Officer, and the Advisory Council on Historic Preservation, Regarding Implementation of the Illinois River Ecosystem Restoration* (appendix A). A copy of the PA will be included in all NEPA reports and referenced in appropriate correspondence. If program activities occur which have the potential to affect historic properties as indicated by previously reported sites or documented research, the Corps will conduct a survey in accordance and coordinate with the appropriate State Historic Preservation Officer and other consulting parties promulgated under the NHPA.

Table 5-3. Submerged Boat Sites on the Illinois Waterway (Custer and Custer 1997:163).

Name	Mile	Location	Disposition	Disposition Date
America	Unknown	Unknown	Snagged	1836
Jessie Bill	88.5	Beardstown	Wrecked	1906
Alphonse de	110.5	Bath	Burned	1849
Beardstown	110.5	Bath	Exploded	1854
Young America	112	Bath	Snagged	1855
Minnesota Belle	128	Liverpool	Snagged	1862
Obion	128	Liverpool	Collision	1856
Tuttle	145	Kingston Mines	Wrecked	1918
Wyoming	152.8	Pekin	Burned	1853
Prairie State	152.9	Pekin	Exploded	1852
Columbia	159.5	Kickapoo Bend	Sank	1918
Emma Harmon	162	Peoria	Ice	1857
Helen Mar	162	Peoria	Exploded	1836
Illinoian	162	Peoria	Snagged	1836
Avalanche	162	Peoria	Burned	1853
Birdie B.	162	Peoria	Lost	1920
Celeste	162	Peoria	Abandoned	1924
Duchess	162	Peoria	Abandoned	1925
Fox	162	Peoria	Foundered	1920
Jennie	162	Peoria	Burned	1922
Nettie	162	Peoria	Abandoned	1925
Nina	162	Peoria	Abandoned	1920
Peoria	162	Peoria	Snagged	1834
Revenue	162	Peoria	Burned	1847
Fred Swain	166	Averyville	Burned	1909
Peerless	172	Mossville	Foundered	1911
Beder	189.2	Lacon	Burned	1918
Wave	222.5	Peru	Burned	1837
Revolution	223	Peru	Burned	1849
R. M. Bishop	223	Peru	Snagged	1867
D & G	243.5	Ottawa	Burned	1932
Altair	252.7	Seneca	Sank	1943
E. S. Conway	293	Lockport	Collision	1938
Andy Wood	293.5	Lockport	Sank	1917
Luster Loomis	301.5	Lemont	Burned	1913
Carrie A. Ryerson	308.9	Willow Springs	Burned	1921
B & C	315.5	Summit	Collision	1912
James Hay	318.5	Chicago	Burned	1925
Coyote	324.8	Chicago	Lost	1921
Lobo	325	Chicago	Burned	1919
Red Crown 2	325	Chicago	Lost	1923
China	325.6	Chicago	Sank	1896
Doris	325.8	Chicago	Burned	1934
Dispatch Boat #1	326	Chicago	Exploded	1935
Harvey	326	Chicago	Burned	1925
Oscar F. Mager	326	Chicago	Collision	1925
Rembha	326.8	Chicago	Sank	1917
D’Artagnan	330.8	Chicago	Lost	1920

4. Created Resources. The proposed program area is almost entirely influenced by humankind, in one fashion or another. Most of the area may be considered a created resource since it is natural resources modified by humans, for a variety of purposes. The Illinois River Basin has been modified and/or used for a myriad of reasons, including but not limited to: commercial waterborne transportation, locks, dams, and regulating structures for navigation; refuges for fish and wildlife management; levees and riprapping for food production and erosion control; highway and railroad embankments, as well as bridges, for transportation; beaches and marinas for recreation; cities; barge terminals; land use changes for urban and agricultural uses; and an endless list of activities designed to provide people with a place to live, work, and play in the basin.

Future ecosystem restoration projects will likely entail impacting some aspect of created resources, whether they involve manipulation of the dams, channel regulating structures, agricultural fields, levees, etc. Those future projects will more specifically identify which aspect of all the created resources could be impacted based on the location, magnitude, and extent of management measures proposed for each project. Some of these physical resources may overlap with historic properties. These potential impacts would be assessed in future site-specific, project planning documents with NEPA compliance.

B. Socioeconomic Effects Recommended Ecosystem Restoration Alternative 6

This assessment addresses the anticipated basin-wide socioeconomic impacts of the recommended Ecosystem Restoration Alternative 6 in support of the study vision for “a naturally diverse and productive Illinois River Basin that is sustainable by natural ecological processes and managed to provide for compatible social and economic activities.” The scope of this social assessment covers the 50-year planning horizon for implementation of the recommended measures and is intended to provide decision-makers with information regarding the various potential basin-wide impacts that could occur as a result of the proposed preferred Ecosystem Restoration Alternative 6. Alternative 6 includes measures that would address restoration needs over the entire 50-year period of analysis. The cost estimate based on an initial 6-year implementation period would invest $131.2 million in ecosystem restoration increasing to $345.6 million over 11 years, bringing corresponding economic and social benefits to areas throughout the region.

Alternative 6 includes six goals for restoration, preservation, and protection of the ecosystem of the Illinois River Basin, under the Overarching Goal to restore and maintain ecological integrity: (1) reduce sediment delivery; (2) restore backwaters and side channels; (3) restore floodplain and riparian habitats; (4) increase fish passage; (5) improve water level management; and (6) improve water and sediment quality. The following is a discussion of potential socioeconomic impacts that could occur following the implementation of the restoration measures recommended in Alternative 6.

1. Community and Regional Growth. No significant long-term impacts to the growth of the community or region would be expected to result from implementation of the recommended alternative. For the measures that would involve some type of construction, be it small or large projects, there would be direct construction expenditures resulting in indirect impacts in the economy of the river basin. However, most of the construction benefits would be site-specific as they would accrue to the cities or counties located adjacent to the construction sites.

2. Community Cohesion. Overall, no significant adverse impacts on community cohesion throughout the river corridor would be expected from the environmental restoration measures in Alternative 6. Environmental restoration would not result in permanent changes to the population of any community, segment, or separate parts of the communities or neighborhoods; change income distribution; cause relocation of residents; or significantly alter the quality of life.

The proposed environmental restoration measures could positively impact community cohesion by attracting visitors and recreationists from other communities to the restored wildlife areas. The potential increase in recreation activities would not adversely impact area property owners. As stated in the Executive Summary for this Comprehensive Plan, the acquisition of lands, easements, and rights-of-way would only be obtained from willing landowners, thereby avoiding adverse impacts. No significant public opposition to the enhancement measures would be anticipated on a basin-wide level.

Any further assessment of specific impacts to urban policy resulting from ecosystem restoration would be addressed in a site-specific analysis.

3. Displacement of People. On a systemic basis, displacement of people is not a significant issue. Residential relocations are not expected to occur in any of the areas involved with the restoration measures. Any potential displacement of people resulting from a future project would be evaluated within a supplemental NEPA document. To the extent possible, such actions would be avoided.

4. Property Values and Tax Revenues. Overall, none of the measures included in Alternative 6 are projected to have major, long-term direct impacts on property values or tax revenues in any of the counties throughout the basin. Any long-term effects would be related to community and regional growth, which is not expected to occur. The Illinois River Basin provides billions of dollars in revenue annually from the millions of visitors that hunt, fish, boat, sightsee, or visit the river, and the potential exists for some increase in local sales tax revenue through purchases of goods and services for these activities. The river system also generates thousands of jobs and millions of dollars in taxes for the State and Federal governments.

Increases or decreases in property values could occur because of the potential for land acquisitions associated with the restoration measures. Such actions could affect revenues for the taxing district. Assessment of any potential impacts would be evaluated in a site-specific evaluation.

Presently, not all of the indirect and induced effects of this alternative, as they relate to property values, are known. Changes in the viewshed and any potential resulting impacts on property values and tax revenues for property owners adjacent to the river or restoration area cannot be determined at this time. Any increase in recreational visitors that may result would likely mean more dollars spent in local retail establishments, resulting in an increase in tax revenues for the surrounding community. The extent of impacts from the floodplain restoration measure cannot be determined at this time since it is unknown if, or how much, agricultural land could be taken out of production.

5. Public Facilities and Services. The Illinois River system is a vital component of the national transportation infrastructure and with timely and appropriate improvements, it will continue to serve recreational, commercial, and environmental interests over the long term. The system, as a whole, is a vast resource used by thousands of recreationists every year, and the restoration measures of Alternative 6 could indirectly improve recreation experiences throughout the river corridor. The area provides vast opportunities for boating, waterfowl hunting, fishing, swimming, wildlife observation, photography, plus activities that are enhanced by proximity to water such as hiking, picnicking, bird watching, camping, and water sports. Public access to these recreational activities throughout the river basin would not be hindered or interrupted by the recommended restoration measures of Alternative 6. Some increases in recreational opportunities could be anticipated if this project were implemented. These increases would be welcome but incidental to achieving the overarching goal of restoring and maintaining ecological integrity, including habitats, communities, and populations of native species, and the processes that sustain them.

For the basin area as a whole, positive impacts to public facilities and services would be expected to result from the enhancement of recreational opportunities associated with improvements included in the preferred alternative. There would be no significant adverse impact on the 9-foot channel navigation project on the Illinois Waterway.

Any potential site-specific impacts to public facilities and services involving the use of public parks, boat ramps, river terminals, water supply, tourism events and attractions, marinas, and recreational areas would be addressed in the site-specific assessments.

The topic of energy conservation at Federal facilities is not applicable to this study.

6. Life, Health, and Safety. Adverse impacts to life, health, or safety generally would not be expected to result from the implementation of the restoration measures recommended in Alternative 6. A hazardous, toxic, and radioactive waste (HTRW) compliance assessment would be conducted prior to the implementation of any measure for a site-specific project and, if deemed necessary, would be addressed in a supplemental document.

7. Business and Industrial Development. Impacts to business and industrial development are generally evaluated in terms of economic impacts to local and regional economy. Direct impacts are those that produce immediate measurable changes, and indirect impacts are those that result in some measurable net change in economic activity over time as a result of the project.

A small increase in business and industrial activity would occur throughout the river basin during construction activities associated with Alternative 6. Development associated with this environmental restoration alternative is not likely to cause displacement of businesses or industries. The most likely long-term impacts to business activity would be related to tourism and recreational activities where increases in visitations and activity by recreationists could serve as a catalyst for the development of small retail businesses that would serve the site users.

All restoration measures included in Alternative 6 requiring some temporary construction activity would result in a short-term increase in business and industrial activity in the areas surrounding the project. A portion of the increase would be attributable to the purchase of materials and supplies, and the remaining increase would result from purchases made by construction workers (e.g., meals, lodging, etc.). These impacts would be evaluated on a site-by-site basis within any supplemental NEPA document. No long-term impacts are anticipated.

8. Employment and Labor Force. For any restoration measures requiring construction, there would be a temporary increase in area employment at the individual site locations. Workers would likely be hired through local labor pools to fill project-related jobs, having little effect on employment throughout the entire basin. Increased employment at construction sites brings spending to the area, creating increases in local income. Direct construction expenditures result in indirect impacts in the local economy as money spent on construction activity, labor and materials generates additional income and employment in a multiplier fashion

Any long-term impacts to employment and labor force would likely be related to business and industrial growth resulting from indirect positive impacts of potential increases in recreation and tourism in the study area. Overall, changes in regional employment would be minor because of implementing the recommended restoration Alternative 6.

9. Farm Displacement. Achieving the study's overall goal of increasing the Illinois River Basin biological diversity and ecological integrity will likely necessitate the conversion of agricultural land to non-agricultural uses. Restoration measures requiring the acquisition of lands, easements or rights-of-way would be pursued with the consent and participation of willing landowners. Also, efforts would be made to minimize the unnecessary conversion of prime farmland to non-agricultural uses. It is anticipated that if any farmland would be removed from production, the total acres impacted would affect a small portion of the total amount of farmland within the study area. Such impacts would be analyzed on a site-specific basis and would be addressed within any supplemental NEPA documentation.

10. Noise Levels. Overall, no significant long-term impacts to noise levels in the study area would result from the implementation of Alternative 6. Construction activities would be site specific and only those locations would experience a temporary increase in noise levels. Any potential elevation of noise levels resulting from increased recreational activities would also be site-specific; however, most recreational activities would probably take place away from heavily populated or residential areas. All site-specific impacts would be further addressed in supplemental documents.

11. Aesthetics. Aesthetics relates to potential visual impacts resulting from a proposed project. Essentially, the restoration features recommended would be planned and constructed to augment the natural areas and open space, to be aesthetically pleasing, and to enhance the overall viewscape.

The project areas that could be designated for ecosystem measures would mostly be rural in nature with limited development, and would result in fairly minor impacts to the aesthetic resources of the areas. Construction activities would negatively impact the viewscape in most areas during the short-term project construction phase.

The recommended Alternative 6 restoration measures would be expected to created long-term positive aesthetic impacts that would enhance scenic beauty and other natural amenities, provide for public wildlife-oriented recreation and education opportunities, restore and enhance a mosaic of riverine wetlands and riparian habitats, and create a vibrant ecosystem.

No long-term adverse impacts to the aesthetics of the river corridor are anticipated, and it is expected that the proposed restoration measures would not diminish the viewscape of most public areas or local communities.

C. Cumulative Impacts

A cumulative impact is defined as the impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (Federal or non-Federal) or person undertakes such other actions (from the Council on Environmental Quality, Regulations for Implementing the Procedural Provisions of the NEPA, 40 CFR Parts 1500-1508).

A U.S. Environmental Protection Agency (EPA) report states that cumulative impacts of an action can be viewed as the total effects on a resource, ecosystem, or human community of that action and all other activities affecting the resource no matter what entity (Federal, non-Federal, or private) is taking the actions (USEPA 315-R-99-002).

This report will focus on the cumulative impacts of actions relating to the overarching goal of ecological integrity and the six goals/resource categories for this project:

Goal 1 Reduce Sediment Delivery

Goal 2 Restore Side Channels and Backwaters

Goal 3 Improve Floodplain, Riparian, and Aquatic Habitat

Goal 4 Restore Connectivity (Fish Passage) At Dams

Goal 5 Naturalize Regimes and Conditions

Goal 6 Improve Water and Sediment Quality

This project should result in improved environmental conditions for various habitats and increase ecological health in the basin.

Overarching Goal – Restore and Maintain Ecological Integrity, Including Habitats, Communities, and Populations of Native Species, and the Processes that Sustain Them

Ecological integrity within the Illinois River Basin has been degraded by development within its watershed, the river, and its floodplain. The Illinois River Basin ecosystem has been degraded by human activities during the last 150 years and its ecological integrity and ability to recover from disturbances have been diminished. Development of the Illinois River Basin has affected nearly every acre of land in the basin in one way or another. The combined effects of habitat losses, through changes in land use, human exploitation, habitat degradation and fragmentation, water quality degradation, and competition from aggressive invasive species have significantly reduced the abundance and distribution of many native plant and animal species in the Illinois River Basin.

In addition, human alterations of Illinois River Basin landscapes have altered the timing, magnitude, duration, and frequency of habitat forming and seasonal disturbance regimes. The cumulative results of these complex, systemic changes are now limiting both the habitats and species composition and abundance in the Illinois River Basin. A cooperative effort among all levels of government and private entities, with an adaptive management strategy, involving implementation of ecosystem restoration projects is needed to improve the condition of the ecosystem.

1. **Goal/Resource Category #1 – Reduce Sediment Delivery to the Illinois River from Upland Areas and Tributary Channels with the Aim of Eliminating Excessive Sediment Load.** Historically, land use changes to agriculture and urbanization have increased sediment delivery to the Illinois River Basin. Effective erosion control due to the implementation of conservation practices and programs have reduced the average rate of erosion from croplands relative to earlier rates. There continues to be significant amounts of sediment transported to the Illinois River Basin from areas not addressed by these practices and programs. Without action, excessive erosion will arise from numerous points within the Basin and sediment loading to the Illinois River will continue at unacceptably high levels for the foreseeable future and will continue to degrade vulnerable habitats and impede downstream restoration efforts. Without additional monitoring, it will continue to be very difficult to determine trends in the sediment transport process within the Illinois River and its basin or to evaluate systemic benefits of improvement projects. If this project is implemented, in 20 years the rates of sediment transport within the Illinois River Basin and the main stem river, especially the transport of silt and clay particles, would be reduced to a level that will better support ecological processes. In order to maintain existing benefits, it will be necessary to ensure that the conservation practices currently installed within the basin remain effective. Recognizing that streams always transport sediment, reduced delivery would be accomplished by implementing projects that reduce bank erosion, allow streams to reach a graded state or control upland sediment as appropriate based on watershed conditions.

2. **Goal/Resource Category #2 – Restore Aquatic Habitat Diversity of the Side Channels and Backwaters, including Peoria Lakes, to provide Adequate Volume and Depth for Sustaining Native Fish and Wildlife Communities.** Since glacial retreat, sediments eroded from steep tributaries have built large alluvial fans and deltas into the lower Illinois River valley causing the formation of natural constrictions and numerous lakes and backwaters. Historically, the complexes of backwaters and side channels along the main stem Illinois River provided incredibly rich habitat for fish and wildlife. However, the lower Illinois River is low gradient and as a result has been aggrading for years. Sedimentation occurring within this reach has increased significantly, since settlement and now threatens to convert many backwater and side channel areas into mudflats and marshes with decrease habitat value due to hydrologic regimes and turbidity, which essentially exclude vegetation from these areas. In many areas, backwater lakes have been reduced from several feet in average depth in 1900 to inches to a couple feet today.

The WEST Consultants, Inc. (2000) found that according to previous studies, significant sedimentation is occurring and by the year 2050 the Illinois River is predicted to lose a significant portion of its off-main channel backwater areas under current conditions of sediment supply.

In the future without-project, it is expected that there would continue to be further loss of both surface area and volume of backwaters and continued low aquatic habitat quality. This will further limit off-channel habitat for fish and other aquatic species. The consensus of a number of scientists working for the State of Illinois was that due to the shallow condition of existing areas and increasing willow colonization an approximately 1 percent loss rate per year represented the most likely future condition. If this rate were to continue throughout the 50-year project life, the acreage of backwaters would drop to just 32,605 acres a 40 percent loss. It is anticipated in the future without project that the quality of side channel areas will continue to remain at relatively low levels. In many areas there will continue to be further loss of side channel length due island erosion, further loss of depth diversity due to sedimentation, and continued lack of adequate structure (woody debris, rock, etc.).

However, with full implementation of Alternative 6, not only would habitat quality increase dramatically, but the loss rate would be cut in approximately half for the roughly 60 backwaters were work is planned. The preferred comprehensive plan alternative would also result in the restoration for islands and side channels most in need of restoration. With the restoration of 12,000 acres in combination with reduced sediment delivery and side channel restoration, the mix of depth diversity critical to the historical ecology of the system will be maintained throughout the program life. The direct restoration of these acres is anticipated to preserve and maintain additional surrounding acreage from conversion to other uses as well. This will greatly increase backwater area and value over anticipated without project conditions.

3. Goal/Resource Category #3 – Improve Floodplain, Riparian, and Aquatic Habitats and Functions. The healthy functioning floodplain system found in the Illinois River Basin resulted from an unfractured landscape that integrated the ecological outputs of the hydrologic cycle (rainfall, droughts, and floods) through the complex structure of prairies, wetlands, and forests to produce an abundance of aquatic, insect, wildlife, and plant species. Land use and hydrologic change, and channelization have reduced the quantity, quality, and functions of aquatic, floodplain and riparian habitats, in the Illinois River main stem and its tributaries. Flood storage, flood conveyance, habitat availability, and nutrient exchange are some of the critical aspects of the floodplain environment that have been adversely impacted. Channelization, wetland drainage, and snagging were extremely common throughout the Illinois River Basin for the purpose of draining water from croplands and for flood control. The adverse effects of such activities are extensive, ranging from the direct destruction of stream habitat, to the reduction of structure and microhabitat for fishes, aquatic invertebrates, mussels, and aquatic plants, to the alteration of water conveyance, which increases erosion and sedimentation. The negative effects of channelization and drainage may persist for very long periods and adversely affect habitat many miles away. The habitats and ecological functions within the Illinois River main stem floodplain and the aquatic, floodplains and riparian areas of the basin tributaries are likely to further degrade in the future if conditions remain as is.

The desired future condition of the Illinois River main stem floodplain is a reversal of historic loss of functions and increase in habitat area and quality. The desired future condition can be approached by the implementation of Alternative 6. The level of restoration of Alternative 6 would provide the necessary building blocks for sustainable aquatic environments in the perennial and intermittent streams and the main stem of the Illinois Basin, as we work towards the desired future condition.

4. Goal/Resource Category #4 – Restore Aquatic Connectivity (fish passage) on the Illinois River and its Tributaries, where Appropriate, to Restore or Maintain Healthy Populations of Native Species. During the early development periods in the 1800s, dams were constructed to power mills and factories located adjacent to streams; this is another reason that development occurred along waterways. On large rivers such as the Illinois, dams were constructed to aid navigation during the 1840s to 1860s, and rebuilt in a large fashion by the Corps, in the 1930s. Later, dams were constructed along major tributaries for water supply, flood control, and recreation.

There is a lack of aquatic hydrologic connectivity on the Illinois River and its tributaries. Aquatic organisms do not have sufficient access to diverse habitat such as backwater and tributary habitat that are necessary at different life stages. There are seven dams on the main stem Illinois River/Illinois Waterway at La Grange, Peoria, Starved Rock, Marseilles, Dresden Island, Brandon Road, Lockport, and T. J. O’Brien. The number and impact of dams on the major tributaries varies.

Additional dams may be constructed in the future. The need for potable water for increasing populations in northeast Illinois may result in construction of dams or modification of existing dams for water supply purposes. It is anticipated that new dams may be constructed to accommodate fish passage; however, any new dams would likely have some impact on connectivity. It is likely that some existing dams will be removed in the future. Dam removal will be municipality driven and will be related to costs of continued operations and maintenance. The success or failure of invasive species barriers will affect connectivity in the future.

The desired future condition is a river system that provides connected habitats for native aquatic species allowing them to utilize critical habitats at critical time periods and re-colonize areas after extreme events or disturbance.

The desired future condition is restoring significant connectivity between the main stem and the appropriate major tributaries. The main stem Illinois River would be connected to the majority of its tributaries including the Sangamon River, Spoon River, Fox River, Kankakee River, and DuPage River. Restored connectivity between the main stem and the Des Plaines River is desirable, but this will need to be balanced with the desire to limit dispersal of invasive species.

The desired future condition is to restore within-tributary connectivity in the major tributary basins. The desired future condition is passage of 100 percent of large-river fish on the Illinois River main stem up to river mile (RM) 286 at Brandon Road Lock and Dam. This would require improved passage at Starved Rock, Marseilles and Dresden Lock and Dams. The Lockport, Brandon, and T.J. O'Brien Locks and Dams would continue to block fish movement, thus limiting dispersal of invasive aquatic species between the Upper Mississippi River System and the Great Lakes.

5. Goal/Resource Category #5 – Naturalize Illinois River and Tributary Hydrologic Regimes and Conditions To Restore Aquatic and Riparian Habitat. Hydrology is a primary driving force for aquatic ecosystem processes. The magnitudes, timing and duration of flows and water levels often regulate the nature of chemical and biological functions in these systems. Because of this, unfavorable hydrologic regimes can prevent desirable levels of ecosystem function; by changing such regimes so that a more desirable range of hydrologic conditions are provided, benefits to a wide range of ecosystem functions can be expected. Historical observations and measurements of flows from undisturbed areas indicate that storm flow rates from Illinois River watersheds prior to European settlement were probably much lower than current rates. Higher tributary flows can be attributed to land use changes, tile drainage, and increased hydraulic efficiency brought about by channelization.

The construction of navigation dams and diversion of flows from Lake Michigan have generally increased the river water surface elevation and have altered the nature of the flooding regime along certain reaches of the river. The magnitude and frequency of water level fluctuations have notably increased in portions of the river since daily water level monitoring began in the 1880's. Reducing the amount of water level fluctuation would likely provide multiple benefits to native biological communities. Several unknown factors, notably potential changes in land cover, land use and climate, play major roles in the future hydrologic regimes throughout the Illinois River Basin.

The future with-project condition minimizes the water level conditions that degrade ecological function in the Illinois River Basin. This does not necessarily require a return to any particular prior state, but rather creating conditions that allow ecosystem functions to sustain themselves at an acceptable level given the constraints of multiple uses throughout the basin. In regard to tributary flows, the current state of knowledge suggests that flow regimes with reduced peaks and increased baseflows will provide more desirable levels of ecosystem function than currently occurs. Along the main stem Illinois River, the future with-project conditions include a reduction in the incidence and speed of water level changes; gradual water level rises and falls would benefit a number of biological functions.

6. Goal/Resource Category #6 – Improve Water and Sediment Quality in the Illinois River and Its Watershed. Natural processes, geomorphology and human activities influence water quality. A number of factors including domestic sewage, industrial wastes, and agricultural land use practices have adversely affected water quality in the Illinois River Basin during the past 100 years. In the past 30 years, improvements in water quality have taken place with implementation of the Clean Water Act. However, runoff from industrialized and urbanized areas, and from agricultural fields in the basin, continue to transport sediment, fertilizers, and pesticides into the waters of the watershed. Waves generated by wind and commercial tows re-suspend fine sediments in the main stem, resulting in ongoing poor water clarity. Sedimentation is perhaps the most serious problem threatening the Illinois River Basin today. The Illinois River Basin has not yet fully recovered to an ecologically sustainable condition. State, Federal, and local natural resource agencies must continue to promote efforts aimed at restoring water quality throughout the Illinois River Basin. This would require basin-wide cooperation with many partners, habitat restoration projects, ecological monitoring and data gathering, and changes in land use practices. Attainment of water quality improvements would not only promote the survival of aquatic organisms, but would also protect public health.

Summary. The estimated projections of the environmental/ecosystem benefits from each Goal/Resource category are based on the assumption that not only will this program be implemented, but that it will be implemented to the full funding amount represented in Alternative 6. Section 3 of this report describes areas of risk and uncertainty associated with this program. One of those areas of uncertainty is funding, at the Federal and/or State level. If that uncertainty becomes a reality at some point in the future, at either level, the assumption made in arriving at the estimated predictions of future ecosystem benefits and trends will have been overstated. Lowered funding levels, and consequential levels of effort compared to what is required to achieve full benefit from implementation of Alternative 6 would result in lower ecosystem benefits than those predicted in the cumulative impact sections above.

Future monitoring results and consequential adaptive management measures could result in new, different cumulative impacts for the future.

D. Environmental Impacts of the Non-Preferred Alternatives

Figure 5-1 depicts the estimated trends, through time, in ecological integrity relative to the eight alternatives evaluated for this program. Alternative 6 is the recommended alternative and Alternative 7 reflects the level of effort/commitment required to achieve the desired future condition for this program.

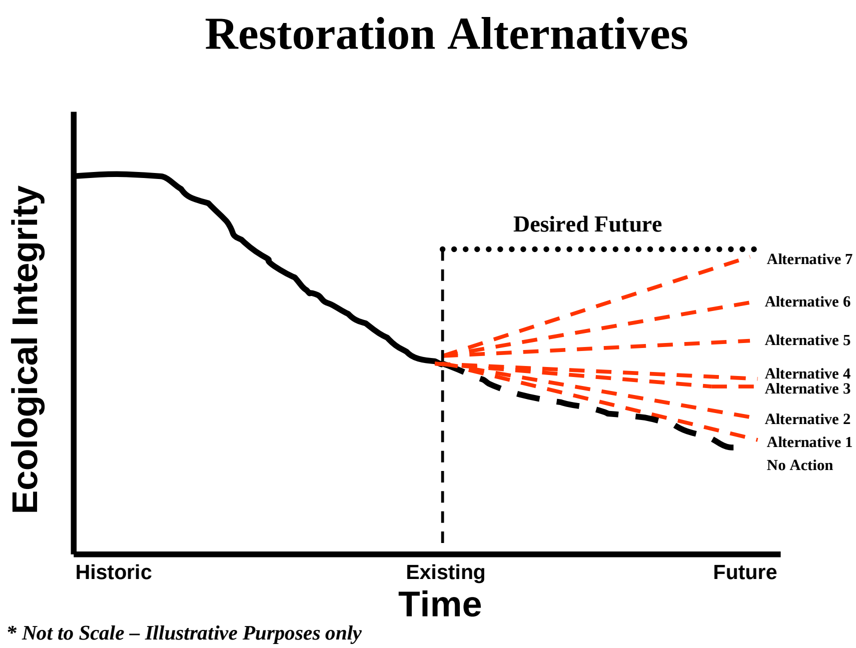


Figure 5-1. Conceptual Restoration Benefits of Alternatives

1. No Action. This alternative represents a continuation of environmental management activities and rehabilitation efforts at current levels. Under this alternative ecosystem integrity/environmental degradation would continue and the habitat loss projected in the Cumulative Effects Study (WEST Consultants, Inc 2000) and the Habitat Needs Assessment (Theiling et al. 2000) would be realized. While the ongoing efforts to protect, maintain, and restore habitat and ecosystem health would be beneficial, the current level of effort would not be sufficient to counteract the cumulative impacts affecting river resources. This alternative does not promote a sustainable system.

Table 5-3 illustrates what level of effort for each goal would be undertaken for each of the eight alternatives.

The numbered alternatives generally represent incrementally higher levels of effort per goal. This is not a strict rule, but a generality. That is, the higher the alternative number, the more the level of effort would be implemented, (e.g., more backwater acres restored, more side channels restored, more acre-feet of stormwater storage constructed, etc) in future restoration projects.

2. Alternatives 1 through 4, if implemented, represent improvements compared to the No Action Alternative, but still show the ecological integrity trend line declining into the future. The difference between Alternatives can be summarized by the differing rates of slowing the decline, (the higher the Alternative number, the slower the rate of decline).

3. Alternative 5 is the first alternative evaluated, where the level of restoration effort would result in stable or improving system ecological integrity.

Table 5-3. System Plan – Benefits Summary

	Overarching Goal	Goal 1	Goal 2	Goal 3	Goal 4	Goal 5	Goal 6
Alternative	**Ecological Integrity**	**Sediment Delivery**	**Backwaters and Side Channels**	**Floodplain, Riparian, and Aquatic**	**Connectivity**	**Water Level Management**	**Water Quality**
No Action	decline	some increase delivery	decline 1%/ yr	No Change	potential improvement	more fluctuations	minor improvement
1	regional improvements	0% upper Tribs 20% Peoria Tribs 0% lower Tribs	3,600 BW acres 10 side channel 10 island protect	5,000 acres MS 5,000 acres Trib 25 stream miles		-1.5% TPF 0% TBF 0% MSF	minor regional improvements
2	maintain current habitat at system level	0% upper Tribs 40% Peoria Tribs 0.5% lower Tribs	6,100 BW acres 20 side channel 15 island protect	5,000 acres MS 10,000 acres Trib 50 stream miles		-2.3% TPF +5% TBF 0% MSF	regional improvement
3	begin system improvements - sediment focus	11% upper Tribs 40% Peoria Tribs 4% lower Tribs	8,600 BW acres 30 side channel 15 island protect	20,000 acres MS 20,000 acres Trib 100 stream miles	Fox, DuPage, Des Plaines	-2.3% TPF +5% TBF 66% MSF	some system improvement
4	begin system improvements - tributary focus	11% upper Tribs 40% Peoria Tribs 4% lower Tribs	6,100 BW acres 20 side channel 15 island protect	5,000 acres MS 20,000 acres Trib 100 stream miles	Fox, DuPage, Des Plaines, Kankakee, Spoon, Aux Sable	-8% TPF +20% TBF 66% MSF	some system improvement
5	ecosystem integrity stable	11% upper Tribs 40% Peoria Tribs 4% lower Tribs	8,600 BW acres 30 side channel 15 island protect	40,000 acres MS 40,000 acres Trib 250 stream miles	Fox, DuPage, Des Plaines, Kankakee, Spoon, Aux Sable	-8% TPF +20% TBF -66% MSF	some system improvement
6	measurable increase at system level	11% upper Tribs 40% Peoria Tribs 20% lower Tribs	12,000 BW acres 35 side channel 15 island protect	75,000 acres MS 75,000 acres Trib 500 stream miles	Fox, DuPage, Des Plaines, Kankakee, Spoon, Aux Sable	-11% TPF +20% TBF -66% MSF	some system improvement
7	reasonable upper bound to system improvements	11% upper Tribs 40% Peoria Tribs 20% lower Tribs	18,000 BW acres 40 side channel 15 island protect	150,000 acres MS 150,000 acres Trib 1000 stream miles	Fox, DuPage, Des Plaines, Kankakee, Spoon, Aux Sable, 3 Main Stem Dams	-23% TPF +50% TBF -73% MSF	some system improvement

Overarching Goal – Ecological Integrity will be addressed by the other goals through prioritization and specifications on restoration measures.
Goal 1 - Sediment delivery benefits are expressed in percentage reductions in tributary delivery resulting from in-channel stabilization and upland practices.
Goal 2 - Backwater (BW) Benefits are expressed in acres dredged, but will benefit larger reaches. Side Channel benefits associated with increased structure and some dredging.
Goal 3 - Main stem (MS) floodplain and riparian (trib) areas are expressed as acreages. Aquatic areas are expressed in stream miles.
Goal 4 - Connectivity (Fish Passage) lists reaches to be addressed. Main stem passage is at Starved Rock, Marseilles, and Dresden Island.
Goal 5 - TPF and TBF are tributary peak flow and base flow, respectively. MSF is the change in the main stem fluctuation regime, representing an average of 5-day windows in the lower river fluctuations over the course of the average growing season. Auto gates allow increased management to smooth flow releases and are included in Alternatives 6 and 7. Wicket dam replacements are considered for the Peoria and La Grange pools in Alternative 7.
Goal 6 - Water quality issues will be addressed through other goals. Greatest benefits likely associated with Goals 1 and 3.
Only rough benefits estimations are included in table; see writeup for additional details.

4. Alternative 7 represents the desired future condition mentioned throughout this report. The desired future was based on the expert opinion of resource managers as to what the system should look like in the future to restore and maintain ecological integrity, including habitats, communities, and populations of native species, and the processes that sustain them. This level of effort was developed to provide an upper limit of potential restoration considering current political, social, and fiscal constraint. The implementation of Alternative 7 would result in greater positive natural resource impacts to the river basin than the preferred Alternative 6. Alternative 7 is the second alternative where significant increases in sustainability of ecological processes and functions could be expected.

E. Probable Adverse Environmental Impacts Which Cannot Be Avoided

When future site-specific ecosystem restoration projects are proposed, planned and ultimately implemented, some of them will have the potential to convert agricultural land to non-agricultural uses. This conversion is regrettable, but probably necessary if the overarching goals of increasing Illinois River Basin biological diversity and overall ecological integrity are to be achieved. Six goals are described in Section 3 of this report. Some specific management measures under certain goals could be implemented and could result in the conversion of agricultural land.

Important, sensitive resources, which may be adversely affected by construction include, but are not limited to fisheries, mussel assemblages, Federal and State endangered and threatened species, bottomland forests, wetlands, rookeries, fish spawning areas, and recreational use areas. Despite this potential adverse impact from construction activities, the overall impact to ecological components, both biotic and abiotic would improve through time.

Following a determination of adverse effect, the Corps will attempt to avoid the archeological, architectural, underwater or other historic object or property.

Section 106 of the National Historic Preservation Act of 1966, as amended (NHPA) and its implementing regulations 36 CFR Part 800: "Protection of Historic Properties," establishes the primary policy, authority for preservation activities, and compliance procedures. The NHPA ensures early consideration of historic properties preservation in Federal undertakings and the integration of these values in to each agency's mission. The Act declares Federal policy to protect historic sites and values in cooperation with other nations, states, and local governments. The Corps shall, prior to the approval of the expenditure of any Federal funds on the undertaking, take into account the effect of the undertaking of any district, site building, structure, or object that is included in or eligible for inclusion in the National Register of Historic Places. The Corps shall afford the Advisory Council on Historic Preservation a reasonable opportunity to comment with regard to such undertaking. In the event that adverse impacts to historic properties occur as a result of implementing the site-specific ecosystem restoration projects that are proposed, planned and ultimately implemented avoidance measure will be discussed and the benefits of the project will be studies relative to the significance of the historic properties, as set forth by Section II of the executed PA (appendix A).

Efforts will be made to minimize the unnecessary and irreversible conversion of prime farmland to non-agricultural uses. Also, efforts will be made to: (1) identify and take into account the adverse effects on the preservation of prime farmland; (2) consider alternative actions, as appropriate, that could lessen adverse effects to prime farmland; and (3) to ensure to the extent practicable, the project is compatible with State and units of local government and private programs to protect prime farmland.

Future site-specific planning documents (EAs) will provide specific amounts of agricultural land, both prime and non-prime, proposed for conversion based on those projects specific goals, system goals, and resultant management measures designed to fulfill those goals.

The only other significant resource that may be adversely impacted is bottomland hardwoods (BLH). It is possible, but not necessarily probable, that some BLH could be adversely impacted if certain management measures were to be implemented. For example, when implementing backwater dredging to deepen and/or enlarge a historic backwater to restore/provide habitat for migratory waterfowl and/or fish, some amount of BLH may need to be removed. Any effort to estimate how much BLH could eventually be adversely impacted—without any precise location of where or which management/restoration measure would be implemented—would carry with it a high degree of uncertainty. When individual projects are developed, more precise estimates of adverse impacts to any significant resource would be analyzed and declared.

The management measures and potential impacts, by goal, are as follows:

Goal 1: Reduce Sediment Delivery

Management Measures

Stream Stabilization. Although most stream stabilization work would consist of work within the channel to establish geomorphically stable conditions, in some cases existing streambanks may be overly steep and require regrading for stability. These instances may require removal of farmland commensurate with the width necessary to grade streambanks to a stable slope.

Upland Sediment Facilities. In specific locations, downstream sediment delivery may be significantly reduced by installation of upland sediment control facilities, such as water and sediment control basins (WASCOBs) or other sediment traps. Areas in agricultural production could be impacted through outright removal from production or acquisition of temporary or seasonal flowage, and flooding easements.

Filter Strips. These practices would be implemented in areas adjacent to tributary streams to filter sheet flow runoff, stabilize streambanks and reduce sediment delivery to receiving waters. This practice would require removal of farmland commensurate with the strip width necessary to achieve reduction goals.

Goal 2: Restore Aquatic Habitat Diversity of Side Channels and Back Waters

Management Measure

Dredging of Backwaters and Side Channels – In association with dredging to restore depth diversity in backwaters and side channels, areas would need to be identified for the placement of dredged materials. To the extent possible the materials would be used to create additional program benefits: restoration of island habitat, increasing topographic diversity on existing islands, and beneficially as cover for brownfield and strip mine sites. Additionally, locations may be identified where dredged material could be stockpiled for beneficial use for any number of purposes if demand can be identified.

It is anticipated that there may be locations were the only available placement option would be on current agricultural lands of willing landowners. While the potential exists to use fine sediments as a soil additive to improve yields of sandy soils, placement on current agricultural land could result in some conversion.

Goal 3: Improve Floodplain, Riparian, and Aquatic Habitats

Management Measures

Riparian Buffer. These practices would be implemented in areas adjacent to tributary streams to filter sheet flow runoff, stabilize streambanks, improve habitat function, and reduce sediment delivery to receiving waters. This practice will require removal of farmland commensurate with the strip width necessary to achieve sediment reduction and ecosystem goals.

Wetland Plantings. Wetland plantings as a stand-alone measure will not normally require conversion of farmland. However, two instances associated with their use may result in farmland conversion impact. The first would be when a larger wetland complex is being constructed within a floodplain area that is currently in production. In the second instance, farmed wetlands could be planted with wetland species.

Prairie Plantings. Restoration of areas of native prairie within the Basin and tributary floodplain is considered to be of major importance to restoration of the ecological integrity of the system. Areas of idled pastureland, active pastureland, and cropland could potentially be impacted by this restoration measure.

Managed Moist Soil Units. Impacts to farmland because of this management measure would potentially include removal of adjacent farmland from production or acquisition of temporary or seasonal flowage and flooding easements.

Wetland Restoration. Restoration of wetland areas with associated native plant species within the Basin is considered to be of major importance to restoration of the ecological integrity of the system. Areas in agricultural production could be impacted through outright removal from production or acquisition of temporary or seasonal flowage, and flooding easements.

Tile Drainage Water Management. This practice could impact farmland by regulating outflows from existing tile-drained areas. While the potential exists for adverse impacts to accessibility and crop yields, the professional literature suggests that these impacts can be mitigated through sound management guidelines.

Tile Removal. This practice may impact farmland by diminishing average yields over time.

Goal 5: Naturalize Illinois River and Tributary Hydrologic Regimes and Conditions To Restore Aquatic and Riparian Habitat

Management Measures

Tributary Stormwater Storage Areas. Providing stormwater storage volume in tributary areas would reduce the adverse geomorphic and ecological effects of high flows in basin rivers and streams, with potential benefits from reduced fluctuations in the main stem Illinois River. These are likely to be a combination of ponds and expanded floodplain benches. Areas in agricultural production could be impacted through outright removal from production or acquisition of temporary or seasonal flowage, and flooding easements.

Tributary Stormwater Infiltration Areas. Increasing infiltration throughout the Illinois River Basin would reduce the adverse geomorphic and ecological effects of high flows in basin rivers and streams, with potential benefits from reduced fluctuations in the main stem Illinois River, and would provide increased low flows between storm events. In some instances infiltration might be increased without changing existing land uses, but in other cases areas may have to be dedicated as infiltration areas or filter strips. Areas in agricultural production could be impacted through outright removal from production or acquisition of temporary or seasonal flowage, and flooding easements.

It is anticipated that no other significant environmental resource would suffer probable adverse impacts from implementation of the systemic project.

F. Any Irreversible or Irretrievable Commitments of Resources if the Selected Alternative Is Implemented

While not directly tied to the preferred comprehensive plan alternative, Congress authorized study and construction of Critical Restoration Projects in Section 519 of WRDA 2000. Since funding of this section in Federal Fiscal Year 2001, funds have been expended on the study of eight site-specific project locations. Plans and Specifications for the first four of these sites are being prepared with the potential for construction of these projects. All future NEPA requirements for restoration projects, under this program, will be addressed through stand-alone Environmental Assessments and their Findings of No Significant Impacts. If implemented prior to the completion and final approval of this report, it would represent a commitment of Federal resources to the restoration of the Illinois River Basin. For a listing and summary of the authorized critical restoration projects, see Section 6.

No irreversible or irretrievable commitment has occurred which would have the effect of foreclosing the formulation or implementation of any reasonable and prudent alternative. No commitment of resources has occurred that would prejudice the selection of any alternative before making a final decision on this program.

G. Relationship of the Selected Alternative to Land Use Plans

Given the magnitude of this program, both in the large array of management measures that could be employed in any given project, but also the geographic size of the Illinois River Basin (approximately

30,000 square miles), determining the precise relationship between any future ecosystem restoration project within the basin and any existing land use planning document is not possible. It is likely that future alterations in land use or habitat type may result from implementation of management measures at ecosystem restoration project sites. These alterations may be in conflict with existing land use, whether they exist in a planning document or not. For example, if some future restoration project dredged out a side channel, placing the dredged material on a nearby agriculture field would represent a change in the previous land use for the placement site. Future site-specific planning documents will accurately assess impacts of proposed ecosystem restoration measures to land use.

H. Compliance with Environmental Quality Statutes

National Environmental Policy Act of 1969, as amended. The compilation of this EA, describing systemic ecosystem restoration as a result of future separate restoration projects throughout the entire basin, fulfills the NEPA obligation for the program. All separate, site-specific future restoration projects under this Comprehensive Plan's authority, would compile individual NEPA documents fully disclosing project alternatives and the environmental impacts of that proposed project. Future site-specific NEPA documents would address compliance with all appropriate environmental quality statutes including, but not limited to, those listed below.

National Historic Preservation Act of 1966, as amended. The Illinois River Basin Restoration is in compliance with the National Historic Preservation Act of 1966, amended through 2000 (NHPA, Public Law 89-665; 16 U.S.C. 470 et seq.). The NHPA and its implementing regulations 36 CFR Part 800: "Protection of Historic Properties," establishes the primary policy, authority for preservation activities, and compliance procedures. The NHPA ensures early consideration of historic properties preservation in Federal undertakings and the integration of these values in to each agency's mission. The Act declares Federal policy to protect historic sites and values in cooperation with other nations, states, and local governments. The head of any Federal agency having direct or indirect jurisdiction over a proposed Federal or federally-assisted undertaking shall, prior to the approval of the expenditure of any Federal funds on the undertaking, take into account the effect of the undertaking of any district, site building, structure, or object that is included in or eligible for inclusion in the NRHP. The head of any such Federal agency shall afford the Advisory Council on Historic Preservation a reasonable opportunity to comment with regard to such undertaking.

The construction of the Site Specific Projects and associated maintenance, operation, and monitoring shall address historic property and cultural resource compliance promulgated by the NHPA and concerns in NEPA documents and related correspondence. Adverse effects would be mitigated under the appropriate stipulations of the PA.

As evidence of compliance, this documentation will be coordinated with those on the final Consulting Parties List (appendix A) and be placed into the permanent files of the signatories of the PA.

Pursuant to Section 800.3 of the ACHP's regulations and to meet the responsibilities under the NEPA, the Corps and the Illinois DNR developed a preliminary consulting parties list and invited participation in the development and review of a draft PA by letter dated July 12, 2004. Those on the preliminary consulting parties list, comprised of 325 parties, including 47 federally-recognized Tribes, were provided an opportunity to comment on a draft of the PA by letter dated October 5, 2001 (appendix A). Since the Corps remains unaware of any lands held in Federal trust or of any Federal trust responsibilities for Native American Indians within the Illinois River Basin, the Corps requested any information concerning our Federal trust responsibilities by the October 5, 2001, letter.

The Corps is concerned about impacts to those traditional cultural properties and sacred sites recognized by Native Americans, tribes, ethnic and religious organizations, communities, and other groups as potentially affected by the Illinois River Basin Restoration. Presently, the Corps is unaware of any traditional cultural properties or sacred sites within the Illinois River Basin. The Corps is unaware of any Native American lands or tribal lands held in trust within the Illinois River Basin. No Federal trust responsibilities are known in the Illinois River Basin. If there are concerns or potential effects known or identified, those on the preliminary consulting parties lists were requested to complete a "Traditional Cultural Property and Sacred Site Form" by the October 5, 2001 letter (appendix A). To facilitate Tribal coordination, the Corps asked those on the preliminary consulting parties list to refer to the National Park Service, NRHP Bulletin 38, *Guidelines for Evaluating and Documenting Traditional Cultural Properties*, available for internet viewing at http://www.cr.nps.gov/nr/publications/bulletins.htm.

Locations of traditional cultural properties or sacred sites, consisting of architecture, landscapes, objects, or surface or buried archaeological sites, identified in this coordination effort, can be considered to be sensitive information, pursuant to Section 304 of the NHPA. Upon request from any consulting parties not to disclose locations, the Corps and the Illinois DNR will secure this information from the public.

Various versions of the draft PA, the executed PA by the signatories, final consulting parties' lists and supporting correspondence is found in Corps letters dated October 16, 2002, December 4, 2002, and February 7, 2003 (appendix A). Those on the list were asked to comment on earlier drafts of this PA and submit a request to be placed on the final consulting parties list. The Corps received comments on the Illinois River Basin Restoration, the draft PA, a completed Traditional Cultural Property and Sacred Site Form, and requests for inclusion in the final consulting parties list (appendix A). The Corps received comments on the Illinois River Basin Restoration, the draft PA, a completed Traditional Cultural Property and Sacred Site Form, and requests for inclusion in the final consulting parties list and attached to the October 16, 2002 letter (appendix A).

Due to the necessity in executing rights-of-entry, curatorial agreements, real estate actions, and etc., for implementing the Illinois River Basin Restoration, the Chicago, Rock Island, and St. Louis Districts of the U.S. Army Corps of Engineers, the Illinois DNR, the SHPO, and the ACHP executed a PA entitled: *Programmatic Agreement Among the Chicago, Rock Island, and St. Louis Districts of the U.S. Army Corps of Engineers, the State of Illinois Department of Natural Resources, the Illinois State Historic Preservation Officer, and the Advisory Council on Historic Preservation, Regarding Implementation of the Illinois River Ecosystem Restoration*. The executed PA by the signatories forms a partnership for the purposes of implementing the Illinois River Basin Restoration, authorized by Section 216 of the 1970 Flood Control Act and Section 519 (Illinois River Basin Restoration) of the WRDA of 2000 and is found in the February 7, 2003 Corps correspondence (appendix A).

Those on the final consulting parties list (appendix A, letter dated October 16, 2002, Enclosure 3) will be provided with study newsletters, public meeting announcements, special releases, and notifications of the availability of report(s), including all draft agreement documentation, as stipulated by 36 CFR Part 800.14(b)(ii) of the NHPA. Consulting parties may request correspondence on future topics relevant to compliance concerning the Illinois River Basin Restoration and to provide comments. Comments on the Illinois River Basin Restoration program or projects received by the Corps and the

Illinois DNR will be taken into account when finalizing plans for the Illinois River Basin Restoration, as promulgated by the NHPA.

The PA allows for determining effects to significant historic properties from both site specific and systemic impacts from the proposed alternatives. Supporting investigations will be conducted in a phased-approach consisting of Phase I survey, Phase II testing, and Phase III treatment. Phase III treatment of a historic property may include preservation, avoidance, or mitigation of the loss of the property through some form of data recovery such as, but not limited to complete excavation of an archeological site or the detailed documentation of a standing structure. This information would be documented in each of the site-specific project NHPA documents.

Where measures and alternatives under consideration for the Illinois River Basin Restoration site-specific projects that consist of corridors or large land areas, or where access to properties is restricted, the Corps may use a phased process to conduct identification and evaluation efforts. The PA was executed pursuant to Sec. 800.14(b) and to comply with the NEPA pursuant to Sec. 800.8 relative to issues of real estate and curation. Also, the programmatic process shall establish the likely presence of historic properties within the area of potential effects for each alternative or inaccessible area through background research, consultation and an appropriate level of field investigation, taking into account the number of alternatives under consideration, the magnitude of the undertaking and its likely effects, and the views of the SHPO/THPO and any other consulting parties. As specific aspects or locations of an alternative are refined or access is gained, the Corps shall proceed with the identification and evaluation of historic properties in accordance with paragraphs (b)(1) and (c) of section 800.4 of the NHPA and the PA.

The Corps and the Illinois DNR executed the PA, promulgated under 36 CFR Part 800.14(b)(ii) of the NHPA to afford protection to known and unknown historic properties accorded by the NHPA (appendix A). As regulated by in 36 CFR Part 800.8(c)(1), the executed PA will be used within reports promulgated under the NEPA. It is the opinion of the Corps and the DNR that the PA is appropriate for the Illinois River Basin Restoration compliance promulgated under NHPA and the protection of any unreported or recorded historic properties.

Pursuant to Subpart C-Program Alternatives, Section 800.14(b) of the NHPA, the PA was negotiated and executed to govern the implementation of the Illinois River Basin Restoration relative to the complex project situations or multiple undertakings. Compliance with the NHPA will be address in each of the site-specific NEPA documents, where the restoration measures and locations can be specifically defined to delineate the area of potential effect. Those on the Final Consulting Parties List (appendix A) will be notified of the proposed restoration project, coordination, and consulting effort by distribution and reporting.

Compliance with the NHPA will be available for consulting parties for public review and comment by distribution of appropriate correspondence, phased historic property reports, and NEPA reports, and ancillary and supporting documentation. All consulting parties must be aware that the specific locations of historic and archaeological properties are subject to protection through nondisclosure under Section 304 of the National Historic Preservation Act. No maps subject to public review/access shall contain any information on archeological sites. This information is not to be released in order to protect the resources at the sites. Any requests for site (significant historic properties) location information should contain formal comment, referencing the correct log number or Corps contract number, from the Illinois Historic Preservation Agency, Springfield, Illinois.

Although the Corps PA assures NHPA compliance, consultation concerning all historic property findings, and that any determination of effects have been identified and documented within the area of potential affect and the Corps has taken into account all historic properties relative to the planning process through consultation and coordination. If any previously undiscovered historic properties are identified or encountered during the undertaking, the Corps will discontinue construction activities and resume coordination with the appropriate SHPOs, THPOs, Tribes, other consulting parties to identify the significance of the historic property and determine potential effects as executed by the PA.

Archaeological and Historic Preservation Act of 1974 (16 U.S.C. § 469). It is the purpose of sections 469 to 469c-1 of this title to further the policy set forth in sections 461 to 467 of this title, by specifically providing for the preservation of historical and archeological data (including relics and specimens) which might otherwise be irreparably lost or destroyed as the result of (1) flooding, the building of access roads, the erection of workmen's communities, the relocation of railroads and highways, and other alterations of the terrain caused by the construction of a dam by any agency of the United States, or by any private person or corporation holding a license issued by any such agency or (2)any alteration of the terrain caused as a result of any Federal construction project or federally-licensed activity or program.

Protection and Enhancement of the Cultural Environment [Executive Order (EO) 11593]. The Federal Government shall provide leadership in preserving, restoring and maintaining the historic and cultural environment of the Nation. Agencies of the executive branch of the Government (hereinafter referred to as 'Federal agencies') shall (1) administer the cultural properties under their control in a spirit of stewardship and trusteeship for future generations, (2) initiate measures necessary to direct their policies, plans and programs in such a way that federally-owned sites, structures, and objects of historical, architectural or archaeological significance are preserved, restored and maintained for the inspiration and benefit of the people, and (3), in consultation with the Advisory Council on Historic Preservation 16 U.S.C. 470(i), institute procedures to assure that Federal plans and programs contribute to the preservation and enhancement of non-federally-owned sites, structures and objects of historical, architectural or archaeological significance.

Preserve American (EO 13287). This EO states policy for the Federal Government to provide leadership in preserving America's heritage by actively advancing the protection, enhancement, and contemporary use of the historic properties owned by the Federal Government, and by promoting intergovernmental cooperation and partnerships for the preservation and use of historic properties. The contemporary historic properties within the Illinois River Basin, consist primarily of the Illinois Waterway lock and dam facilities. The historic resources of the Illinois Waterway Navigation Facilities consist if seven multiple property historic districts, and was signed by the Illinois State Historic Preservation Officer on December 10, 2002. The NRHP form delineates the 7 district boundaries, categorizes the 35 contributing and 18 noncontributing resources, and evaluates each District's contribution to patterns of transportation, maritime history, engineering, commerce, conservation, military, politics, economics, labor, and social history from 1905 to 1952.

To fulfill the requirements of the certification procedure, the Corps' Rock Island and St. Louis Districts forwarded both NRHP nomination forms for the Illinois Waterway Navigation Facilities to the Corps Headquarters in Washington, DC, which were certificated by the Deputy Historic Preservation Officer (DHPO). The NRHP nomination forms were formally submitted to the National Park Service Keeper of the National Register of Historic Places in January 2004 for evaluation and potential certification for listing. This evaluation is ongoing. If the UMR and IWW are listed on the

NRHP, they will achieve much-deserved international attention. The Corps' contribution to the Nation's engineering history will be ensured for our significant waterways.

It is not expected that any ecosystem measures will affect the National Register of Historic Places eligibility of the Illinois Waterway Navigation Facilities. If any site-specific ecosystem projects are located near ant of the seven multiple property historic districts the Corps will comply with the goals and intent of EO 13287

Archaeological Resources Protection Act, as amended (16 U.S.C. 470aa et seq.). This Act requires a permit for excavation or removal of archaeological resources from publicly held or Native American lands. Excavations must further archaeological knowledge in the public interest, and the resources removed are to remain the property of the United States. If a resource is found on land owned by a Native American tribe, the tribe must give its consent before a permit is issued, and the permit must contain terms or conditions requested by the tribe. Requirements of the Archaeological Resources Protection Act would apply to any project excavation activities that resulted in identification of archaeological resources.

Locating Federal Facilities in Historic Properties in our Nation's Central Cities (EO 13006). Artifacts, reports, samples, and any ancillary data generated by the excavation or removal of archaeological resources from publicly held lands in Illinois and one copy of all final reports will be curated at Illinois State Museum Society, Springfield, Illinois.

Abandoned Shipwreck Act of 1987 (43 U.S.C. 2101-2106). The Abandoned Shipwreck Act asserts the ownership of the United States over any abandoned shipwreck in State waters and submerged lands. The act provides federal protection to any shipwreck that meets the criteria for eligibility for inclusion in the National Register for Historic Places, therefore dredging, dredged disposal, or other ancillary disturbances on or near vicinity of such wrecks may require determinations of effect, archaeological surveys and investigations and coordination with consulting parties. The Corps conducted an archival search for historic properties following the "Policy and Procedures for the Conduct of Underwater Historic Resource Surveys for Maintenance Dredging and Disposal Activities" (DGL-89-01, 1989) to assist in avoidance of significant impacts to these types of resources. The Corps has also contracted the report *An Investigation of Submerged Historic Properties in the Upper Mississippi River and Illinois Waterway* (Custer and Custer 1997). Final copies are located in the permanent files of the Illinois Historic Preservation Agency and the Corps.

American Indian Religious Freedom Act of 1978 (42 U.S.C. 1996). The American Indian Religious Freedom Act reaffirms Native American religious freedom under the First Amendment and establishes policy to protect and preserve the inherent and constitutional right of Native Americans to believe, express, and exercise their traditional religions. This law ensures the protection of sacred locations and access of Native Americans to those sacred locations and traditional resources that are integral to the practice of their religions. Further, it establishes requirements that would apply to Native American sacred locations, traditional resources, or traditional religious practices potentially affected by the construction and operation of the proposed project. In compliance with this Act, the Corps letter dated October 5, 2001 (appendix A) was send via Distribution lists that contained a Consulting Parties List, comprised of 325 parties, including 47 federally-recognized Tribes. This correspondence also contained a "Traditional Cultural Property and Sacred Site Form," to facilitate tribal coordination, the Corps requested the consulting parties List to refer to the National Park Service, NRHP Bulletin 38, *Guidelines for Evaluating and Documenting Traditional Cultural Properties*, available for Internet viewing at (http://www.cr.nps.gov/nr/publications/bulletins.htm).

Locations of traditional cultural properties or sacred sites, consisting of architecture, landscapes, objects, or surface or buried archaeological sites, identified in this coordination effort, can be considered to be sensitive information, pursuant to Section 304 of the NHPA. Upon request from any consulting parties not to disclose locations, the Corps and the Illinois DNR will secure this information from the general public.

Native American Graves Protection and Repatriation Act of 1990 (25 U.S.C. 3001 et seq). The Native American Graves Protection and Repatriation Act provides for the protection of Native American cultural items, and establishes a process for the authorized removal of human remains, funerary objects, sacred objects, and objects of cultural patrimony from sites located on lands owned or controlled by the federal government. Major actions to be taken under this law include (1) the establishment of a review committee with monitoring and policymaking responsibilities, (2) the development of regulations for repatriation, including procedures for identifying lineal descent or cultural affiliation needed for claims, (3) the oversight of museum programs designed to meet the inventory requirements and deadlines of this law, and (4) the development of procedures to handle unexpected discoveries of graves or grave goods during activities on federal or tribal land. The provisions of the Act would be invoked if any excavations led to unexpected discoveries of Native American graves or grave artifacts. The Corps, the THPOs and the SHPOs have entered an agreement to address the potential applicability of the Native American Graves Protection and Repatriation Act to artifacts collected during site characterization activities.

If human remains, funerary objects, sacred objects, or objects of cultural patrimony are encountered or collected, the Corps will comply with all provisions outlined in the appropriate state acts, statutes, guidance, provisions, etc., and any decisions regarding the treatment of human remains will be made recognizing the rights of lineal descendants, Tribes, and other Native American Indians and under consultation with the State Historic Preservation Officer/Tribal Historic Preservation Officer(s) and the other consulting parties, designated Tribal Coordinator, and/or other appropriate legal authority for future and expedient disposition or curation. When finds of human remains, funerary objects, sacred objects, or objects of cultural patrimony are encountered or collected from Federal lands or federally-recognized tribal lands, the Corps will coordinate with the appropriate federally-recognized Native American Tribes, pursuant to the Native American Graves Protection and Repatriation Act of 1990 (25 U.S.C. § 3001 *et seq*.) and its implementing regulations (43 CFR Part 10).

Antiquities Act (16 U.S.C. 431 *et seq.*). The Antiquities Act protects historic and prehistoric ruins, monuments, and objects of antiquity (including paleontological resources) on lands owned or controlled by the Federal Government. If historic or prehistoric ruins or objects were found during the construction or operation of facilities associated with this project, the Corps would have to determine if adverse effects to these ruins or objects would occur. If adverse effects would occur, the Secretary of the Interior would have to grant permission to proceed with the activity (36 CFR Part 296 and 43 CFR Parts 3 and 7).

Indian Sacred Sites (EO 13007). This EO directs federal agencies, to the extent permitted by law and not inconsistent with agency missions, to avoid adverse effects to sacred sites and to provide access to those sites to Native Americans for religious practices. The Order directs agencies to plan projects to provide protection of and access to sacred sites to the extent compatible with the project. To preserve, conserve, and encourage the continuation of the diverse traditional prehistoric, historic, ethnic, and folk cultural traditions within the Illinois watershed, the Illinois River Basin Restoration will be implemented in compliance with EO 13007, specifically:

In order to preserve, conserve, and encourage the continuation of the diverse traditional prehistoric, historic, ethnic, and folk cultural traditions along UMR and IWW, the Navigation Study will be in compliance with Executive Order No. 13007, specifically:

> *Section 1. Accommodation of Sacred Sites*. (a) In managing Federal lands, each executive branch agency with statutory or administrative responsibility for the management of Federal lands shall, to the extent practicable, permitted by law, and not clearly inconsistent with essential agency functions, (1) accommodate access to and ceremonial use of Indian sacred sites by Indian religious practitioners and (2) avoid adversely affecting the physical integrity of such sacred sites. Where appropriate, agencies shall maintain the confidentiality of sacred sites.
>
> The Secretary of the Interior's Standards and Guidelines for Federal Agency Historic Preservation Programs pursuant to the National Historic Preservation Act states that a:
>
> *Traditional Cultural Property* is defined as a property that is associated with cultural practices or beliefs of a living community that (1) are rooted in that community's history, and (2) are important in maintaining the continuing cultural identity of the community.

In compliance with this Act, a Corps letter dated October 5, 2001 (appendix A) was sent via Distribution lists that contained a Consulting Parties List, comprised of 325 parties, including 47 federally-recognized Tribes or Tribal contacts. This correspondence also contained a *Traditional Cultural Property and Sacred Site Form*," to facilitate tribal coordination, the Corps requested the consulting parties List to refer to the National Park Service, NRHP Bulletin 38, *Guidelines for Evaluating and Documenting Traditional Cultural Properties*, available for Internet viewing at (http://www.cr.nps.gov/nr/publications/bulletins.htm). Locations of traditional cultural properties or sacred sites, consisting of architecture, landscapes, objects, or surface or buried archaeological sites, identified in this coordination effort, can be considered to be sensitive information, pursuant to Section 304 of the NHPA. Upon request from any consulting parties not to disclose locations or traditional cultural properties or sacred sites, the Corps and the Illinois DNR will secure this information from the general public.

No Consulting Parties, including Tribes identified traditional cultural properties or sacred sites within the Illinois River Basin within the State of Illinois and no *Traditional Cultural Property and Sacred Site Form* was completed and returned to the Corps. Therefore, the Illinois River Basin Restoration is perceived to have no potential to affect tribal lands, interfere with Federal trust responsibilities, or affect sites or areas of religious and cultural significance to any Native American Tribes. It is the intent of the Corps to accommodate and comply with Native American Tribes' access rights, maintain confidentiality, and avoid adversely affecting sacred sites and traditional cultural properties.

Consultation and Coordination with Indian Tribal Governments (EO 13175). This Executive Order directs Federal agencies to establish regular and meaningful consultation and collaboration with tribal governments in the development of Federal policies that have tribal implications, to strengthen United States government-to-government relationships with Indian tribes, and to reduce the imposition of unfunded mandates on tribal governments. The Corps and the Illinois DNR developed a preliminary Consulting Parties List. Those on the preliminary Consulting Parties List, comprised of 325 parties, including 47 federally-recognized Tribes or Tribal contacts, were provided an opportunity to comment on a draft of the PA by letter dated 5 October 2001 (appendix A). Although the Illinois

River Basin Restoration predominantly lies within the State of Illinois, consulting parties from elsewhere in the United States are given equal and due consideration. Since the Corps remains unaware of any lands held in Federal trust or of any Federal trust responsibilities for Native American Indians within the Illinois River watershed, the Corps requested any information concerning our Federal trust responsibilities by 5 October 2001 letter**.** During this coordination, consulting parties were asked to participate in the development of a final consulting parties list (appendix A). Anyone, other consulting parties, Tribes, or Tribal Contacts can be included on the Final Consulting Parties upon request.

Allowing for tribal review and comment contributes to fulfilling obligations as set forth in the NHPA (PL 89-665), as amended**;** the National Environmental Policy Act of 1969 (PL 91-190)**;** EO 11593 for the "Protection and Enhancement of the Cultural Environment" (Federal Register, May 13, 1971)**;** the Archaeological and Historical Preservation Act of 1974 (PL 93-291)**;** the ACHP "Regulations for the Protection of Historic and Cultural Properties" (36 CFR, Part 800)**;** and the applicable National Park Service and Corps regulations.

Illinois Compiled Statutes: Human Skeletal Remains Protection Act (20 ILCS 3440/ 0.01 through 3440/ 3). This act declares that there is an immediate need to protect the graves of prehistoric and historic Indians, pioneers and Civil War veterans from persons engaged for personal or financial gain in the mining of such graves and to assure that all human burials be accorded equal treatment and respect for human dignity without reference to ethnic origins, cultural backgrounds or religious affiliations. Requires a person who discovers human skeletal remains to notify the coroner within forty-eight hours. Declares that a person who fails to do so shall be guilty of a class C misdemeanor, unless the person has reasonable cause to believe that the coroner had already been notified. Directs the coroner to notify promptly the Historic Preservation Agency prior to the removal of any human skeletal remains that appear to be from an unregistered

Illinois Compiled Statues: Human Skeletal Remains Protection Act: permits; remains and artifacts held in trust; regulations; exemptions (20 ILCS 3440/13 through 3440/16). This act directs the Historic Preservation Agency to develop regulations, in consultation with the Illinois State Museum, for the issuance of permits for the removal of human skeletal remains and grave artifacts from unregistered graves or the removal of grave markers. Requires each permit to specify all terms and conditions under which the removal of human skeletal remains, grave artifacts or grave markers shall be carried out. Directs that all costs accrued in the removal of such materials shall be borne by the permit applicant. Requires the permit holder to submit a report of the results to the Historic Preservation Agency. Declares that all human skeletal remains and grave artifacts in unregistered graves are held in trust for the people of Illinois by the state and are under the jurisdiction of the Historic Preservation Agency. Directs that all materials collected under this act shall be maintained, with dignity and respect, for the people of the state under the care of the Illinois State Museum. Directs the Historic Preservation Agency to promulgate regulations to carry out the purposes of this act. Exempts from permitting requirements under this act or any law, rule or regulation adopted thereunder activities reviewed by the Historic Preservation Agency pursuant to Section 106 of the National Historic Preservation Act and activities permitted pursuant to the Federal Surface Mining Control and Reclamation Act of 1972.

Illinois Compiled Statues: Archeological and Paleontological Resources Protection Act (20 ILCS 3435/7). This statute requires all materials and associated records to remain the property of the state to be managed by the Illinois State Museum, Springfield, Illinois.

Clean Air Act of 1972, as amended. It is not anticipated that specific ecosystem restoration projects, planned and implemented under this systemic program document, would result in either short- or long-term violations to air quality standards. It is not anticipated that the outdoor atmosphere would be exposed to contaminants/pollutants in such quantities and of such duration as may be or tend to be injurious to human, plant, or property, or which unreasonably interferes with the comfortable enjoyment of life, or property, or the conduct of business. It is anticipated future projects would be in full compliance.

Clean Water Act of 1972 (Sections 401 and 404), as amended. Any and all specific ecosystem restoration projects, implemented under this systemic program, would address the impacts of placing dredged and/or fill material into the waters of the United States on an individual, site-specific basis in a separate NEPA document. State Water Quality Certification (Section 401) would be received prior to any specific project implementation.

Endangered Species Act of 1973, as amended. Coordination with appropriate Federal and State natural resource agencies for this report has resulted in an extensive list of endangered, threatened, or special concern species within the Illinois River Basin. Within the NEPA documents of all future ecosystem restoration projects under this authority, a full discussion of the project features and their potential impact on endangered, threatened, or special concern species would appear.

Fish and Wildlife Coordination Act of 1958, as amended. This Comprehensive Plan has been coordinated with the USFWS and the Illinois DNR. The District coordination letter (March 24, 2003) to the appropriate Federal and State agencies and all responses can be found in Section 7 of this report. Any/all future restoration projects under this authority would accomplish compliance with the Fish and Wildlife Coordination Act within a separate NEPA document, specific to that project.

Rivers and Harbors Acts, as amended. It is not anticipated that future restoration projects would place any obstruction across navigable waters or place obstructions to navigation outside established lines. For any/all future restoration projects under Section 519, WRDA 2000 authority, compliance with all Sections of the River and Harbor Acts would be documented separately.

Wild and Scenic Rivers Act of 1968, as amended. The National Rivers Inventory (NRI) is used to identify rivers, or sections of rivers that may be designated by Congress to be component rivers in the National Wild and Scenic Rivers System. The following rivers/river sections or streams are listed in the National Rivers Inventory (NRI): Fox River, (Wisconsin) Elgin to W. Dundee dam, Algonquin to Wilmot dam, Wedron to Yorkville; Illinois River (Illinois), Pekin to Kickapoo Creek, Woodford-Tazewell County line to Chillicothe; Kankakee River, (Indiana) 12d boundary to Indiana State line; Mackinaw River, (Illinois) from confluence with Illinois River to Colfax; Mazon River, (Illinois) mouth to source; Sangamon River, (Illinois) nine sections (too numerous to mention); Spoon River, (Illinois) confluence with Iroquois River to 3 miles south of Onarga; Sugar Creek, (Indiana and Illinois) from confluence with Iroquois River, upstream approximately 36 miles to where channelization begins.

Executive Order 11988 (Flood Plain Management). Implementation of any/all future site-specific ecosystem restoration projects would avoid, to the extent possible, long- and short-term adverse impacts associated with the occupancy and modification of the base floodplain. They also would avoid direct and indirect support of development or growth (construction of structures and/or facilities, habitable or otherwise) in the base floodplain wherever there is a practicable alternative. In the separate NEPA documents associated with future site-specific restoration projects, additional evaluations would be performed to identify any changes to the 100-year flood profile. The Corps would obtain and adhere to all stipulations of the floodplain permit from the appropriate State agency prior to implementation of any/all site-specific restoration projects.

Executive Order 11990 (Protection of Wetlands). Any/all future restoration projects associated with this authority would address potential impacts to wetlands resulting from project features in a separate NEPA document. One of the primary objectives of any ecosystem restoration project(s) is to cause betterment to the environment (including wetlands). It is anticipated that any future site-specific ecosystem restoration project would not cause an overall degradation to wetlands.

Farmland Protection Policy Act, of 1981. It is well understood the prominent role that agriculture plays in the Illinois River Basin. It is important that all future restoration projects be designed and implemented in a manner that is as compatible as practicable with the agricultural community. Balancing environmental restoration goals with protecting the integrity of agricultural operations should be one of the guiding principles as we proceed with implementation of this Comprehensive Plan. Future site-specific restoration projects would be closely coordinated with agricultural groups and organizations. Unwarranted destruction and unnecessary conversion of farmland, particularly prime farmland, would be avoided. Any/all future site-specific projects that propose conversion of farmland would compile NEPA documents where appropriate Federal, State, and local agencies tasked with protecting farmland are consulted.

Federal Water Project Recreational Act, of 1965. Effort was not made to identify opportunities for recreational development or aspects of the alternatives conducive to recreational development. Recreational opportunities may result from implementation of this program, but would be incidental to the achievement of the overarching goal of restoring and maintaining ecological integrity, including habitats, communities, and populations of native species, and the processes that sustain them. Should these opportunities be identified for future projects, they would be discussed in those projects' site-specific planning document with NEPA compliance.

Invasive Species (EO 13112). Efforts to monitor the introduction and spread of listed harmful and invasive species in the Illinois River basin are ongoing. The implementation of fish passage measures at dams could facilitate the spread of invasive species. Exotic fish considerations will be further coordinated as new information becomes available. Any future site-specific project that has management features that could lead to violations of the EO would be discussed in that projects planning document with NEPA compliance.

Administrative Procedures Act, of 1946. The Illinois River Basin Restoration project has complied with the provisions of this act through public meetings, newsletters, coordination, and the NEPA review process.

Safe Drinking Water Act. The Illinois River Basin Restoration project, if implemented, should result in improvements in water quality. This program should not degrade the basin's sources of drinking water, and should protect public health to the extent practicable.

Migratory Bird Treaty Act, as amended. The USFWS will review this Comprehensive Plan and future site-specific project planning documents with NEPA compliance, to determine whether any project's activities would comply with or violate the requirements of this Act.

Bald Eagle Protection Act, as amended. The USFWS will review this report and all subsequent planning documents of this Illinois River Basin Restoration report to determine whether any project's activities would violate this Act.

National Wildlife Refuge System Administration Act, of 1966. The USFWS will review the Illinois River Basin Restoration report and all site-specific project planning documents with NEPA compliance to determine compliance with this Act.

Responsibilities of Federal Agencies to Protect Migratory Birds (EO 13186). Numerous aspects of this ecosystem restoration program and subsequent site-specific project features should enhance migratory bird habitat and lead to positive impacts to bird populations.

Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations (EO 12898). Potential impacts of the alternative plans are not expected to result in a disproportionate burden, or benefit, on minority or low-income communities in the study area.

6. PLAN IMPLEMENTATION

A. IMPLEMENTATION OVERVIEW

The Illinois River Basin Restoration Comprehensive Plan (Comprehensive Plan) identifies the vision, goals, objectives, and recommended level of effort needed to restore the basin. The success of the Comprehensive Plan will be a reflection of its implementation over a period of up to 50 years. It will take a well-coordinated strategy to be the driving force behind the sequence and pace at which specific project features are undertaken.

To carry out the recommendations, an implementation framework for the Illinois River Basin Restoration was developed. This section addresses the implementation assumptions and strategies, cooperative conservation and collaborative planning approach, and details on the identification, selection, study and implementation of Critical Restoration Projects and other specific components. In a relatively short time, and in specific areas, Critical Restoration Projects will begin to reverse the pattern of ecological degradation that has been occurring for decades. As a result of Tier I and II restoration efforts, areas within the Illinois River Basin will be ecologically healthier by 2011 and 2015.

Implementation will require integration of many related projects and tasks. The Comprehensive Plan comprises an overarching goal, six specific goals, and hundreds of small projects that need to be integrated with each other and with other Federal, state and local programs and projects. Implementation will require an innovative and collaborative project management and organizational effort. This section describes the project implementation process and the near term schedule developed to implement the recommended Comprehensive Plan.

1. Tiered Implementation Approach. The recommendations call for continuing restoration efforts under the existing authority of Section 519. Corps of Engineers cost shared restoration efforts would begin with $131.2 million in funding through 2011 (Tier I), increasing to $345.6 million in restoration efforts through 2015 (Tier II). The funding and activities would begin significant restoration consistent with eventual implementation of Alternative 6 (preferred comprehensive plan alternative). The initial phases are proposed to demonstrate the benefits of the various measures and project components prior to seeking additional funds.

While some work would occur throughout the basin, restoration efforts would focus on tributaries to the upper watershed and, in particular, the Peoria Pool and its tributaries and the Kankakee River Basin. Within these areas, the focus will be on addressing excess sediment delivery, altered hydrologic regimes, and critical habitats and connectivity. These initial focus areas were chosen, since the most likely near term success is to start in the upstream reaches working on the most critical issues and then working down stream in future Tiers. In combination, these screening criteria provide considerable focus in the selection of initial projects. In addition, a few other restoration projects are also proposed to address critical habitat needs throughout the basin such as backwater, side channel, and island restoration

The restoration efforts undertaken in partnership with the Corps of Engineers would be cost shared 65 percent Federal and 35 percent non-Federal. Funding would be allocated into three major categories: (1) planning, design, construction and adaptive management of Critical Restoration Projects; (2) technologies and innovative approaches component; and (3) system management. If funding is available, a report to Congress will be submitted in the 2011 timeframe, documenting the project successes and the results from Tier I restoration efforts, estimated at $131.2 million (table 6.1).

Table 6-1. Estimated Projects and Cost Breakdowns

	TIER COMPONENTS			TOTAL COSTS	
	Projects	**Technologies & Innovative Approaches**	**Management**	**Federal Costs (65%)**	**Non-Federal Costs (35%)**
Tier I $131.2 million through 2011	$122.3 million • 8 small watersheds • 2 reaches of major tributaries • 3 backwaters, 4 side channels/islands, 1 floodplain areas on mainstem Illinois River	$6.1 million	$2.75 million	$85.3 million	$45.9 million
Tier II $345.6 million through 2015	$309.1 million • 20 small watersheds • 4 reaches of major tributaries • 4 backwaters, 8 side channels/islands, 2 floodplain areas on mainstem Illinois River	$30.8 million	$5.75 million	$224.6 million	$121 million

	Projects	**Technologies & Innovative Approaches**	**Management**	**Total Costs**
Alternative 6 $7.4 billion through 2055	$6.8 billion • 150 small watersheds • 88 reaches of major tributaries • 60 backwaters, 35 side channels/islands, 150 floodplain areas on mainstem Illinois River	$585 million	$55 million	$7.4 billion - cost shared among numerous Federal, State, and local agencies and programs

2. Implementation Framework Goals. The purpose of the implementation framework includes:

- Ensuring that Illinois River Basin Restoration projects address system ecological needs and system goals at sub-watershed, watershed, pool segment, pool, and system scales by coordinating all planning, restoration, and monitoring efforts.
- Ensuring the system prioritization criteria used for watershed and project identification maximize sustainability.
- Enhancing public understanding and trust in the decision-making process by making Illinois River Basin Restoration evaluation criteria explicit and consistent.
- Ensuring interagency coordination and matching of potential projects with appropriate Federal and State restoration and management programs or other restoration initiatives.
- Retaining the flexibility necessary to ensure efficient, effective program execution and to apply adaptive management principles to project planning, design, and implementation.

3. Assumptions and Strategy for Initial Efforts

a. Authorization. The following section summarizes the existing Section 519 of WRDA 2000 authorization and presents assumptions regarding additional authorization in the future.

- *Planning, Design, and Construction of Critical Restoration Projects* was authorized in Section 519. This authorization is ongoing and limited only by the specific yearly appropriations. The Assistant Secretary of the Army for Civil Works [ASA(CW)] approves Critical Restoration Projects.
- The Section 519 authorization, sub-sections (b)(6) Additional Studies and Analyses, allows planning of additional restoration projects over the $5 million Federal per project limit, but the Feasibility reports would need to go to Congress for authorization.
- For the purposes of this Comprehensive Plan, it is assumed that potential modifications to the existing authorization will be refined and may be recommended at some future date. These potential recommendations include:

  i. The per project Federal cost limit for Critical Restoration Projects, be increased from $5 million to $20 million.

  ii. Authorize implementation of a Technologies and Innovative Approaches Component as a component of the Comprehensive Plan that complements the Critical Restoration Project activities. Activities would include initiatives called for in Section 519 (b).(3).(A) development and implementation of sediment removal technology, sediment characterization, sediment transport, and beneficial uses of sediment; (C) long term resource monitoring; and (D) and a computerized inventory and analysis system.

  iii. Pursue authorization allowing the development of cooperative agreements and fund transfers between the Corps of Engineers and the State of Illinois; State of Indiana;

State of Wisconsin; scientific surveys at the University of Illinois; and units of local government: counties, municipalities, and Soil and Water Conservation Districts to facilitate more efficient partnerships.

iv. Authorization to allow the Corps of Engineers to deviate from normal procurement laws and regulations and to provide funding directly to landowners to undertake short term structural and land management conservation measures. Such authorization would be similar to certain the Natural Resources Conservation Service assistance programs, and the Corps likely would work closely with the NRCS in the provision of such assistance, if ultimately pursued and authorized. Further discussions will also involve the United States Fish and Wildlife Service for outreach, project planning, and project implementation, including efforts with private landowners.

v. Authorization be expanded to allow non-profit organizations to serve as sponsors and sign Project Cooperation Agreements (PCAs) for restoration projects implemented under the Illinois River Basin Restoration Project.

b. Funding. The annual cost shared execution capability of the Corps of Engineers Districts and non-Federal sponsors is estimated to reach approximately $40 million per year by 2011 and increase to approximately $60 million per year by 2015. If significant multi-agency progress is going to be made on implementing the Comprehensive Plan, other Federal and State agencies would also need funding expanded beyond current levels. A more detailed discussion of other agencies' potential roles in implementation is included in section 4.b of this report, *Interagency Missions, Programs, and Authorities*.

c. Strategy. Because of the large number of complex features that will be developed over a long period of time and the benefits that will be gained, the strategy for implementation of the recommended Comprehensive Plan will be pursued as a program. Approaching implementation as a program will allow flexibility in the management of program scheduling and funding. To ensure continued progress in implementing the Comprehensive Plan, a project implementation process is needed to allow for additional studies that would support project development and future Congressional authorizations. Key assumptions regarding agreements that are necessary to proceed with implementation of the Comprehensive Plan are as follows:

- A collaborative planning approach will utilize the expertise, missions, programs, and funding of other Federal, State, and local agencies, and also non-Governmental Organizations (NGOs).

- Program management, additional studies and analysis, and feasibility planning of Critical Restoration Projects will continue using GI funding under the original Feasibility Cost Sharing Agreement.

- In the future if authorized, an agreement will be signed covering the technologies and innovative components. Cost sharing would be 65/35 Federal/non-Federal.

- Other implementation of Critical Restoration Projects will occur following the current process: (1) Division Endorsement of report to Headquarters, U.S. Army Corps of Engineers (HQUSACE), and (2) HQUSACE and ASA(CW) review and approval. After Division Endorsement, Plans and Specifications (P&S) can be initiated at 100 percent Federal costs. The total project cost for P&S and construction will be cost shared 65/35 Federal/non-Federal using Construction, General (CG) funding , following signing of the PCA.

- In the future, as experience is gained with the program the Districts will request the approval of projects be delegated.

4. Cooperative Conservation

a. Organizational Framework. The Comprehensive Plan was formulated to address system restoration needs and was not specific to Corps of Engineers and Illinois Department of Natural Resources (DNR) activities. As a result, the total restoration costs include a relatively large portion of work for other agencies. The process of identifying agency missions and programs has been initiated and documented in the following section, but the process of full multiple agency implementation will continue to develop over the initial years of the program. This section presents the organizational framework for continued coordination and implementation of projects. It is acknowledged that there are funding challenges for all agencies, which highlights the need to partner in the implementation of the Illinois River Basin restoration. This continued agency coordination will be done in the spirit of cooperative conservation, where the resources of numerous agencies are focused on solving a resource problem.

Since the Comprehensive Plan formulation addresses total needs, some recommended measures could potentially be conducted by more than one agency. Estimates of the allocation of effort by agency were developed, but represent only rough approximations due to funding uncertainties for each agency. This funding uncertainty is a key reason for the proposed interagency coordination and adaptive implementation framework for the restoration activities. Restoration and monitoring activities will be conducted under the organizational structure shown in figure 6-1.

i. Executive Committee. The Committee will have representatives from two Corps Regional Headquarters (Mississippi Valley Division, MVD, and Great Lakes and Ohio River Division, LRD); four Corps Districts (Rock Island, St. Louis, Chicago, and Detroit); and the non-Federal sponsors (Illinois DNR and representatives from the States of Indiana and Wisconsin). The Executive Committee will be chaired by the MVD. It will be responsible for oversight of the management and implementation of the project, including decisions on project funding. The Executive Committee will meet approximately twice a year, with meeting schedules timed to synchronize receipt or provision of input from other committee meetings as needed.

Members of this committee will participate on the Navigation and Ecosystem Sustainability Programs (NESP) coordination teams to assure consistency and coordination between the Illinois River Basin Restoration (Section 519) efforts and any restoration work resulting from the Upper Mississippi River-Illinois Waterway System (UMR-IWW) Navigation Study (if authorized).

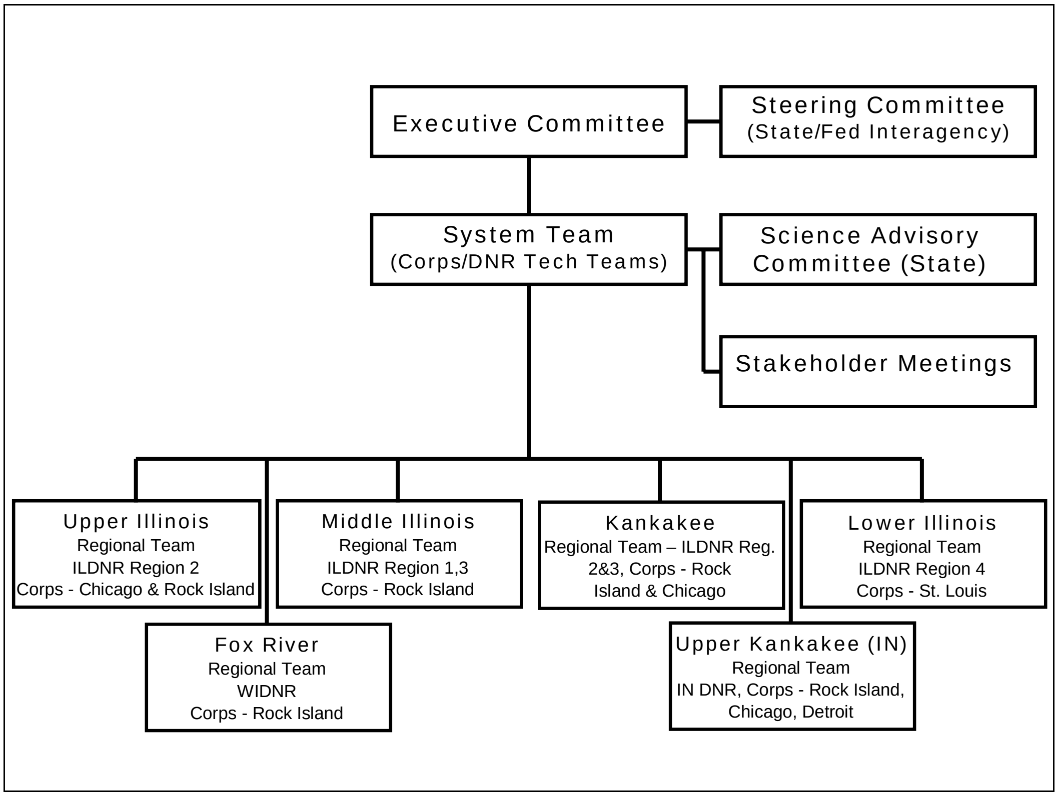


Figure 6-1. Study Organizational Structure

ii. Steering Committee. The Steering Committee will be the interagency group responsible for coordinating the Illinois River Basin and Ecosystem Restoration efforts. It will be co-chaired by the Corps of Engineers and the Illinois DNR, and will be composed of State and Federal agency representatives. This Committee will meet approximately twice a year to exchange views, information, and advice to ensure coordination among various agency programs.

iii. System Team. The System Team will be composed of the multi-disciplinary technical staff primarily from the Corps of Engineers and State DNRs. Additional team members may be selected. This team will have primary responsibilities for overall project delivery and system evaluations. The team will incorporate the expertise of scientists and technical staff as necessary. Team size is anticipated to be approximately 10 members with suggested disciplines to include:

- Geomorphology
- Limnology
- Fish ecology/management
- Forestry
- Hydrology
- Wildlife ecology/management
- Wetlands
- Engineering

iv. Science Advisory Committee. The existing State of Illinois Science Advisory Committee (SAC), a sub-committee of the Illinois River Coordination Council, can exchange views and provide information to the System Team.

v. Regional Teams. Organizing efforts by geographic region allows for the more efficient accomplishment of project activities. Six regions established for the basin are Upper Illinois, Fox River, Kankakee, Upper Kankakee, Middle Illinois, and Lower Illinois. Each regional team, consisting of Corps of Engineers and State DNR personnel, will have primary responsibilities for the evaluation and implementation of Critical Restoration Projects. Regional Team meetings will provide a forum for groups—with detailed information on resource concerns—to exchange views and information regarding areas in need of assessment and potential Critical Restoration Projects, evaluate the proposed site-specific projects, and facilitate the detailed study of these projects.

Invited attendees include the Illinois Environmental Protection Agency (EPA); Illinois Department of Agriculture; representatives from the States of Indiana and Wisconsin; USDA Natural Resources Conservation Service (NRCS) and Farm Service Administration (FSA); U.S. Fish and Wildlife Service (USFWS); USEPA; U.S. Geological Survey (USGS); Ecosystem Partnership Groups; Soil and Water Conservation Districts (SWCDs); NGOs; Levee and Drainage Districts; and Local Governments.

vi. Stakeholder Meetings. Stakeholder meetings will provide a forum to present study status and information on implementation and management to all interested Federal, State, and local agencies, as well as NGOs. Stakeholder meetings will be held approximately once a year in each of the six regions or as interim products are completed. Their primary focus will be public involvement, information sharing, and dialog among all groups and interests.

b. Interagency Missions, Programs, and Authorities. The Plan effort has been an open, collaborative process with participation from Federal and State agencies, local governments, and non-governmental organizations. The interagency team approach will continue throughout the implementation period to coordinate the development, review, evaluation and adaptive management of the Plan. These efforts will be carried out in a manner consistent with the August 26, 2004 Executive Order on Facilitation of Cooperative Conservation.

The mission, programs, and authorities of the Corps of Engineers and other Federal and State agencies are briefly presented below.

i. U.S. Army Corps of Engineers (USACE). The mission of USACE is to provide quality, responsive engineering services to the nation including "… planning, designing, building and operating water resources and other civil works projects (Navigation, Flood Damage Reduction, Ecosystem Restoration, Disaster Response, etc.)." As it relates to Illinois River Basin Restoration activities, the Corps has a number of programs and authorities that can be utilized for ecosystem restoration and other purposes in addition to the Section 519 authority.

Programs and Authorities

Upper Mississippi River - Environmental Management Program (EMP). The EMP established in 1986 is comprised of two elements—Habitat Rehabilitation and Enhancement

Projects (HREPs) and the Long Term Resource Monitoring Program (LTRMP). This ongoing system program provides a combination of monitoring and habitat restoration activities. Restoration activities under the EMP are limited to the Mississippi River and navigable portions of its tributaries (which includes the Illinois River) and their adjacent floodplains.

The HREPs employ a variety of restoration measures to address the unique circumstances of a particular area in order to protect, preserve, and enhance fish and wildlife habitat in the Upper Mississippi River System (UMRS). As of February 2004, 73 HREPs are in various stages of planning, design, construction, and post-construction evaluation, and more than 40 HREPs have been completed. On the Illinois River, the EMP has undertaken seven projects with five completed, one under construction, and one scheduled for construction in 2008. Project planning, engineering, construction, and monitoring approaches applied to HREPs have evolved with the program and have resulted in improved efficiency, productivity, and responsiveness.

The LTRMP provides resource managers and decision makers with information necessary for maintaining the UMRS as a sustainable multiple-use large river ecosystem. The goals of the LTRMP include: (1) developing a better understanding of the ecology of the UMRS and its resource problems; (2) monitoring resource changes; (3) developing alternatives to better manage the UMRS; and (4) providing for the proper management of LTRMP information. The LTRMP work in the LaGrange and Alton Pools of the Illinois River will serve as a basis for further monitoring under Section 519.

Navigation and Ecosystem Sustainability Program (NESP). This effort encompasses the subsequent planning and design efforts related to the Upper Mississippi River - Illinois Waterway System Navigation Feasibility Study completed in September 2004. These efforts address the need for navigation improvements and ecosystem restoration in an area which includes 854 miles of the Upper Mississippi River—with 29 locks and dams between Minneapolis/St. Paul and the mouth of the Ohio River—and 327 miles of the Illinois Waterway—with eight locks and dams. Restoration activities would be limited to the mainstem rivers and adjacent floodplains. The study area lies within portions of Illinois, Iowa, Minnesota, Missouri, and Wisconsin. Recommendations awaiting authorization include:

- $2 billion in navigation improvements over 15 years. (50/50 funding with the Inland Waterway Users Trust Fund)
    - Mooring facilities at Lock and Dams 12, 14, 18, 20, 22, 24, La Grange
    - Switchboats at Lock and Dams 20, 21, 22, 24, and 25
    - 1,200’ chambers at locks 20, 21, 22, 24, and 25, Peoria, and La Grange

- $1.5 billion of ecosystem restoration over 15 years (100 percent funding for projects on Federal lands, 65/35 cost share on non-Federal lands)
    - Fish passage at UMR dams 4, 8, 22, and 26
    - Changes in water-level control at UMR dams 25 and 16
    - 225 projects of less than $25 million each: island building, water-level management, backwater/side-channel restoration, wing dam/dike alterations, island shoreline protection
    - 35,000 acres floodplain restoration

While no authorization for construction has been provided, subsequent study and design efforts were initiated in 2005 for a number of navigation and ecosystem restoration components for the entire UMRS-IWW.

Peoria Riverfront Development (Ecosystem Restoration) Study, Illinois. This project is located within Peoria and Tazewell Counties, Illinois, between Illinois River Miles 162 and 167. The feasibility study was conducted by the Corps of Engineers and Illinois DNR (non-Federal sponsor) to investigate Federal and State interest in ecosystem restoration within Peoria Lake and the Farm Creek Watershed. Its principal goal is to enhance aquatic habitats through the restoration of depth diversity and to reduce sediment delivery and deposition; ancillary benefits are expected for recreational boating and fishing. The preferred comprehensive plan alternative includes dredging and island creation. Specific authority for conducting the Peoria Riverfront Development Study is contained in Resolution 2500 of the Committee on Transportation and Infrastructure, adopted May 9, 1996. The report was completed in March 2003, and Planning, Engineering, and Design were initiated in January 2004 to prepare plans and specifications. In 2004, approval was given to initiate dredging and construct the first of three islands under Section 519 authority.

Upper Mississippi River Comprehensive Plan. The Comprehensive Plan Study was authorized by Section 459 of WRDA 1999 to:

> "… develop a plan to address water resource and related land resource problems and opportunities in the Upper Mississippi and Illinois River basins from Cairo, Illinois, to the headwaters of the Mississippi River, in the interest of the systemic flood damage reduction by means of
>
> (1) Structural and nonstructural flood control and floodplain management strategies;
> (2) Continued maintenance of the navigation project;
> (3) Management of bank caving and erosion;
> (4) Watershed nutrient and sediment management;
> (5) Habitat management;
> (6) Recreation needs; and
> (7) Other related purposes.

The study focuses on the 500-year floodplains of the reach of the UMR between Anoka, Minnesota, and Thebes, Illinois, and the reach of the Illinois River between its confluence with the Mississippi and the confluence of the Kankakee and Des Plaines Rivers. Although the development of the Plan will be at Federal expense, any feasibility studies resulting from development of the plan will be subject to cost sharing under Section 105 of WRDA 1986 (33 U.S.C. 2215).

The Plan embraces the dual overarching national goals of flood damage reduction and associated environmental sustainability. The study focuses on development and evaluation of multiple systemic alternative plans composed of various combinations of structural and nonstructural measures that, if implemented, would result in reduced flood damage potential and net improvements to floodplain habitat conditions. An integrated study approach in developing ecosystem goals and objectives has been accomplished with the UMRS Navigation Study. The Navigation Study addressed goals and objectives related to the navigation system, and the

Upper Mississippi River (UMR) Comprehensive Plan is addressing those goals and objectives related to flood damage reduction. The UMR Comprehensive Plan will be completed in Fiscal Year 2007, with any recommendations for implementation being forwarded to the Committee on Transportation and Infrastructure of the House of Representatives and the Committee on Environment and Public Works of the Senate.

Kankakee River Basin Feasibility Study. The Kankakee River Basin drains an area of approximately 5,200 square miles in Illinois and Indiana. Recurrent flooding causes damages to agriculture and infrastructure. The flooding is the result of several factors, including increased runoff from development, loss of river capacity due to channelization and sediment buildup, and loss of wetlands to retain water. A study by the Chicago District of the U.S. Army Corps of Engineers is investigating opportunities within the basin for flood damage reduction, sediment reduction, and ecosystem restoration. The non-Federal project sponsors are the Indiana and Illinois DNRs and the Kankakee River Basin Commission. The feasibility study is cost shared equally between the Federal Government and non-Federal sponsors and is currently on hold.

Environmental Continuing Authorities Program (CAP). The Environmental CAP encompasses ongoing Corps of Engineers Authorities to perform various small ecosystem restoration projects with non-Federal Sponsors, including.

- **Section 206 of the 1996 Water Resources Development Act - Aquatic Ecosystem Restoration.** These projects are for improving the quality of the environment by restoring habitat for fish and wildlife. A project is approved for construction after investigation shows engineering, economic and environmental feasibility. These projects are cost-shared 65 percent Federal and 35 percent non-Federal. Each project is limited to a Federal cost of $5 million. Such projects will usually include manipulation of the hydrology in and along bodies of water, including wetlands and riparian areas. Deep water dredging to improve habitat conditions for the over-winter survival of fish in an otherwise shallow lake area is an example of this type of project.

- **Section 1135 of the 1986 Water Resources Development Act - Project Modification for Improvement of the Environment.** These projects are for modifications to an existing Corps project and/or its operations. The work must improve the quality of the environment by restoring habitat for fish and wildlife. Justification is based on a comparison of monetary and non-monetary costs vs. benefits. These projects are cost-shared 75 percent Federal and 25 percent non-Federal. Each project is limited to a Federal cost of $5 million. An example of this type of project might be to construct water control structures within a wetland to better optimize conditions for the production and availability of waterfowl-preferred food plants near an existing Corps project.

- **Section 204 of the 1992 Water Resources Development Act - Beneficial Use of Dredged Material.** These projects protect, restore and create aquatic and/or wetland habitats associated with dredging for authorized Federal navigation projects. A project is constructed after investigation shows engineering, economic and environmental feasibility. These projects are cost-shared 75 percent Federal and 25 percent non-Federal. Placing dredged material from the maintenance of a navigation channel at a specific location is an example of this type of project.

Potential Role in Implementing the Comprehensive Plan. Proposed restoration efforts under this plan would be closely coordinated with two ongoing Corps of Engineers Restoration Programs the Upper Mississippi River – Environmental Management Program (EMP) and the Navigation and Ecosystem Sustainability Program (NESP). Restoration activities under both programs would be limited to the main stem rivers and adjacent floodplains. The EMP and NESP authorities are anticipated to be utilized for many of the projects on the mainstem (i.e. backwaters, side channels, islands, and mainstem floodplain restoration efforts) and provide funding for a significant portion of the mainstem monitoring. See the next section for more detailed assumptions. Close coordination among all three programs will assure the best use of Federal and non-Federal sponsor resources. In addition, there is the potential for Environmental CAP to be used to conduct some aquatic ecosystem projects throughout the basin.

ii. U.S. Department of Agriculture (USDA). The mission of the USDA is to "provide leadership on food, agriculture, natural resources, and related issues based on sound public policy, the best available science, and efficient management." The USDA provides funding through the Natural Resources Conservation Service (NRCS) and the Farm Service Agency (FSA), to agricultural producers in support of environmental objectives on lands with a crop history.

Programs and Authorities

The **Environmental Quality Incentives Program (EQIP)** provides technical, financial, and educational assistance to farmers and private landowners who are faced with serious threats to soil, water, and related natural resources. Processing approximately 490 contracts within the Illinois River Basin, NRCS has expended approximately $5.1 million for financial assistance to treat natural resources concerns on cropland, confined livestock, and grazing lands in Fiscal Year (FY) 2005.

The **Wildlife Habitat Incentive Program (WHIP)** provided approximately $64,754 of financial assistance to develop and improve wildlife habitat on private lands within the Illinois River Basin in FY 2005.

The **Wetland Reserve Program (WRP)** increases wildlife habitat and improves water quality by providing additional wetland habitat, slowing overland flow, and providing natural pollution control. Since 1994, approximately $14.4 million has been spent in the Illinois River Basin to restore 9,927 acres of habitat on 23 properties.

The **Conservation Reserve Program (CRP)** and **Conservation Reserve Enhancement Program (CREP)** enrollments provide additional in-place conservation practices facilitating resource management in the Illinois River Basin. From 1998 to 2004, the State of Illinois provided $51 million to leverage $271 million in Federal funds to enroll 110,000 acres in Federal CRP easements and 73,000 acres in State CREP easements. Private landowners can enroll in conservation easements (CRP) with the USDA through a 15-year Federal contract. The lands enrolled in the Federal portion are then eligible for a voluntary 15-year or 35-year state contract extension, or a state permanent conservation easement (CREP).

Approximately 45,000 acres of the State easements are on lands where there is a Federal contract. The State also acquired State-only easements on numerous adjacent areas and now holds roughly 28,000 acres in these State-only easements. There is the potential for an additional $242 million in Federal funds through December 31, 2007 to enroll approximately 123,000 more acres in the basin if State leveraging funds are provided. In August 2005, the State of Illinois announced its budget for the upcoming year which includes $10 million to leverage $40 million in Federal funds, allowing for CREP easements on approximately 15,000 more acres.

In April 1997, the USDA officially launched the National Conservation Buffer Initiative and pledged to help landowners install 2 million miles of conservation buffers by the year 2002. The initiative is led by the NRCS in cooperation with the Agricultural Research Service, Farm Service Agency; Forest Service; Cooperative State Research, Education, and Extension Service; state conservation agencies; conservation districts; and numerous other public and private partners. The National Conservation Buffer Initiative encourages farmers and ranchers to understand the economic and environmental benefits of buffer strips and use these practices through the various programs of the conservation tool kit. Programs used for this effort include the continuous CRP signup, as well as EQIP, WHIP, WRP, Stewardship Incentives Program, and Emergency Watershed Protection Program.

The **Conservation Security Program (CSP)** is a voluntary conservation program that supports ongoing stewardship of private agricultural lands by providing payments for maintaining and enhancing natural resources. CSP identifies and rewards those farmers and ranchers who are meeting the highest standards of conservation and environmental management on their operations. The Farm Security and Rural Investment Act of 2002 (2002 Farm Bill) (Pub. L. 107-171) amended the Food Security Act of 1985 to authorize the program. The CSP is offered only in selected watersheds across the Nation. The Upper Sangamon, a watershed within the Illinois River Basin, was selected as a CSP area for 2006.

Potential Role in Implementing the Comprehensive Plan. The USDA has the mission and programs to implement many of the projects in the upper reaches of watershed and along the tributaries. In particular, efforts to restore floodplain wetlands, improve riparian buffers along streams, and improved farm practices directly relate to implementing the restoration plan. However, funding for these programs would need to expand to meet the needs identified in the restoration plan.

iii. U.S. Environmental Protection Agency (USEPA). The mission of the USEPA is to "protect human health and the environment." The five goals of the USEPA's Strategic Plan are based air and global climate change; water; land; communities and ecosystems; and compliance and environmental stewardship. USEPA programs related to the Illinois River Basin Restoration include water, watershed management, and wetlands. USEPA Region 5 oversees EPA activities in the Illinois River Basin. Major activities ongoing in the basin include nutrient mapping, targeted watersheds grant program, and State List of Illinois Water Quality Impairments, summarized below. In addition, USEPA has delegated activities under Section 319 (Non-Point Source Grant Program) of the Clean Water Act and Total Maximum Daily Loads (TMDL) to the Illinois EPA.

Programs and Authorities

Nutrient Mapping of the Upper Mississippi. The USEPA Region 5 provides assistance and opportunities for multi-state collaboration to delegated Clean Water Act State programs in the Upper Midwest. One area of focus is the Upper Mississippi River Basin, which includes the Illinois River Basin. Nutrients have been linked to localized water quality impairments throughout the Upper Mississippi Basin, as well as in the Gulf of Mexico.

The USEPA is exploring ways to rank watersheds based upon their contribution of nutrients to the Gulf of Mexico. This effort could be utilized in the future to focus EPA's nutrient reduction activities to maximize reductions achieved with available resources. The study consists of a basin-scale, landscape analysis of existing water quality data to determine statistically significant factors that define an area's potential to contribute phosphorus to the waters of the Upper Mississippi Basin.

Targeted Watersheds Grant Program. Through this program, the USEPA provides grants to local groups working to protect and restore watersheds. In 2004, the Sangamon River Basin was one of 14 watersheds nationally that was selected to apply for EPA's *Targeted Watersheds Grant Program.* The selected watersheds will apply for grants between $700,000 and $1,300,000. This competitive grant program provides needed resources to watershed organizations whose restoration plans set clear goals and objectives. Special consideration is given to proposals which emphasize water quality monitoring, innovation, public education and strong community support. For the 2004 grants, a programmatic emphasis was placed on proposals that incorporated market-based incentives, or related to nutrient loading in the Mississippi River basin contributing to hypoxia (dead zone) in the Gulf of Mexico. The Upper Sangamon River Watershed Committee will devote Targeted Watershed funds to three interrelated projects to improve water quality locally, regionally, and in the Gulf of Mexico by reducing unnecessary nutrient discharges from agricultural areas.

2004 State List of Illinois Water Quality Impairments. Section 303(d) of the Clean Water Act provides a coordinated framework between states and the USEPA to systematically track and address impaired waters both statewide and nationwide. Under Section 303(d), the Illinois EPA must submit a list of water quality impaired waters in the state, and USEPA must review and approve or disapprove the list. The Illinois 2004 Section 303(d) list (or Total Maximum Daily Load Program list) was approved by the USEPA in October, 2004. The list is available on the Illinois EPA website, http://www.epa.state.il.us/water/tmdl/303d-list.html.

Total Maximum Daily Load Program (TMDLs). Although much success has been achieved through the 303(d) process and NPDES permitting program in reducing pollutants discharged to waterways by municipal treatment works and industrial discharges, some impaired waterways are not expected to recover through the application of technology-based effluent treatment alone.

States are required to list impaired waters every 2 years and to prioritize each water for an in-depth analysis of pollutant sources and the reductions necessary so that they attain all of the uses that they are assigned (or "designated" in CWA terminology). The in-depth analysis is called a *Total Maximum Daily Load* or *TMDL*. A stream can have many different segments within a stretch, as well as numerous impairments representing a variety of needed improvements in its chemical, physical, and biological state.

The most recent TMDL list for the State of Illinois was approved in November 2004. The list can be found at the Illinois EPA website, http://www.epa.state.il.us/. The pollutant reductions called for in TMDLs may require voluntary actions and the cooperation of many programs such as the CWA 319 program, CREP program, and ecosystem restoration actions recommended in this document in order to realize the water quality improvements called for in the TMDL and realize the water quality goals of the Clean Water Act.

Potential Role in Implementing the Comprehensive Plan The EPA has the mission and programs to implement many projects in the upper reaches of watershed and along the tributaries. In particular, the Section 319 grant program and Targeted Watersheds efforts have the potential to provide restoration funding to improve water quality. In addition, the EPA's current and probable future monitoring has the potential to meet a portion of the systemic monitoring needs. However, funding for these programs would need to expand to meet the needs identified in the restoration plan.

iv. U.S. Fish and Wildlife Service (USFWS). The mission of the USFWS is "working with others to conserve, protect and enhance fish, wildlife and plants and their habitats for the continuing benefit of the American people." Key functions of the USFWS include: enforcing Federal wildlife laws, protecting endangered species, managing migratory birds, restoring nationally significant fisheries, conserving and restoring wildlife habitat, helping foreign governments with their international conservation efforts, and overseeing the Federal aid program that distributes money to State fish and wildlife agencies.

As site specific ecosystem restoration projects are identified and planning efforts initiated (site location, project features, and additional details) the Rock Island District would, as part of a separate NEPA document under this program, coordinate with the USFWS. This coordination would involve letters from the District to the USFWS pertaining to Section 7 of the Endangered Species Act. This is to insure that any action authorized, funded or carried out, is not likely to jeopardize the continued existence of any endangered or threatened species or result in destruction or adverse modification of critical; habitat. This coordination would also insure compliance with the Fish and Wildlife Coordination Act for construction of water resource development projects. This Act requires the Rock Island District to give full consideration of fish and wildlife resources and their habitat. It is likely that most, if not all future site specific ecosystem restoration projects would require USFWS coordination/participation for compliance with these laws.

Programs and Authorities.

Refuges. The USFWS manages four National Wildlife Refuges along the Illinois River and throughout the basin, encompassing 17,696 acres. The refuges include:

- Calhoun and Gilbert Lake Divisions of Two Rivers Refuge near the confluence of the Illinois and Mississippi Rivers;
- Meredosia Refuge at the north end of the Alton Pool;
- Chautauqua and Emiquon Refuges near Havana in the La Grange Pool; and
- Cameron/Billsbach Division south of Henry in the Peoria Pool.

These refuge lands are managed primarily to provide for the needs of wetland-dependent migratory birds, threatened species such as the bald eagle and decurrent false aster, and for native fish. When new lands are acquired, wetlands, prairie, and forest habitats are restored as needed. In some cases, water levels are manipulated in wetlands to provide optimum habitat diversity for numerous species of waterfowl, shorebirds, wading birds, and fish. The refuges provide opportunities for wildlife-oriented recreation such as hunting, fishing, wildlife observation, photography, interpretation, and environmental education when and where such activities are compatible with refuge objectives. Refuge goals, objectives, and management direction are outlined in the draft *Comprehensive Conservation Plans for the Illinois River National Wildlife and Fish Refuge Complex and for the Mark Twain National Wildlife Refuge Complex.* The refuges also actively support the Partners for Wildlife and Fish program described below.

An additional refuge is proposed for the Grand Kankakee Marsh National Wildlife Refuge, Indiana and Illinois. The development of the Grand Kankakee Marsh National Wildlife Refuge is: for the development, advancement, management, conservation, and protection of fish and wildlife resources" and "for 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…" Habitat restoration activities would include restoration and preservation of approximately 30,000 acres of wetland, prairies, and oak savanna habitat to meet the needs of migratory birds, threatened and endangered species, and aquatic resources in the Basin.

The **Partners for Fish and Wildlife (PFW) Program** has been utilized to restore numerous basins consisting of thousands of acres of natural habitats on private lands, typically non-cropped, within the State of Illinois. The program focuses on Federal trust resources, migratory birds, Federal threatened and endangered (T&E) species, and proximity to as well as benefits to refuge lands. Although not all the following restored acreage is within the Illinois River Basin, the information provided outlines the USFWS' PFW conservation efforts within the State of Illinois (Fischer, 2005).

Wetland basins	-	1987-2003, PFW restored 376 wetland basins consisting of 7,581 acres
Upland restoration	-	1991-2003, PFW restored 46 upland areas consisting of 1,603 acres
During FY 2003	-	PFW restored 20 basins totaling 2,015 acres

This program, administered by the Illinois Private Lands Office, is a very effective and efficient way of restoring habitat, and should be considered in future goal attainment calculations. During FY 2003 alone, the PFW program restored approximately 2,015 acres of habitat within the state. The number of projects and acres can be highly variable, but typically range in size from 10 to 15 acres. In addition, the PFW is complementary with USDA programs and actively works with interested landowners to satisfy their interests through either USDA farm programs or PFW. The USFWS biologists within the PFW program have formed integral relationships with NRCS district conservationists, state biologists, and many other conservation authorities throughout the state. Through the combination of the effectiveness of the program and the partnering relationships that have formed among natural resources managers, the program has become very successful.

Potential Role in Implementing the Comprehensive Plan. The USFWS has the potential to implement a number of tributary projects through the PFW program. In addition, the USFWS is prepared to assume operation and maintenance (O&M) responsibilities for restoration sites at its Refuge sites. However, funding for these programs would need to expand to meet the needs identified in the restoration plan. At current levels, the PFW program receives $60,000 to $80,000 in habitat restoration on the Middle and Lower Illinois Rivers. This roughly translates into 15 to 25 projects annually, restoring or improving from 50 to as many as 1,500 acres in the Illinois River watershed.

v. U.S. Geological Survey (USGS). The mission of the USGS is to serve the Nation "by providing reliable scientific information to describe and understand the Earth; minimize loss of life and property from natural disasters; manage water, biological, energy, and mineral resources; and enhance and protect our quality of life." The USGS Illinois Water Science Center (IWSC) performs various activities in the Illinois River Basin as part of specific studies and special networks and programs.

Programs and Authorities

Under the **Basic Data Collection Program**, the USGS IWSC operates eight streamflow gaging stations on the Illinois River (five continuous discharge and three stage-only stations) and numerous other stations on tributaries. The IWSC operates three sediment stations on the main stem. As part of the Lake Michigan diversion accounting (a part of the Supreme Court Decree), the IWSC is applying Acoustic Doppler Current Profilers (ADCP) and Acoustic Velocity Meters (AVMs) to measure flows from Lake Michigan to the Illinois River system at various locations in the Chicago area. All data collected are made available in the IWSC Digital Annual Data Report, and the discharge and stage data are available on a near real-time basis.

The **USGS National Water-Quality Assessment (NAWQA) Program** is a long-term program with goals to describe the status and trends of water quality conditions for large, representative parts of the Nation's ground and surface water resources. Assessment activities are being performed in 42 study units (major watersheds and aquifer systems) that account for a large percentage of the Nation's water use. A wide array of chemical constituents is measured in ground and surface water, streambed sediments, and fish tissue.

In Illinois, two NAWQA study units (the upper and lower Illinois River Basin study units) have been operational since 1986 with the beginning of a pilot study in the upper basin. Work on the lower basin began in 1994 and was reestablished on the upper basin in 1997. Various data sets and reports are available as part of the studies in both basins.

Funding for the NAWQA Program in the Illinois River Basin is expected to be as shown in table 6-2.

Table 6-2. NAWQA Funding by Federal Fiscal Year

Fiscal Year	Funding
2006	$626,400
2007	$620,000
2008	$449,000
2009	$1,157,000
2010	$881,000
2011	$600,000
2012	$440,000
2013	$440,000
2014	$440,000
2015	$440,000

The IWSC has numerous other activities in the Illinois River Basin, many carried out as part of the Water Cooperative Program, whereby local or State governments pay a portion of the study/data collection cost and the USGS pays no more than 50 percent of the cost. The IWSC collects continuous streamflow and rainfall data in the rapidly developing suburban counties of metropolitan Chicago. These data are used to calibrate USGS models of watershed runoff response to rainfall, which then are used to simulate runoff and flooding associated with a variety of land-use conditions and storms. Stream restoration, dam removal, and geomorphic analysis studies have been conducted on numerous locations in the Illinois River Basin. Numerous other site-specific studies have been and are being conducted on groundwater flow and quality in the basin, as well as work on the dissemination of a variety of hydrologic information through an Internet Map Server concerning source waters for the state. The IWSC also compiles and distributes water use information for the state on a 5-year basis.

U.S. Geological Survey activities in the Illinois River Basin involving other USGS disciplines (geology, geography, and biological resources) include involvement in a network of monitoring sites as part of the National Atmospheric Deposition Program/National Trends Network that provide continuous measurement and assessment of the chemical constituents in precipitation throughout the United States, glacial and bedrock mapping throughout Illinois and nearby states as part of the Great Lakes Mapping Coalition, coal availability and recovery, and various mapping initiatives, including partnerships with various agencies to update topographic maps and aerial photography throughout the state.

Potential Role in Implementing the Comprehensive Plan. The USGS has the mission and programs to contribute significantly to systemic and site specific monitoring. In addition, the USGS also has capabilities to assist with watershed assessments and project planning. However, funding for these programs would need to expand to meet the needs identified in the restoration plan.

vi. Illinois Department of Natural Resources (DNR). The mission of the Illinois DNR is to manage, protect and sustain Illinois' natural and cultural resources; provide resource-compatible recreational opportunities; and promote natural resource-related issues for public safety and education. In addition to serving as the primary sponsor for Section 519, the DNR has a number of other ongoing programs with the potential to restore portions of the basin over the next 50 years.

Programs and Authorities

The Illinois DNR is the lead State agency working with USDA and the Illinois Department of Agriculture on the Conservation Reserve Enhancement Program (CREP). These efforts are summarized as part of the programs of the USDA above.

In 1995, the State initiated and funded a $100 million **Conservation 2000 (C2000) Program** to protect and manage Illinois' natural resources. The program is authorized through the year 2009 and is subject to annual appropriations. The nine programs funded under C2000 are administered by three State agencies—Illinois DNR, Illinois Department of Agriculture, and Illinois EPA.

The largest C2000 Program administered by the Illinois DNR is the Ecosystems Program. The Ecosystems Program provides financial and technical support for maintaining, restoring, and enhancing ecological and economic conditions in key watersheds throughout the Illinois River Watershed and the rest of the state. The C2000 Program is delivered through ecosystem partnerships, which are coalitions of local stakeholders who develop and implement natural resources plans that include a broad array of projects for restoration, protection, enhancement, monitoring, and education. The partnerships apply for competitive grants and have been awarded funding for projects that are directly related to Illinois River Restoration. As of 2001, the value of all C2000 Ecosystem projects totaled $43,487,865. The C2000 Program contribution was $16,583,458, with matching funds of $26,904,408. These projects provide for streambank stabilization, wetland restoration, prairie restoration, riparian buffers, vegetative covers on construction sites, and restoration of oxbows in tributaries of the Illinois River.

The Illinois DNR currently manages 51 conservation sites, encompassing approximately 101,013 acres. Twelve State of Illinois conservation areas totaling 26,568 acres can be found along with two State forests of 3,673 acres. State Fish and Wildlife Areas can be found at 12 locations totaling 18,138 acres. Finally, the Illinois DNR operates 25 State Parks within the Basin with 42,138 acres dedicated to conservation and recreation.

The **Landowner Incentive Program (LIP)** supports collaborative efforts with private landowners interested in conserving natural habitat for species at risk, including federally- listed endangered or threatened species and proposed or candidate species, on private land while these individuals continue to engage in traditional land-use practices. The Landowner Incentive Program, funded through competitive grants with money from the Soil and Water Conservation Fund, establishes or supplements existing landowner incentive programs that provide technical or financial assistance to private landowners. All grants need to be matched at least 25 percent from a non-Federal source. The State of Illinois received a grant in 2005 to develop a pilot project on the Lower Sangamon to improve threatened and endangered species habitat primarily on CREP lands.

Potential Role in Implementing the Comprehensive Plan: The Illinois DNR is the primary sponsor of the Plan and current Critical Restoration Projects. It will provide funding and in kind services to match Federal funding on many of the projects. In addition, it will need to continue ongoing restoration, monitoring, and management activities and programs to maintain their current restoration efforts. Furthermore, funding will need to expand above existing levels to meet the needs identified in the restoration plan.

vii. Illinois Department of Agriculture. The mission of the Illinois Department of Agriculture is to be an advocate for Illinois' agricultural industry and provide the necessary regulatory functions to benefit consumers, agricultural industry, and natural resources. The agency will strive to promote agri-business in Illinois and throughout the world.

Programs and Authorities

During the reporting period of June 1, 2003 to September 1, 2005, the **C2000 Program** funded $2.2 million worth of upland soil and water conservation practices in the 39 counties that have significant land in the Illinois River Watershed. Administered by the Department and County Soil and Water Conservation Districts (SWCDs), this program provides 60 percent of the cost of constructing conservation practices that reduce soil erosion and protect water quality. Eligible conservation practices include terraces, grassed waterways, water and sediment control basins, grade stabilization structures and nutrient management planning. Approximately 1,330 individual conservation projects were completed in the Illinois River Watershed, bringing soil loss to tolerable levels on over 20,894 acres of land. This translates to over 113,914 fewer tons of soil loss each year.

In FY 2004, the State of Illinois, through the Department of Agriculture, provided over $3.3 million to 51 county SWCD offices in the Illinois River Watershed. Funds were used to provide financial support for SWCD offices, programs, and employees' salaries. Employees, in turn, provided technical and educational assistance to both urban and rural residents of the Illinois River Watershed. Their efforts are instrumental in delivering programs that reduce soil erosion and sedimentation and protect water quality.

In an effort to stabilize and restore severely eroding streambanks that would otherwise contribute sediment to the Illinois River and its tributaries, the Department of Agriculture is administering the **Streambank Stabilization and Restoration Program (SSRP).** The SSRP, funded under C2000, provides funds to construct low-cost vegetative or bio-engineered techniques to stabilize eroding streambanks. In FY 2004, 40 individual streambank stabilization projects, totaling $386,681 were constructed in 19 counties within the Illinois River Watershed. In all, over 24,746 linear feet of streambank, or more than 4.6 miles, have been stabilized to protect adjacent water bodies.

Another environmentally-oriented C2000 Program administered by the Department of Agriculture is the **Sustainable Agriculture Grant Program.** Grants are made available to agencies, institutions, and individuals for conducting research, demonstration, or education programs or projects related to profitable and environmentally safe agriculture. In FY 2004, over $347,000 was awarded to 17 grant recipients with programs or projects in the Illinois River Watershed to investigate such areas as alternative crops, nitrogen rate studies, riparian management, integrated pest management, and residue management.

Potential Role in Implementing the Comprehensive Plan. Along with the Illinois DNR, the Illinois Department of Agriculture is involved with the preparation of the Comprehensive Plan and could serve as the sponsor for future Critical Restoration Projects. The department could provide funding and in-kind services to match Federal funding on some Critical Restoration Projects. In addition, it will need to continue ongoing restoration and management activities and programs to maintain their current restoration efforts. Furthermore, funding will need to expand above existing levels to meet the needs identified in the restoration plan.

viii. Illinois Environmental Protection Agency (EPA). The mission of the Illinois EPA is to safeguard environmental quality, consistent with the social and economic needs of the State, so as to protect health, welfare, property and the quality of life.

Programs and Authorities

Through programs it administers, such as **Section 319 (Non-Point Source Grant Program) of the Clean Water Act**, the Illinois EPA has completed over 130 projects to reduce non-point source pollutants to Illinois waters since 1990, and over 35 projects are ongoing. Projects include watershed planning, installation of Best Management Practices, development of educational materials, and CREP assistance.

Section 303(d) of the Federal Clean Water Act requires states to identify waters that do not meet applicable water quality standards or do not fully support their designated uses. States are required to submit a prioritized list of impaired waters, known as the 303(d) List, to the USEPA for review and approval. The CWA also requires that a Total Maximum Daily Load (TMDL) be developed for each pollutant of an impaired water body. The Illinois EPA is responsible for carrying out the mandates of the Clean Water Act for the State of Illinois.

The establishment of a TMDL sets the pollutant reduction goal necessary to improve impaired waters. It determines the load, or quantity, of any given pollutant that can be allowed in a particular water body. A TMDL must consider all potential sources of pollutants, whether point or nonpoint. It also takes into account a margin of safety—which reflects scientific uncertainty—as well as the effects of seasonal variation.

Potential Role in Implementing the Comprehensive Plan: Along with the Illinois DNR, the Illinois EPA is involved with the preparation of the Comprehensive Plan and could serve as the sponsor for future Critical Restoration Projects. The agency may provide funding and in kind services to match Federal funding on some projects and monitoring activities. In addition, it will need to continue ongoing restoration, monitoring, and management activities and programs to maintain their current restoration efforts. Furthermore, funding will need to expand above existing levels to meet the needs identified in the restoration plan.

ix. States of Indiana and Wisconsin. The States of Indiana and Wisconsin are exploring options to participate in future restoration efforts under Section 519. If they decide to become full sponsors, the missions, programs, and roles of the various State agencies will be further defined.

c. Allocation of Recommended Section 519 Projects. As a collaborative planning study effort, this Plan not only recommends actions for the Corps of Engineers, but includes restoration efforts and components that would best be implemented by other Federal, State, and local agencies. By bringing together the expertise and programs of all the appropriate agencies, collaborative planning will solve problems at the proper scale, integrate solutions, and leverage funds.

The following is a conceptual breakdown of the estimated $7.4 billion in restoration needs over an anticipated 50-year period by Federal agency. While the notes and associated chart focus on Federal Agency, there would be local and state cost share funding associated with most of these programs. In order to estimate the breakdown, each area of potential work was evaluated relative to the agency and program missions to identify the most likely areas. However, it should be noted that the actual funding for all agencies is subject to further agency coordination and the level of annual appropriations made by the Administration and Congress.

Assumptions on future funding by Federal agency are shown in figure 6-2 (State and local matches are included as part of the associated Federal funds they leverage) In many cases, the local cost sharing match equals 25 to 50 percent of the total shown for each Federal agency.

- **Sediment Delivery.** Assumed 40 percent Corps of Engineers cost shared efforts with a focus on instream efforts, 40 percent USDA with a focus on detention areas, 20 percent USEPA-319 funds with a focus on water quality

- **Backwaters.** Assumed all Corps of Engineers work, majority 75 percent Navigation and Ecosystem Sustainability Program/Upper Mississippi River-Environmental Management Program (NESP/EMP) and 25 percent Illinois River Basin Restoration (Sec 519)

- **Side Channels.** Assumed all Corps of Engineers work, 75 percent NESP/EMP and 25 percent Sec 519

- **Island Protection.** Assumed all Corps of Engineers work, 75 percent NESP/EMP and 25 percent Sec 519

- **Mainstem Floodplain.** Assumed Corps of Engineers would lead effort to restore 20,000 acres under the NESP/EMP authorities out of tentative selected plan level of 75,000 total. Of the remaining 55,000 acres, it is assumed that roughly 50 percent or 27,500 acres would be funded out of Illinois River Basin Restoration Sec 519 authority and 27,500 acres would be funded through USDA's WRP and CRP program.

- **Tributary/Floodplain/Riparian.** Assumed 40 percent Corps focus on areas tied to wetland and instream structures, 40 percent USDA focus on corridor and buffers, 15 percent USEPA-319 funds, 5 percent USFWS Partners for Fish and Wildlife

- **Tributaries - Instream.** Assumed 40 percent Corps of Engineers with a focus on instream efforts, 40 percent USDA with a focus on detention areas, 20 percent USEPA-319 funds

- **Connectivity.** Assumed of the Federal funding, 100 percent Corps of Engineers 519 funding for fish passage. The potential exists that Illinois DNR – Office of Resource Conservation may implement up to 25 percent of the fish passage projects on their own, without Corps of Engineers cost share.

- **Water Level - Tributaries.** Assumed 40 percent Corps of Engineers, 40 percent USDA, 15 percent USEPA-319 funds, 5 percent USFWS Partners for Fish and Wildlife

- **Water Level - Gates.** Assumes these features will be put in place under the Corps of Engineers - NESP

- **Pool Drawdown.** Assumes 100 percent Corps of Engineers O & M Funded

- **Other Components/Monitoring.** Assumes some monitoring tasks covered by EMP (LTRMP)/NESP ~20 percent, USGS ~7.5 percent, and USEPA ~5 percent

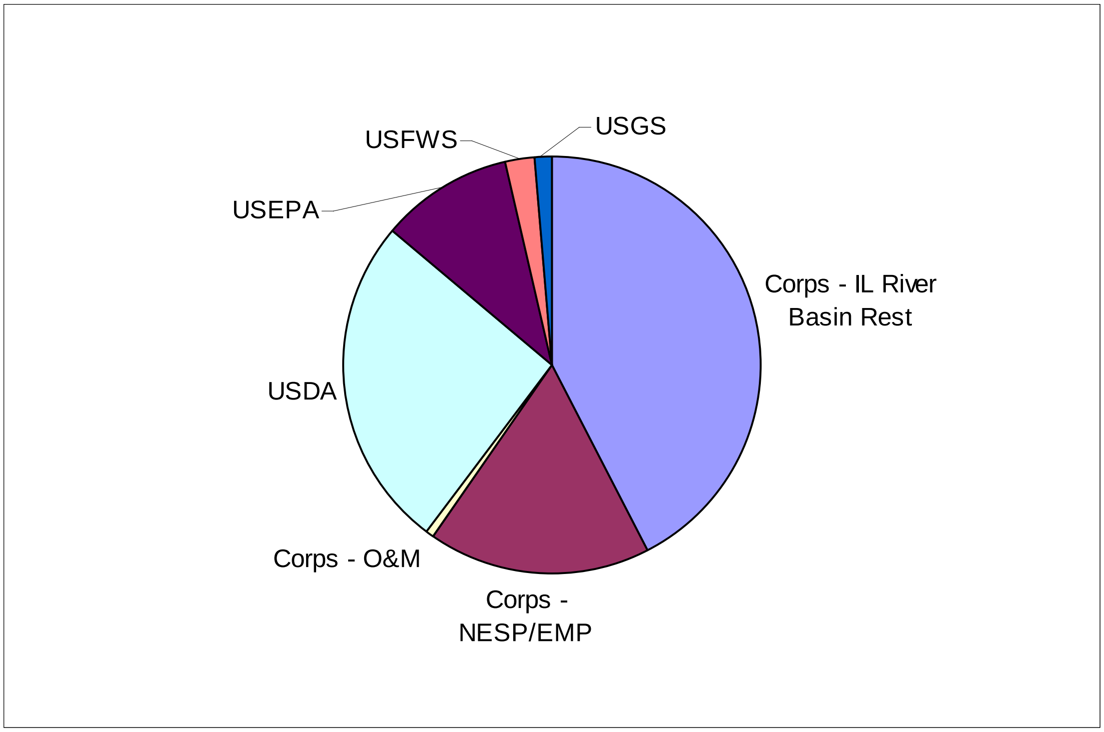


Figure 6-2. Conceptual Breakdown of preferred comprehensive plan alternative Funding by Federal Agency
Note: Most Federal funded projects will require non-Federal sponsor matching (state or local).

d. Potential Actions to Support Collaborative Planning and Cooperative Conservation. Two specific actions were identified by the study team that could provide for more efficient cooperation between Federal, State and Local organizations. Authorization to allow these actions could help to strengthen and provide more direct partnership opportunities, while also reducing costs; the Corps plans to study these actions further and is making no recommendation at this time.

Authorization does not currently exist allowing the development of cooperative agreements and fund transfers between the Corps of Engineers and the State of Illinois; State of Indiana; State of Wisconsin; scientific surveys at the University of Illinois; and units of local government: counties, municipalities, and Soil and Water Conservation Districts to facilitate more efficient partnerships. A provision allowing cooperative agreements could improve the efficiency in reaching and utilizing the most efficient organizations to conduct various program tasks. In particular, more efficient mechanisms are needed to engage and fund various state, University, and some local organizations to utilize their unique staff capabilities to support the program (e.g. State of Illinois Field Survey Crews, University of Illinois professors and staff of the State Water, Geologic, and Natural History Surveys). While some potential tasks for these organizations would be performed as work-in-kind, there is not currently a mechanism to transfer Federal and state cost-share funds held by the Corps to fund the assistance of these organizations. These organizations have staff with detailed knowledge of the system, existing field stations, background data, and relationships with key partners that could improve the efficiency of the program.

Likewise, authorization does not currently exist for the Corps of Engineers to deviate from normal procurement laws and regulations and to provide funding directly to landowners to implement structural and land management conservation measures. If in the future the Corps decides to pursue, and Congress provides, such authority, it is likely that the Corps would work closely with NRCS, which has established programs for the provision of this type of assistance. Further, if authorization is pursued, it is envisioned at this time that providing funds directly to landowners to accomplish work would be a limited portion of the Corps of Engineers program, used in those cases where it would improve efficiency and cost effectiveness. For example, in a river or stream reach requiring a number of features (series of riffle-pool grade control features and associated adjacent features), most of the project features could be constructed through traditional Corps contracting; however, there may be aspects or locations where cost effectiveness and landowner willingness would make provision of funds directly to the landowners a more viable and efficient approach. Further discussions will also involve the USFWS for outreach, project planning, and project implementation.

e. Regulatory Activities. In addition to interagency coordination of restoration activities, careful consideration will be given to ongoing regulatory activities in the Illinois River Basin. The implementation framework will be developed to identify constraints and tradeoffs among new projects, existing projects, and other planning and regulatory decisions that affect the implementation and effectiveness of restoration efforts. Any procedures for successful restoration of streams, wetlands, and riparian areas resulting from this restoration program will be shared with regulatory agencies and local communities for consideration in future permit and land use actions.
Despite efforts to address this important provision, it is acknowledged by many stakeholders that a more thorough and comprehensive effort is needed to ensure consistency throughout the basin. It is further recognized that the Plan is an appropriate vehicle for initiating such an effort. Potential steps towards such consistency in implementing the Plan could include:

- "Basin Consistency" reviews held approximately annually. Members of the System Team and regulatory staff could meet to review the locations of Critical Restoration Projects as well as recent and significant regulatory actions. Tracking regulatory actions using the Operations and Maintenance Business Information Link Regulatory Module (O.R.M.) database and Critical Restoration Projects using geographic information systems (GIS) would allow for joint analysis as a way of identifying opportunities for joint efficiencies and avoiding inconsistent actions.

- Early coordination between the States, Corps, and other Federal agencies through the Steering Committee and Regional Teams for projects in the basin that have potential impacts upon restoration activities.

- As the primary regulator of Section 404 permits, the Regulatory Branch of the Corps plays an important role in the success of this restoration initiative. The Regulatory Branch is frequently contacted by landowners interested in stream and wetland modifications. Interested and willing landowners could be directed to contact key members of regional teams for assistance in projects such as stream restoration (as opposed to channelization) or wetland protection and restoration (as opposed to draining/development). Wetland, stream, and forest mitigation as outlined in the Corps' recent "draft mitigation guidelines" could be emphasized for the most important areas within each tributary watershed of the Illinois River Basin.

- Special Area Management Plans (SAMPs) be developed for key areas of the basin where considerable planning and restoration activities occur. With SAMPS, the Corps of Engineers undertakes a comprehensive review of aquatic resources in an entire watershed. This approach is more environmentally sensitive than the traditional project-by-project process. The traditional approach may lead to the cumulative loss of resources over time. With the SAMP approach, potential impacts are analyzed at the watershed scale in order to identify priority areas for preservation, identify potential restoration areas, and determine the least environmentally damaging locations for proposed projects. The goal of SAMPs is to achieve a balance between aquatic resource protection and reasonable economic development. SAMPs are designed to be conducted in geographic areas of special sensitivity. These comprehensive and complex efforts require the participation of local, state, and Federal agencies.

B. IMPLEMENTATION FRAMEWORK

The following plan implementation process specifically addresses how activities proposed for funding through the Corps of Engineers would be conducted. The approach of utilizing multi-agency regional teams to review project submissions and the involvement of higher level staff from other agencies in an Illinois River Basin Steering Committee will provide a sound basis for matching proposed restoration with the authorities and funding of various agencies. Implementation activities will involve three areas: program management, Critical Restoration Projects, and technologies and innovative approaches.

1. Program Management. Management efforts would include funding for both the Corps of Engineers Districts and non-Federal sponsors for project management and coordination activities. Specifically this funding would address: (1) briefing and interaction with the Executive Committee, Steering Committee, System Team, and Regional Teams, (2) active participation at Illinois River related task forces, committees, work groups, conferences and meetings, (3) development and negotiation of programmatic cooperative agreements, (4) initial meetings and site visits for prospective projects, (5) program agreements and administration, (6) program budgets, (7) responding to program data calls, (8) program information and project solicitation, (9) annual reporting, and (10) preparation of formal documents and related support functions.

A certain level of annual funding would be necessary in order to cover system management costs. The estimated cost assumes the initial project funding increases to approximately $750,000 annually, or approximately 1.8 and 1.5 percent of the initial project costs through years 2011 and 2015, respectively. These costs include estimates of the management costs incurred by the non-Federal sponsors, which could be creditable as in-kind services.

2. Critical Restoration Projects. Section 519 currently authorizes the planning, design, and construction of Critical Restoration Projects with a current per project limit of $5 million Federal and $7.7 million total. The specific criteria and prioritization process for Critical Restoration Projects are as follows:

a. Criteria

i. Section 519 of WRDA 2000 specifies that if a restoration project for the Illinois River basin will produce independent, immediate, and substantial restoration, preservation, and protection benefits, the Corps of Engineers shall proceed expeditiously with the implementation of the project.

ii. Additional criteria have been developed as part of the Plan, including giving priority to projects that improve quality and connectivity of habitats; providing habitat for regionally significant species; reducing sediment delivery; naturalizing hydrology; maximizing sustainability; considering and addressing threats; improving water quality; considering other agency activities; and having public support.

b. Prioritization Process. The proposed assessment and implementation process seeks to create a systemic, comprehensive approach that is accessible to project partners and stakeholders. The ecological merits of proposed projects will be the most important selection factor. Other factors to be considered will include goal-specific factors, public interest and acceptability, and administrative issues. It is important to emphasize that project implementation will not proceed rigidly in strict order of numerical rankings. Flexibility is essential, and the Corps of Engineers, working with the Illinois DNR and other sponsors, and in consultation with the other agencies and stakeholders, will exercise reasonable judgment to resolve unexpected issues, respond to unforeseen opportunities, and ensure efficient program execution. Regulatory agencies will be included in the assessment and feasibility phases to better identify areas of concern as a watershed approach is taken during implementation of the program.

The four-part general implementation process is described as follows and is summarized in figure 6-3. The steps include assessment process, feasibility process, implementation/construction process, and post-construction evaluation process. The implementation process will have three separate decision phases – initiation of assessments, initiation of project implementation reports (feasibility study phase); and identification of a recommendation and start of design/construction sequence.

It is anticipated that decisions on which projects will proceed into each of these phases will be made annually, based on funding issues. Decisions to move forward with the program at each decision phase will be made by the Executive Committee. For the Corps, the Assistant Secretary of the Army (Civil Works) [ASA (CW)] will approve the project implementation reports. The MVD working with LRD will retain responsibility for decisions regarding project submissions to Corps HQUSACE and the ASA (CW) on all programming and budgetary decisions. Ultimately, some delegation of approval authority to MVD and the Districts for projects is anticipated.

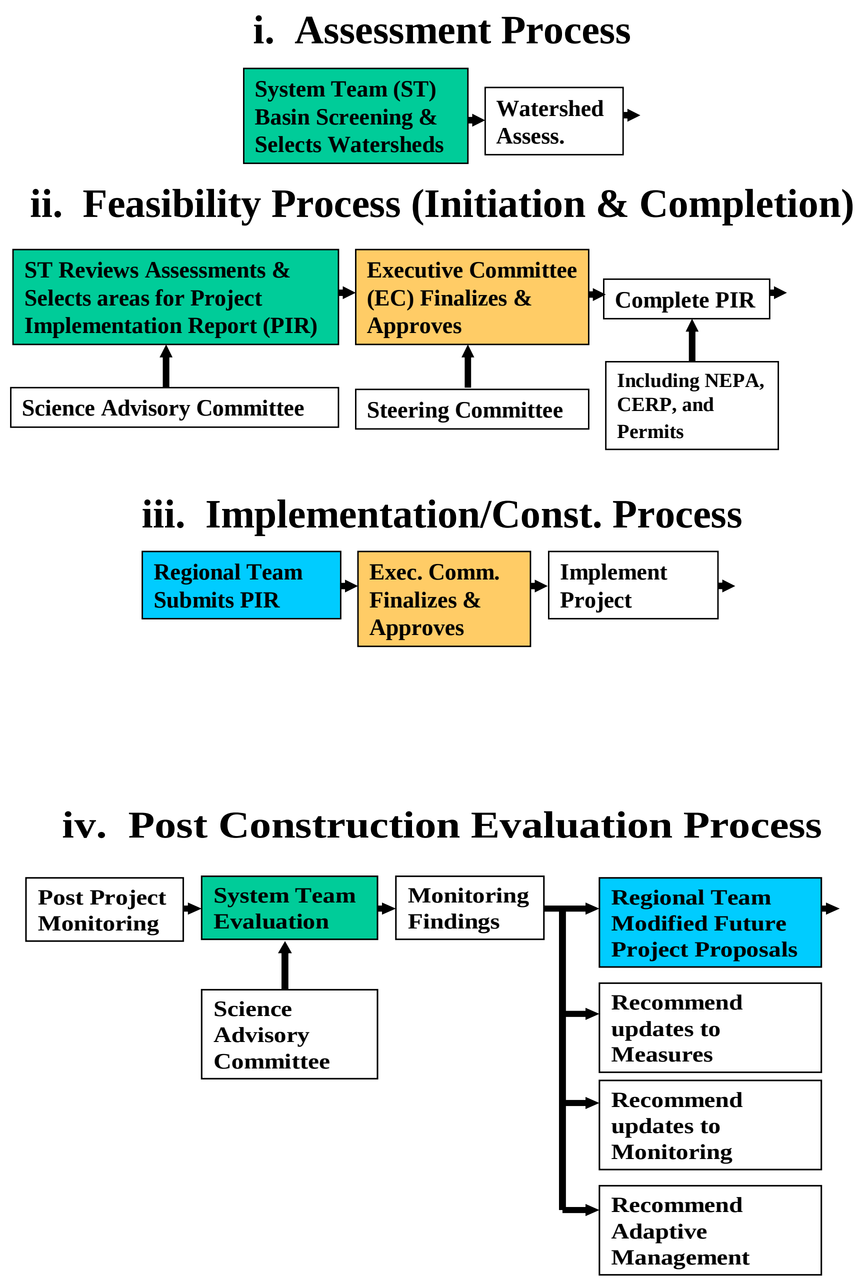


Figure 6-3. Process Diagrams for Project Implementation Phases

i. Assessment Process

Basin Screening. The initial identification and selection of the watersheds and pools for assessment will be conducted by the System Team using the system prioritization criteria, with input from the regions and other study committees. The System Team will perform an initial screening of subwatersheds in the basin using existing information, and will rely heavily on GIS data. Mainstem Illinois River evaluations will be coordinated closely with the activities of the NESP and EMP programs. Screening will specify problems and restoration opportunities, and identify specific areas (sub-watershed or pool segments) in need of a more detailed assessment. The primary criteria are shown on table 6-3 and include: improve quality and/or increase area/connectivity of high quality habitat areas, sediment reduction to the Illinois River, presence of threats (population increase, water quality), other agency efforts, and public support (local plan/partnership group). The most promising watersheds identified at this level will be recommended for Watershed Assessments.

An initial screening was conducted in 2005 to identify additional Critical Restoration Projects. Due to the current time and funding constraints, only those basin areas specifically nominated for consideration by the Illinois DNR or other potential sponsors were considered. However, future basin screening efforts would include the entire basin.

Watershed Assessment. The first step in initiating site specific work in the basin will be to conduct detailed Rapid Watershed Assessments and Pool Assessments for portions of the basin evaluating ecologic, geomorphologic, and hydraulic conditions (typically at the small/sub watershed level ~100 square mile basins). These areas will be selected based on a basin screening conducted by the System Team using system prioritization criteria, with input from the regions and other study committees. The emphasis of the assessments will be on evaluating and more clearly defining the more localized areas where system restoration should be accomplished and types of measures needed throughout the basin. As a result, Watershed Assessment Reports will be submitted on each area evaluated, verifying the basin screening criteria; identifying problems, opportunities, and potential projects; and relating potential projects to the program goals. Table 6-3 outlines the screening prioritization criteria. In addition, these reports will gather more specific data allowing further project definition and selection of feasibility study areas. Regional Teams will be asked to submit existing assessments from other sources to assist in the process. As they are completed, the Watershed Assessments will be shared with other agencies through the Steering Committee and Regional Teams to evaluate which agencies are best able to address the needs identified.

The Watershed Assessment Reports will be evaluated by the System Team. Projects identified through the watershed assessment to proceed as CRP's under the Corps 519 authority will move into the next phase; preparation of a Project Implementation Report (PIR). The System Team will propose areas for PIR investigation and will solicit input and recommendations from the State Surveys and/or Science Advisory Committee (SAC). The Watershed Assessments will be used to scope projects to fit the current project dollar cap ($5 million Federal; $7.7 million total). Multiple projects may result from one assessment, or several assessments may be combined for one project. The Executive Committee will review and approve these as part of setting the annual work plan.

Table 6-3. Basin, Watershed, and Project Prioritization Process

Criteria Description	Basin Screening	Watershed Assessment
Location in IL River basin	Priority/greater initial weighting will be placed on watershed draining into Peoria Pool and upstream, then Alton & LaGrange pools	
Reduce sediment delivery to Illinois River	Existing data from past reports and system study on delivery	Field verification of Phase I factors. Field investigation of geomorphological attributes—i.e. locating headcuts and monitoring erosion of banks.
Improve quality and/or increase area/connectivity of Biologically Significant Areas (BSA)/Resource Rich Areas (RRA)	Office assessment of existing biological and GIS data from Corps, DNR, TNC, EPA. Contiguous habitat.	Field verification of Phase I factors. Field investigation of biological attributes (ability to meet system patch size, spacing, connectivity, etc. goals).
Improve, protect and expand habitat for regionally significant species (including T & E), patch size and spacing	Number of threatened/ endangered species	Identification of specific species and potential to benefit.
Increase base flows and/or decrease peak flows	Preliminary Assessment	More detailed analysis
Threats to Ecological Quality/Integrity	Consider population density, pop. Growth rates, percent impervious cover, and water quality (303d)	Field verification of Phase I factors. Land use changes, increased isolation, invasive species
Other Agency Efforts	Identify known areas of other agency restoration activity	Identify specific other agency actions and potential to collaboratively address problems.
Public support	Existence of local plan or ecosystem partnership group	Identified support in progress, landowner interest
Sustainability		Assessment of potential to be self sustaining/add to system self sustaining.

ii. Feasibility Process (Project Implementation Report)

Selection of Projects for Feasibility. The feasibility process will be initiated on the most promising projects following review of the watershed assessments. The System Teams will conduct a system-level evaluation and sequencing of the projects based on the data in the assessments. The purpose of the system evaluation will be to propose which projects best meet system ecological needs and goals. In addition to the prioritization criteria outlined in table 6-3, additional system criteria will consist of the following, but may be modified with the concurrence of the System Team:

- Measures of how well the project meets system goals as identified in the system study, and watershed and pool assessments, monitoring trend data, and other pertinent databases
- Consistency with other habitat goals such as those identified in master plans, the North American Waterfowl Management Program, U.S. Shorebird Conservation Plan's Upper Mississippi Valley/Great Lakes Regional Shorebird Conservation Plan, Partners in Flight Bird Conservation Plan, State watershed and river programs, national hypoxia/nutrient plans, etc.
- Natural process considerations, such as hydrology, sedimentation, flow distribution, floodplain connectivity, fire, etc.
- Sequencing of projects on the basis of their anticipated ecological and geomorphic interrelationships
- Focus on the quality of the habitat and habitat patch size, spacing criteria, connectivity
- Focus on the presence of threats to the ecological integrity
- Considerations of the project's habitat sustainability and long-term viability
- Risk and uncertainty of project success
- Public support

Once the system evaluation is complete, the highest rated projects will be presented to the Executive Committee. The Executive Committee will review the information collected to date and consider other factors relating to policy and administrative issues (e.g. partnership opportunities, funding availability, and mix of projects). This step will end with recommendations from the Executive Committee on which projects should proceed into the PIR phase and develop site-specific recommendations.

Feasibility Study. Each Critical Restoration Project selected for further study will be evaluated through a separate decision document (Project Implementation Report). The evaluations will define benefits such as habitat units created, stream miles of connectivity, tons of sediment reduced, and other measures. Cost Effective and Incremental Cost analyses will be used to evaluate the benefits and costs of various project alternatives and to identify a preferred comprehensive plan alternative. For any preferred comprehensive plan alternative, the evaluations must show that the outputs of each project outweigh its respective costs. The feasibility phase will be cost shared 65/35 with the sponsor.

iii. Implementation/Construction Process. As feasibility study efforts are completed, the reports will go through a formal HQUSACE approval process (Section c, *Corps Procedures for Processing Critical Restoration Project.*) the local sponsors will also review the reports. Once approved, the recommended plans will be forwarded to the Executive Committee to identify a preferred implementation/ construction sequencing. Included in the implementation phase is the actual implementation construction, monitoring, and adaptive management.

If more projects are awaiting implementation than funding allows, it is reasonable to shift the evaluation criteria to the question of which administrative mix of projects is appropriate to meet long-term ecological sustainability of the Illinois River Basin and maintain public interest and participation. The Corps and Illinois DNR will develop a proposed "Illinois River Basin Restoration Program Plan" based upon the high priority ecological projects resulting from the previous two-stage ecological screening process and other factors relating to policy and administrative issues. The Corps and State Program Managers will lead the Program Planning effort for the Executive Committee.

In selecting the sequenced ecological projects, a variety of policy and administrative considerations will be considered to determine an optimal project mix. These considerations will include:

- Ability to provide system benefits
- Combination of innovative and proven techniques, considering applicability of innovations to future projects and replicability
- Variety in types of measures
- Geographic distribution
- Yearly funding
- Maintaining minimum district delivery capability
- Cost sharing
- Public support
- Readiness (NEPA, permits, land availability)
- Leveraging non-IRBR funds
- Compatibility with other river uses
- O&M requirements

The program plan will be provided to the Steering Committee for review and comment. Coordination will also occur with other groups including the Regional Teams, System Team, Stakeholders, and others regarding various factors affecting project implementation.

Future PCAs will be modeled after the Peoria Riverfront Development – Upper Island PCA, approved in September of 2005. Overtime, it is anticipated that a model PCA will be developed for the program from the initial projects, allowing delegation of PCA approval in future years.

iv. Post-Construction Evaluation Process. Following actual construction, any planned post-construction monitoring would be conducted. The results of this monitoring will be provided to the System Team to assess the overall success of various types of projects and measures, assess the monitoring approach, and recommend adaptive management actions if necessary. The System Team will provide results to the regional teams to consider in modifying future projects.

c. Corps Procedures for Processing Critical Restoration Projects. Future actions necessary for project approval, budgeting, and implementation are summarized below. The Mississippi Valley Division will provide overall management and budgeting for the program, in accordance with the Memorandum of Understanding executed January 4, 2006 by the Executive Committee. The Comprehensive Plan establishes a process for prioritization of projects, program management, and processing. Project Implementation Reports (PIRs), Project Cooperation Agreements (PCAs), and other submissions to higher authority will be processed through the division where the project is located (MVD or LRD). The MVD as the overall program lead and the Rock Island District as the Regional Program Lead should be kept aware of the status of In Progress Reviews (IPR) and HQUSACE issues on projects in LRD.

i. As a given PIR nears completion, an IPR will be scheduled with HQUSACE and the appropriate division to discuss the findings in the PIR. An information package similar to that provided for an Alternative Formulation Briefing will be prepared for the meeting. This requirement may be waived as experience is gained in the program.

ii. The final PIR will be provided to the appropriate division to conduct a policy compliance review. For initial PIRs submitted, the division will conduct this review prior to review by HQUSACE. As experience is gained through the program, concurrent review will be conducted with HQUSACE.

iii. Upon completion of the policy compliance review and endorsement by the appropriate division, the PIR will then be submitted to HQUSACE for submission to the Office of the ASA(CW) for approval.

iv. Subject to the availability of Construction General funds, Plans and Specifications can be initiated upon issuance of the division endorsement to HQUSACE, or as further noted in this paragraph. When concurrent review with HQUSACE is put in place, the appropriate division can provide instructions for initiation of Plans and Specifications when it is satisfied that policy and procedural requirements are met prior to full completion of the review process. Actual Plans and Specifications initiation will be subject to funding availability, which shall be coordinated with the Rock Island District as the Regional Program Lead for inclusion in the annual work plan and approval by the Executive Committee.

v. Subsequent to PIR approval by the ASA(CW) and Construction General funding being provided by the Congress, a PCA must be negotiated and executed with the non-Federal sponsor. The PCA describes the critical restoration project, the items of local cooperation, and the responsibilities of the Government and the non-Federal sponsor in the cost sharing, financing and execution of the critical restoration project.

vi. The Corps can submit a budget request for Construction General funds for any critical restoration project in which the Project Implementation Report (PIR) has been approved by ASA(CW) by August 1 of the program year less 2 years. The initial new start submission is made by June 1 each year, with changes possible until August 1. However, in order for a given critical restoration project to be included in the President's Construction General budget, the PIR must be reviewed by OMB in accordance with Executive Order 12322 and be cleared by OMB for budgeting. At this time, two critical restoration projects (Peoria Riverfront Development, Upper Island and Pekin Lake Northern Unit) have been approved by the ASA(CW) for implementation, subject to the availability of Construction General funds and execution of a PCA. The Peoria Riverfront Development project is currently under review by OMB and the Pekin Lake Northern Unit will be requested to be submitted to OMB in the near future. There are no Construction General funds in the President's FY 2007 budget for this program. To date Congress has appropriated (through adds) a total of $3.7 million in Construction General funds for the program ($2 million in FY 2003, $1.5 million in FY 2004, and $200,000 in FY 2005). The PCA for the Peoria Riverfront Development, Upper Island project was executed on April 25, 2006 with project implementation limited by the Construction General funds that are currently available.

vii. Subject to the availability of Construction General funds, the Corps will complete final design and Plans and Specifications for the project construction.

viii. The non-Federal sponsor will be required to provide all lands, easements, rights-of-way, relocations and disposal areas (LERRD)necessary for project construction and OMRR&R.

ix. Subject to execution of a PCA, the availability of the required Construction General and applicable non-Federal funds, and the non-Federal sponsor providing the necessary LERRD, construction contracts will be advertised and awarded.

xi. Upon completion of construction, the critical restoration project will be turned over to the non-Federal sponsor, who will be responsible for OMRR&R in accordance with guidelines in the PCA and the OMRR&R manual as furnished by the Corps.

3. Status of Critical Restoration Projects. Restoration of the Illinois River Basin requires the identification and implementation of projects within the watershed and along the course of the river that repair past and ongoing ecological damage so that a more highly functioning, self-sustaining ecosystem can develop within the basin. Critical Restoration Projects will produce immediate ecological benefits, will help evaluate the effectiveness of various restoration methods before system wide application, and make best use of the current local and State interest in ecosystem restoration within the basin. Construction of Critical Restoration Projects will allow sponsors and the public to see immediate results that will help to provide broad support for future projects. The Corps of Engineers will implement these Critical Restoration Projects in collaboration with the non-Federal sponsor and other Federal and local agencies.

Feasibility level investigations for six site-specific projects were initiated under the Illinois River Ecosystem Restoration Study. The list was expanded to eight following further evaluation at Pekin Lake, which identified two separate study efforts and inclusion of the first separable increment of the Peoria Riverfront Development Project. These projects will produce independent, immediate, and substantial restoration, preservation, and protection benefits and are being completed and implemented as the initial Critical Restoration Projects of the Illinois River Basin Restoration Project. Eight additional projects were added in 2006 (figure 6-4). These projects are being developed as stand alone documents with separate evaluation and coordination of environmental and cultural effects. Future Critical Restoration Projects will be tiered from the programmatic Environmental Assessment contained in this document.

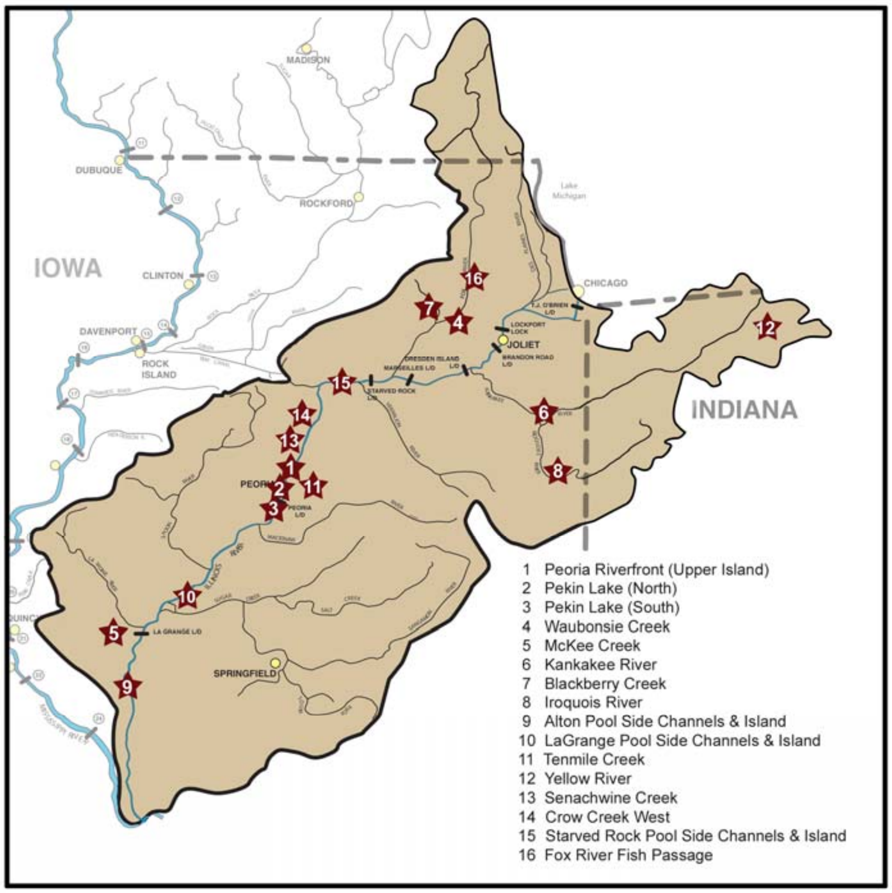


Figure 6-4. Critical Restoration Project Locations

a. Peoria Riverfront Development - Upper Island. The project area includes upper portions of Lower Peoria Lake, RM 166 and is adjacent to the Cities of Peoria and East Peoria. Peoria Lake is the largest bottomland lake in the Illinois River Valley and has experienced loss of depth similar to other Illinois River backwater lakes. Loss of aquatic habitat due to sedimentation is the greatest threat to the healthy function of Peoria Lake. The principal goal is to improve depth diversity enhancing aquatic habitat in Peoria Lake with ancillary recreational benefits. The recommended plan for the Upper Island includes dredging approximately 54 acres within Lower Peoria Lake to create deepwater habitats and constructing one 21-acre island. The project costs are estimated at $7.5 million. This effort is consistent with system goals of restoring aquatic habitat diversity of side channels and backwaters, and improving floodplain and habitats and functions. The expected benefits clearly outweigh the investment cost. The feasibility and design phases are complete, and construction can occur once funding is available.

b. Pekin Lake Northern Unit. Pekin Lake Northern Unit is the northern portion of a backwater lake complex located adjacent to the Illinois River at RM 153-156. The backwater lakes and side channels once provided large areas of deep and shallow water habitat, sloughs, and forested and non-forested wetland habitats. Sedimentation and willow invasion have significantly reduced aquatic and wetland plant production. The project will allow for management of water levels for habitat and remove large areas of willow trees to increase moist soil plant production. The improved wetland will provide a reliable food source and critical stopover along the internationally significant Mississippi River Flyway. The project will maintain a historic heron rookery and slow the anticipated loss of the backwater lake. The project costs are estimated at $6.9 million. This effort is consistent with system goals of restoring aquatic habitat diversity of side channels and backwaters; improving floodplain, riparian and aquatic habitats and functions; and restoring hydrologic regimes on 681 acres. The feasibility phase is complete, and design is nearing completion.

c. Pekin Lake Southern Unit. Pekin Lake Southern Unit is the southern portion of a 1,200-acre backwater lake complex located adjacent to the Illinois River at RM 153-156. The area once provided fish over wintering habitat that has since been degraded by excess sedimentation from the Illinois River. Currently, there are no existing overwintering fish habitats within approximately 20 miles of Pekin Lake State Fish and Wildlife Area. Higher water levels throughout the system have nearly eliminated the mast producing hardwood forests in the Illinois floodplain, and completely at Pekin Lake. The project will address the lack of over wintering fish habitat and the declines in diverse bottomland forest areas. The alternatives considered include dredging for overwintering habitat with the placement of some of the dredged material onsite to create suitable areas for mast producing trees. The project costs are currently estimated at $7.6 million. This effort is consistent with system goals of restoring aquatic habitat diversity of side channels and backwaters; and improving floodplain, riparian and aquatic habitats and functions on 390 acres. The feasibility phase is complete, and design is nearing completion.

d. Waubonsie Creek. Waubonsie Creek is located in northeastern Illinois. The creek has a number of low-head dams that prevent movement of fish from the Fox River into approximately 7 miles of potential spawning and nursery habitat in Waubonsie Creek. The project will restore fish access to quality spawning habitat, allow fish recolonization of the creek following high flow, restore riparian wetlands, improve aquatic habitat, and provide off-channel refuge for fish during high flow events. Total project costs are estimated at $2.2. This effort is consistent with system goals of improving floodplain, riparian and aquatic habitats and functions; and restoring longitudinal connectivity on the tributaries. The feasibility phase is complete, and design has been initiated.

e. Kankakee River Riffles. The Kankakee River is a high quality river located in northeastern Illinois and northwestern Indiana. The Kankakee River carries an excessive sediment load, and habitat quality in the river is expected to decline due to sedimentation. Side channel and pool areas in this reach are expected to continue to lose depth and habitat diversity as cobble and gravel substrates become covered by sand. The project will restore and maintain deep-water and high quality riffle habitat critical to many state-protected species along 30 miles of the Kankakee River. Total project costs are estimated at $6.5 million. This effort is consistent with system goals of reducing sediment delivery to the Illinois River and improving floodplain, riparian and aquatic habitats and functions. The feasibility phase is ongoing.

f. Iroquois River. The Iroquois River is located in eastern Illinois and western Indiana and is a tributary to the Kankakee River. Modifications of tributaries through ditching and straightening have increased velocities, bed and bank erosion, and the sediment load delivered to the Iroquois River and eventually the Illinois River. Once the fine sediment is mobilized, it remains suspended until much lower flow velocities occur. It is transported into the Illinois River and drops out in backwater lake areas. The sedimentation of these highly productive backwater lakes is recognized as the greatest threat to the Illinois River ecosystem. Channel instability also negatively affects the habitat value of the tributary stream and its riparian corridor. The project will reduce delivery of sediment to the Illinois River, stabilizing a portion of the Iroquois river basin by addressing a head cut on one of its tributaries, Sugar Creek. The project will maintain aquatic habitat in 10 miles of tributary stream by preventing degradation associated with upstream progression of channel incision. Stream stabilization structures will be designed to provide in-stream habitat. Total project costs are estimated at $6 million. This effort is consistent with system goals of reducing sediment delivery to the Illinois River; improving floodplain, riparian and aquatic habitats and functions; and improving water and sediment quality in the Illinois River and its watershed. The feasibility phase is on hold pending funding.

g. McKee Creek. McKee Creek is a direct tributary to the Illinois River located in west-central Illinois. Modifications of McKee Creek and its tributaries through ditching and straightening have increased velocities, bed and bank erosion, and the sediment load delivered directly to the lower Illinois River. The stream has incised channels and high rates of lateral migration. The lower 30-mile reach erodes an estimated 100,000 tons of bank material per year. The project will prevent delivery of an estimated 2.5 million tons of sediment to the Illinois River over the project life by stabilizing head cuts on the lower 10 miles of McKee Creek. The project will maintain and improve aquatic habitat in over 30 miles of stream by preventing degradation associated with upstream progression of channel incision, widening, and bank collapse. Stream stabilization structures will be designed to provide in-stream habitat. Total project costs are estimated at $6.3 million. This effort is consistent with system goals of reducing sediment delivery to the Illinois River; improving floodplain, riparian, and aquatic habitats and functions; restoring hydrological regimes; and improving water and sediment quality in the Illinois River and its watershed. The feasibility phase is on hold pending funding.

h. Blackberry Creek. Blackberry Creek is located in northeastern Illinois and is a tributary of the Fox River. Currently, the stream has high quality habitats, but a 10-foot dam near the confluence with the Fox River severely limits fish, mussel, and macroinvertebrate access to this habitat. The project will restore fish passage at the Blackberry Creek Dam. The project will restore access to 30 miles of quality stream habitat and allow fish recolonization of the creek following high flow events. This effort is consistent with system goals of improving riparian and aquatic habitats and functions and restoring longitudinal connectivity on the tributaries. This project is currently in the feasibility phase.

i. Senachwine Creek. Senachwine Creek is located within Peoria and Marshall counties in Illinois. The watershed drains approximately 85 square miles and is predominately agricultural in nature. Although the local tributaries of Peoria Lake, such as Senachwine Creek, contain only 4 percent of the drainage area, the sediment budget developed by Demmissie et al. 2004 indicates that they contribute approximately 31% of the sediment delivered to the Lake. The project will reduce sediment delivery to the Illinois River from riparian areas and tributary channels with the aim of eliminating excessive sediment load, and will improve floodplain, riparian, and aquatic habitats and functions. Also, the project will restore Illinois River and tributary hydrologic regimes to reduce the incidence of water level conditions that degrade aquatic and riparian habitat and will improve water and sediment quality in the Illinois River and its watershed. The feasibility phase is ongoing.

j. Crow Creek West. The Crow Creek watershed is located in Marshall, Putnam and Bureau counties, about 35 miles north of Peoria, Illinois in the west-central part of Illinois. Crow Creek drains portions of Marshall, Putnam, and Bureau Counties and empties directly into Weiss Lake which is a part of a USFWS Refuge. The project will reduce sediment delivery to the Refuge and the Illinois River from riparian areas and tributary channels with the aim of eliminating excessive sediment load, and will improve floodplain, riparian, and aquatic habitats and functions. Also, the project will restore Illinois River and tributary hydrologic regimes to reduce the incidence of water level conditions that degrade aquatic and riparian habitat and will improve water and sediment quality in the Illinois River and its watershed. The project has not been initiated.

k. Tenmile Creek. The Tenmile Creek Watershed is a direct tributary of the Illinois River. Draining 11,027 acres in Woodford and Tazewell Counties, Tenmile Creek is approximately 10 miles long and flows northwest to the Narrows of Peoria Lake at the Illinois River. The Illinois Department of Natural Resources (non-Federal sponsor) initiated watershed planning, through a local agency, to identify ecological resource concerns in this watershed in 2001. As a result, a Watershed Restoration Plan completed in 2004 identified a number of ecosystem problems present in the watershed. These problems include: Invasive plant species are decreasing species diversity and resulting in erosion and habitat loss, large fluctuations in surface water volume and rates result in increased streambed and bank erosion, and delivery of approximately 23,500 tons of sediment on an annual basis to Upper Peoria Lake contributes to the ecological decline of Peoria Lake. The project will reduce sediment delivery to the Illinois River from riparian areas and tributary channels with the aim of eliminating excessive sediment load, and will improve floodplain, riparian, and aquatic habitats and functions. Also, the project will restore Illinois River and tributary hydrologic regimes to reduce the incidence of water level conditions that degrade aquatic and riparian habitat and will improve water and sediment quality in the Illinois River and its watershed. The project has not been initiated.

l. Yellow River. The 281,000-acre Yellow River watershed is located in Starke, Marshall, St. Joseph, Elkhart, and Kosciusko Counties in Northern Indiana. The Yellow River flows through the 4,095-acre Kankakee Fish and Wildlife Area (maintained by the Indiana Department of Natural Resources) before it merges with the Kankakee River. Sedimentation problems in the Yellow River basin have been observed since the channelization of the 13-mile reach that extends from upstream of Knox, Indiana, to the confluence with the Kankakee River. The Yellow River is a major contributor of sand bed load to the Kankakee River system and was most likely named for the appearance resulting from this sediment transport characteristic. The project will reduce sediment delivery to the Illinois River from upland areas and tributary channels with the aim of eliminating excessive sediment load, and will improve floodplain, riparian, and aquatic habitats and functions. Also, the project will restore Illinois River and tributary hydrologic regimes to reduce the incidence of water level conditions that degrade aquatic and riparian habitat and will improve water and sediment quality in the Illinois River and its watershed. An initial determination of federal interest and draft FCSA for signature by the IN DNR are being prepared.

m. Fox River. The Fox River is the third largest tributary to the Illinois River and drains approximately 1,720 square miles in northeastern Illinois and 940 square miles in Wisconsin. The Fox River watershed occupies portions of McHenry, Lake, Cook, Kane, DuPage, Dekalb, Lee, LaSalle, Kendall, Grundy and Will counties in northeastern Illinois. The total length of the river is 185 miles, 115 miles of which are in Illinois. There are 15 channel dams on the Fox River in Illinois and an unknown number of tributary dams. The Fox River Fish Passage Feasibility Study (Santucci and Gephard, 2003) evaluated the effects of the dams on the aquatic organisms and found that the dams adversely affected the biotic integrity of the Fox River on both local and landscape scales. The project will improve floodplain, riparian, and aquatic habitats and functions, and will restore and maintain fish passage on the Illinois River and its tributaries, where appropriate, to reestablish healthy populations of native species. Also, water and sediment quality will be improved in the Illinois River and its watershed. A potential site is the Upper Batavia Dam (River Mile 56.3 in Batavia, Illinois), but other sites may be considered as well. The project has not been initiated.

n. Starved Rock Pool. Starved Rock Pool is the portion of the Illinois River that extends from Starved Rock Lock and Dam (River Mile 231) to the base of Marseilles Dam (River Mile 247), for a total length of 16 miles. There has been a dramatic loss in productive backwater, side channel, and island habitat since the construction of Starved Rock Lock and Dam. This project will explore alternatives to improve habitat in the Lower Starved Rock Pool by reducing turbidity, providing suitable conditions for the growth of submerged aquatic vegetation, improving side channel habitat, and restoring island habitat. This project is expected to improve habitat for fish, waterfowl, and other aquatic species. This effort is consistent with system goals of restoring aquatic habitat diversity of backwaters, side channels and islands to provide adequate volume and depth for sustaining native fish and wildlife communities, and improving water quality. The feasibility phase is ongoing.

o. La Grange. La Grange Pool is the portion of the Illinois River that extends from La Grange Lock and Dam (River Mile 80.2) to the base of Peoria Lock and Dam (River Mile 157.6), for a total length of 77.4 miles. There are numerous islands and side channels in this pool of the Illinois River. A dramatic loss in productive backwaters, side channels, and channel border areas due to excessive sedimentation is limiting ecological health and altering the character of this unique floodplain river system. In particular, the Illinois River has lost much of its critical spawning, nursery, and overwintering areas for fish, habitat for diving ducks and aquatic species, and backwater aquatic plant communities. The project will restore aquatic habitat diversity of selected backwaters, side channels and islands to provide adequate volume and depth to sustain native fish and wildlife communities, and improve water and sediment quality. The project has not been initiated.

p. Alton Pools. Alton Pool is the portion of the Illinois River that extends from the confluence of the Mississippi and Illinois Rivers (River Mile 0) to the base of La Grange Lock and Dam (River Mile 80.2), for a total length of 80.2 miles. A dramatic loss in productive backwaters, side channels, and channel border areas due to excessive sedimentation and erosion is limiting ecological health and altering the character of this unique floodplain river system. In particular, the Illinois River has lost much of its critical spawning, nursery, and overwintering areas for fish, habitat for diving ducks and aquatic species, and backwater aquatic plant communities. The project will restore aquatic habitat diversity of selected backwaters, side channels and islands to provide adequate volume and depth to sustain native fish and wildlife communities, and improve water and sediment quality. The feasibility phase is ongoing.

4. Initial Project Schedules through 2011(Tier I) and 2015 (Tier II). The Plan recommendations call for continuing restoration efforts under a tiered approach utilizing the existing authority of Section 519. The Corps of Engineers cost shared restoration efforts would begin with $131.2 million in funding through 2011 (Tier I) increasing to $345.6 million in restoration efforts through 2015 (Tier II).

This section provides additional detail on proposed Tier I efforts. The purpose of this tier is to begin restoration efforts and demonstrate the benefits of the various measures and project components prior to seeking additional funds. The System Team worked with the sponsors and other agencies to identify the projects, technologies and innovative approaches components, and management efforts that would make up the first $131.2 million in restoration efforts ($85.3 million Federal funds). Depending on project progress and Federal and State funding, Tier I is anticipated to cover work on the program from now until the first Report to Congress is completed in the 2011 timeframe. Tier II will be developed in greater detail in the coming years based on the lessons learned from Tier I.

Tier I restoration efforts will include the sixteen existing Critical Restoration Project along with potentially one or two additional projects. Areas of work were selected based on the project implementation framework and basin screening criteria. Appendix E presents a proposed implementation schedule for planning, design, and construction of Critical Restoration Projects as well as program management and other specific components. While some work will occur throughout the basin, restoration efforts will focus on the upper watershed and, in particular, the Peoria Pool and tributaries and the Kankakee River Basin. These high value resource areas were selected due to their quality and location in the upper reaches of the basin, which has the potential to more rapidly demonstrate the effectiveness of the various projects.

5. Adaptive Management Principles. It is expected that implementation of the Plan components will provide restoration outputs as planned. However, due to the uncertainties inherent in ecosystem restoration, adaptive management is an essential strategy. The U.S. Army Corps of Engineers recognizes the need for adaptive management as one of the tools for successfully developing projects in the aquatic ecosystem restoration mission area. Engineering Circular (EC) 1105-2-210 (21) (a) dated 1 June 1995, states, *"Because of the relative newness of restoration science and uncertainty in ecosystem restoration planning, theories, and tools, success can vary due to a variety of technical and site specific factors. Recognizing this uncertainty, it is prudent to allow for contingencies to address restoration problems during, or after, project construction. To accomplish this, a technique called 'adaptive management' should be considered for inclusion in restoration projects recognized during planning to have the potential for uncertainty in achieving restoration objectives."*

In addition, current planning guidance from Engineering Regulation (ER) 1105-2-100, Planning Guidance Notebook, (April 2000) states, *"For complex specifically authorized projects that have high levels of risk and uncertainty of obtaining the proposed outputs, adaptive management may be recommended."*

Initial measures implemented for the Illinois River restoration will be based on scientific research and lessons learned from past efforts on the Illinois and other river systems. However, knowledge of ecosystem function is frequently inadequate to provide clear answers to restoration and management problems. Adaptive management should be used to help reduce the uncertainty and risk of ecosystem recovery actions and to increase the knowledge about ecosystems. Adaptive management requires that all ecosystem recovery actions be viewed, implemented, and monitored as tests of hypotheses about ecosystem responses to restoration actions. Under adaptive management, reducing uncertainty becomes an objective of management, the ecological effects of restoration are monitored, and policies are adapted depending on observations. Adaptive management has the added benefit of integrating science and resource management, ensuring applied science is well directed and scientific advances are transferred to managers.

The success of an adaptive management approach will require an open management process that includes partners and stakeholders during the planning and implementation stages. Project-specific monitoring should be designed and implemented so that information returned can be used to make changes in the existing project. Information on the success of ecosystem recovery actions should be used to design future projects. Adaptive management should be used to revise and update restoration goals and objectives. Environmental thresholds or triggers are essential in adaptive management. These must be agreed upon ahead of time, must be measurable, and must be unequivocally linked to goals of the ecosystem recovery action or program. Science, monitoring, and management institutions should be engaged in adaptive management. In addition, scientists, managers, and policy makers must be prepared to accept that some actions will not go as expected.

One of the main benefits of adaptive management is the development of an iterative and flexible approach to management and decision-making. The results of the restoration activities can be monitored and future management decisions can be informed by the outcomes of previous decisions. Another important benefit of adaptive management lies in the opportunity for scientists and managers to collaborate in the design of state-of-the-art solutions to meet the challenges of managing complex and incompletely understood ecological systems. Alternative management actions can be stated as hypotheses and addressed from the perspectives of rigorous experimental design and decision analysis. The probable outcomes of management alternatives and the values of such outcomes can be estimated in relation to management goals and objectives. The adaptive approach recognizes that uncertainty is unavoidable in managing large-scale ecological systems. Importantly, uncertainty can be analyzed and exploited to identify key gaps in information and understanding. The results of such analyses of uncertainty can be used to efficiently allocate limited management resources to new research or monitoring programs.

The adaptive management process is a six-step cycle (figure 6-5) and emphasizes that successful adaptive management requires managers to complete all six steps. However, in instances where the evaluation shows projects are performing as desired, no adjustments are required.

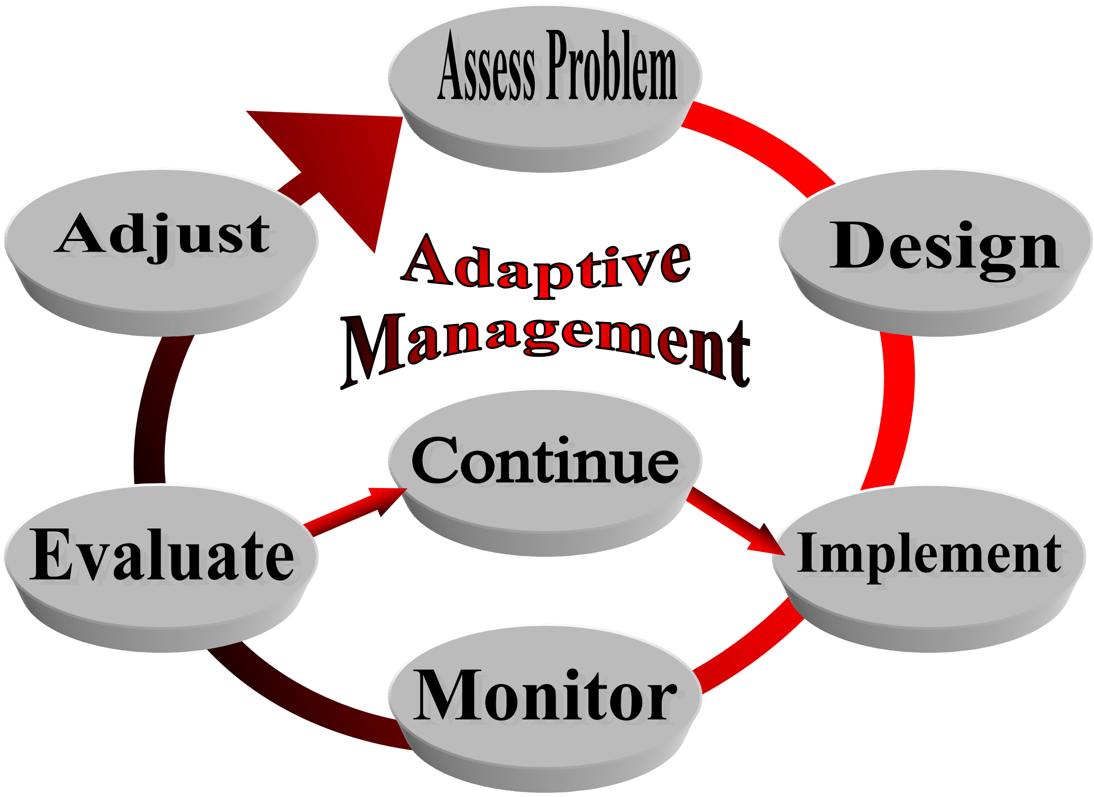


Figure 6-5. Adaptive Management Process

Some of the differentiating characteristics of adaptive management include:

- acknowledging uncertainty about what policy or practice is "best" for the particular management issue;
- thoughtfully selecting the policies or practices to be applied (the assessment and design stages of the cycle);
- carefully implementing a plan of action designed to reveal the critical knowledge that is currently lacking;
- monitoring key response indicators;
- analyzing the management outcomes in consideration of the original objectives; and
- incorporating the results into future decisions.

Within the scientific community, ecosystem restoration is viewed as an evolving science. Since such projects deal with living organisms, there is both risk and uncertainty regarding the outcome. There is less certainty of performance than in other mission areas, such as flood damage reduction. This uncertainty requires the organization to accept, plan, and manage for risk, even risk that may result in failure. This allowance for risk is not a substitute for good planning or avoidance of requirements, but is the assessment of taking risks to test methods that may yield better outcomes than current approaches. Monitoring and adaptive management allow the adjustments that reduce the risk of failure and provide "insurance" for the monetary investment. When the objective of the restoration project is to increase biodiversity, there may not be an obvious best course of action, particularly if there is not prior ecosystem management experience to utilize. Monitoring and adaptive management then provide the background information that is needed to move the project towards the most appropriate and effective solution.

Incremental implementation allows testing of hypotheses (e.g. extent to which the identified system goal are the limiting factors and additional detail on their interrelationships), thus providing an essential means for learning more about ecological cause and effect relationships with much greater certainty than is possible with ecological models. Incremental implementation also provides opportunities to refine plans to more effectively meet overall program objectives. An incremental process is required for the Illinois River Basin Restoration Program because of the large and complex nature of the ecosystem and its problems, and because of the uncertainties regarding the ecological responses that will occur as more natural hydrological and sediment conditions are established. These uncertainties are inherent where major alterations in the region's spatial scale and landscape have substantially changed ecological relationships among species, habitats, and communities throughout the region. If an unexpected response occurs, it becomes the basis for reviewing and revising the operating set of hypotheses, which results in an ever-improving focus on the actions required to meet the ultimate restoration objectives.

Recommendation

Based on the large study area, complexity of the ecosystem restoration, and the opportunities for increased cost effectiveness over the long duration of the program, adaptive management for the Illinois River Basin Restoration Project should be 3 percent of the initial construction costs through 2015, which is approximately 2.4 percent of total program costs through 2011 and 2.5 percent through 2015. It is anticipated that this adaptive management approach will decrease project costs in the long run, improve ecosystem outputs, protect Federal investments, and provide valuable information to make higher quality future projects more cost effective. The cost share for adaptive management is the same 65 percent Federal and 35 percent non-Federal cost share as the original project. This recommendation will be reviewed periodically throughout the life of the program and will be adjusted accordingly.

The intent of this program will be to use active adaptive management and the systemic and project-specific monitoring programs to reduce overall project costs below the current estimates. This systematic process of modeling, experimentation, and monitoring will compare the outcomes of alternative restoration or management actions and make modifications as needed to ensure project success. Specifically adaptive management is recommended to: (1) ensure projects are functioning as designed and providing the maximum benefit to the ecosystem, (2) provide the ability to undertake state-of-the-art approaches and ensure their success, (3) take into account the results of project monitoring in order to improve future restoration projects, and (4) result in long term savings to future projects by determining the most effective restoration methods. For example, monitoring and adaptive management of backwater restoration projects are anticipated to help determine the best configuration and extent of restoration to provide the most sustainable projects. This will provide an approach to evaluate and more precisely identify the necessary level of restoration, potentially providing millions of dollars in implementation and O&M cost savings over the life of the project. Various methods would be compared in their effectiveness, the bio-response generated, and long-term sustainability for each measure. Specific areas for adaptive management include:

- **A variety of measures to reduce sediment delivery.** For example, riffle-pool structures are perceived as the most environmentally beneficial measure to reduce sediment delivery in unstable streams. However, other options may provide similar stabilization with greater habitat benefits.

- **Different dredging configurations and scales, and placement options for backwater restoration.** During alternative plan formulation, based on current scientific research, it was assumed that dredging 40 percent of each backwater area was most ecologically beneficial as well as being more sustainable. However, a variety of scales should be evaluated to test potentially less costly but more or equally beneficial options.

- **A variety of measures to restore floodplain areas.** Measures to consider include controlling non-indigenous and invasive species, utilizing the existing seed bank, and, where necessary, using various scales and densities of planting to maximize benefits and reduce implementation costs, as well as options to reconnect the floodplain to the river for floodplain restoration.

- **Modify in-stream aquatic restoration to compensate for changes in land use within the watershed that may affect hydrology.** Improving the design of channel structures could also be a high priority area for adaptive management and subsequent cost savings, drawing on Section 32 of the Streambank Erosion Control Demonstration Program (USACE 1981).

C. TECHNOLOGIES AND INNOVATIVE APPROACHES COMPONENT

The Plan found that potential future legislative updates will be required to begin full implementation of the specific components called for in Section 519 (WRDA 2000)(b)(3). The specific components include: (1) development and implementation of a program for sediment removal technology, sediment characterization, sediment transport, and beneficial uses of sediment, (2) development and implementation of restoration projects, (3) the development and implementation of a long-term resource monitoring program, and (4) the development and implementation of a computerized inventory and analysis system. Component B is addressed through the ongoing Critical Restoration Project authority and proposed modifications to the per project limits, etc. Authorization of the other three components is being considered as part of a future authorization for a single Technologies and Innovative Approaches Component. The following section describes the need for these components and recommendations for implementation.

1. Illinois River Basin Monitoring Program (IRBMP). One of the most critical aspects of assessing ecosystem responses is that a scientifically rigorous long term monitoring program should be implemented from the onset of any restoration process (Likens 1992). These long term data provide the foundation for evaluating accomplishment of program goals. This information feeds back into the adaptive management process as more knowledge is gained on how a given ecosystem works. This feedback will work specifically towards measuring accomplishments made towards restoration goals and objectives, and will also identity areas where additional work may be needed.

Long term data are also essential in providing information that will assist in understanding the underlying processes that define an ecosystem's structure and function, which can also be useful in implementation of restoration projects (Thomas 1999). All of these aspects highlight the fact that dedication and support of long term study of an ecosystem is a fundamental requirement for restoration. The information gained will provide invaluable insight for managers, scientists, and policy makers to make decisions in the future. The over-riding mechanism for this process is such that as long term information is fed into the iterative, adaptive management process, to provide a direct means to gauge the efficiency and efficacy of restoration work.

The purpose of the Illinois River Basin Monitoring Program (IRBMP), which includes both the long-term resource monitoring program and the supporting computerized inventory and analysis system, is to evaluate the status of the Illinois River system in achieving the overarching goal to "*restore and maintain ecological integrity, including habitats, communities, and populations of native species, and the processes that sustain them*" and provide insight into mechanisms affecting achievement of that goal. This purpose drives the design and implementation of the program so that monitoring efforts are able to communicate ecosystem status and provide input to guide ongoing project implementation.

Specific objectives of the IRBMP are to:

a. improve understanding the Illinois River Basin ecosystem, including establishing a pre-project reference state and establishing variability for each of the performance measures;

b. measure, by the use of data collected, responses as projects are constructed and implemented;

c. monitor trends and effects on selected resources;

d. provide a basis for identifying options for improvements in the design and operation of projects and components (for use in adaptive management);

e. support scientific investigations designed to increase ecosystem understanding, establish cause and effect relationships, and interpret unanticipated results; and

f. develop reports on the status and trends of the Illinois River Basin ecosystem and restoration progress for the public, stakeholders, agencies, the State of Illinois and Congress.

In summary, the IRBMP is designed to help establish the framework for measuring and understanding system responses to restoration, to help determine how well the program is meeting its goals and objectives, and to help identify opportunities for improving the performance of the program where needed. The monitoring identified in the IRBMP relies and builds on monitoring already being conducted by multiple agencies and identifies new monitoring required for a complete interpretation of ecosystem responses. This plan also acknowledges that a certain degree of systemic risk and uncertainty exist in a large, dynamic system such as the Illinois River Basin. Long term resource monitoring is an effective means of reducing risk and uncertainty inherent in project planning in this environment. Long term resource monitoring will result in better projects that return higher benefits for less cost.

Successful implementation of the IRBMP is dependent on two key assumptions:

- Existing monitoring will continue with existing funding sources (i.e., the IRBMP should not replace ongoing agency efforts that are essential to the plan implementation including the LTRMP and State of Illinois monitoring efforts)

- Partnering agencies will contribute funding and/or will participate in implementation of the IRBMP (e.g. particularly the USGS and USEPA).

a. Plan Structure. The conceptual model for the Illinois River Basin Restoration Program is based on the understanding that there are a number of specific factors that are currently undermining or limiting the integrity of the ecological systems within the Illinois River Basin. Conceptually, in order to restore or improve the ecosystem function, all of these system-limiting factors must be addressed to some degree, and it follows that, if these are sufficiently addressed, overall ecosystem function will improve. Since construction of individual projects is the mechanism by which goals are addressed, project-specific monitoring is required to evaluate the effectiveness of various project attributes to advance each goal. A second level of monitoring (goal-level monitoring) would evaluate the progress in each of the supporting goals, indicating progress for each particular system-limiting factor identified by the project team. Since ecological integrity is the overarching goal that is supported by the other goals, evaluating the progress toward systemic integrity suggests overall program success (figure 6-6). Such system-level monitoring would be designed to develop a snapshot of the overall system health. The existing Long Term Resource Monitoring Program of the EMP, which monitors the LaGrange Pool, will be relied on to continue to provide information of the health of the Lower Illinois River. Additional monitoring effort undertaken as part of Illinois River Basin Restoration and NESP will be integrated with and expand on the existing LTRMP monitoring. All other existing monitoring programs and data will be incorporated into the systemic monitoring plan, as appropriate. Finally, the program should recognize the need for limited-duration focused studies to evaluate specific issues that arise. These may include efforts to better understand particular system-limiting factors and their interrelationship, evaluate restoration measure effectiveness, refine monitoring needs and techniques, and develop and refine models.

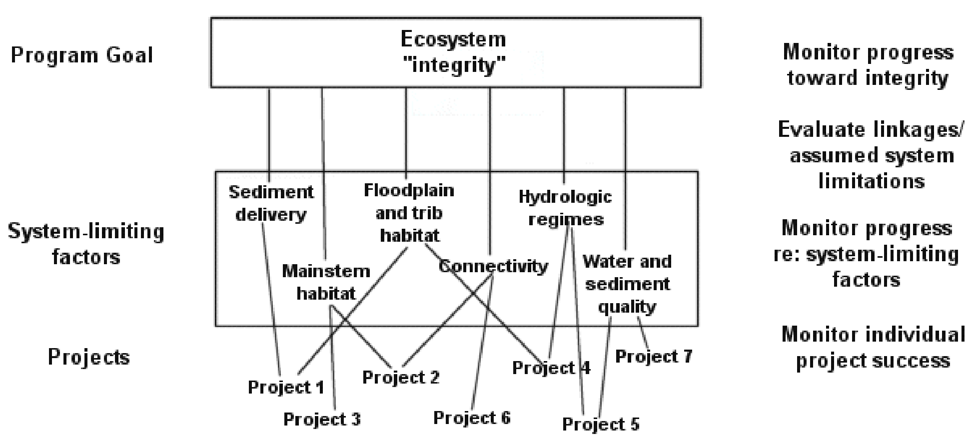


Figure 6-6. Conceptual Model of Illinois River Basin Restoration Project with Monitoring Requirements

i. Project-Level Monitoring. The purpose of this level of monitoring is to determine if the implemented projects are providing the intended physical and biological benefits. For example, this monitoring should determine if sediment projects are reducing excess sediment delivery and if backwater projects are improving ecological functions in backwaters. Monitoring results will be utilized for adaptive management by guiding design improvements to better meet ecosystem goals.

ii. Goal-Level Monitoring. Each goal is associated with a set of measurable objectives. Goal-level monitoring accounts for the progress toward each objective and thereby assesses the degree to which goals are being attained. The metrics to be monitored are therefore drawn directly from the objectives (e.g. sediment delivery, water level fluctuations, and acreage restored). If it is discovered that objectives are being met but that comparable improvements are not observed in system-level indicators, it may be necessary to reevaluate either the system indicators, the assumed system-limiting factors, or identify other critical factors.

iii. System-Level Monitoring. System-level monitoring must provide a holistic evaluation of the state of the ecosystem using a number of performance indicators that span all of the relevant features of the desired ecosystem state ("integrity"). This level of monitoring would encompass information from throughout the basin—main stem and tributary areas. Rather than evaluating individual aspects of integrity, such as richness, resilience, resistance, etc., the evaluation can look for indications that the desirable ecosystem is reemerging or that undesirable aspects of the system are declining (e.g. aquatic plants, diving ducks, etc.). The monitoring program must accurately represent all of the processes crucial to ecosystem health with the most economical set of indicators possible. If the evaluation is designed correctly, it could be assumed that ecosystem health is improving if all of the indicators are showing improvement. That would suggest that the appropriate system-limiting factors are being addressed and that progress is being made toward the goal.

Restoration success must be measured in time scales that relate to the species and systems being managed, and to the periodicity of extreme environmental conditions characteristic of the region. Measures of restoration success must be done within spatial scales that relate to a whole ecosystem, and success must be measured at the ecosystem level with long-term evaluation (Zedler 1988). This requires ecologically meaningful and measurable indicators that mark progress toward ecosystem management and restoration goals (Richter et al. 1996).

iv. Computerized Inventory and Analysis (CIA) System. A CIA will be developed to inventory and analyze monitoring information. All monitoring data will be posted to a CIA system within one year of collection with summaries provided every 5 years. Efforts will also be made to share results of models and analysis tools. The estimated cost is $1.2 million through Tier II.

v. Focused Research Efforts. Specific targeted special studies are proposed to improve planning, design, and construction of the restoration projects and improve success of the overall program. These efforts would be directed at efforts to improve the understanding of the condition of the system, and improve the analysis techniques available. Initial special studies will focus on the following areas. The estimated cost is $2 million through Tier II.

a. System Ecology. Efforts would include developing a composite system metric similar to the Chesapeake Bay (www.cbf.org). This would address items such as key species abundance, invasive species abundance, macroinvertebrate analysis, range expansion of indicator species, etc. to determine program success and remaining needs. Additional research will focus on the scalability of ecosystem metrics to develop representative characterizations of aspects of the ecosystem and provide cost efficiencies in data collection. Also, a critical aspect of the planning and evaluation of restoration projects is benefit quantification. A tool, such as Hydro Geomorphic Method (HGM) approach for basin wetlands, would be developed in order to improve project planning and the accuracy and efficiency of the benefit quantification of potential restoration projects.

b. Aquatic Ecology. Two issues key to the restoration of ecosystem function along the main stem river are the use of different types of habitat by fish and the factors that currently limit vegetation growth. Focused research is proposed to provide greater understanding of these issues, both of which are anticipated to contribute to refinements of management practice, restoration location needs, and evaluation of habitat restoration effectiveness.

c. Terrestrial Ecology. Several research efforts have been suggested to augment ongoing ecological monitoring. Specifically, studies of shorebirds, furbearers, marsh birds and bats would allow greater application of data collected by resource managers. Studies of avian reproduction and amphibian reproduction are potential indicators of habitat suitability and fragmentation, and hydrology and water quality, respectively. Focused research would evaluate the use of these functions as system indicators.

d. Hydrology and Sediment. Three special studies are proposed to better monitor and model the sediment dynamics in the Illinois Basin. One would evaluate the use of automated samplers—a technique that would reduce the cost of monitoring sediment—and determine methods to compare results from such sampling to historic sampling results, allowing the use of both historical data and new data to assess trends in sediment transport. The second monitoring study would focus on developing methods to better estimate bed loads in the system. A third special study would develop a systemic sediment transport model that would integrate monitoring data to evaluate basin-wide trends and transfer information from the areas being monitored to those that will not be monitored. The model would also be used to evaluate the effectiveness of different alternatives for reducing sediment delivery.

e. Geomorphology. Initial efforts would focus on means to improve resolution of impervious cover class in land cover and land use data sets and to evaluate slope at different data scales. These would provide improvements to landscape-scale evaluation of geomorphic processes which would thereby improve assessment of basin conditions at multiple scales.

b. Plan Design. Each element of the monitoring plan must be evaluated for relevance, technical merit, and practicality to see if it is the proper way to evaluate progress toward “endpoints” identified for its particular level of monitoring. Statistical considerations are extremely important; the issues of uncertainty and detecting change will strongly influence the number and types of sampling locations required to evaluate the anticipated effects. Data quality, anticipated measure response, and natural variability must be considered so that proposed sampling strategies and techniques are adequate to detect the changes expected from program implementation; without the statistical power to detect change it may not be worth the effort to monitor. Appropriate monitoring methodologies are efficient, produce accurate, reasonable and replicable data, and satisfy time and cost constraints.

Existing monitoring efforts provide some of the information required for the monitoring plan; where appropriate, this information will be used and augmented to provide the level of detail and coverage necessary to meet the monitoring requirements of this plan. Also, an effort was made to maximize the inter-disciplinary connections of monitoring, and to design the program to make the information usable at a number of scales (site-specific, watershed, system-wide).

c. Proposed Plan. For each goal, potential indicators of success were developed through consideration of direct measurements of objective completion, additional physical and biological measures of success, and the requirements of adaptive management. These indicators were translated into specific monitoring plan elements (table 6-4). The monitoring plan proposal developed by the Illinois Natural History Survey team (Appendix H) provides specific measures, techniques, and strategies to monitor these elements at the main stem, sub-basin, and project levels. These overlap with the monitoring requirements in that the monitoring to evaluate ecological integrity at the main stem and sub-basin level will be used to satisfy the system-level monitoring, that the monitoring to evaluate the other goals at the main stem and sub-basin level will satisfy the goal-level monitoring, and that the project-level monitoring levels are directly comparable. The proposed system- and goal-level monitoring would amount to approximately $4 million per year. The contract report also suggests a number of focused research items for budgetary consideration. Based on scientific and stakeholder input, research efforts will be prioritized and the list of potential research projects will be refined over time to reflect changing system understanding and project needs.

d. Recommendations. A systemic long-term resource monitoring program is justified to provide additional information on the status of the ecological integrity of the system and to identify success of restoration efforts. Three levels of monitoring are recommended to best evaluate the system and effectiveness of restoration efforts. At the system-level, it is recommended that monitoring would be designed to develop a snapshot of the overall system health using system indicators. A second level of monitoring (goal-level monitoring) would evaluate the progress in each of the supporting goals, indicating progress for each particular system-limiting factor identified by the project team (e.g. reducing sediment delivery, improving backwater habitats, etc.). Since construction of individual projects is the mechanism by which goals are addressed, project-specific monitoring is also required to evaluate the effectiveness of various project attributes to advance each goal. The outputs of all monitoring efforts will be closely coordinated with project teams and form the basis for adaptive management efforts to maximize the effectiveness of restoration activities. Finally, the program should include funding to address the need for limited-duration focused studies to evaluate specific issues that arise over the course of the program, such as implications of and means to address system-limiting factors, monitoring needs and techniques, or restoration design features.

The proposed system- and goal-level monitoring when fully implemented would amount to approximately $4 million per year. The level of site-specific project monitoring would be scaled based on the level of construction activity. Based on the large study area, complexity of the ecosystem restoration, and the opportunities for increased cost effectiveness, the funding level for the Illinois River Basin Restoration Project should be up to $4 million annually for systemic monitoring and up to 6 percent of the construction costs for site specific monitoring, which would equal approximately 5 percent of total program costs through 2011 and 9 percent through 2015. The IRBMP shall include funds for the provision of a data repository publicly accessible via the internet.

Since systemic and goal level monitoring is not currently authorized for implementation, only site specific monitoring is anticipated to be completed until 2008. Once authorized, it is anticipated that the monitoring will be phased in over approximately a 5-year period and be in full effect by 2015. Based on estimated funding levels, it is anticipated that in the initial years approximately $1 million will be available for system and goal level monitoring tasks. While some refinements in the plan are anticipated, it is estimated that in the initial years approximately 60 percent would be used to fund physical parameter monitoring (water, sediment, and geomorphic efforts), and approximately 40 percent would be used for ecological monitoring.

While awaiting full authorization, some additional analysis is appropriate to further refine this component. For example, additional studies related to the TIA could better define ways to combine, consolidate, and build upon existing monitoring data sets (e.g. attempt further consolidation of existing state, Federal, and local monitoring data to further leverage existing data); refine the monitoring plan to seek the most efficient approaches to gathering additional necessary data; better define representative system metrics (e.g. evaluate the use of various species/processes to serve as system indicators); and conduct special studies to collect data to increase our understanding of various processes that could reduce future restoration costs (e.g. detailed study of fish use of tributaries throughout the year and selected evaluations of sediment technologies and applications). A final area of activity would be monitoring of key focus areas to establish pre-project data for use in more completely evaluating problems, opportunities, and project success.

The initial focus will be on filling gaps in the existing condition (baseline) data. Four goals have been established to help provide logic for sequencing the implementation of the various IRBMP components:

- Establish monitoring stations and components necessary to measure stressors identified in the conceptual ecological models
- Close the gaps in biologic, hydrologic, and water quality monitoring components in existing programs
- Initiate priority baseline research to address uncertainties in system response
- Initiate priority baseline monitoring components

Proposed focus areas for water and sediment monitoring included the Peoria Pool tributaries, Kankakee, Spoon, and LaMoine Rivers. The Spoon and LaMoine were mentioned due to potential benefits associated with more detailed monitoring activities of the state in those basins. Ecological monitoring would look at Peoria Pool, Peoria tributaries, and potentially the Kankakee and LaMoine Basins.

Table 6-4. Proposed Illinois River Basin Restoration Monitoring Program

		Monitoring Program		
Goal	**Objectives**	**Main Stem**	**Sub-Basin**	**Project**
Ecosystem Integrity	Address limiting factors, conserve and restore critical prime habitats, establish existing and reference conditions	Fish, macroinverts, aquatic vegetation, zooplankton, water quality, mussels, land use/land cover (digitized, refined and verified), waterfowl, wading birds, shorebirds, reptiles, mammals and amphibians		GIS – project type and location
Sediment Delivery	Reduce sediment delivery to Illinois River by 20%	Gaging network, backwater TSS, river surveys	Gaging network, stream channel dynamics	Channel geomorphology, project gaging
Backwaters and Side Channels	Restore 12,000 acres of backwater, protect 15 islands, restore 35 side channels	Bathymetry, sediment characterization, sedimentation rates, hydrodynamics		Fish overwintering, waterfowl, water quality, macroinvert, vegetation
Floodplain, Riparian, and Stream Habitats	Create additional 150,000 acres of wetland, prairie and forest combined on main stem floodplain and tributary riparian areas. Reduce effects of channelization on 500 miles of streams.	Land use/land cover (digitized, refined and verified)	Land use/land cover (digitized, refined and verified)	HGM, FQI, IBI, birds, amphibians, avian and amphibian reproduction
Longitudinal Connectivity	Connect tributaries to main stem, connection within tributary areas, connection along main stem			Fish, mussels, effective passage, velocities
Water Levels	Reduce fluctuations, increase baseflow, decrease peakflow, document sources of instability, drawdown	Survey of basin impervious, stream power, gaging network, annual report of basin water conditions	Annual report of tributary water conditions	Aquatic. plants, fish communities, project gaging, substrate and aerial drawdown photos
Water and Sediment Quality	Reduce adverse water quality conditions	Augment existing programs		Water quality sampling as part of biological assessments

2. Sediment Removal and Beneficial Use. Another aspect of the Technologies and Innovative Approaches component called for in Section 519 was the development and implementation of a program for sediment removal technology, sediment characterization, sediment transport, and beneficial uses of sediment. This section describes the general need for this component; various technologies and beneficial use options that are available and have been tested in the basin; further technologies, testing, and applications that should be explored; and ends with recommendations regarding further work. Much of the restoration effort will involve dredging outside of the navigation channel for environmental enhancement and will, therefore, differ in some respects from the more traditional navigation dredging.

The U.S. Army Corps of Engineers Dredging Operations and Environmental Research (DOER) Program conducts research that is designed to balance operational and environmental initiatives and to meet complex economic, engineering, and environmental challenges of dredging and disposal in support of the navigation mission. Research results provide dredging project managers with technology for cost-effective operation, evaluation of risks associated with management alternatives, and environmental compliance. The Corps of Engineers also operates the Regional Sediment Management (RMS) program. The RMS program is focused on managing sediment regionally in a manner that saves money, allows use of natural processes to solve engineering problems, and improves the environment. The Illinois DNR has worked to develop dredging and beneficial use techniques suitable for Illinois River Restoration, including projects with the Corps under the Section 519 authority.

It is anticipated that Illinois DNR will continue as a partner in future efforts under this Illinois River Basin Restoration component, and that the efforts will be coordinated with the DOER and RMS program.

a. Background. Illinois River restoration efforts will require the removal and placement of several million cubic yards of sediment. There is great variation in the size and physical setting of the many backwaters (including side channels and the Peoria Lakes) within the floodplain. These factors make it necessary to consider innovative dredging techniques, innovative methods of handling and transport, and beneficial use options and techniques in addition to conventional methods.

Conventional hydraulic dredging is an efficient and cost-effective method of removing sediment where suitable sites exist for constructing diked areas to dewater and store sediment. Mechanical dredging is commonly used for small jobs and projects where the dredged material can be placed within the reach of a crane or excavator arm, or where construction of a dewatering containment facility is not desired. Additional steps such as loading and unloading barges or trucks, mechanical dewatering, and transport from drying beds and mixing with other soil components all add costs to sediment management efforts.

Most Illinois River sediment washes from streambeds and banks, bluffs and farmland. Heavier sand and gravel particles that enter the floodplain tend to form deltas at stream mouths or move down the main channel. Backwater sediment is largely composed of fine-grained silt and clay particles that are carried farther and settle in slow moving backwaters. Thus, much of the sediment in the backwaters and side channels is similar in physical characteristics to native topsoil. It should, therefore, be possible to use these sediments as soil barring contamination.

A large number of placement and use options in various combinations could be used to accommodate millions of cubic yards of dredged sediment over the next 50 years. Some can be readily implemented with conventional dredging equipment, while others require innovative applications of new or existing equipment. An ideal development would be a device that could remove and transport sediment as readily as hydraulic dredges and place it with the consistency and water content of mechanical buckets. Given that areas outside the main channel are often a foot or less deep and the desired depth of much of the restoration is 3 to 6 feet, the ability to operate in shallow water is also desirable. Another factor is the fine-grained nature of most of the sediment that requires removal.

Innovative approaches to design and implementation are as necessary as innovative technology in a restoration project of this magnitude. The river system has degraded over more than a century, and several feet of sediment has accumulated in most areas.

b. Summary of Potential Areas of Evaluation. This section briefly summarizes areas of potential investigations of sediment characteristics, beneficial use options, and innovative dredge technology. A brief summary of some analyses conducted as part of the Illinois River Basin Restoration planning and recent State of Illinois activities is given, but additional detail is provided in Appendix D.

i. Innovative Use of Hydraulic Dredging. Hydraulic dredges could be used in a number of innovative ways. It is possible to pump material for miles if suitable areas are not available near the dredging location. A pipeline over 20 miles long was used when the White Rock Reservoir was dredged in Dallas to deposit material in an old mining pit. When quantities are great enough, such distances are not out of the question along the Illinois River. Corridors could follow existing highways, railways, streams, storm sewers, and the river itself. Such a system could deliver dredged material to a number of mined areas in Illinois. It may also be possible to use out-of-service gas or oil pipelines to transport slurried dredged material.

Several companies have used mechanical dewatering systems in conjunction with hydraulic dredges. The systems separate most of the water from the sediment and then run it through a belt press. It can then be placed directly into trucks or stockpiles. These systems could be used to dewater sediment piped from miles away for island construction, loading into barges or trucks, placing on fields or other purposes. Polymers can be used in the mechanical processes to speed thickening in the tanks or in dewatering ponds. Among other things, the polymers allow the discharge to meet regulatory standards with less holding time.

ii. Sediment Handling and Transport Technology

a. Conveyors. Conveyor belts have the potential to effectively extend the reach of excavator and crane mounted clamshell buckets. Backwater sediment excavated be placed on islands, on shore, or in trucks that are within reach of the excavator. In order to use large buckets in backwaters, it is necessary to dig deep enough to bring in a floating crane. If material is to be moved beyond the arm’s reach, it must generally be loaded onto a barge that may require additional depth. A floating conveyor could operate in shallow water and transport material considerable distances to islands, the shore or barges in the channel.

Some trial demonstrations were conducted to evaluate this transport and handling option (Marlin 2003a and Marlin 2003b). These demonstrations show that backwater sediment can be conveyed with conventional equipment. A system dedicated to sediment should have some modifications from the concrete system. Such features as the hopper and transfer points could have more clearance and splatter could be better controlled.

Floating conveyors over 2,000 feet long are used in the sand and gravel industry and presumably could be designed for use on the Illinois River backwaters. Given the shallow nature of the backwaters, the floating conveyor would be most useful if it drew a foot or less of water. Pipe conveyors are another option. These systems use additional rollers to fold the conveyor belt over itself so that material is contained inside. It unfolds at each end for loading and discharging. These conveyors can curve without using a transfer point.

b. Positive Displacement Pumps. Positive displacement pumps are commonly used for handling concrete and various slurries. They have been used for to handle sediment in several situations. Their main advantage is the ability to deliver sediment without adding large volumes of water. Large pumps can handle over 500 cubic yards per hour and pumping distances in excess of 2,500 yards are attainable. The quantity pumped generally decreases with distance. Two demonstrations of these pumps were conducted with Illinois River sediment in 2002 (Marlin 2002) and (Marlin 2003a). These demonstrations showed the promise of these technologies.

For use in backwater restoration, existing concrete pumps could be placed on floats or work barges and fed with an excavator or crane. The material could then be pumped onto an island, to shore, into geotextile tubes, or into barges or trucks. A placing boom could be mounted on a barge or on shore to place the sediment in a specified pattern and depth. Equipment of this type could provide great operational flexibility, especially where shallow depths are desired and building containment berms is not an option.

c. Barge Transport. Sediment was barged to a Chicago landfill site in the fall of 2002 in order to evaluate the feasibility of moving backwater sediment long distances using conventional equipment (Marlin 2003b). Nine hundred tons of material dredged from Lower Peoria Lake was placed in a barge with a clamshell bucket. The bucket was heaped to minimize the amount of free water placed in the barge. The barge was towed 163 miles to a Chicago dock on the waterway and unloaded into trucks for the 1-mile trip to the landfill. The material presented no serious handling difficulty and the trucks and barge cleaned normally after the project.

In 2004, the State of Illinois moved 68 barge loads of Peoria Lake sediments to the Chicago Lake front to restore a portion of the 100 acre former U.S. Steel site as part of the State's "Mud to Parks" demonstration. This project further demonstrated the potential feasibility of transporting river sediment relatively long distances to utilize these sediments as a resource.

iii. Placement Options. In many restoration projects dredged material is used to create islands or increase existing land elevations. However, due to the scale of restoration needs, only a limited amount of material can be used to develop islands, increase existing island elevations, and create wind and wave breaks in backwaters. Such structures will restore some of the features of the original system that were lost when water levels were increased during the last century, including: adequate elevations to support native floodplain hardwood trees; relatively isolated areas for wildlife to rest, forage, or nest; and structure to break waves reducing sediment re-suspension.

Sites capable of holding large quantities of dredged sediment either permanently or for later use exist in the basin, but not always in proximity to backwaters needing restoration. Potential placement options include gravel pits, strip mines, and fields. The material can be dewatered behind a dike or dried and piled to any desired shape. A mound could be several stories high and as long and wide as desired.

The bulk of the material in the backwaters is quite similar to topsoil. Clean sediment could be used for landscaping, landfill cover, restoration of mine land and industrial sites, amending agricultural soil, and as bagged soil. Some sediment is suitable for use as construction fill, levee repair, and other projects depending upon its physical properties. If options with commercial value are found, it may be possible to offset all or part of the cost of some restoration dredging.

One technology the State of Illinois has evaluated on a limited scale is geotubes. Four 15-foot-circumference tubes were placed in shallow water in Upper Peoria Lake in conjunction with the Drydredge ™ demonstration in May of 2001. They were filled with the DryDredge™. They formed an island about 50 feet on a side that was filled with sediment at near *in situ* moisture content.

iv. Beneficial Use

a. Dredged Sediments as Soil. Landscaping soil is a potential beneficial use of large quantities of sediment removed from water bodies, and the chemical and physical properties of the dredged material will largely determine its suitability. Sediment from the Illinois River valley has properties that indicate that it would make excellent landscaping soil. Much of the sediment found in the Illinois River valley originated from eroded fertile rural areas. Consequently, it contains less pollution in the form of heavy metals and other chemical contaminants than is typically found in sediments from urban or industrial areas. Some compounds found in sediments, such as ammonia, that are often toxic in an aquatic environment, may be beneficial to plants when placed on land. A variety of tests have shown that the germination and growth of a variety of plants in sediment and central Illinois topsoil was essentially equivalent (Darmody and Marlin 2002, Darmody et al, 2004 in press). The conclusion is that sediments can serve as well as natural, high quality topsoil as a plant growth medium in the greenhouse.

b. Amendment to Sandy Agricultural Soil. Crop production on sandy soil amended with Illinois River sediment is under study by University of Illinois soil scientist Dr. Robert Darmody with funding from the state. Preliminary results indicate that sediment moderates fluctuations in soil temperature and significantly improves moisture-holding capacity in sandy soil. Seed germination and plant growth were also greater on sediment plots. During the 2003 season corn yields were greater on all sediment plots. Plots with 6 to 12 inches of sediment produced over 3.5 times the yield of untreated sandy soil plots. Soybean yields were not as dramatic, although the 6-inch treatments produced statistically higher yields than the controls or other sediment plots. The 6-inch incorporated plots produced 1.6 times the yield of the controls.

Sandy soils are found in several counties bordering the Peoria and La Grange Pools. Given the nearness of some fields to the river and backwaters, it may be feasible to pump sediment directly to fields or transport it short distances by other means. Further study will help determine whether sediment will improve soil conditions enough to warrant placement onto sandy fields. Placing a 6-inch layer on a 100-acre field would require about 80,600 cubic yards of sediment.

c. Sediments Used for Greenhouse Applications. In terms of standard agronomic parameters such as plant growth, results confirm previous work that established that sediments from the Peoria Lakes reach of the Illinois River make excellent topsoil material. Both legume and grass plants grew well in all sediment mixtures and improved the plant growth potential of unleached biosolids. Addition of biosolids to sediment mitigates some of the problem with growing plants directly in sediments or biosolids. Pure sediments may have poor physical characteristics, at least initially under some field conditions. Pure biosolids have excessive salts that inhibit plant growth, particularly legumes, as evidenced by the death of some snapbean plants on 100 percent biosolids. The sediments may experience improved tilth and higher plant nutrient content under field conditions when mixed with biosolids.

c. Recommendations. Innovative Sediment Removal and Beneficial Use Technologies will be evaluated and tested to evaluate more ecologically sound, cost effective, and beneficial ways to dredge and place material. These efforts would be closely coordinated with ongoing Corps activities related to dredging and regional sediment management. Potential efforts include summaries of lessons learned from past dredging projects, demonstrations of various methods to build islands, use of geotextile tubes and other means of forming narrow windbreaks to reduce wave action and re-suspension of sediments, utilize sediments on farmland as a soil amendment, transport options (pumps, pipeline, rail, barge, etc.) and evaluate various innovative technologies and methods.

Another concept to be explored involved project and construction sequencing. A promising implementation option may involve a contractor removing incremental amounts of sediment from several locations in a river reach at different times during the first year and repeating the process over several years until the desired depths are met. This would allow the material at the placement sites to consolidate or be removed for use in more manageable quantities. It would likely require less land and construction at the placement site. This approach is similar in principle to some maintenance dredging contracts that cover river reaches.

In regard to beneficial use, the chemical and agronomic character of deposited sediment and the underlying original bottom in backwaters should be determined in order to identify restoration sites where beneficial use is a viable option. The initial work should require a few samples for chemical contamination and a larger number for characterization of suitability for use as soil or fill. A market analysis for sediment by itself or mixed with other material as a bagged or bulk soil would be useful. The material on the deltas is sandy and is likely to be useful as fill or in some cases commercial sand. Cores of this material should be taken and evaluated. There is a need for such material at construction and brownfield redevelopment sites near the river and in the Chicago area. The feasibility of moving these deposits by barge, rail and truck needs to be investigated. In addition, sediment could be used as the basis for flowable fill, to be used in utility, road repair, and other construction applications.

Additional testing and use of innovative technologies and beneficial use options are recommended. This is justified based on the fact that restoration of depth diversity within the Illinois River Basin is a major goal that will require dredging and placement. In addition, a wide range of potential technologies and uses exist that merit further exploration.

D. DIVISION OF PLAN RESPONSIBILITY

This section presents the requirements for implementing the preferred comprehensive plan alternative, including Federal and non-Federal cost sharing, and the division of responsibilities between the Federal Government and the non-Federal sponsor, the Illinois DNR and potentially others. It also lists the major milestones necessary for project approval, and a schedule of milestones associated with designing and constructing the preferred comprehensive plan alternative.

1. Recommended Plan Cost Sharing. Federal and non-Federal cost sharing for the preferred comprehensive plan alternative is in accordance with Section 210 of WRDA 1996, which establishes the cost-sharing rules for projects authorized after October 12, 1996, and Section 519 of WRDA 2000, with cost-sharing provisions for this project. Section 519 specifies that the non-Federal share of the cost of projects and activities shall be 35 percent, with no more than 80 percent of the non-Federal share from in-kind services. The non-Federal Sponsors will provide 100 percent of any lands, easements, rights-of-way, relocations of utilities or other existing structures, and disposal areas (LERRD). The value of LERRD will be included in the non-Federal 35 percent share. Where the LERRD exceed the non-Federal Sponsor's 35 percent share, the sponsor will be reimbursed for the value of the LERRD that exceed the 35 percent non-Federal share. The non-Federal Sponsor is also responsible for 100 percent of the costs for operation, maintenance, repair, rehabilitation, and replacement (OMRR&R) of project features. Table 6-6 breaks out these estimated program costs.

Table 6-6. Summary of Tier I Cost Sharing - $131.2 million ($85.3 million Federal)

Illinois River Basin Restoration		**Non-Federal**		**Federal**	
Project Feature	**Cost**	**%**	**Cost**	**%**	**Cost**
First Cost of Construction	$122,300,000	35	$42,805,000	65	$79,495,000
Program Cost	$8,900,000	35	$3,115,000	65	$5,785,000
Total Restoration Program	$131,200,000	35	$45,920,000	65	$85,280,000
LERRD Credit	$18,000,000	35	$18,000,000	65	$0
Cash	$113,200,000		$27,920,000		$85,280,000
OMRR&R (average annual)	$125,000	100	$125,000	0	$0

2. Federal Responsibilities. The Federal Government would provide 65 percent of the first cost of implementing the preferred comprehensive plan alternative, including a restoration implementation program, a technologies and innovative approaches component, and system management, which is estimated to total $85.3 million. In addition to its financial responsibility, the Federal Government would:

a. Complete assessments, project reports, plans and specifications, and construction of the preferred comprehensive plan alternative.

b. Implement the Technologies and Innovative Approaches Component including:

   1. Illinois River Monitoring Program (including Long Term Resource Monitoring, Special Studies, and Computerized Inventory and Analysis System) to evaluate system trends and performance of restoration projects.

   2. Evaluate innovative dredging technology and beneficial use options.

c. Administer and manage contracts for construction and supervision of the program after authorization, funding, and execution of a Project Cooperation Agreement with the Illinois DNR.

3. Non-Federal Responsibilities. The Illinois DNR and other local sponsors would be responsible for providing 35 percent of the First Cost of implementing the preferred comprehensive plan alternative. The 35 percent share of the project cost includes the Illinois DNR's and other sponsors responsibility for providing all LERRD. The estimated non-Federal costs are $45,900,000, which includes $27,920,000 in cash with $18,000,000 in LERRD credit.

The Illinois DNR and other local sponsors would also be responsible for OMRR&R of project features.

The Illinois DNR and other local sponsors also would be required to provide certain local cooperation items based on Federal law and policies. The items of local cooperation are:

a. Provide a minimum of 35 percent of total project costs as further specified below:

   1. Provide, during the first year of construction, any additional funds needed to cover the non-federal share of design costs;

   2. Provide all lands, easements, and rights-of-way, including suitable borrow and dredged or excavated material disposal areas, and perform or assure the performance of all relocations determined by the Federal Government to be necessary for the construction, operation, and maintenance of the project;

   3. Provide or pay to the Federal Government the cost of providing all retaining dikes, wasteweirs, bulkheads, and embankments, including all monitoring features and stilling basins, that may be required at any dredged or excavated material disposal areas required for the construction, operation, and maintenance of the project; and

   4. Provide, during construction, any additional costs necessary to make its total contribution equal to 35 percent of total project costs;

b. Provide the non-Federal share of that portion of the costs of mitigation and data recovery activities associated with historic preservation, that are in excess of 1 percent of the total amount authorized to be appropriated for the project, in accordance with the cost sharing provisions of the agreement;

c. Do not use Federal funds to meet the non-Federal Sponsor's share of total project costs unless the Federal granting agency verifies in writing that the expenditure of such funds is authorized;

d. Operate, maintain, repair, replace and rehabilitate the project, or functional portion of the project, including mitigation, at no cost to the Federal Government, in a manner compatible with the project's authorized purposes and in accordance with applicable Federal and State laws and regulations and any specific directions prescribed by the Federal Government;

e. Give the Federal Government a right to enter, at reasonable times and in a reasonable manner, upon property that the non-Federal Sponsor, now or hereafter, owns or controls for access to the project for the purpose of inspecting, operating, maintaining, repairing, replacing, rehabilitating, or completing the project. No completion, operation, maintenance, repair, replacement, or rehabilitation by the Federal Government shall relieve the Non-Federal Sponsor of responsibility to meet the Non-Federal Sponsor's obligations, or to preclude the Federal Government from pursuing any other remedy at law or equity to ensure faithful performance;

f. Hold and save the United States free from all damages arising from the construction, operation, maintenance, repair, replacement, and rehabilitation of the project and any project-related betterments, except for damages due to the fault or negligence of the United States or its contractors;

g. Perform, or cause to be performed, any investigations for hazardous substances that are determined necessary to identify the existence and extent of any hazardous substances regulated under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), Public Law 96-510, as amended (42 U.S.C. 9601-9675), that may exist in, on, or under lands, easements, or rights-of-way that the Federal Government determines to be required for the initial construction, periodic nourishment, operation, and maintenance of the project. However, for lands that the Federal Government determines to be subject to the navigation servitude, only the Federal Government shall perform such investigations unless the Federal Government provides the Non-Federal Sponsor with prior specific written direction, in which case the Non-Federal Sponsor shall perform such investigations in accordance with such written direction;

h. Assume, as between the Federal Government and the non-Federal Sponsor, complete financial responsibility for all necessary cleanup and response costs of any CERCLA regulated materials located in, on, or under lands, easements, or rights-of-way that the Federal Government determines to be necessary for the initial construction, periodic nourishment, operation, or maintenance of the project;

i. Agree that, as between the Federal Government and the Non-Federal Sponsor, the Non-Federal Sponsor shall be considered the operator of the project for the purpose of CERCLA liability, and to the maximum extent practicable, operate, maintain, and repair the project in a manner that will not cause liability to arise under CERCLA;

j. Prevent obstructions of or encroachments on the project (including prescribing and enforcing regulations to prevent such obstruction or encroachments) which might reduce the level of protection it affords, hinder operation and maintenance, or interfere with its proper function, such as any new developments on project lands or the addition of facilities which would degrade the benefits of the project;

k. Keep and maintain books, records, documents, and other evidence pertaining to costs and expenses incurred pursuant to the project, for a minimum of 3 years after completion of the accounting for which such books, records, documents, and other evidence is required, to the extent and in such detail as will properly reflect total costs of construction of the Project, and in accordance with the standards for financial management systems set forth in the Uniform Administrative Requirements for Grants and Cooperative Agreements to State and Local Governments at 32 Code of Federal Regulations (CFR) Section 33.20;

l. Comply with Section 221 of Public Law 91-611, Flood Control Act of 1970, as amended (42 U.S.C. 1962d-5), and Section 103 of the Water Resources Development Act of 1986, Public Law 99-662, as amended (33 U.S.C. 2213), which provides that the Secretary of the Army shall not commence the construction of any water resources project or separable element thereof, until the non-Federal sponsor has entered into a written agreement to furnish its required cooperation for the project or separable element;

m. Comply with all applicable Federal and State laws and regulations, including, but not limited to, Section 601 of the Civil Rights Act of 1964, Public Law 88-352 (42 U.S.C. 2000d), and Department of Defense Directive 5500.11 issued pursuant thereto, as well as Army Regulation 600-7, entitled "Nondiscrimination on the Basis of Handicap in Programs and Activities Assisted or Conducted by the Department of the Army", and all applicable Federal labor standards and requirements, including but not limited to 40 U.S.C. 3141- 3148 and 40 U.S.C. 3701 – 3708 (revising, codifying and enacting without substantial change the provisions of the Davis-Bacon Act (formerly 40 U.S.C. 276a *et seq.*), the Contract Work Hours and Safety Standards Act(formerly 40 U.S.C. 327 *et seq.*) and the Copeland Anti-Kickback Act (formerly 40 U.S.C. 276c *et seq.*); and,

n. Comply with all applicable provisions of the Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970, Public Law 91-646, as amended (42 U.S.C. 4601-4655), and the Uniform Regulations contained in 49 CFR Part 24, in acquiring lands, easements, and rights-of-way, necessary for the initial construction, periodic nourishment, operation, and maintenance of the project, including those necessary for relocations, borrow materials, and dredged or excavated material disposal, and inform all affected persons of applicable benefits, policies, and procedures in connection with said Act.

E. INSTITUTIONAL REQUIREMENTS

1. Sponsorship Agreement. Prior to the start of construction for each restoration project, the Illinois DNR will be required to enter into a Project Cooperation Agreement (PCA) with the Federal Government and satisfy State laws and all applicable regulations. In general, the items included in the PCA have been outlined in the previous paragraphs.

2. Local Cooperation. The Illinois DNR provided a letter of intent on June 30, 2004, indicating their support for the preferred comprehensive plan alternative and their willingness and intent to execute PCAs for the Critical Restoration Projects including providing the non-Federal required assurances.

3. Project Management Plan. A revised Program Management Plan (PMP) for continued implementation of the preferred comprehensive plan alternative will be prepared. The PMP will describe activities, responsibilities, schedules and costs required for the continuation and implementation of the program.

4. Plan Implementation. The final comprehensive plan will be forwarded to HQUSACE for coordination with ASA(CW) and processing to Congress.

5. Views of Non-Federal Sponsor(s) and Any Other Agencies with Implementation Responsibilities. The Non-Federal Sponsor the State of Illinois, acting through the Illinois DNR, is in support of the draft preferred comprehensive plan alternative and is interested in continuing efforts to proceed to construction on the initial Critical Restoration Projects. In addition the Indiana DNR and Kankakee River Basin Commission have expressed interest in participating in projects within their jurisdiction.

The State of Illinois, Office of the Governor, provided a letter of intent on June 30, 2004. The letter extends the State's full support for Alternative 6 and recommendation set forth in this Plan document. The letter also requests that work continue to proceed towards construction with the signing of Project Cooperation Agreements (PCAs) for the initial Critical Restoration Projects including Peoria Riverfront Development – Upper Island, Pekin Lake Northern Unit, and Pekin Lake Southern Unit.

In addition to the State of Illinois, the potential exists for both the States of Indiana and Wisconsin to participate in projects within their portions of the watershed as well as other potential local sponsors. The Indiana DNR submitted a letter on September 16, 2004 expressing interest in serving as a sponsor in restoration efforts under this authority. The Kankakee River Basin Commission, consisting of 24 members from eight Indiana Counties in the drainage basin submitted a letter on September 10, 2004 expressing interest in potential partnerships along the Kankakee and Yellow Rivers. In addition during the public review period, additional letters were received from the US EPA and USFWS. All letters expressed support for the Plan. More details can be found in the Statement of Findings

7. SUMMARY OF COORDINATION, PUBLIC VIEWS, AND COMMENTS

This section provides a summary of the public views and comments associated with efforts to educate and involve individuals and groups with an interest in the study. The section concludes with a summary of National Environmental Policy Act (NEPA) coordination and correspondence.

A. PUBLIC VIEWS AND COMMENTS

1. Public Involvement. This section discusses activities undertaken to involve the public throughout the development of the Illinois River Basin Restoration Comprehensive Plan (Plan). The public includes the study's cost-sharing partner, the Illinois Department of Natural Resources (DNR); elected congressional representatives; Federal, State, county, and city governmental agencies; environmental groups/organizations; farm bureaus; levee and drainage districts; businesses; media; and the unaffiliated general public. The scoping process, that is, the effort to discover the significant issues of any given project, associated with the Corps planning process was also applied to the National Environmental Policy Act (NEPA) scoping requirement at the appropriate level. Informal discussions concerning this program have taken place with the appropriate points of contact of the States of Wisconsin and Indiana. In addition, the States of Wisconsin and Indiana will be provided the Plan for review and comment during the public review process.

Throughout any planning effort, the Corps of Engineers (Corps) strives to inform, educate, and involve the many groups who may have an interest in the plan. This coordination is paramount to assuring that all interested parties have the opportunity to be part of the planning process.

One process used for coordination is the public involvement process. Public involvement is the exchange of information with various segments of the public, designed to reduce unnecessary conflict and achieve consensus. The goal is to open and maintain channels of communication in order to fully consider public views and information in the planning process.

An effective public involvement program must identify and respond to as many affected publics as possible throughout the study process and consider their input in the study's decision-making process. Content analysis is the method employed to identify public opinion, study concerns, and potential controversy. It ensures that the public involvement plan is responsive to the level of interest and concern expressed by the public, and it assesses the effectiveness of the public involvement techniques.

The main avenues for providing information to and receiving feedback from all of the publics were through the study's newsletters, open houses, and public meetings. Newsletters provided points of contact for the publics' questions and comments. The open houses and public meetings allowed for an information exchange between the attendees and the study team. The public also was made aware of study activities via the study website (www.mvr.usace.army.mil/ILRiverEco/default.htm).

The following is a discussion of the two major public involvement efforts—Study Initiation Open Houses and Public Meetings—that were conducted during the study process.

2. Study Initiation Open Houses. In November 2000, a study newsletter was mailed to over 1,600 addresses notifying the public of the study's initiation and inviting them to attend a cost-sharing signing ceremony and a public open house following the ceremony. The newsletter also described the study area; provided the study background; discussed coordination efforts; invited the public to attend one of six additional public open houses scheduled throughout the study area; and listed the Corps and Illinois DNR points of contact for comments or questions. In addition, three news releases to media outlets (television, radio, and newspaper) in the study area provided information about the cost-sharing signing ceremony and the public open houses. The cost-sharing signing ceremony and first open house were held in Peoria, Illinois, on November 29, 2000. The ceremony, sponsored by Congressman Ray LaHood (IL-18), formally signified the partnership formed by the Rock Island District of the Corps of Engineers and the Illinois DNR to execute this study.

Six additional open houses were scheduled to be held in December 2000; however, due to inclement weather, three of the meetings were rescheduled for February 2001. A supplemental newsletter and news release announcing the rescheduled meetings were issued in January 2001.

Copies of the newsletter, supplemental newsletter, and news releases are attached in Appendix A. The newsletters also are available on the study's website. The following table shows the dates and locations of the open houses.

Date	Location
November 29, 2000	Gateway Center Peoria, IL
December 4, 2000	Interstate Center Bloomington, IL
December 5, 2000	Kankakee Civic Auditorium Kankakee, IL
December 6, 2000	Beecher Community Building Yorkville, IL
February 20, 2001	Pere Marquette State Park Lodge Grafton, IL
February 26, 2001	Starved Rock State Park Lodge Utica, IL
February 27, 2001	Western IL University Union Macomb, IL

a. Purpose. The purpose of the open houses was to provide the public with the opportunity to learn about the ecosystem restoration study; to discuss, on a one-to-one basis, information on the range of alternatives for restoring the environment in the Illinois River watershed; and to gather comments on the alternatives and problems in the area. The open house format allowed ample opportunity for the public to visit the displays at their convenience, and to talk with Corps and Illinois DNR study team members.

b. Displays. The Corps provided three display with study information—maps, photographs, and graphic—on Illinois River Ecosystem Restoration Study, Illinois River Watershed Restoration Efforts, and Illinois River Ecosystem Restoration Study Efforts.

The Illinois DNR provided several displays explaining river modeling, sediment budget, Conservation Reserve Enhancement Program (CREP), Watershed Conservation 2000, dredging, and plants and sediment block. A video entitled *Constructing Riffles and Pools for Stream Rehabilitation* also was available for viewing. The Illinois State Water Survey provided extensive material on a summary of research on the Illinois River and Peoria Lake.

c. Attendance. Total open house attendance for all locations was 195. The numbers were smaller than anticipated; however, attendees did spend considerable time viewing the displays and discussing relevant topics with study team members. Attendance at each location is as follows:

Location	Attendance
Peoria	72
Bloomington	14
Kankakee	37
Yorkville	8
Grafton	17
Utica	32
Macomb	15

d. Public Comments. Open house attendees were asked to complete a comment sheet at each session. Sixty-one percent of the attendees completed comment sheets. Overall, comments were very favorable regarding the open house format, displays, and the goals of the study. The table below summarizes the responses from study-specific question on the comment sheets. As some statements were not answered, not all rows total 100 percent.

Statement	Agree	Neutral	Disagree
I support ecosystem restoration efforts along the Illinois River and its tributaries.	94%	5%	0%
In the Illinois River Basin, the principal problems limiting aquatic and associated fish and wildlife habitat are:			
• loss of backwaters and side channels due to sedimentation	90%	2%	2%
• destabilized tributary streams	87%	3%	2%
• changed hydrologic regimes and water fluctuations	80%	10%	2%
• other impacts on the system	53%	14%	0%
In my opinion, study and eventual restoration efforts should focus on:			
• watershed/tributary restoration	80%	3%	0%
• side channel and backwater restoration	75%	5%	1%
• water level management	50%	20%	2%
• floodplain restoration and protection	71%	9%	2%

The comment sheet also provided space for additional participant comments, summarized as follows:

Issues supporting the restoration study efforts included:

- the study and projects are long overdue
- the study needs to be completed before it is too late
- the interested groups need to work together to be more effective and successful

The principal problems affecting aquatic habitat in the Illinois River Basin were described as:

- farmland erosion
- agricultural contaminants in river
- sediment
- lack of aquatic plant growth

Many additional remarks about the study efforts stated that all four of the focus areas are interrelated, and that by addressing these issues solutions to other problems would fall into place naturally.

e. Open House Summary. This series of public open houses covered a wide geographic region throughout the study area. The open houses met the objective of providing residents in the study area the opportunity to meet with study representatives and to comment on the range of study alternatives. Although there were not a large number of attendees, those who did attend offered many comments that assisted the study team as they worked toward selecting a preferred comprehensive plan alternative. In addition, those in attendance who were not on the study's mailing list were added to the list.

3. Team Meetings to Discuss Goals and Alternatives. Following the Study Initiation Open Houses, team members from the Corps and the Illinois DNR study met several times to develop goals for ecosystem restoration and alternatives to address these goals. Regular stakeholder and inter-agency steering committee meetings were also held. In addition, the study was discussed at the 2001 and 2003 Governor's Conferences on the Illinois River.

4. Site-specific Open Houses. Site-specific open houses were held for Waubonsie Creek in Oswego and Montgomery, Illinois, in July 2002, and for Pekin Lake in Pekin, Illinois, in August 2002.

a. Waubonsie Creek Open Houses. Two site-specific open houses were held for the Waubonsie Creek project in July 2002. The first open house was held on July 1, 2002, at the Illinois Village Hall, Montgomery, Illinois. The second open house was held on July 9, 2002, in the Community Room of the Law Enforcement Center (Police Station), Oswego, Illinois. The open house was publicized in at least two local newspapers and through open house invitations mailed to 243 individuals on the study mailing list, including congressional representatives; Federal, State, county, and city agencies/representatives; businesses; media; and the general public.

Purpose. The purpose of the open houses was for the public to view the proposed project plan and talk one-on-one with the study team during the public review phase. The open house also served as a forum for gathering comments on the recommended plan.

Format. One open house session was held from 5-8 p.m. at each location. Subject matter experts from the Corps of Engineers and the Illinois Department of Natural Resources were available to answer questions on all facets of the proposed project.

Displays. The Corps of Engineers provided photographs and graphics of the project area, a display depicting the Illinois Waterway System, information about the Waubonsie Creek Development Study, and general Corps of Engineers information. The Illinois Department of Natural Resources provided two complementary displays addressing the proposed environmental effect of the project.

Attendance. Approximately 19 visitors attended the open house in Montgomery; approximately 22 attended in Oswego.

Public Comments. Meeting attendees were asked to complete a comment sheet. Twelve comment sheets were returned at the Montgomery open house; 16 were returned at the Oswego open house.

All of the respondents agreed that the open house provided an opportunity to gain a better understanding about the study's goals and purposes, while most agreed that the open house provided an opportunity to gain a better understanding about the study's preferred comprehensive plan alternative. All agreed that the open house provided an opportunity for everyone to offer comments about the study's preferred comprehensive plan alternative and that they had a change to talk to a study team member. All felt that the information provided on the displays was valuable in helping them understand the study's recommended plan. In addition, the majority agreed that they understood how the Waubonsie Creek Site Specific Project fit in with the overall purpose of the Illinois River Ecosystem Restoration Study.

None of the attendees disagreed with the plan. There were few actual comments; however, some expressed concern about debris removal and some expressed their desire to see the project progress more quickly.

Summary. Both open houses met the objective of providing residents in the study area an opportunity to meet with study representatives, to hear how the study plan was selected, and to ask questions and offer feedback on the preferred comprehensive plan alternative.

b. Pekin Lake Open House. An open house was held August 6, 2002, in Pekin, Illinois. The purpose of the open house was to provide information on the study status and on the alternatives being considered for restoring the environment within the Illinois River watershed along the Pekin riverfront and to gather comments on the alternatives. Corps of Engineers, Illinois Department of Natural Resources, and Illinois State Water Survey representatives were present at the open house to discuss the study with the public on a one-to-one basis and to receive the public's comments.

A total of 55 people attended the open house. Of those, 27 percent (15) returned comment sheets.

Overall, comments were very favorable regarding the open house format, displays, and the goals of the study. A strong majority of attendees agreed:

- That the open house provided an opportunity to gain information and a better understanding of the study, that the materials and displays were informative, and that they had a chance to talk to a study team member and offer comments about the study.
- That the goal of the study should be to create and restore aquatic, wetland, and terrestrial habitats and provide ancillary recreation benefits.

The majority of questions asked during the question and answer sessions were directed at how the project would affect boating, fishing, hunting, water quality, and flood heights. Ducks Unlimited provided formal written comment on the project that raised several issues. The issue of most concern regarded the adequacy of a 1,000 gallon per minute groundwater well and pump to provide water to the Northern Unit. Subsequently, the study team reevaluated the well and pump design and made appropriate modifications to address these comments.

Summary. The public open house met the goals of informing the public about the proposed alternatives, providing an opportunity for one-on-one discussions with the study team, and serving as a forum for gathering comments on the recommended plan.

Public open houses will be held at additional site-specific locations where study results show projects to be justified and funded.

5. Public Meetings - 2003. After the study team developed draft goals and preliminary alternatives, a round of meetings with the public was scheduled. In November 2003, a study newsletter was mailed to a distribution list that had grown to over 1,900 addresses. The newsletter summarized the November and December 2000 and February 2001 open houses; focused on the study's goals and alternatives; and invited the public to attend one of a series of public meetings to be held in December 2003. The Corps and the Illinois DNR points-of-contact for comments or questions were again listed. A news release was issued to media contacts in the study area. Copies of the newsletter and news release are attached in appendix A.

The following table shows the dates and locations of the public meetings.

Date	**Location**
December 1, 2003	Knights of Columbus Hall Mt. Sterling, Illinois
December 2, 2003	Wildlife Prairie Park Hanna City, Illinois
December 3, 2003	Quality Inn and Suites Bradley, Illinois
December 4, 2003	Hilton Lisle/Naperville Lisle, Illinois

a. Purpose. The purpose of the public meetings was to provide a study update; discuss the draft alternatives being considered at this point in the study; discuss the level of restoration for areas within the Illinois River Basin; and to gather public comments on the draft alternatives.

b. Format. Two sessions were held at each location: an open house from 2-4 p.m. and a public meeting from 6-8 p.m. The afternoon session was informal and allowed ample opportunity for the attendees to visit the displays and talk to Corps and Illinois DNR study team members on a one-to-one basis. The evening session consisted of a formal presentation beginning at 6 p.m., followed by questions and answers and statements.

c. Displays. The Corps provided two displays which included a study map; information on the vision, goals, and alternatives of the program; and complementary photographs.

The Illinois DNR displays consisted of a poster on Natural Grade Control and Stream Channels and two videos entitled *Constructing Riffles and Pools for Stream Rehabilitation* and *Watershed Causes of Channel Erosion.*

Handouts included the November 2003 study newsletter, a copy of the slides used during the formal presentation, and a comment sheet. These handouts, plus the full text of the presentation, were made available on the study's website.

d. Attendance. A total of 153 persons attended the public meetings, as follows.

Location	Attendance	Afternoon/Evening
Mt. Sterling	36	20 afternoon/16 evening
Hanna City	30	16 afternoon/14 evening
Bradley	78	28 afternoon/50 evening
Lisle/Naperville	9	3 afternoon/6 evening

e. Public Comments. Public meeting attendees were asked to fill out a comment sheet after each session. A total of 43 sheets, or 28 percent, were returned. Most of the 43 respondents agreed that the meeting provided an opportunity to gain information and obtain a better understanding of the study. Overall, comments were favorable regarding the open house format and displays, and over 75 percent of the respondents felt that attending the meeting was worth their time.

Respondents' primary areas of interest in the study are:

Area of Interest	Percent
Environmental	35%
Personal Interest	16%
City/County Government	12%
Regional Planning	12%
Agriculture	7%
State Government	5%
Other Business/Industry	5%
Education	2%
Federal Government (Congressional)	0%
Federal Government (All Other)	0%
Media	0%
Recreation	0%
Waterborne Industry	0%
No Answer	6%

Attendees were asked to agree or disagree with statements concerning the appropriateness of alternative plans. Data is given in the following table.

Study Process Statements	Agree	Neutral	Disagree
I understand the principal ecosystem restoration problems which are being addressed by this study.	91%	5%	4%
The range of alternative plans presented to maintain and restore biodiversity and sustainable populations of native species is appropriate.	77%	12%	11%
The range of alternative plans presented to reduce sediment delivery to the Illinois River is appropriate.	67%	7%	26%
The range of alternative plans presented to restore aquatic habitat diversity of side channels and backwaters is appropriate.	70%	19%	11%
The range of alternative plans presented to improve floodplain, riparian, and aquatic habitats and functions is appropriate.	70%	21%	9%
The range of alternative plans presented to restore and maintain fish passage is appropriate.	56%	35%	9%
The range of alternative plans presented to reduce unnatural water level fluctuations is appropriate.	51%	37%	12%
The range of alternative plans presented to improve water and sediment quality in the Illinois River and its watershed is appropriate.	60%	19%	21%

The public was asked additional questions about the study; responses are as follows:

- The majority of respondents agreed that the restoration goals are appropriate to achieve the desired ecosystem restoration needs in the Illinois River Basin.
- Most agreed that the alternative plans presented address the appropriate range of alternatives for ecosystem restoration in the Illinois River Basin.
- The major concerns expressed by respondents were related to sediment delivery and funding issues.

f. Public Meeting Summary. The public meetings met the objective of discussing both the alternatives being considered in the study and the level of restoration for areas within the Illinois River Basin, and gathered the public's comments on the draft alternatives. The dialogue between study team personnel and the public was informative, and feedback received will be used by the study team in selecting a draft preferred comprehensive plan alternative.

6. Public Meetings - 2006. Following completion of the draft Illinois River Basin Restoration Comprehensive Plan, a series of public meetings was held during the public review period for the document. In February 2006, a newsletter announcing the public meetings was mailed to nearly 3,200 names on the study distribution list. The mailing also contained a study brochure that highlighted project goals, problems, and recommendations. A news release was issued to media contacts in the study area. Copies of the newsletter, brochure and news release are attached in appendix A.

Date and locations of the public meetings were:

Date	Location
March 7, 2006	Starved Rock Lodge & Conference Center Utica, Illinois
March 8, 2006	Hilton Garden Inn Kankakee, Illinois
March 9, 2006	Holiday Inn Express Oswego, Illinois
March 14, 2006	Gateway Center Peoria, Illinois
March 15, 2006	Pere Marquette State Park Grafton, Illinois
March 16, 2006	Dickson Mounds Museum Lewistown, Illinois

a. Purpose. The purpose of the public meetings was to discuss and gather feedback on the draft preferred comprehensive plan alternative for the Illinois River Basin Restoration Comprehensive Plan.

b. Format. Two sessions were held at each location from 2-4 p.m. and from 6-8 p.m. Both sessions contained a formal presentation followed by a question and answer session. Corps of Engineers and Illinois Department of Natural Resources staff were present to speak to the public one-to-one.

c. Displays. The three Corps of Engineers displays were titled: Illinois River Basin Restoration Study (provided general information); Illinois River Basin Restoration System Alternatives; and Illinois River Basin Restoration Critical Restoration Project Status.

Handouts included the February 2006 study newsletter, the study brochure, a copy of the slides used during the formal presentation, and a comment sheet. These handouts, plus the full text of the presentation, were made available on the study's website. Fact sheets for some of the site-specific projects were also made available at the meetings.

d. Attendance. A total of 170 persons attended, as follows.

Location	Attendance
Utica	22
Kankakee	40
Oswego	11
Peoria	67
Grafton	7
Lewistown	23

e. Public Comments, Public meeting attendees were asked to fill out a comment sheet after each session. A total of 49 sheets and one attendee statement were returned. Subsequent to the public meetings, ten letters and one form letter (containing 163 signatures) were submitted for the record.

The majority of respondents conveyed continued support for the study and stated that the recommended Alternative #6 would be a very good plan to restore the ecological integrity of the Illinois River Basin system. Primary areas of concern expressed by respondents included:

- Need to focus on headwaters as the source of sand and sediment
- Need to focus on sand-bed load as well as sediment
- Prioritization of projects
- Overall cost of the plan is expensive and perhaps prohibitive
- Costs and efficiencies of fish passage component
- Partnering with other agencies to accomplish the work
- Consider more natural, as opposed to engineered, solutions for restoration

Overall, comments were very favorable regarding the meeting format and displays, and 84 percent of the respondents felt that attending the meeting was worth their time.

7. Summary of Public Involvement Process. The public was kept informed and involved throughout this process through several avenues—newsletters, public open houses, public meetings, and the study's website. These activities provided the public with numerous opportunities to provide feedback to the study team. This feedback was used by the study team during the plan formulation process; thus, the draft preferred comprehensive plan alternative has been influenced by the public involvement process. In addition, the study's mailing list grew to almost 3,200 names, primarily as a result of the public involvement activities. Therefore, the goals of the process—(1) opening and maintaining channels of communication with the public in order to give full consideration to public views, and (2) gathering information for use by the study team—were met.

B. NEPA COORDINATION

Section 519 of WRDA 2000 defines the Illinois River Basin as the Illinois River, Illinois, its backwaters, its side channels, and all tributaries, including their watersheds, draining into the Illinois River. Upper reaches of this program area are located outside the Illinois State boundaries, confined to the southeast corner of Wisconsin (headwaters of the Fox and Des Plaines Rivers) and the northwest corner of Indiana (headwaters of the Kankakee and Iroquois Rivers). The original coordination efforts for this program did not include any area outside the boundaries of Illinois. In the event that future projects associated with the program are proposed within the state boundaries of Wisconsin and/or Indiana, individual coordination with appropriate Federal and State agencies would be conducted for compliance with NEPA and other Federal laws and policies applicable to all plans recommended for implementation.

The NEPA scoping process for the EA included coordination letters, public meetings, newsletters, and regularly scheduled meetings with the non-Federal sponsor.

Although a certain amount of risk and uncertainty is inherent for any such undertaking as this, the human environment would not be exposed to any unusual or unique risks or any extreme uncertainties that could lead to significant effects on the human environment. Risk and uncertainty for Goals 1 through 5 can be found in Section 3, of this report, *Plan Formulation*. Given the beneficial nature of this ecosystem restoration program, implementation activities should not result in highly controversial impacts on the quality of the human environment. Overall project uncertainty is reduced by incorporating a comprehensive monitoring plan as well as adaptive management techniques.

All coordination letters from the Rock Island District for this program are found at the end of this section. Coordination was initiated early and continued throughout the plan formulation process. The following agencies received the NEPA coordination letter dated March 24, 2003:

Federal Emergency Management Agency, Region 5
U.S. Environmental Protection Agency, Region 5
U.S. Coast Guard
U.S. Army Corps of Engineers, Detroit District
U.S. Army Corps of Engineers, St. Louis District
U.S. Army Corps of Engineers, Chicago District
U.S. Department of Agriculture, Farm Service Agency
U.S. Department of the Interior, U.S. Geological Survey
U.S. Fish and Wildlife Service, Rock Island Field Office
U.S. Fish and Wildlife Service, Chicago Field Office
Natural Resource Conservation Service
Illinois Department of Natural Resources, Director
Illinois Department of Natural Resources, Scientific Research & Analysis
Illinois Department of Natural Resources, Office of Resource Conservation
Illinois Department of Natural Resources, Office of Resource Conservation,
Wetland Watershed & EMP Program Administration
Illinois Department of Agriculture, Director
Illinois Department of Agricultural, Association of Illinois Soil and Water Conservation Districts
Illinois Department of Natural Resources, Office of Water Resources
Illinois Environmental Protection Agency, Watershed Management Section
Illinois Department of Transportation
Illinois River Coordinating Council
Izaak Walton League
Izaak Walton League, Heartland Water Resource Board
Illinois Sierra Club
The Nature Conservancy, Illinois River Project Director

The Illinois Department of Agriculture, Division of Natural Resources responded by letter dated April 3, 2003. The department described the importance of the agricultural industry in Illinois. It stated it is essential that all restoration projects be designed and implemented in a manner that is as compatible as possible with the agricultural community. The department also stated that balancing environmental restoration goals while protecting the integrity of agricultural operations should be one of the guiding principles for this program. In addition, the department highly recommended that the Corps closely coordinate with agricultural groups and organizations—such as local soil and water conservation districts, levee and drainage districts, and county Farm Bureaus—on all Illinois River restoration projects. The department urged the Corps to look for opportunities to achieve multiple environmental objectives in planning restoration activities.

The U.S. Fish and Wildlife Service, Rock Island Field Office, responded by letter dated April 22, 2003. To comply with Section 7 of the Endangered Species Act of 1973, the office enclosed a map of the Illinois River Basin and a map of Illinois, with endangered species information included by county. Also included was a more specific description of federally-listed species within Illinois and each species' habitat distribution status.

The Director of the Illinois DNR responded by letter dated April 28, 2003. The DNR recommended that any developments associated with the Plan should be carefully designed to ensure the sensitive resources of Illinois (e.g., wetlands, backwater lakes, threatened and/or endangered species and habitat, natural areas, high quality woodlands, etc) are not inadvertently harmed. The DNR further suggested that future restoration efforts may need to be designed with possible timeframe restrictions (avoidance windows), and expressed the need for pre-construction surveys to avoid impacting sensitive resources (e.g., freshwater mussels, bat roosting areas, etc.).

The U.S. Fish and Wildlife Service, Rock Island Field Office, responded by letter dated August 10, 2005, stating that, contrary to the Coordination Act Report, May 2004 furnished to the District, and after informal consultation with the District, it is mutually agreed that it is not possible to address Section 7 of the Endangered Species Act with a programmatic Biological Assessment. After more information is known concerning the specific restoration projects; individual, site specific and species specific Biological Assessments would be prepared, as necessary.

HAGERTY/dmd/5286

March 24, 2003

Planning, Programs, and
Project Management Division

SEE DISTRIBUTION LIST

The Rock Island District of the U.S. Army Corps of Engineers (Corps) is currently undertaking a Feasibility Study for the Illinois River Ecosystem Restoration project in Illinois. This study will result in the Illinois River Basin Comprehensive Plan with an integrated programmatic environmental document. This study is being conducted under the Corps of Engineers General Investigations (GI) Program in partnership with the Illinois Department of Natural Resources, under the authority of Section 216 of the Flood Control Act of 1970 and the Illinois River Basin Restoration Authority, Section 519 of the Water Resources Development Act of 2000.

The study area encompasses the Illinois River watershed within the State of Illinois. This study will investigate reducing impacts to the fish and wildlife habitat in the Illinois River Basin and providing opportunities in water and related land resources projects and planning services within the Illinois River watershed. Specific attention will be given to identifying opportunities for restoring degraded ecosystem structures and functions, including the ecosystem's hydrology and plant and animal communities, to a less degraded or more naturalized condition.

There are generally two types of efforts occurring: (1) system evaluations focused on assessing the overall watershed needs and general locations for restoration, and (2) site-specific evaluations focused on developing detailed restoration options for possible implementation at specific sites. The focus of this letter is on the system level study for restoration opportunities. All current and future site-specific projects will be coordinated separately.

The basin-wide restoration opportunities fall into four focus areas, as follows:

a. Watershed/Tributary Restoration – Evaluate options to address tributary degradation and instability, looking at stream and wetland restoration, water retention, conservation easements, and riparian buffers.

b. Side Channel and Backwater Restoration – Consider opportunities to restore aquatic habitats in these areas, including off-channel deep water habitat, backwater lakes, side channels, islands, etc.

c. Water Level Management – Evaluate options to reduce rapid fluctuations and naturalize flows.

d. Floodplain Restoration and Protection – Evaluate floodplain use, potential restoration of floodplain function, and value of/potential for acquisition/use of conservation easements.

The proposed study has not been addressed in previous National Environmental Policy Act (NEPA) documents prepared by the Rock Island District. The Comprehensive Plan, with an integrated programmatic environmental document, will evaluate an array of alternatives and recommend an optimum combination of features for achieving ecosystem restoration benefits. The Comprehensive Plan for this study is scheduled for completion in the summer of 2004.

At this time, we are requesting your comments concerning this study and information regarding any significant existing resources or environmental concerns associated with restoration of the Illinois River Basin, including, but not limited to, riparian, floodplain, and aquatic resources. Specifically, any endangered species, critical aquatic habitat, wetlands, land-use plans, floodplain issues that could be adversely affected by the proposed study, and other issues or problems associated with this study should be reported at this time.

Please provide any comments you may have regarding the proposed study within 30 days of the date of this letter. More information regarding this study can be found on our web site at http://www.mvr.usace.army.mil/ILRiverEco/default.htm. If you have any questions, please call Ms. Karen Hagerty (biologist) of our Economic and Environmental Analysis Branch at 309/794-5286. Written comments may be sent to our address above, ATTN: Planning, Programs, and Project Management Division (Karen Hagerty).

Sincerely,

ORIGINAL SIGNED BY

John P. Carr
Acting Chief, Economic and
Environmental Analysis Branch

MFR: Initial Coordination Letter for the Illinois River Ecosystem Restoration GI/519 Study, Illinois River Basin, IL.

Copies Furnished:

Mr. Jim Mick
Havana Field Headquarters
Illinois Department of Natural Resources
700 South 10th Street
Havana, Illinois 62644

Copies Furnished (Continued):

ATTN: CELRC-PM-PM (Linda Sorn)
District Engineer
U.S. Army Engineer District, Chicago
111 North Canal Street, 12th Floor
Chicago, Illinois 60606-7205

ATTN: CEMVS-PM-F (Tamara Atchley)
District Engineer
U.S. Army Engineer District, St Louis
1222 Spruce Street
St Louis, Missouri 63103-2822

Dist File (PM-M)
√PM-A (Hagerty)
PM-A (Deiss)
PM-A (Bollman)
PM-A (Jackson)
PM-M (Thompson)
ED-DM (Sunderman)
ED-HH (Schwar)
ED-DN
OD-I (Granados)
OC

IL RIVER ECOSYSTEM RESTORATION 90X 13 MAR 03 (DRAFT)

ERIC BERMAN
FEDERAL EMERGENCY MGMT AGENCY - REG 5
536 S CLARK ST 6TH FLOOR
CHICAGO IL 60605

ROBERT HOLMES
DISTRICT CHIEF
US DEPT OF INTERIOR-US GEOLOGICAL SURVEY
221 N BROADWAY AVE
URBANA IL 61801

DONALD KATHAN
US ENVIRON PROTECTION AGENCY - REG 5
77 W JACKSON BLVD (B19J)
CHICAGO IL 60604-3507

RICHARD NELSON
FIELD SUPERVISOR
US FISH AND WILDLIFE SERVICE
4469 48TH AVE CT
ROCK ISLAND IL 61201

JAMES RASMUS
US COAST GUARD
FOOT OF WASHINGTON ST
EAST PEORIA IL 61611

JOHN ROGNER
CHICAGO FIELD OFFICER DIRECTOR
US FISH AND WILDLIFE SERVICE
1250 S GROVE SUITE 103
BARRINGTON IL 60010

CHIEF, ENVIRONMENTAL
US ARMY ENGR DIV - DETROIT
477 MICHIGAN AVE
DETROIT MI 48226

OWEN DUTT
RIVER NAVIGATOR
ATTN: CEMVS-PM-N
US ARMY ENGR DIST - ST LOUIS
1222 SPRUCE ST
ST LOUIS MO 63103-2833

GENE FLEMING
PD-E
US ARMY ENGR DIST - CHICAGO
111 N CANAL ST - 12TH FLOOR
CHICAGO IL 60606-7206

WILLIAM GRADLE
STATE CONSERVATIONIST
NATURAL RESOURCE CO NSERVATION SERVICE
211 W PARK CT
CHAMPAIGN IL 61821

BILL GRAFF
DIRECTOR
FARM SERVICE AGENCY
US DEPT OF AGRICULTURE
3500 W WABASH PO BOX 19273
SPRINGFIELD IL 62707

ACTING DIRECTOR
OFFICE OF RESOURCE CONSERVATION
IL DEPT OF NATURAL RESOURCES
ONE NATURAL RESOURCES WAY
SPRINGFIELD IL 62702-1271

BRIAN ANDERSON
SCIENTIFIC RESEARCH & ANALYSIS
IL DEPT OF NATURAL RESOURCES
ONE NATURAL RESOURCES WAY FLR 001
SPRINGFIELD IL 62702-1271

JOEL BRUNSVOLD
DIRECTOR
IL DEPT OF NATURAL RESOURCES
ONE NATURAL RESOURCES WAY
SPRINGFIELD IL 62702-1271

1

IL RIVER ECOSYSTEM RESTORATION 90X 13 MAR 03 (DRAFT)

CHRISTOPHER STONE
EXEC DIRECTOR
IL DEPT OF AGRI-BUR OF SOIL & WATER/AISWCD
EMERSON BLDG 2520 MAIN ST
SPRINGFIELD IL 62702

SCOTT STUEWE
WETLAND WATERSHED & EMP PROG ADMIN
OFFICE OF RESOURCE CONSERVATION
IL DEPT OF NATURAL RESOURCES
ONE NATURAL RESOURCES WAY
SPRINGFIELD IL 62702-1271

DONALD VONNAHME
DIRECTOR
OFFICE OF WATER RESOURCES
IL DEPT OF NATURAL RESOURCES
ONE NATURAL RESOURCES WAY
SPRINGFIELD IL 62702-1270

BRUCE YURDIN
MANAGER
WATERSHED MANAGEMENT SECTION
IL ENVIRONMENTAL PROTECTION AGENCY
1021 N GRAND AVE E
SPRINGFIELD IL 62702

DIRECTOR
IL DEPT OF AGRICULTURE
PO BOX 19281 PO BOX 19281
SPRINGFIELD IL 62794-9281

TIMOTHY MARTIN
SECRETARY
IL DEPT OF TRANSPORTATION
2300 S DIRKSEN PKWY RM 300
SPRINGFIELD IL 62764

PAT QUINN
IL RIV COORDINATING COUNCIL
214 STATE HOUSE PO BOX 7347
SPRINGFIELD IL 62791-7347

IL SIERRA CLUB
200 N MICHIGAN AVE STE 505
CHICAGO IL 60601-5908

IZAAK WALTON LEAGUE
1125 SPRING BAY RD
EAST PEORIA IL 61611

DOUG BLODGETT
IL RVR PRJ DIR
THE NATURE CONSERVANCY
11304 N PRAIRIE RD
LEWISTOWN IL 61542

RICHARD EICHELKRAUT
HEARTLAND WATER RESOURCE BOARD
IZAAK WALTON LEAGUE
208 WILSHIRE DR
WASHINGTON IL 61571

Illinois Department of Agriculture

Rod R. Blagojevich, Governor

Division of Natural Resources
State Fairgrounds • P.O. Box 19281 • Springfield, IL 62794-9281 • 217/785-4233 • Voice/TDD 217/785-2427 • Fax 217/524-4882

April 3, 2003

Ms. Karen Hagerty
Department of the Army
Rock Island District, Corps of Engineers
Planning, Programs, and Project Management Division
Clock Tower Building-P.O. Box 2004
Rock Island, Illinois 61204-2004

Dear Ms. Hagerty:

We are in receipt of Mr. John P. Carr's March 24, 2003 correspondence regarding the Feasibility Study that is underway for the Corps of Engineers' Illinois River Ecosystem Restoration Project in Illinois. Mr. Carr has invited all interested parties to provide comments pertaining to the study and information concerning significant natural resources or environmental concerns. Hence, the Illinois Department of Agriculture is conveying the following comments.

The agriculture industry plays a prominent role in the Illinois River Basin. The 26,000-square mile watershed contains more than 10 million acres of some of the most productive farmland in the world, which represents approximately 50% of Illinois' agricultural economy. In addition, through natural resource conservation programs such as Illinois' Conservation 2000 Program, the federal-state Conservation Reserve Enhancement Program, and the USDA Farm Bill Programs, Illinois' agricultural producers are installing conservation practices at an accelerated pace to protect soil and water resources throughout the basin. Undoubtedly, agriculture has a huge stake in the restoration of the Illinois River Basin.

It is our understanding that four components comprise the basin-wide restoration initiative: 1) Watershed/Tributary Restoration, 2) Side Channel and Backwater Restoration, 3) Water Level Management and 4) Floodplain Restoration and Protection. Certainly, these are laudable goals for protecting and enhancing the Illinois River Basin. However, it is essential that all restoration projects be designed and implemented in a manner that is as compatible as possible with the agricultural community. For example, water level management schemes should take into account how the manipulation of water levels will affect agricultural operations in the basin. The same concern applies to the restoration of floodplain function, in terms of potential impacts to agriculture. Balancing environmental restoration goals with protecting the integrity of agricultural operations should be one of the guiding principles adhered to by the Corps of Engineers as they proceed with the Illinois River Restoration Comprehensive Plan and the integrated programmatic environmental document.

Ms. Karen Hagerty
April 3, 2003
Page 2

We highly recommend that the Corps of Engineers closely coordinate with agricultural groups and organizations on all restoration projects for the Illinois River. Examples include local soil and water conservation districts, levee and drainage districts and county Farm Bureaus. These groups and organizations have broad local knowledge that will be valuable to the Corps of Engineers as restoration plans are developed and implemented.

We also urge the Corps to look for opportunities to achieve multiple environmental objectives (e.g., nutrient management, carbon sequestration) in planning restoration activities.

Thank you for the opportunity to comment with regard to the Feasibility Study. The Illinois Department of Agriculture will furnish comments in the future when site-specific projects are disclosed by the Corps of Engineers.

Sincerely,

Mike Beaty, Division Manager
Division of Natural Resources

Copy: Acting Director Tom Jennings, IDA
Tom Doubet, IDA
Cheryl Day, IADD
Chris Stone, AISWCD
Kevin Rund, IFB
Gary Clark, IDNR

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Rock Island Field Office
4469 48th Avenue Court
Rock Island, Illinois 61201
Phone: (309) 793-5800 Fax: (309) 793-5804

IN REPLY REFER TO:
FWS/RIFO

April 22, 2003

Mr. Jack Carr
Acting Chief, Economic and
Environmental Analysis Branch
U.S. Army Engineer District
Rock Island
Clock Tower Building, P.O. Box 2004
Rock Island, Illinois 61204-2004

Dear Mr. Carr:

This responds to a letter dated March 24, 2003, from your office asking for initial coordination comments on the Feasibility Study of the Illinois River Ecosystem Project. As described in the letter, the feasibility study will have two general objectives: (1) system evaluations focused on assessing the overall watershed needs and general locations for restoration, and (2) site-specific evaluations focused on developing detailed restoration options for possible implementation at specific sites. This information request is specifically concerned with the system level study for restoration opportunities.

To comply with Section 7 of the Endangered Species Act of 1973, as amended, we have enclosed a map of the Illinois River basin delineated with all counties which lie within the watershed and a map of the entire State of Illinois, with endangered species information included by county. A more specific description of federally listed species within Illinois and their habitat distribution status are also enclosed.

The Fish and Wildlife Service (Service) looks forward to working with the Corps of Engineers to formulate alternatives which benefit trust species and to help protect the natural resources of the Illinois River system.

This letter provides comments under the authority of and in accordance with provisions of the Fish and Wildlife Coordination Act (48 Stat. 401, as amended; 16 U.S.C. 661 et seq.); and the Endangered Species Act of 1973, as amended. If you have any questions please contact Mr. Kraig McPeek of my staff at (309) 793-5800 ext 514.

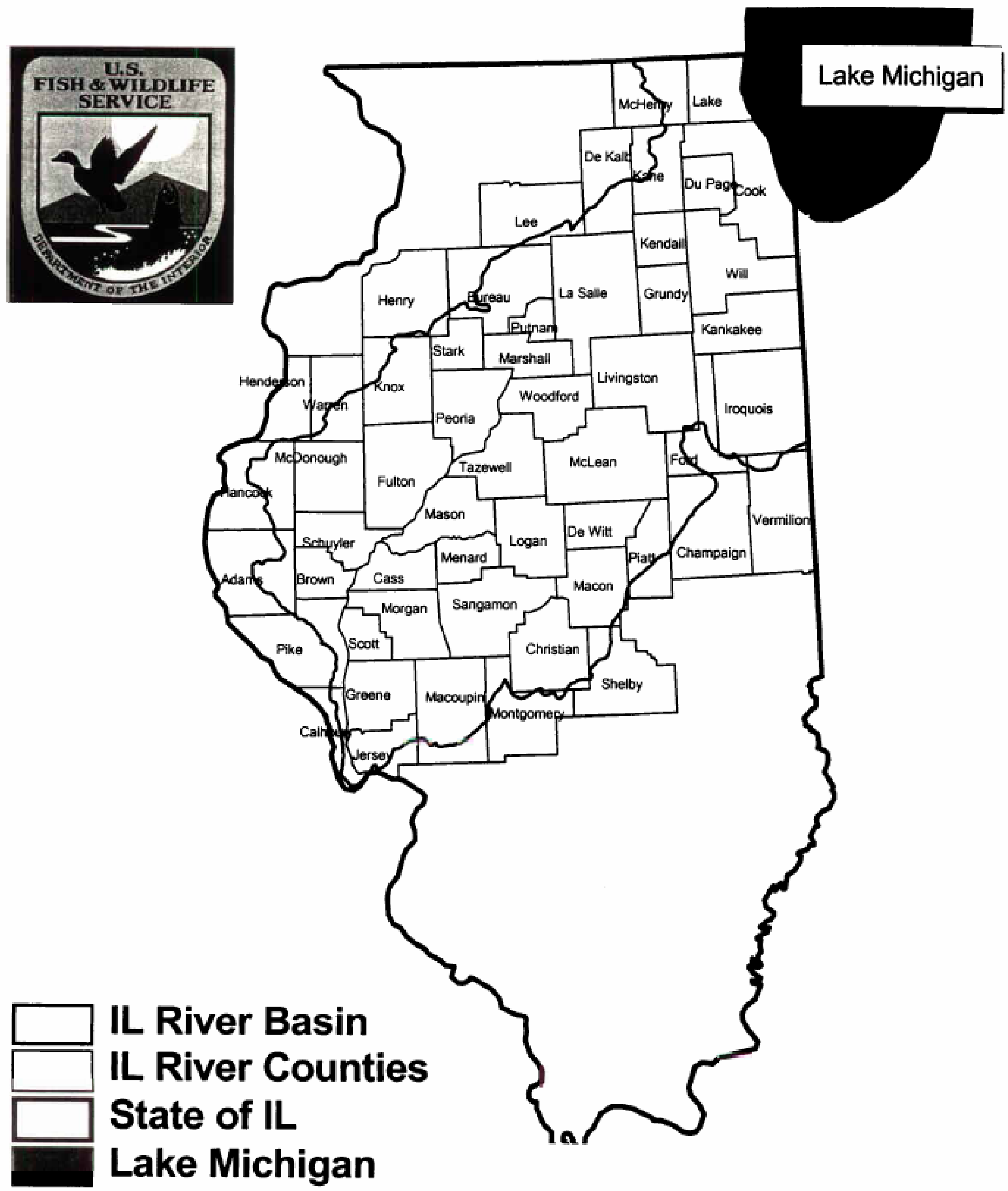
Sincerely,

Richard C. Nelson
Supervisor

Enclosures

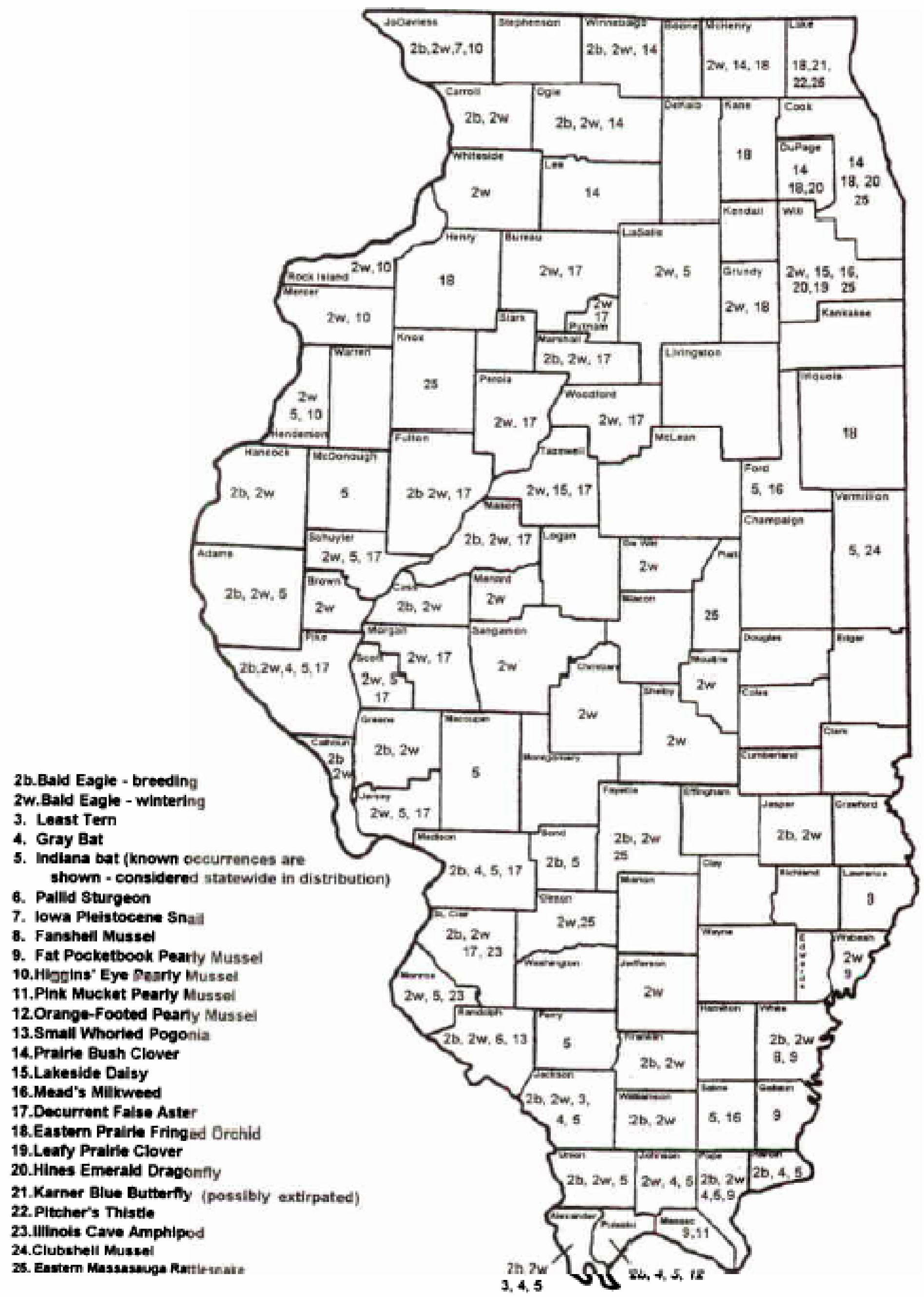
G:\Office Users\Kraig\Illinois Ecosystem study\Initial Coordination Letter to Corps.doc

Counties that fall w/in the IL River watershed



Current Distribution of Federally-Listed Threatened and Endangered Species in Illinois

US Fish & Wildlife Service - Rock Island, Illinois



DISTRIBUTION OF FEDERALLY-LISTED THREATENED (T), ENDANGERED (E), AND PROPOSED (P) SPECIES IN ILLINOIS

Contact: U.S. Fish and Wildlife Service, 4469 48th Avenue Court, Rock Island, IL 61201 Phone: (309) 793-5800

Revised November 20, 2001

BIRDS	STATUS	HABITAT	CURRENT DISTRIBUTION	POTENTIAL HABITAT	HISTORICAL RECORDS
Peregrine falcon *Falco peregrinus*	Delisted 8/25/99				
Bald eagle *Haliaeetus leucocephalus*	P (Delisting)	Breeding	Adams, Alexander, Bond, Calhoun, Carroll, Fayette, Fulton, Greene, Jo Daviess, Jackson, Mason, Pike, Pope, Randolph, St. Clair, Union, Winnebago, Williamson	Hancock, Jasper	
		Wintering	Adams, Alexander, Brown, Bureau, Calhoun, Carroll, *Cass, Christian, Clinton, De Witt, Fayette, Franklin, *Fulton, Greene, Grundy, Hancock, *Henderson, Jackson, Jasper, Jefferson, *Jersey, Jo Daviess, Johnson, LaSalle, Madison, Marshall, Mason, McHenry, Menard, *Mercer, Monroe, *Morgan, Moultrie, Ogle, Peoria, Pike, Pulaski, *Putnam, Randolph, *Rock Island, Sangamon, *Schuyler, Scott, Shelby, St. Clair, Tazewell, Union, Wabash, White, *Whiteside, Will Winnebago, Williamson, Woodford ***Counties with night roosts**		
Least Tern *Sterna antillarum*	E	Bare alluvial and dredged spoil islands	Alexander, Jackson, Massac, Pope (Mississippi & Ohio Rivers)	Gallatin, Hardin, Pulaski (Ohio River); Wabash, White (Wabash River); Madison (Mississippi River)	
Piping Plover *Charadrius melodus*	E	Lakeshore beaches	EXTIRPATED	Cook, Lake (Lake Michigan shoreline	Cook, Gallatin, Lake, Madison, Pope

FISH	STATUS	HABITAT	CURRENT DISTRIBUTION	POTENTIAL HABITAT	HISTORICAL RECORDS
Pallid Sturgeon *Scaphirynchus albus*	E	Large rivers	Mississippi River downstream of confluence with Missouri River	Ohio River below Dam #53	Calhoun, Hancock, Henderson

DISTRIBUTION OF FEDERALLY-LISTED THREATENED (T), ENDANGERED (E), AND PROPOSED (P) SPECIES IN ILLINOIS
Contact: U.S. Fish and Wildlife Service, 4469 48th Avenue Court, Rock Island, IL 61201 Phone: (309) 793-5800

Revised August 4, 2000

MAMMALS	STATUS	HABITAT	CURRENT DISTRIBUTION	POTENTIAL HABITAT	HISTORICAL RECORDS
Gray bat *Myotis grisescens*	E	Caves and mines; rivers & reservoirs adjacent to forests	Alexander, Hardin, Jackson, Johnson, Madison, Pike, Pope, Pulaski	Search for bats prior to any cave impacting project, particularly in southern and southwestern Illinois.	Adams, Jersey
Indiana bat *Myotis sodalis*	E	Caves, mines (hibernacula); small stream corridors with well developed riparian woods; upland forests (foraging)	Adams, *Alexander, Bond, Ford, *Hardin, Henderson, *Jackson. *Jersey, Johnson, *LaSalle, Madison, Macoupin, McDonough, *Monroe, Perry, Pike, *Pope, Pulaski, *Saline, Schuyler, Scott, *Union, Vermillion ***Counties with hibernacula** **Critical Habitat: Blackball Mine, LaSalle County**	Statewide - search for bats prior to any cave impacting project, particularly in southern and southwestern Illinois.	Cook, Christian, Jo Daviess, Madison, Morgan, Will

INVERTEBRATES	STATUS	HABITAT	CURRENT DISTRIBUTION	POTENTIAL HABITAT	HISTORICAL RECORDS
Karner blue butterfly *Lycaeides melissa samuelis*	E	Pine barrens and oak savannas on sandy soils and containing wild lupines (*Lupinus perennis*), the only known food plant of the larvae	EXTIRPATED	Carroll, Iriquois, Jo Daviess, Kankakee, Lake, Lee, Ogle, Winnebago	
Hines emerald dragonfly *Somatochlora hineana*	E	Spring fed wetlands, wet meadows and marshes	Cook, Will, DuPage, (Des Plaines River drainage)		
Illinois cave amphipod *Gammarus acherondytes*	E	Cave streams in Illinois sinkhole plain	Monroe, St. Clair		
Iowa pleistocene snail *Discus macclintocki*	E	North-facing algific talus slopes of the driftless area	Jo Daviess		

REPTILES	STATUS	HABITAT	CURRENT DISTRIBUTION	POTENTIAL HABITAT	HISTORICAL RECORDS
Eastern massasauga rattlesnake *Sistrurus c. catenatus*	CAN	shrub wetlands	Clinton, Cook, Fayette, Knox, Lake, Piatt, Will		Adam, Champaign, Clark, Coles, Crawford, Cumberland, DeKalb, De Witt, DuPage, Edgar, Hancock, Logan, Madison, McLean, Mercer, Peoria, Stark, Tazewell, Warren

DISTRIBUTION OF FEDERALLY-LISTED THREATENED (T), ENDANGERED (E), AND PROPOSED (P) SPECIES IN ILLINOIS

Contact: U.S. Fish and Wildlife Service, 4469 48th Avenue Court, Rock Island, IL 61201 Phone: (309) 793-5800

Revised August 4, 2000

Page 3 of 4

MUSSELS	STATUS	HABITAT	CURRENT DISTRIBUTION	POTENTIAL HABITAT	HISTORICAL RECORDS
Higgins= eye pearlymussel *Lampsilis higginsi*	E	Mississippi River; Rock River to Steel Dam	Jo Daviess, Mercer, Henderson, Rock Island **Essential Habitat: Sylvan Slough at Rock Island**	Adams, Carroll, Hancock, Pike, Whiteside (Mississippi River upstream of Dam 22)	
Fanshell mussel *Cyprogenia stegaria (=C. irrorata)*	E	Wabash River	White	Gallatin)	
Fat pocketbook pearlymussel *Potamilis capax*	E	Mississippi, Wabash, Little Wabash, Ohio Rivers	*Hancock, *Pike (Mississippi River); Gallatin, Lawrence, Wabash, White (Wabash & Little Wabash Rivers); Pope, Massac (Ohio River) ***Transplanted populations**		
Pink Mucket pearlymussel *Lampsilis orbiculata (=Plethobasis abrupta)*	E	Ohio River	Massac	Alexander, Gallatin, Hardin, Pope, Pulaski	
Orange-footed pearlymussel *Plethobasis cooperianus (=P. striatus)*	E	Ohio River below confluence with Cumberland River)	Pulaski	Alexander, Massac, Pope	Clark, Crawford, Lawrence, Wabash (Wabash River)
Tubercled-blossom pearlymussel *Epioblasmas torulosa torulosa*	E	Rivers	EXTIRPATED		
White warty-back pearlymussel *Plethobasis cicatricosus*	E	Rivers	EXTIRPATED	Clark, Gallatin, White (Wabash River)	Clark, Crawford, Lawrence, Vermillion, Wabash (Wabash River)
Clubshell *Pleurobema clava*	E	Rivers	Vermillion (N. Fork Vermillion River)		Wabash & Lower Ohio Rivers
Rough pigtoe *Pleurobema plenum*	E	Rivers	EXTIRPATED		Wabash & Lower Ohio Rivers
Ring pink *Obovaria retusa*	E	Rivers	EXTIRPATED		

DISTRIBUTION OF FEDERALLY-LISTED THREATENED (T), ENDANGERED (E), AND PROPOSED (P) SPECIES IN ILLINOIS

Contact: U.S. Fish and Wildlife Service, 4469 48th Avenue Court, Rock Island, IL 61201 Phone: (309) 793-5800

Revised August 4, 2000

PLANTS	STATUS	HABITAT	CURRENT DISTRIBUTION	POTENTIAL HABITAT	HISTORICAL RECORDS
Prairie bush clover *Lespedeza leptostachya*	T	Dry to mesic prairies with gravelly soil	Cook, DuPage, Lee, Ogle, McHenry, *Winnebago * introduced	Search for this species whenever prairie remnants are encountered	
Small whorled pogonia *Isotria medeoloides*	T	Dry woodlands	Randolph		St. Clair, Tazewell, Williamson
Eastern prairie fringed orchid *Platanthaera leucophaea*	T	Mesic to wet prairies	Cook, DuPage, Grundy, Henry, Iroquois, Kane, Lake, McHenry	Search for this species whenever prairie remnants are encountered	
Mead=s milkweed *Asclepias meadii*	T	Virgin prairies	*Ford, Saline, *Will * introduced	Search for this species whenever prairie remnants are encountered	
Lakeside daisy *Hymenopsis herbacea*	T	Dry rocky prairies	*Tazewell, *Will * introduced		Logan, Menard
Decurrent false aster *Boltonia decurrens*	T	Distrubed alluvial soils	Bureau, Fulton, Jersey, Madison, Marshall, Mason, Morgan, Peoria, Pike, Putnam, Schuyler, Scott, Tazewell, Woodford (Illinois River floodplain; St. Clair (Mississippi River floodplain)	Brown, Calhoun, Cass, Greene, Grundy, LaSalle, Pike (Illinois River floodplain); Alexander. Jackson, Monroe, Randolph, St. Clair (Mississippi River floodplain)	
Leafy prairie clover *Dalea foliosa*	E	Prairie remnants on thin soil over limestone	Will (Des Plains River floodplain)		
Dune thistle *Cirsium pitcheri*	T	Lakeshore dunes	Lake (introduced)		Cook
Running buffalo clover *Trifolium stoloniferum*	E	Distrubed bottomland meadows	EXTIRPATED		Cook, Fulton, Hancock, Henderson, Peoria
Price=s potato bean *Apios priceana*	T	Wet floodplain forests, shrubby swamps	EXTIRPATED		Cook

Illinois
Department of
Natural Resources
One Natural Resources Way · Springfield, Illinois 62702-1271

http://dnr.state.il.us
Rod R. Blagojevich, Governor

April 28, 2003

Mr. John P. Carr
Acting Chief, Economic and Environmental Analysis Branch
Rock Island District, Corps of Engineers
Clock Tower Building, P.O. Box 2004
Rock Island, Illinois 61204-2004

Dear Mr. Carr:

Reference is made to your letter of March 24, 2003 concerning the proposed Feasibility Study for the Illinois River Ecosystem Restoration project in Illinois. The Feasibility Study will result in an Illinois River Basin Comprehensive Plan with an integrated programmatic environmental document. Your letter requests comments regarding the Feasibility Study, as well as information concerning any significant resources or environmental concerns associated with the Illinois River basin.

The Illinois River basin contains myriad sensitive resources including wetlands and backwater lakes, endangered/threatened species habitat, natural areas, and high quality woodlands, to list but a few. Any developments associated with the Comprehensive Plan will need to be carefully designed to ensure these resources are not inadvertently harmed. We foresee the need to design some elements of the plan to avoid encroachment into natural areas or listed species habitat, possible time restrictions on construction activities to avoid spawning, breeding, and nesting periods, and pre-construction surveys for such things as freshwater mussel populations, bat roost trees, and other resources of special concern.

The details of impact avoidance and minimization will, of necessity, have to be determined after more is known about the various plan elements. However, because of IDNR's partnership in the plan, all of its elements will be subject to a comprehensive environmental review under various Illinois statutes protecting endangered/threatened species, natural areas, nature preserves, wetlands, and cultural resources. These analyses, in addition to reviews of any required Corps of Engineers and/or IDNR, Office of Water Resources permits, will be coordinated through the Department's Division of Resource Review and Coordination.

We look forward to working closely with the Rock Island District in development of the Comprehensive Plan. Please contact Robert Schanzle of my staff at 217-785-4863 if we can provide specific resource information or be of any other assistance at this time.

Sincerely,

Joel Brunsvold
Director

JB:RWS:rs

cc: IDNR/OREP (Tom Flattery, Steve Davis, Robert Schanzle)
IDNR/ORC (Brian Anderson, Debbie Bruce, Jim Mick)
IDNR/OWR (Loren Wobig)
USFWS (Richard Nelson)
Division File

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Rock Island Field Office
4469 48th Avenue Court
Rock Island, Illinois 61201
Phone: (309) 793-5800 Fax: (309) 793-5804

IN REPLY REFER TO:
FWS/RIFO

August 10, 2005

Colonel Duane P. Gapinski
District Engineer
U.S. Army Corps of Engineers
Rock Island District
Clock Tower Building, P.O. Box 2004
Rock Island, Illinois 61204-2004

Dear Colonel Gapinski:

The letter regards the Illinois River Basin Restoration Study (Study), and the Fish and Wildlife Coordination Act Report (Report) prepared for the study dated May 2004. In our Report, we recommended that feasibility planning include preparation of a programmatic Biological Assessment (BA) pursuant to Section 7 of the Endangered Species Act. During further informal consultation with your staff, we have come to the mutual conclusion that it is not possible to establish program boundaries or the scope of effects sufficiently to support a programmatic approach for the Study.

Many of the objectives for the Study and the Navigation and Ecosystem Sustainability Program overlap, and most of the mainstem and floodplain activities proposed as part of the Study are identical to those described in the 2004 programmatic BA and Biological Opinion prepared by our respective offices for the Upper Mississippi River – Illinois Waterway System Navigation Feasibility Study. As projects proposed under the Study are initiated, informal consultation will allow us to determine whether Section 7 compliance may be expedited in the second tier of the programmatic process established in the Navigation Study, or if compliance will require site-specific consultation. Other actions undertaken outside of the Navigation Study planning area, such as watershed work, will require individual consultation and Section 7 compliance on a project-by project basis.

This letter provides comments under the authority of and in accordance with provisions of the Fish and Wildlife Coordination Act (48 Stat. 401, as amended; 16 U.S.C. 661 et seq.); and the Endangered Species Act of 1973, as amended. We look forward to assisting your office in further planning and implementation of this important program. Questions regarding this letter may be directed to Mr. Bob Clevenstine at the above telephone number, extension 205.

Sincerely,

Richard C. Nelson
Field Supervisor

cc: R3 (Lewis, Szymanski)
Refuges (Steinbach, Mabery)
Illinois DNR (Schanzle)

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8. CONCLUSIONS

The Comprehensive Plan identified that collaborative implementation of the Illinois River Basin Restoration Program with other state and Federal agencies would contribute to National Ecosystem Restoration (NER) goals consistent with the Corps policy and guidance by increasing the net habitat quality and quantity of the aquatic ecosystem within the Illinois River Basin.

The Comprehensive Plan found, that over the next 50 years, the Illinois River Basin Restoration Program, authorized in Section 519 of WRDA 2000, should be continued and expanded to more fully address the restoration needs of this nationally significant resource. Since Section 519 provides the necessary authority to begin implementation, no further activities are planned under Section 216.

A. PREFERRED PLAN AND OUTPUTS

A series of eight alternatives were examined in the comprehensive plan study (seven action alternatives and the no-action alternative). All action alternatives would provide regional habitat and ecological integrity benefits by slowing, stabilizing or reversing the decline of ecological integrity in the Illinois River Basin. Alternatives 1, 2, 3, and 4 represent local to regional gains in ecological integrity, although system-wide ecological integrity would continue to decline over the 50-year period of analysis. Alternatives 5, 6, and 7 represent a range of gains that reverse the declining ecological trend, and provide system-wide improvements in ecological integrity over the 50-year period of analysis. Three types of outputs (acres benefited, stream miles benefited, and percent attainment of the objectives) were evaluated and utilized to conduct cost effectiveness and incremental cost analysis. Only Alternatives 6 and 7 were best buy plans under all three analyses. Alternative 6 was selected as the preferred Comprehensive Plan alternative, since it was more cost effective while still significantly addressing the key system limiting factors.

Alternative 6, if fully implemented over the next 50 years, would provide benefits to approximately 225,000 acres and 33,000 miles at a cost of approximately $7.44 billion in funding from various Federal, state, and local partnering agencies. Other specific outputs include:

- provide a measurable increase in system ecological integrity
- reduce systemic sediment delivery by 20 percent
- restore 12,000 acres of backwaters
- restore 35 side channels
- protect 15 islands
- restore 75,000 acres of main stem floodplain
- restore 75,000 acres of tributary floodplain and riparian areas
- restore 1,000 stream miles of aquatic habitat
- provide fish passage along the Fox, DuPage, Des Plaines, Kankakee, Spoon, and Aux Sable Rivers
- produce an 11 percent reduction in the 5-year peak flows in tributaries
- increase tributary base flows by 20 percent
- reduce water level fluctuations along the main stem during the growing season by 65 percent
- provide system level improvements in water quality.

B. TIERED IMPLEMENTATION

Given the magnitude of the restoration needs, a collaborative and tiered implementation approach is proposed. The Corps of Engineers cost-shared restoration efforts should begin with $131,200,000 ($85,280,000 Federal funds) in restoration funds through 2011 (Tier I) with the potential to expand to $345,640,000 ($224,670,000 Federal funds) in restoration efforts through 2015 (Tier II). The funding and activities would begin significant restoration consistent with eventual implementation of Alternative 6 (preferred Comprehensive Plan alternative). These initial phases are proposed to demonstrate the benefits of the various practices and project components prior to seeking additional funding. If Tier I and Tier II efforts are successful, additional tiers could be developed.

Tier I efforts would result in the completion of 16 critical restoration projects cost shared 65 percent Federal ($85.28 million) and 35 percent non-Federal ($45.92 million). This funding level would provide approximately $122.3 million for planning, design, construction, and adaptive management of restoration projects; $3.5 million for site specific, pre- and post- project monitoring, and $2.6 for additional studies and analysis including refinement of a Technologies and Innovative Approaches (TIA) component; and $2.75 million for system management. The estimated annual Operation and Maintenance cost, once all features are in place, is $125,000. If funding is available, a report to Congress will be submitted in the 2011 timeframe documenting the project successes and the results from Tier I restoration efforts.

While the sustainability of critical restoration projects would be highest with full implementation of Alternative 6, the individual projects implemented under Tier I and Tier II will be formulated to remain sustainable on their own, even if further restoration efforts do not continue. However, these projects will require some operation and maintenance as estimated in the report. We anticipate that the sustainability of the mainstem projects would continue to improve as additional tributary projects are undertaken. Tier I and II efforts would cover the entire range of potential project measures discussed in Section 4 –A, *Component Measures In Restoration Projects.* In addition to the success of system-wide efforts at improving project sustainability, site specific conditions affecting sustainability will be investigated and accounted for in site specific PIR's for each Critical Restoration Project."

C. RISK AND UNCERTAINTY

As a comprehensive plan for an area of over 30,000 square miles looking at a 50 year planning horizon, there are a number of risks and uncertainties. Some of the major uncertainties relate to the lack of existing models and scientific data to relate sediment reductions to system habitat improvement and sustainability gains and defining the most effective approaches to restore a more natural hydrologic regime. A particular area of uncertainty is defining the specific amounts of restoration required to improve these system limiting factors to the point were necessary biological thresholds are exceeded and significant ecosystem recovery occurs. Some other areas of risk and uncertainty include development patterns, agricultural programs/practices, and climate change. The recommended Tier I and Tier II projects along with additional studies and analysis activities will seek to address and better understand these risks prior to more complete implementation of the Comprehensive Plan.

D. AREAS FOR ADDITIONAL INVESTIGATION

While Section 3 documents a large number of potential additional studies that would be beneficial to restoration efforts, some of the key issues relate to continued development and refinement of a systemic monitoring program and report card, improved models, and information on the ability of restoration projects to provide systemic sediment and hydrologic restoration. Another need for further study is to explore opportunities to naturalize hydrology and restore native aquatic vegetation. While existing programs have worked to define methods to sample large rivers, a critical need is to determine the best methodology and approach for monitoring large tributaries and small watersheds. These specific areas are proposed for additional study and analysis concurrent with the implementation of Tier I and Tier II to help reduce the risk and uncertainty over time. When the full Program is authorized, these additional studies and activities would be pursued as part of the TIA component, working to continually reduce the risk and uncertainty in the program.

While awaiting full program authorization, some additional analysis is appropriate to further refine this component. For example, additional studies related to the TIA could

- better define ways to combine, consolidate, and build upon existing monitoring data sets (e.g. attempt further consolidation of existing state, Federal, and local monitoring data to further leverage existing data);
- refine the monitoring plan to seek the most efficient approaches to gathering additional necessary data;
- better define representative system metrics (e.g. evaluate the use of various species/processes to serve as system indicators); and
- conduct special studies to collect data to increase our understanding of various processes that could reduce future restoration costs (e.g. detailed study of fish use of tributaries throughout the year and selected evaluations of sediment technologies and applications).

A final area of activity would be monitoring of key focus areas to establish pre-project data for use in more completely evaluating problems, opportunities, and project success.

E. ROLE OF OTHER FEDERAL, STATE AND LOCAL AGENCIES

In recognition of the technical expertise of the other Federal, state, and local partner agencies, as well as the continued limitations on the Federal budget, we have worked collaboratively with our partners to evaluate the various programmatic authorities of each agency and investigate opportunities for synergy in implementing the proposed Illinois River Basin restoration initiatives. While the process of full multiple agency implementation will continue to be refined over the initial years of the program, based on collaboration to date the following breakdown of work is anticipated.

U.S. Army Corps of Engineers (USACE). The USACE could take the lead role in Illinois River main stem restoration utilizing the existing EMP program and proposed NESP programs to fund the majority. These programs are estimated to address approximately 75 percent, of main stem work and much of the main stem system monitoring activities. The Section 519 authority could focus primarily on watershed restoration addressing approximately 40 percent of the identified need for work in the tributaries, riparian, and floodplain areas with a focus on restoring the structure and function of aquatic and wetland areas, but would also provide a mechanism to conduct some additional main stem work,. The Section 519 authority could be utilized to develop and implement an integrated system monitoring program utilizing existing data collected by other Corps programs, other Federal agencies, and state and local groups.

U.S. Department of Agriculture (USDA). The USDA has a number of programs and experience and history in restoration throughout the basins. It is estimated that roughly 40 percent of the identified watershed and floodplain work could be addressed by existing and expanded USDA programs.

U.S. Environmental Protection Agency (USEPA). The USEPA has some restoration funding available. It is estimated that roughly 15 to 20 percent of the watershed work could be addressed by USEPA with a particular focus on water quality related issues. The USEPA also has active monitoring programs that could be integrated and help serve as a basis for future systemic monitoring.

U.S. Fish and Wildlife Service (USFWS). The USFWS has some limited restoration authorities and funding. It is estimated that up to 5 percent of the watershed work could be addressed by USFWS using existing and expanded programs, with a particular focus on private lands habitat restoration projects.

U.S. Geological Survey (USGS). The USGS Illinois Water Science Center (IWSC) performs various monitoring and study activities in the Illinois River Basin, and could serve as a key partner agency in the development and implementation of any long term monitoring.

State Agencies. The Illinois Department of Natural Resources (DNR), Illinois Environmental Protection Agency, Illinois Department of Agriculture, Indiana DNR, Wisconsin DNR could continue to expand their ongoing restoration efforts as well as to serve as sponsors providing the required matching for many of the Federal programs.

Local Agencies. Local governments and non-governmental organizations are critical to future restoration efforts. In particular, they could play key roles in ensuring proper zoning and protection of sensitive areas, storm water management, land owner interaction, and protection and restoration of habitat areas. They also have the ability to match Federal funding sources.

F. POTENTIAL AMENDMENTS TO SECTION 519 OF THE WATER RESOURCES DEVELOPMENT ACT (WRDA) OF 2000, PUBLIC LAW 106-541

The current authorization provides ongoing authority to evaluate and implement Critical Restoration Projects; conduct associated project-specific monitoring; and conduct additional studies and analyses. The current authority does limit some types of restoration due to the per project cost limits (e.g. not able to perform some larger backwater restorations and watershed efforts, etc.). The technologies and innovative approaches component could not be implemented without further authority, which currently limits the collection and analysis of systemic monitoring and evaluation of dredging technologies and beneficial use. In addition, collaboration could be improved if non-profit organizations were authorized to act as non-Federal sponsors for these projects. Finally, rather than following normal procurement laws and regulations, there is the potential for improved implementation efficiency with the use of methods similar to the NRCS. The NRCS is authorized to provide funding directly to landowners to undertake certain structural and land management conservation practices. In addition, NRCS assistance is often tied to shorter term measures. No recommendation is being provided at this time on whether to seek similar authority for the Corps. In summary, although the existing authorization provides adequate authority to implement much of the restoration plan, additional authority may be sought in the future to improve the efficiency of program implementation.

The following text highlights some potential legislative updates identified in the study process as areas of consideration to improve the future efficiency in implementing Section 519. These potential opportunities for legislative updates to Section 519 were developed in cooperation with the State of Illinois DNR, other Federal and state agencies, local governments, and various non-governmental organizations.

- Increasing the per project Federal cost limit for Critical Restoration Project from $5 million to $20 million. Increasing the per project cost limit would allow implementation of a wider range of critical restoration projects more directly matching the scale identified in the Comprehensive Planning efforts. Without modification, many larger projects could not be implemented as effectively or at all.

- Authorize implementation of a Technology and Innovative Approaches (TIA) Component as a component of the Comprehensive Plan that complements the Critical Restoration Project activities. Activities would include initiatives called for in Section 519 (b).(3).(A) development and implementation of sediment removal technology, sediment characterization, sediment transport, and beneficial uses of sediment; (C) long term resource monitoring; and (D) and a computerized inventory and analysis system. The addition of a TIA component would add the collection and analysis of critical data and investigations of innovative approaches. These items will help address and reduce the risk and uncertainty associated with implementation and work to improve the efficiency of restoration efforts over time.

- Authorization allowing the development of cooperative agreements and fund transfers between the Corps and the State of Illinois; State of Indiana; State of Wisconsin; and scientific surveys at the University of Illinois and between the Corps and units of local government—counties, municipalities, and Soil and Water Conservation Districts—to facilitate more efficient partnerships. The efficiency and cost effectiveness of the program would be improved, based on the improved collaboration and involvement of appropriate state and local organizations that may not have adequate funding to participate any other way.

- Authorization to allow the Corps of Engineers to deviate from normal procurement laws and regulations and to provide funding directly to landowners to undertake shorter-term structural and land management conservation practices. As indicated above, in paragraph F, no decision has been made on whether to seek such authority. If in the future the Corps decides to pursue, and Congress provides, such authority, it is likely that the Corps would work closely with the NRCS in the provision of such assistance. Watershed based ecosystem restoration projects highlight the need to work closely with other agencies and in some cases jointly implement solutions. In particular, restoration in the upper reaches of watersheds would benefit from an ability to partner with the NRCS and utilize their established procedures to deliver projects to local landowners in the most cost-efficient manner. The practicality and policy implications of this approach will be evaluated during more detailed feasibility studies. Following these additional studies an agency position will be finalized.

- Authorization to allow non-profit organizations to serve as sponsors and sign Project Cooperation Agreements for restoration projects implemented under the Illinois River Basin Restoration program. The addition of NGOs as potential sponsors, many of whom are actively pursuing restoration projects in the basin, could provide improved opportunities for collaboration and effectiveness in implementing restoration.

9. RECOMMENDATIONS

This Illinois River Basin Restoration Comprehensive Plan was prepared in response to Congressional directive contained in Section 519(b) of the Water Resources Development Act (WRDA) of 2000. The plan was developed for the purposes of restoring, preserving, and protecting the Illinois River Basin for submission to Congress as required by Section 519(b)(5). It is recommended that the Secretary forward this report to Congress in response to their directive and the Illinois River Basin Restoration Program, as authorized in Section 519 of WRDA 2000, be continued under the existing authority to restore this nationally significant resource.

The 16 Tier I critical restoration projects identified in the Comprehensive Plan would produce independent, immediate and substantial restoration, preservation and protection benefits. As such, upon approval by the Secretary, these projects could be implemented under existing authority, subject to the availability of funds and execution of a PCA. Implementation of the Tier I projects would follow established implementation guidance and project cost sharing would be in accordance with Section 519(g), 65% Federal/35% non-Federal. To date, the Secretary has approved implementation of the Pekin Lake Northern Unit and Peoria Riverfront Upper Island critical restoration projects at a combined estimated total cost of $12,641,100 to be cost shared $8,216,715 Federal and $4,424,385 non-Federal. Implementation of the Tier I projects would begin significant restoration consistent with the preferred Comprehensive Plan alternative.

In addition, as Tier I planning efforts are completed, it is recommended that Tier II efforts be initiated following Assistant Secretary of the Army (Civil Works) approval to proceed with any additional critical restoration projects. This would allow for a seamless transition from Tier I to Tier II projects. Currently 45 potential projects have been identified. Specific projects for Tier II would be selected utilizing the process and criteria described in section 6 of this document.

Finally, it is recommended that additional studies and analyses be pursued in accordance with Section 519(b)(6). Pursuant to Section 519(b)(6), the Secretary shall continue to conduct such studies and analyses related to the comprehensive plan as are necessary. Potential areas for additional studies include further refinement to the Technologies and Innovative Approaches component and potentially additional monitoring to address the critical needs to determine the best methodology and approach for monitoring large tributary and small watersheds.

If fully implemented, Tier I efforts would result in the completion of 16 critical restoration projects and critical additional studies and analyses at a total cost of $131.2 million, cost shared $85.3 million Federal and $45.9 million non-Federal. The total estimated annual operation, maintenance, rehabilitation, and replacement cost, of the Tier I projects completed by 2011, is estimated at $125,000. These operation, maintenance, rehabilitation, and replacement costs would be the responsibility of the non-Federal project sponsors.

The recommendations contained herein reflect the information available at this time and current Departmental policies governing formulation of individual projects. They reflect neither the program and budgeting priorities inherent in the formulation of the national Civil Works construction program nor the perspective of higher review levels within the Executive Branch. Consequently, the recommendations may be modified before transmittal to Congress as proposals for authorization and implementation funding.

23 MARCH 2007

(Date)

ROBERT A. SINKLER
Colonel, U.S. Army
District Engineer

May 19, 2006

ILLINOIS RIVER BASIN RESTORATION
COMPREHENSIVE PLAN
WITH INTEGRATED ENVIRONMENTAL ASSESSMENT

STATEMENT OF FINDINGS

I. PROJECT DESCRIPTION

A. This statement concerns a proposal by the Rock Island District (District) of the U.S. Army Corps of Engineers to restore the ecological integrity of the Illinois River Basin System. This Plan has four components: a restoration program; a long-term resource monitoring program; a computerized inventory and analysis system; and a program to encourage innovative dredging technology and beneficial use of sediments.

An implementation framework and criteria was developed to guide the identification, selection, study and implementation of restoration projects, monitoring and adaptive management activities, and further system investigations.

B. A report entitled, *Illinois River Basin Restoration, Comprehensive Plan with Integrated Environmental Assessment* (Report), and unsigned Finding of No Significant Impact (FONSI) addressing the impacts of the proposed program was prepared by the U.S. Army Corps of Engineers, Rock Island District's (District) multi-disciplinary product delivery team, and was circulated for public review from approximately February 17, 2006 to May 5, 2006.

II. PUBLIC INTEREST REVIEW

The draft Report was completed in February 2006 and was circulated for an approximate 90-day public review period from February 17, 2006 to May 5, 2006. The mailing list for the Report is included as Appendix J and is on file at the Rock Island District Office.

Public meetings were also held to inform and involve the public, solicit comments, and answer questions on the proposed restoration program. The last set of public meetings was held on March 7, 8, 9, 14, 15, and 16 at various locations throughout the Illinois River Basin. A summary of the comments received at the Public Meetings and the District's responses can be found in Section 7 of the Final Report.

III. PUBLIC REVIEW COMMENTS

The following is a list, summarizing the letters pertinent to the Report and EA, received during the approximate 90-day public review period. They appear in the order in which they were received, and each is followed by the Rock Island District's response. A copy of each letter is attached to this package.

A. From Arlene D. Peterson, dated March 1, 2006:

1. COMMENT/CONCERN: Comments are in regard to the Fox River, and its future dependence on recreation. With that in mind she recommends leaving the dams in place. Construct a single chute in each dam large enough to accommodate floats, canoes, and fish passage.

DISTRICT RESPONSE: A feasibility report will be completed for each project that would be constructed through the Illinois River Basin Restoration Program. Corps policy requires that the feasibility report evaluate a range of alternatives, and compare the cost and habitat benefits for each of the alternatives. The feasibility report would consider potential benefits and/ or impacts to recreation for each of the alternatives.

2. COMMENT/CONCERN: Dredge each shallow in a test section of the Fox River 3 feet deep and 10 feet wide to afford yearly flow sufficient to encourage floating industries.

DISTRICT RESPONSE: The Illinois River Basin Restoration Authority is an ecosystem restoration authority. While some minimal recreational features may be accomplished in conjunction with restoration efforts, purely recreational features are not authorized.

B. From the Northern Illinois Anglers Association, J. R. Black, Executive Director, dated March 13, 2006:

1. COMMENT/CONCERN: Despite some lack of site specific project information, they express concerns for the Kankakee River. They would like to hear/read more about sand removal, both sandbar and bedload extraction; and reducing the sand contribution to the river, particularly in the upper reaches of the Kankakee River.

DISTRICT RESPONSE: As a Comprehensive Plan for the entire 30,000 square mile watershed, only limited data was provided on any one tributary or river reach. Additional detail will be included and developed as the Critical Restoration Projects in the Kankakee Basin continue their study, design, and potential implementation of restoration activities.

2. COMMENT/CONCERN: They express concern that the proposed restoration program/report should begin in the upper reaches of the basin, addressing the source of sand/sediment entering the basin rather than beginning at Peoria Lake.

DISTRICT RESPONSE: The programs intent is to address the source of problems. The implementation section of the Report page 6-1 states that, "While some work will occur throughout the basin, restoration efforts would focus on the upper watershed and, in particular, the Peoria Pool and tributaries and the Kankakee River Basin. These are two of the high value resource areas and, due to their location in the upper reaches of the basin, have potential to more rapidly demonstrate the effectiveness of the various projects." However, some main channel restorations are necessary in the near term to maintain critical habitats, while concurrent tributary restoration work on the Kankakee and other streams address some of the sediment delivery, altered hydrology, and degraded habitats.

3. COMMENT/CONCERN: They request to be kept informed of the progress of the entire restoration program, but especially for the Kankakee River.

DISTRICT RESPONSE: The Corps of Engineers will work to continue to keep the public informed through continued public notices, newsletters, and the project website as additional information becomes available on the program and specific Critical Restoration Projects. The Corps of Engineers will be working to establish and maintain multi-agency regional teams in various areas of the basin including the Kankakee River Basin to involve interested agencies, organizations, and members of the public in the planning process.

4. COMMENT/CONCERN: The District may count on the support of the Northern Illinois Anglers Association for the ecosystem restoration program.

DISTRICT RESPONSE: The support is appreciated.

C. From the Sac & Fox Tribe of the Mississippi in Iowa, Johnathan L. Buffalo, Historical Preservation Coordinator, dated March 14, 2006:

1. COMMENT/CONCERN: No objections.

DISTRICT RESPONSE: None.

D. From the Kankakee River Partnership (Commission), J. R. Black, Chairman, dated March 15, 2006:

1. COMMENT/CONCERN: They express strong support of the Illinois River Basin Restoration Plan.

DISTRICT RESPONSE: The support is appreciated.

2. COMMENT/CONCERN: They contend it is now time to address the sand problem (bedload and sandbars) in the Kankakee River. They strongly recommend sand removal be inserted as a corrective measure in the restoration plan.

DISTRICT RESPONSE: Three critical restoration projects have been identified within the Kankakee River Basin, all with at least a partial focus specifically on sediment and related degradation.

3. COMMENT/CONCERN: They would like to see the restoration plan expanded to include the entire Kankakee River basin in Indiana as well as Illinois.

DISTRICT RESPONSE: The Comprehensive Plan does include the Indiana portions of the basin. Efforts have been initiated on the Yellow River Critical Restoration Project (a smaller tributary to the Kankakee located entirely in Indiana), which will evaluate restoration needs along that tributary, including options to reduce contributions of sand.

4. COMMENT/CONCERN: Construction (restoration projects) should begin in the upper reaches of the Illinois River System before initiating restoration projects downstream.

DISTRICT RESPONSE: The programs intent is to address the source of problems. The implementation section of the report (page 6-1) states that "While some work will occur throughout the basin, restoration efforts would focus on the upper watershed and, in particular, the Peoria Pool and tributaries and the Kankakee River Basin. These are two of the high value resource areas and, due to their location in the upper reaches of the basin, have potential to more rapidly demonstrate the effectiveness of the various projects." However, some main channel restorations are necessary in the near term to maintain critical habitats, while concurrent tributary restoration work on the Kankakee and other streams addresses some of the sediment delivery, altered hydrology, and degraded habitats.

5. COMMENT/CONCERN: They desire to be kept informed of future program/project development.

DISTRICT RESPONSE: The Corps of Engineers will work to continue to keep the public informed through continued public notices, newsletters, and the project website as additional information becomes available on the program and specific Critical Restoration Projects. The Corps of Engineers will be working to establish and maintain multi-agency regional teams in various areas of the basin including the Kankakee River Basin to involve interested agencies, organizations, and members of the public in the planning process.

E. From Dr. Richard Sparks, dated March 16, 2006:

1. COMMENT/CONCERN: Compliments the District, the Illinois Department of Natural Resources, and others that developed a thorough and ambitious Plan that, if implemented, will renew the Illinois River Basin and the Illinois Floodplain-River Ecosystem.

DISTRICT RESPONSE: Compliments are appreciated.

2. COMMENT/CONCERN: Capture the natural and free energies of the system. He requests the restoration plan to include at least one dechannelization project for a tributary of the Illinois River floodplain. Dechannelization would trigger an upstream healing process to reduce total Dechannelization would trigger an upstream healing process to reduce total sediment delivery to the Illinois River.

DISTRICT RESPONSE: Dechannelization, or remeandering, is addressed as an item for study and potential implementation under Goal 3: floodplain, riparian, and aquatic.

3. COMMENT/CONCERN: Recommends the creation of "seed islands" to restore aquatic habitat diversity of side channels, and backwaters, including the Peoria lakes.

DISTRICT RESPONSE: A specific reference to "seed islands" has been added as a potential restoration practice under Goal 2, restoration of backwaters and side channels.

4. COMMENT/CONCERN: Recommends using restoration methods to reconnect the river to the floodplain. These reconnections should be managed adaptively and the results carefully assessed to develop and improve this innovative technique. This, along with dechannelization of tributaries, and construction of temporary ponds could help to restore floodplain, aquatic, and riparian habitat. The value of temporary ponds should be explicitly recognized in the report text and Executive Summary.

DISTRICT RESPONSE: Options to reconnect the floodplain are discussed in the report under Goal 3, Section 3. Project and systemic monitoring will be conducted to assess the effectiveness of the projects and guide potential adaptive management measures. It is envisioned that where stream re-meandering would occur, riparian practices discussed in the report would also be implemented as part of a comprehensive approach to restoring ecological health to a given stream reach. Among those measures are riparian wetland restorations. Temporary ponds for the purposes mentioned could be included in the wetland restoration design as they would function as seasonal wetlands. Language has been added to the report and executive summary, identifying temporary ponds as a method of wetland restoration that could be used during restoration of floodplain tributary streams.

5. COMMENT/CONCERN: Carefully assess the risks of invasive species dispersal before undertaking fish passage projects, particularly in the Des Plaines River. Also, carefully assess projects to restore connectivity and its potential to impact genetically distinct fish stocks in the middle Illinois River and its tributaries.

DISTRICT RESPONSE: The Comprehensive Plan acknowledges the impacts invasive/nonindigenous species could cause. Therefore, fish passage is not recommended at Brandon Road, Lockport, and T.J. O'Brien Locks and Dams. The risk posed by invasive species will be carefully evaluated for every fish passage project, as it is evaluated. In addition, the potentially affected fishery will be evaluated prior to implementation of any fish passage project.

6. COMMENT/CONCERN: Regarding naturalizing Illinois River and tributary hydrologic regimes, he suggests one additional analysis might be the effect of reconnection of the river and its floodplain in reducing small floods during summer growing seasons. This has the potential to reduce small flood sufficiently so that significantly more moist soil vegetation might grow at higher elevations in the floodplain.

DISTRICT RESPONSE: Further studies are desired regarding the effects of reconnecting the main stem river to its floodplain and are currently addressed in Section I. 4. e. *Information and Further Study Needs,* Section 3. A specific reference regarding the need to study the effects of reconnecting the river to its floodplain on small floods during the summer growing season, will be included in Section I. 4. e. *Information and Further Study Needs,* Section 3.

7. COMMENT/CONCERN: Suggests that careful assessment of the beneficial effects of reducing sediment inputs into the river and reducing sediment suspension be undertaken. He suggests that beneficial effects could be undone if improved light penetration stimulates harmful algal blooms because of excessive nutrient levels in the rivers and lakes.

DISTRICT RESPONSE: The potential for algal blooms exists if turbidity is reduced in the Illinois River due to the possibility of excess nutrients in the water. It will take several years, however, to fully realize the benefits (reduced turbidity) from sediment reduction measures. During the same period of time, the influx of excess nutrients to the Illinois River may be reduced. Another consideration is that in some locations within the Illinois River system, reduced sediment does not necessarily mean turbidity will be reduced, i.e., in the Kankakee River where much of the sediment is sand. There are too many uncertainties to assume that reduced sediment delivery will inevitably lead to algal blooms. If algal blooms become a problem on the Illinois River in the future, the causes and measures to address the problem will be studied.

8. COMMENT/CONCERN: Suggests that more time and money should be allocated for adaptive management, system and site-specific monitoring, special studies, the computerized inventory and analysis system at the beginning of the program, and not wait until 1-3 years after projects have begun. Initial measurements need to be taken to allow a basis for comparison.

DISTRICT RESPONSE: Efforts will be made to initiate system and site specific monitoring, special studies, and computerized inventory and analysis systems as early in the process as possible. Currently only site specific monitoring is authorized and funding has not been available. Additional authorization is needed to implement system monitoring and the computerized inventory and analysis system.

F. From the Tri-County Regional Planning Commission, George W. Murray, Chairman, dated March 17, 2006:

1. COMMENT/CONCERN: They provide this letter of support for the District's Plan, concur with the Plan's goals, support the tiered implementation and continuing restoration efforts, and are prepared to assist the District with implementation of plans in any way possible.

DISTRICT RESPONSE: Their support is greatly appreciated.

G. From the County of Peoria, County Administration, Patrick Urich, Peoria County Administrator, dated April 6, 2006:

1. COMMENT/CONCERN: They send this letter in support and express agreement with the programs goals. They would appreciate District cooperation in advising the County on any regulatory issues that may be involved in future projects.

DISTRICT RESPONSE: The support and offer of future cooperation is greatly appreciated.

H. An electronic message from M&L Marcotte, dated April 11, 2006:

1. COMMENT/CONCERN: Suggests that the project use data from various existing reports (mentioned in the e-mail) concerning surface and shallow aquifer contamination to make sound decisions to protect water quality in the restoration plan.

DISTRICT RESPONSE: All projects considered under the 519 authority would make use of all available resources, included those mentioned, in order to best achieve the project purposes.

I. From Jo Ann Hustis, dated April 12, 2006:

1. COMMENT/CONCERN: She wishes to nominate the south channel of the Illinois River at Ballards Island in the Upper Pool at Marseilles as a desperately needed restoration project. The channel has silted in as a result from early 1950s work by the Corps of Engineers. It has become a breeding ground for mosquitoes and a breed pool that is a hazard to public health and safety by virtue of possible transmission of West Nile virus.

DISTRICT RESPONSE: The south channel of Ballards Island has been added to the list of potential Critical Restoration Projects. It will be considered as additional selections of site specific projects are made.

J. From The Nature Conservancy in Illinois, Bruce Boyd, Director, dated April 13, 2006:

1. COMMENT/CONCERN: They support the Report's findings and recommendations and support the recommended Alternative 6. They strongly support the programs implementation in an adaptive framework and believe it is imperative that sufficient monitoring be conducted not only at the project level, but at the reach and system level as well.

DISTRICT RESPONSE: The support is appreciated, and efforts will be made to proceed with an adaptive framework supported by an ongoing monitoring program. At the current time, only site specific monitoring is authorized. Further additional studies and analysis are planned in the near term to refine a system monitoring plan for the reach and system level. This is anticipated to lead to the request for implementation authority for reach and system level monitoring in the future.

K. An electronic message from Jim Sweeney, dated April 14, 2006:

1. COMMENT/CONCERN: Natural is better. Engineering solutions should only be used when absolutely necessary. Sediment reduction, backwater, side channel and island protection, and improving water quality should be addressed by implementing natural solutions such as re-meandering streams, wetland and floodplain restoration.

DISTRICT RESPONSE: Efforts will be made to maximize the use of natural processes and natural designs. For any project that is constructed through the Illinois River Basin Restoration Program, a feasibility report would evaluate a range of alternatives and compare the cost to the habitat benefits. Project features that implement "natural solutions" could include re-meandering streams, planting vegetation to stabilize streambanks, and utilizing other natural processes to achieve restoration goals.

2. COMMENT/CONCERN: He is unfamiliar with "sediment compaction" and wonders if it refers to mechanically compacting the sediments in place.

DISTRICT RESPONSE: Soil and sediments that are deposited and remain below and near the water surface have high water contents. As sediment is exposed to the air and water is lost to drying, the soil particles consolidate/compact. In this report, "sediment compaction" refers to the natural process (not mechanical) by which sediments consolidate as water is lost from the interstitial spaces of the soil matrix due to pool drawdowns or dry periods, etc. As the water levels in the pool raise, the sediment would remain in the compacted condition, and could potentially reduce turbidity.

3. COMMENT/CONCERN: Floodplain**,** riparian, and aquatic habitat function is what this is all about. Solutions should start in the upper reaches of the watershed and then work downstream.

DISTRICT RESPONSE: The study recommends the approach indicated in the comment. While some initial efforts would be spread throughout the basin to address critical needs. The primary focus will be on the Peoria Pool and upstream areas. In these areas the focus will be on restoring ecosystem structure and function.

4. COMMENT/CONCERN: Fish passage by engineered and mechanical means doesn't work. Close and demolish the locks and dams on the Illinois River. They are the biggest barrier to a healthy river and are not economically justified.

DISTRICT RESPONSE: One of the study constraints was to not impact the currently authorized 9-Foot Channel Navigation project. In addition, due to the presence of numerous invasive species, the preferred ecological recommendation was to not provide fish passage at the upper river lock and dam facilities as a way to limit the spread of these species. Fish passage is currently available roughly 40-50 percent of the year at the Peoria and LaGrange Lock and Dam facilities based on the operation of the structures.

5. COMMENT/CONCERN: This report should mention/reference the U.S. Fish and Wildlife Service project Grand Kankakee Marsh National Wildlife Refuge as part of the solution to Illinois River problems.

DISTRICT RESPONSE: Given the size of the basin (30,000 square miles) the decision was made to not be overly specific in regards to the numerous tributary basins. However, as individual Critical Restoration Projects are undertaken in these areas these details will be recorded and considered. A summary of the proposed refuge has been provided in Section 6 as part of the discussion of ongoing activities by other Federal Agencies.

L. Electronic message from Marianne Hahn, dated April 16, 2006:

1. COMMENT/CONCERN: Engineering solutions should only be used when absolutely necessary. Sediment reduction, backwater, side channel and island protection, and improving water quality should be addressed by implementing natural solutions such as re-meandering streams, wetland and floodplain restoration.

DISTRICT RESPONSE: Efforts will be made to maximize the use of natural processes and natural designs. For any project that is constructed through the Illinois River Basin Restoration Program, a feasibility report would evaluate a range of alternatives and compare the cost to the habitat benefits. Project features that implement “natural solutions” could include re-meandering streams, planting vegetation to stabilize streambanks or islands, and utilizing other natural processes to achieve restoration goals.

2. COMMENT/CONCERN: To protect the health and biological diversity of the river, first priority should be given to backwater, side channel, and island restoration.

DISTRICT RESPONSE: The proposed implementation approach seeks to do some immediate work on backwaters, side channels, and island restoration to restore and preserve some of theses critical habitats early in the implementation process. However, additional near term efforts are planned to begin to address some of the root causes of excess sediment delivery and altered hydrology by working in the tributary basins.

3. COMMENT/CONCERN: This report should mention/reference the U.S. Fish and Wildlife Service project Grand Kankakee Marsh National Wildlife Refuge as part of the solution to Illinois River problems.

DISTRICT RESPONSE: Given the size of the basin (30,000 square miles) the decision was made to not be overly specific in regards to the numerous tributary basins. However, as individual Critical Restoration Projects are undertaken in these areas these details will be recorded and considered. A summary of the proposed refuge has been provided in Section 6 as part of the discussion of ongoing activities by other Federal Agencies.

M. From the United States Department of the Interior, Fish and Wildlife Service, Rock Island Field Office, Richard C. Nelson, Field Supervisor, dated April 19, 2006:

1. COMMENT/CONCERN: Suggests the report contains numerous and unnecessary repetitions of both text and figures. Suggests using referencing to reduce redundancy, particularly the six goals and objectives.

DISTRICT RESPONSE: Efforts will be made to reduce redundancy as appropriate.

2. COMMENT/CONCERN: Suggests that adaptive management (AM) principles should be presented earlier in the report such as in Figure ES-2. Also suggests figure ES-2 should be revised to incorporate the AM principles illustrated in Figure 6-5.

DISTRICT RESPONSE: Additional reference and description of adaptive management will be added to the executive summary. However, in the interest of keeping the executive summary as a brief overview of the program Figure 6-5 will not be included.

3. COMMENT/CONCERN: Suggests the Overarching Goal might be more appropriately labeled as the “vision” for the program.

DISTRICT RESPONSE: As part of the collaborative planning for the program, the vision statement developed as part of Illinois River Integrated Management Plan was accepted by project stakeholders as the vision for this plan and the overarching goal was identified. It does not seem appropriate to change the vision at this time.

4. COMMENT/CONCERN: Concerning Goal 5 Objective D: informs the District that NESP concluded that any changes that could be made in dam operation would not provide any fish/wildlife benefits to justify the cost.

DISTRICT RESPONSE: The fourth objective under Goal 5 relates to reducing fluctuations resulting from operation of the wicket gates at Peoria and La Grange (i.e., transitioning between regulated and open river conditions). This objective is also part of the Navigation Study's recommended plan for ecosystem restoration (Alternative D*, see discussion beginning on page 507 of the Final Feasibility Report for the Navigation Study). Modifications to the structure, or operation, of the wickets is not part of the 15-year plan for the first phase of implementation of the recommended plan; and therefore was not include in the initial set of PED activities under NESP. However, it is still being considered for future implementation.

5. COMMENT/CONCERN: Concerning the section on Technologies and Innovative Approaches Component; recommends this section should include a discussion on AM principles and should mention how Illinois River floodplain activities (e.g. monitoring and computerized inventory) would be integrated with NESP and EMP.

DISTRICT RESPONSE: Program monitoring is discussed in section 6, p 6-37 through 6-43. One basic assumption of the proposed monitoring program is the LTRMP will continue. The 519 monitoring program also assumes that other existing monitoring efforts in the watershed will continue. The draft monitoring plan, found in Appendix H, provides the plan details, summarized in section 6. The majority of the new monitoring will occur in the watershed and in the Illinois River not monitored by LTRMP. No systemic monitoring is proposed under NESP.

6. COMMENT/CONCERN: Concerning recommendations expressed in the Executive Summary; include a recommendation that facilitates the cooperation of the multiple Federal agencies in funding this Comprehensive Plan, including "cross-cutting budgeting".

DISTRICT RESPONSE: A recommendation regarding the need for continued interagency coordination and development of cross-cut budgeting will be added.

7. COMMENT/CONCERN: There is no mention in the Report of the existing EMP LTRMP and how it could be integrated with this Comprehensive Plan.

DISTRICT RESPONSE: Additional text will be added to the Executive Summary and Section 6 relating how these efforts will be integrated with the proposed Technologies and Innovative Approaches component.

8. COMMENT/CONCERN: Suggests the Report discuss how this Comprehensive Plan will be coordinated/integrated with NESP and EMP, including the reference to a "Regional Team". Are the NESP Regional Team and this Comprehensive Plans Regional Team the same/different.

DISTRICT RESPONSE: The 519 Regional Teams include the tributary watersheds and are not limited to the main stem floodplain. Section 6 will be revised to provide additional discussions on the relationship and coordination approach between Section 519, EMP, and NESP.

9. COMMENT/CONCERN: Informs the District that Asian carp are now common up to Starved Rock Lock and Dam, if not farther upstream; and round gobies have been collected as far south as Peoria.

DISTRICT RESPONSE: We will utilize this information in follow on planning efforts.

10. COMMENT/CONCERN: Concerning Goal 5, Objective 4 ("Remove the dramatic water level changes…"): suggests revising or eliminating some verbiage based on NESP investigations.

DISTRICT RESPONSE: This system Comprehensive Plan analysis provides for the definition of overall system needs, proposed system measures, and lays out more specific near term restoration efforts, tiers. Since plan implementation is planned using an adaptive management framework over the next 50 year plan, additional information that becomes available over time will be incorporated into period updates to the report. No immediate action is planned at the dams, the additional information developed by the NESP efforts and any other new information will be utilized during any Comprehensive Plan updates or site specific projects.

11. COMMENT/CONCERN: Concerning Alternative 6: points out that verbiage on page 3-167 is repeated almost word for word in Chapter 4 (page 4-1).

DISTRICT RESPONSE: This repetition was deemed appropriate, as a brief recap of the selected Comprehensive Plan alternative, prior to more detailed discussion of its component.

12. COMMENT/CONCERN: Suggests the Main Stem Water Level Management recommendation should be re-examined in light of new NESP investigations.

DISTRICT RESPONSE: See response to comment 10, above.

13. COMMENT/CONCERN: Suggests adding verbiage to reflect USFWS concurrence with the District decision not to complete a programmatic Biological Assessment (BA), but to complete site specific BAs when individual projects under the Comprehensive Plan are identified.

DISTRICT RESPONSE: Suggested verbiage has been added.

14. COMMENT/CONCERN: Suggests that the first two recommendations listed in Section 5 are extremely critical to the programs success and should be "laid" or introduced earlier, in Section 1 under Study Organization.

DISTRICT RESPONSE: Additional text on the relationships of this study to the Environmental Management Program (EMP) and NESP has been added to the Executive Summary and Section 1.

15. COMMENT/CONCERN: Questions the Report's conclusion that "No significant long-term impacts to growth of the community or region would be expected to result." Questions whether improved ecosystem conditions would not provide incentive for people to live and work in the region.

DISTRICT RESPONSE: On a systemic basis, ecosystem restoration would not be expected to have a 'significant' impact on community and regional growth. Some growth could occur but it would likely be more specific to the communities and regions where individual projects are implemented that would draw new visitors/businesses/residents to those local areas.

16. COMMENT/CONCERN: Regarding cumulative impacts: suggests discussing under one heading rather than as a discussion for each Goal.

DISTRICT RESPONSE: There is no one best way to address the very difficult concept of cumulative impacts. The comment's thrust is more organizational than content related. The relevant discussions on cumulative impacts are present. The current discussion on cumulative impacts will remain organized as is.

17. COMMENT/CONCERN: Suggests that Chapter 6 should outline a strategy for coordinating the floodplain elements of the Comprehensive Plan with EMP and NESP.

DISTRICT RESPONSE: This strategy is discussed on page 6-20 of the Comprehensive Plan. Section 6 will be revised to provide additional discussions on the relationship and coordination approach between Section 519, EMP, and NESP.

18. COMMENT/CONCERN: Questions how the Steering Committee would interact with the NESP River Council; the Science Advisory Committee; the NESP Science Panel; the System Team; and the NESP Project Delivery Team; and how the Regional Teams would interact with the NESP Regional Management Teams. Each of these groups' roles and responsibilities should include a discussion regarding how they could interact with the NESP and EMP counterparts.

DISTRICT RESPONSE: Section 6 will be revised to provide additional discussions on the relationship and coordination approach between Section 519, EMP, and NESP. As a restoration program that encompasses considerable project areas not covered under EMP and NESP. We do not see the need to address the specific relationship in regards to every committee and group.

19. COMMENT/CONCERN: Suggests that we consider constructing a detailed organizational structure for coordination with respect to the ecological needs and opportunities of the broader regional scale (e.g. UMR System).

DISTRICT RESPONSE: The ecological needs and opportunities presented in the Comprehensive Report are limited to the authorized program area; the Illinois River Basin. Needs identified for this basin are consistent with needs identified for the main stem floodplain under NESP.

20. COMMENT/CONCERN: Concerning Section 6, suggests this section should include a discussion of the USFWS and U.S. Army Corps of Engineers responsibilities under the Fish and Wildlife Coordination Act and Section 7 of the Endangered Species Act.

DISTRICT RESPONSE: Some additional verbiage has been added.

21. COMMENT/CONCERN: Suggests that the concepts of adaptive management should be presented earlier in the report along with discussion on how the Comprehensive Plan will follow them.

DISTRICT RESPONSE: Adaptive management is a component of the implementation of the recommended plan. Alternatives for AM were not formulated and do not require presentation earlier in the report.

22. COMMENT/CONCERN: Regarding Section 6: The Landowner Incentive Program should be placed under the Illinois Department of Natural Resources.

DISTRICT RESPONSE: The text on this program will be moved under the IDNR.

23. COMMENT/CONCERN: Regarding Section 6 (page 6-14): In the first sentence in PFW description, add "and enhance" after restore.

DISTRICT RESPONSE: Update made.

24. COMMENT/CONCERN: Lists some updated information through the PFW program in Illinois.

DISTRICT RESPONSE: Updates made.

25. COMMENT/CONCERN: Regarding Authorization discussion in Section 6, they encourage discussion with the USFWS regarding authorization for outreach, project planning, and project implementation with emphasis on private landowners.

DISTRICT RESPONSE: Some additional verbiage has been added to Section 6, 3. a. third bullet, iv. Additional discussions with USFWS will continue and expand as additional detailed planning, design, and implementation efforts are initiated.

N. From the USEPA Region 5, Kenneth A. Westlake, NEPA Implementation Section, Office of Ecosystems and Communities, undated but received in the District May 5, 2006:

1. COMMENT/CONCERN: Overall, they are supportive of the goals of the comprehensive plan and look forward to opportunities to work with the Rock Island District.

DISTRICT RESPONSE: None required.

2. COMMENTS/COMCERNS: The USEPA recommends that we, if appropriate, identify the relationship of the six goals of the Comprehensive Plan to the ecological goals that have been established for the Upper Mississippi River System.

DISTRICT RESPONSE: The 519 Goals are consistent with those proposed under NESP. The 519 goals also include the Illinois River Basin watershed, not included under NESP.

3. COMMENT/CONCERN: We should describe the standard operating procedures for how the overall goals of the Comprehensive Plan will be coordinated with various permitting and regulatory programs under the Clean Water Act such as Section 404 Wetland permitting, and Section 402 Storm Water Program.

DISTRICT RESPONSE: Section 5. H. Compliance with Environmental Quality Statutes gives a brief overview on this point by saying the site specific ecosystem restoration projects will address compliance with Sections of the Clean Water Act.

4. COMMENT/CONCERN: Concerning the Executive Summary page 11: under Goal 6, Water and Sediment Quality, Objective A, 303(d) is not the program that determines the status of the water body. Water body impairments are assessed using a methodology that is described in the State's 305(b) report: a biennial report to Congress on the Status of the Nation's waters. The impairments are merely tracked in 303(d). Please correct this reference in the ES and other parts of the document where the goals are stated.

DISTRICT RESPONSE: Reference corrected in Executive Summary and report.

5. COMMENT/CONCERN: Concerning ES page 11, letter D, USEPA does not issue State Water Quality Standards. This is a Clean Water Act Program that is delegated to the States. The USEPA issues criteria for water quality and the States adopt these into their administrative code through the Illinois Pollution Control Board.

DISTRICT RESPONSE: Will change to EPA.

IV. SUMMARY OF ENVIRONMENTAL IMPACT REVIEW

A. A Report with integrated EA has been prepared for this project. This review has not identified any potentially significant adverse impacts, either direct, indirect, or cumulative resulting from implementation of the project as proposed. The Ecosystem Restoration Program should result in net environmental improvements throughout the river basin. Thus, a Finding of No Significant Impact was prepared and included in the Report.

B. Alternatives considered for this project were No Action and seven iterations of the recommended alternative, varying only in degree of effort and financial commitment.

C. The preferred alternative for this project (Alternative 6) was recommended based on an assessment of numerous key evaluation criteria.

ILLINOIS RIVER BASIN RESTORATION
COMPREHENSIVE PLAN
WITH INTEGRATED ENVIRONMENTAL ASSESSMENT

STATEMENT OF FINDINGS

V. SUMMARY OF FINDINGS

I find that the implementation of the project, as proposed, and under conditions set forth, and as prescribed by all applicable laws and regulations, is not contrary to the public interest.

5 JUN 06
(Date)

DUANE P. GAPINSKI
Colonel, U.S. Army
District Engineer

- - - PM - 1

March 1, 2006
Arlen D. Peterson
Forest Restoration Consultant
1231 Superior St.
Aurora, Illinois, 60505
(630) 898-3113
a-p-peterson@juno.com

U. S. Army Engineer
Mr. Brad Thompson (CEMVR-PM-F),
P.O. Box 2004
Rock Island, Illinois, 61204-2004

ILLINOIS RIVER BASIN RESTORATION PLAN

Mr. Thompson:
Please allow me to direct our planning for the river project to the Fox River, the flow and yearly access to the public for recreation. Attempts are being made to utilize the Fox River in floating and canoing which has been diffcult because of restricted flow of water assets especially during the summer months of the year. Much has been said about the removal of dams which may too expensive to be truly considered. Many areas between the dams are too shallow to facilitate floating of any kind. It is my opinion that the future of the river depends upon its use for recreational purposes. Therefore I recommend the following:

1.Leave the dams in place.

2. Construct a single shute in each dam large enought to accomodate floats and canoes and migration of fish. This will also conserve the back water environment in back of the dams.

3. Dredge each shallow in a test section of the river 3 feet deep and 10 feet wide to afford yearly flow sufficient to encourage floating industries. This could easlily be done with a single caterpillar tractor with a cutter on the front and a hook on the back of the vehicle.

It is my opinion that expanded use of the river system by the public will engender wider interest in developing and preserving this sleeping resource.

I will be attending the meeting in Oswego next week and look forward to talking to your representatives there.

Sincerel Yours:

Arlen D. Peterson

NORTHERN
ILLINOIS
ANGLERS
ASSOCIATION
BOX 188, BOURBONNAIS, IL 60914

March 13, 2006

Brad Thompson, AICP
U.S. Army Corps of Engineers
Clock Tower Building
P.O. Box 2004
Rock Island, Illinois 61204-2004

Dear Mr. Thompson:

The Northern Illinois Anglers Association appreciates the opportunity to comment on the Illinois River Basin Restoration Plan. The NIAA has been a strong supporter of this project since its' inception. We supported the Illinois Department of Natural Resources and the State of Illinois in their efforts to enjoin the Federal Government and the U.S. Army Corps in this project. You may not be aware, but we were the organization that gave birth to the Alliance to Restore the Kankakee and the Kankakee River Basin Partnership (Commission), both have been very instrumental in support to this restoration effort. ARK, the Alliance to Restore the Kankakee partnered with the USGS in developing a study of the sand and sediment issue in the Kankakee. This USGS Kankakee River Sand and Sediment Study, served as a reference for the Corps in the development of their plan. The Kankakee River Basin Partnership (Commission) provided the opportunity to purchase the land for the State Line Project. This was accomplished with C2000 funding for the Kankakee River Conservancy. Additional land purchases in the Momence Wetlands was made possible through a line item in Governor Edgar's Budget, that provided one and a half million dollars for the Kankakee River Basin Partnership's restoration efforts. As you can see, we have been a supporter for many years and our support has not weakened since we believe this is the most critical issue facing Illinois rivers and streams. Having said all of the above, we find it difficult to comment specifically on the present plan as presented since there is little detail for projects considered in the Kankakee River System. We will limit our comments basically to the Kankakee River System that serves as the Headwaters to the Illinois River since this is the area where we have the most expertise. Basically, we are pleased that the Kankakee River is a priority area in the overall project and we feel rightfully so. We send approximately 1.2 million tons of sediment annually to the Illinois River. One must understand that this is the sediment that is moving through the system. Our sand-bed load is not included in this quantity since if moves slowly through the system, creeping along the bottom of the river. There is a portion of this sand-bed load that is breeching the man made dams and moving into the Illinois River, but a non-quantified amount remains in the Kankakee River. When one hears all the comments and reads the various studies concerning the sand bed load, one realizes that there could be millions of tons of sand in the system. One study points to 18,000 tons in one sandbar at the State Line, one study refers to the Upper Pool losing 1/3 of it's storage capacity to sand, 25,000 cubic yards of sand pass over the State Line annually, the Corps stated that near the State Line there was a sandbar holding approximately 150,000 cubic yards of sand, and the list goes on. This needs to be taken into consideration in any restoration plan and not just the sediment that passes slowly through the system or the suspended sediment. We are discouraged that we hear very little about sand extraction. All agencies that have studied the system point to the sand-bed load as a major problem, but you hear very little about removing the sand from the system. The NIAA is extremely encouraged by the addition of the Yellow River as a major area of concern. We hope that more action will be taken in the upper reaches of the Kankakee River System. We believe that we must restore the source if we are to receive significant benefits downstream. The mere fact that Indiana is being cooperative in the Yellow River is a major plus for the plan. Indiana needs to become more involved in the overall restoration efforts of the Kankakee and Iroquois Rivers. In reference to the Iroquois River and the logjam problems, we agree that this issue must be addressed to prevent further cutting that contributes to the sediment problems. On the other hand, we feel that any logjam removal needs to be monitored in a better fashion than the ones recently completed. The removal of a logjam near Sheldon by the IDOT caused problems for the Kankakee when many of the logs were freed and moved downstream. The same problem was experienced when the logjams were addressed in the Watseka area. Evidence of these problems can be viewed near Minnie Creek, at Gooseberry Island, and near Baker Creek. Catch teams need to be in place when removing these jams. The current information available in the plan concerning the Kankakee River primarily centers around three specific areas, namely, the Yellow River, the State Line, and the Upper Pool. We are concerned that the reach from the State Line to Aroma Park has fallen through the cracks. There are considerable deposits of sand in the State Line to Aroma Park reach of the river. These are most notable near the State Line, at Coops Island, Maple Island, Eagle Island, Hieland Ditch, American Legion, Elks Country Club, and Spring Creek. We are not proposing wholesale dredging, but we believe that many of the major deposits need to be addressed. It would be next to impossible, in our minds, to divert all of these deposits to a collection area for extraction. Above all, we haven't heard that sand removal is definitely a part of the plan. The present State Line Project as stated does not address the sand and sediment issue. The wetlands restoration project will do little to benefit the sand and sediment problems. There will be some small benefit by slowing the flow and providing a settlement area, but basically the project will enhance a wetland and provide for a fisheries habitat. By our comments, one can see that we support the removal of the large deposits of sand and reducing the sand contribution to the system at the source. A final concern we have is the construction site schedule as outlined to date. Construction efforts have begun in the Peoria area with sand and sediment removal. We do not oppose these actions, but we feel that the effort would be better served by beginning at the source rather than in the lower reaches of the system. Removal of sediment in the Peoria area is definitely necessary, but when one considers that the Headwaters are still contributing to the problem, a percentage of the effort at that site will be lost as contributions of sand and sediment from upstream continue to flow in major quantities. In summary, you may count on the support of the Northern Illinois Anglers Association for the Illinois River Basin Restoration Plan. The NIAA would prefer your efforts begin in the Headwaters sooner than later. We definitely support removal of sand from the Kankakee River System. We applaud your efforts to encourage the State of Indiana to address the needs of the Kankakee River as a portion of the restoration plan. We encourage better monitoring of logjam removal to prevent causing additional problems downstream. Above all, keep us abreast of the progress of the entire restoration plan, especially the efforts and plans for the Kankakee River. We desire to be involved in the process and express our willingness to aid your efforts in any way you deem warranted.

Sincerely,

J.R. Black

J.R. Black
Executive Director

Sac & Fox Tribe of the Mississippi in Iowa

349 Meskwaki Road, Tama, IA 52339-9634 • (641) 484-4678 FAX (641) 484-5424

"MESKWAKI NATION"

MAR 2 7 [illegible]

March 14, 2006

Department of the Army
Rock Island District, Corps of Engineers
Clock Tower Building
P.O. Box 2004
Rock Island, IL 61204-2004

To Whom It May Concern:

Thank you for the letter concerning the project:

Illinois River Basin Restoration Comprehensive Plan with Integrated Environmental Assessment

At this time, the Historical Preservation Department of the Sac and Fox of the Mississippi in Iowa has determined the above listed has:

- ☐ No interest in the area geographically
- ☐ No comment on the proposed undertaking
- ☑ No objections. However, if human skeletal remains and/or any objects falling under NAGPRA are uncovered during construction, please stop immediately and notify the NAGPRA Representative, Johnathan L Buffalo.
- ☐ Have an objection or require additional project information. Please send the following: ____________________

Sincerely,

Johnathan Buffalo

Johnathan L. Buffalo
Historical Preservation Coordinator
Sac and Fox of the Mississippi in Iowa

Cc: File

March 15, 2006

Brad Thompson, AICP
U.S. Army Corps of Engineers
Clock Tower Building
P.O. Box 2004
Rock Island, Illinois 61204-2004

Dear Mr. Thompson:

The Kankakee River Basin Partnership (Commission) wishes the Rock Island Corps to know that we are in strong support of the Illinois River Basin Restoration Plan based on the information we have to date. We understand that there will be more specific information forthcoming concerning the restoration efforts planned for the Kankakee River System. We are strongly encouraged by the fact that the Kankakee River is being considered a priority area in the overall restoration plan. It is our firm belief that any restoration efforts to address the sediment and sand issues facing the Illinois River must include the upper reaches of the system. The Kankakee River serving as the Headwaters is degrading rapidly and is a major contributor of sediment to the Illinois River System. Since our major problem is the sand bed load present in the Kankakee, our overall negative contribution of sand and sediment to the Illinois River is grossly understated. This sand bed load moves slowly along the bottom of our river and tends to be held back by manmade dams. In more recent years, a portion of this sand has breeched the dams and is moving slowly into the Illinois River System. We feel certain, based on various studies, that there is millions of tons of sand moving towards the Illinois and is destroying our Kankakee River in the process. Although some of the names of the organizations change over the years, the efforts to correct these problems date back more than 35 years and some of the individuals that were involved at that point in time are still active today addressing the problems facing our beloved river system. It becomes easy for one to understand our frustration when you count the years, the effort, the support base, the fund raising, and the promises. We have made great strides by helping to place over 25 projects on the ground to benefit the river, aiding in the purchase of land in the Momence Wetlands, providing a USGS Sand and Sediment Study to benefit future actions, supporting the IWS in additional studies to provide data for future construction efforts, by initiating the necessary action to ensure the Corps cooperation and study, working with various agencies to improve the system by supporting CREP and other erosion control measurers, by using IEPA grant funds to address river cleanups, working with educational entities to develop a greater awareness of river protection, seeking the help of the County Government to address river issues, and the list goes on and on. We have tried to the best of our ability and available finances to be good stewards of the Kankakee River System and to seek the help of the U.S. Army Corps in addressing the major issues facing the Kankakee River. Frustrated is putting it mildly. We have yet to see the first grain of sand being removed from the Kankakee River in Illinois. We have been offered a lot of rhetoric over the years, but without action to address the comments. We will take the liberty to list a few of those comments:

Senator Dick Durbin (2003) Speaking of logjams on the Iroquois: "These are the worst I have ever seen in my life."

Illinois Representative Mary K. O'Brien (2004) "I support the restoration efforts in the Kankakee River and the need for immediate action. This river is important to all the citizens of Illinois."

Congressman Jerry Weller (2000) "Clean up of the Kankakee River is a top priority and sand removal is the first step in that process"

Jim Mick, IDNR (2002) "Due to channeling of the river, the slope and flow has changed and is now incising the banks and causing massive failure"

Dr. Nani Bhowmik, IWS (2002) "I have probably studied this river more than anyone. Over the decades, my studies have shown the problems of the Kankakee. I am standing here before you telling you now is the time for action and time is running out. I won't be back to study the river again because I am retiring, but if you wait there will be no need to study the river again anyway."

Illinois Senator Larry Walsh (2001) "We need to keep the sand and sediment out of the river and on the land. We need to remove what is in the river and keep the rest of it where it belongs."

Congressman Jerry Weller (2000) "My number one concern is the sand and sediment and its' impact on the quality and future of the Kankakee River."

Lt. Governor Bob Kustra (1997) "As part of the headwaters to the Illinois River, the Kankakee River must receive resources essential to preserve it."

Congressman Tom Ewing (1995) "The areas surrounding the Kankakee River and its' tributaries have faced an increasing flood problem in recent years due to sedimentation. Storms which did not cause flooding a few years ago, now cause major problems."

Congressman Jerry Weller (1997) "We have already spent hundreds of thousands on studies on the Kankakee River and have another underway. Now it is time for action."

Paul Terrio, USGS "The goal is to keep the river moving along, not the sediment"

Paul Terrio, USGS "The Kankakee River is losing its' capacity to store water, especially in the upper pool, and sediment is to blame."

Senator Paul Simon (1994) "This river is a valuable resource for the people of Illinois and Indiana. I admire the efforts to restore the river and I pledge my support."

Lt. Governor Bob Kustra (1996) "I don't care who your are or where you are from, you look at this (restoration of the Kankakee) as one of the most important priorities of State Government."

Governor Jim Edgar (1997) "We have a long term responsibility to be good stewards of our land, water and air, and to conserve our State's natural resources. The Illinois River and its' tributaries are an important natural resource and necessary for a strong economy."

Ken Derickson, US Army Corps (1996) "Illinois has its' act together and now Indiana needs to get their act together."

Jim Mick, IDNR (1997) "We are not giving up at the IDNR. We are not just going to let an opportunity to do something for the Kankakee River pass us by."

Dr. John Marlin, IDNR (2001) "Sediment is to a river as a tumor or clogged artery is to the human body and this river has too much sediment."

Steve Russell, US Army Corps (2001) "Monsters sometimes hide behind best intentions. Good intentions led to draining the Grand Marsh and placing the river in a channel. We don't want to create any more monsters like our forefathers did."

Senator Peter Fitzgerald (2000) "Rarely in this State have I seen such a widespread interest and agreement for backing a local Partnership. We need to support their efforts to restore the Kankakee River. This is a valuable resource for the area and the people of Illinois."

Brent Manning, Director IDNR (2000) "We need a vision for the Kankakee River Basin that includes efforts in both Illinois and Indiana."

Lt. Governor Corinne Wood (2000) "If nothing else is done, there will be a heavy price for negligence. It's a price we can't afford to pay."

Jim Garner, IDNR (2000) "We see a decline in the past decades and we want to restore the Kankakee River to what it once was."

Congressman Jerry Weller (2000) "The Kankakee River will play a critical role in the success of the Illinois 20-20 program since it is the headwaters of the Illinois River."

We could go on and on with support comments from governmental officials that basically all agree that the time is now to address the needs of the Kankakee River. As you can see, some of these comments were made years ago and still we haven't seen one grain of sand removed. Frustrated? You bet! With all the years of hard work and disappointments, one can understand the reason we hear many extreme comments concerning the solution to the problems facing the Kankakee River. Such comments as suing the State of Indiana for damages, building a dam at the State Line to hold back the sand, blowing the manmade dams and allowing the sand to flush through the system, forcing the Corps to use their authority against the many drainage districts who's actions cause further blockage in the waterway, calling upon the U.S. EPA to enforce the Clean Water Act that includes sand as a pollutant, and the list goes on. Even through all of this, the Kankakee River Basin Partnership (Commission) has remained steadfast in their support. We are the ones that receive most of the criticism for lack of action. People want to know what good we are doing. At least we deserve the respect of serving as a buffer for criticism between the general public and governmental agencies. When one evaluates all sides of the issue, the answer comes down to the same basic issue and that is our area citizens want the sand and sediment issue addressed, not talked about. As far as the current plan goes, we have very little detail to comment on, but we know that we need the help of the Corps if we are to realize our dream of restoring the Kankakee River. We would like to see the plan expanded to include the entire Kankakee River Basin in Indiana as well as Illinois. The original plan of opening backwaters, connecting old oxbows, breeching the current levee, and allowing the river to seek as much of it's original course as possible seems like the best plan to our organization. We are pleased to note that the Yellow River is being addressed and that is a starting point for further expansion. The State Line Project fails to address sand and sediment issues in a major fashion. Basically, the only benefit to the sand and sediment problems is the slowing of the flow and possibly providing a settlement area. The reach of the Kankakee River from the State Line to Aroma Park seems to be abandoned. There are several major slugs of sand in this reach of the river that we feel must be addressed. Mother nature cannot move all that sand to an extraction location. Speaking of extraction, we see no concrete evidence that sand removal is a definite part of the plan. We strongly recommend sand removal as a correction measure. We understand diverting sand, but at some point, sand must be removed. We do not believe in wholesale dredging of the river, but we feel that the major deposits must be removed if we are to be successful in our endeavor to restore the river. Our last point is that we feel the construction should begin in the upper reaches of the Illinois River System. The Kankakee River being the headwaters should be addressed before major construction begins downstream. Since you have already began the project in the Peoria area, an area that we totally agree needs to be addressed, we feel that a portion of your efforts will be wasted since the upper reaches of the system are still contributing large amounts of sediment to the downstream areas. We believe you need to begin at the source if you are to be successful. We are certain that we will have additional comments once more specific details are made available concerning actions for the Kankakee River. We definitely desire to be kept informed and feel that we have a major stake in the system since we live here, raise our families here, recreate here, and depend on this river for a quality lifestyle. We offer our services when desired and assure you that we are in support of the protection, restoration, and enhancement of the Kankakee River and the entire Illinois River System.

Sincerely,

J.R. Black

J.R. Black
Chairman

Comments on the February 2006 Version of the Illinois River Basin Restoration Plan
http://www.mvr.usace.army.mil/ILRiverEco/Documents/IRBR_MainReport_small.pdf

Submitted by
Dr. Richard E. Sparks
Former Director of the Illinois Water Resources Center (retired 2002)
P. O. Box 176, Elsah, IL 62028, rsparks@uiuc.edu

Presented: Wednesday 15 March 2006, Pere Marquette State Park, Grafton IL
Updated 16 March 2006

Thank you for the opportunity to submit these oral and written comments on the Illinois River Basin Restoration Plan. My name is Richard Sparks. I retired a few years ago from the University of Illinois in Urbana-Champaign, where I was Director of the Illinois Water Resources Center. Prior to my stint at the Water Resources Center, I directed the Illinois Natural History Survey's Large River Research Program on the Upper Mississippi River and the Illinois River for 26 years. I have provided advice on management of floodplain ecosystems and large rivers in Argentina, Brazil and India. At the state level, I served on Lt. Governor Robert Kustra's Illinois River Strategy Team, which generated many of the recommendations that are now incorporated in the current version of the Illinois River Basin Restoration Plan, and I currently serve on the Science Advisory Committee for Illinois River Coordinating Council, which is chaired by Lt. Governor Patrick Quinn. On a volunteer basis, I serve as a science advisor to American Rivers and The Nature Conservancy. The following comments are my own and do not necessarily represent positions of the agencies or organizations I've mentioned.

I have provided 7 comments, numbered below.

1. **Compliments.** First, I want to compliment the Corps, the Illinois Department of Natural Resources, and others who served on work teams that developed a thorough and ambitious plan that, if implemented, will renew the Illinois River Basin and the Illinois Floodplain-River Ecosystem. As the Plan points out, the river and its associated floodplain wetlands, side channels, and lakes belong in a world class of large, floodplain-river ecosystems and are well worth restoring. Like other members of this world class, the Illinois River was phenomenally productive and harbored a large number of species, including several unique to this river. Over much of its length, it is still a watery, green corridor in a landscape that is now mostly developed. It is therefore a wonderful and unique asset to people who want to live along the river and those who travel to view or use its natural resources. Economists have pointed out that natural attractions, such as the river, draw people here. These attractions cannot be outsourced, nor can the economic benefits be transferred easily overseas, in contrast to many other forms of economic activity.

The plan is also to be complimented for incorporating the recommendations of the Integrated Management Plan for the Illinois River Watershed (which I mentioned above), a consensus document completed nearly ten years ago by a group of over 100 people representing state agencies, non-governmental organizations, businesses (including farmers and agribusinesses), and citizens from up and down the river.

So, the comments that follow are intended as constructive contributions to a plan that is solidly founded on previous consensus-based planning efforts and that is truly monumental in terms of scope and the effort that went into preparing it.

2. Capture the natural and free energies of the system. One of the principles adopted in the original Integrated Management Plan for the Illinois River of 1997 was to "utilize the natural and free energies of the system" whenever possible. To my knowledge, this concept was first stated and applied in the Kissimmee River restoration in Florida. This same idea is quoted on the cover of the color brochure, Illinois River Basin Restoration, Section 519, Water Resources Development Act 2000, that was circulated prior to these public meetings: "*Restore and maintain ecological integrity, including habitats, communities, and populations of native species, and the processes that maintain them.*" The last phrase, "*restore and maintain ... processes that maintain them*" embodies the idea that it is generally more efficient and better to restore natural processes than to attempt to replace natural processes with human intervention. After all, why use money, manpower, and fossil fuel energy to do things that the river could do itself? In many cases, application of a relatively small amount of money, manpower, and energy is necessary, but will be greatly multiplied if it triggers a natural, healing process. Two specific examples follow:

a. The measures under **Goal 1** in the Executive Summary (*reducing total sediment delivery to the Illinois River*) include placement of rock riffles, sheet piling, stone barbs and toes, stone armoring, and construction of dry basins. Bioengineering is to be incorporated (bank stabilization with vegetation). These measures emphasize hard structures and engineering. While these measures may be necessary in some places, I would also like to see the plan include the following:

At least one **dechannelization** of a downstream portion of a tributary that crosses the Illinois River floodplain. If the dechannelization is successful in triggering an upstream healing process, then apply the technique, where possible, to other channelized tributaries on the floodplain. This technique has been suggested by Dr. Edwin Hajic, a geologist and independent contractor who has done much work with the Illinois State Museum in the lower Illinois River Valley. Dr. Hajic found that downstream channelization of tributaries, shortly after European settlement of the floodplain, triggered upstream erosion that ate its way into upstream tributaries and their branches over the course of 180 years. It is likely that the inverse manipulation, downstream dechannelization, would trigger an upstream healing process.

b. **Goal 2** in the Executive Summary (*restore aquatic habitat diversity of side channels and backwaters, including the Peoria Lakes*) is to be achieved by "*various configurations and levels of sediment removal and placement. For side channels and island protection, various measures were evaluated including instream structures for habitat*". In the main text (III-66) stone stub dikes are mentioned as a means of providing habitat and directing the river current so that the channel is self-scouring and the need for dredging is reduced. The latter is a good example of "harnessing the natural and free energies of the river". There is another innovative technique that should be included, that I did not see mentioned, and that is "**seed islands**". "Seed islands" are started by placing stones in such a way that the river itself "grows" an island through the process of sedimentation in the desired location downstream of the stones. This technique has been used successfully by the Corps on the Upper Mississippi River and was suggested by the Illinois State Water Survey as one approach to reestablishing island wind-and-wave breaks in the Peoria Lakes.

3. **Goal 3** (*restore floodplain, aquatic, and riparian habitat*). "*Wetland habitat would be created or rehabilitated through the creation of Moist Soil Management Units (MSMUs), wetland planting, and/or reconnection of floodplain areas to backwater areas* (Section 4-11)."

Most of the subsequent analysis in the text deals with Moist Soil Management Units and wetland planting, but there are few details on **reconnection of floodplains** to backwaters or to the river. Areas to be reconnected would have to be carefully selected, based on effects of dam operations on the mainstem river and influence of tributaries. The reconnection would probably have to be managed initially with gates, until other measures restored a more natural seasonal hydrograph to the main river. Such connections should be managed adaptively and the results carefully assessed to develop and improve this innovative technique.

Dechannelization of tributaries *in* restored floodplains (see comment 2a above) would also allow tributaries to rejuvenate floodplains through natural geomorphic processes such as meandering and building of natural levees. In many areas of the floodplain, valuable nut-bearing trees are able to grow on the natural, raised levees once created by tributaries, where flooding is less frequent than on the floodplain itself.

The value of **temporary ponds** on the floodplains should be explicitly recognized in the text and Executive Summary. Threatened species, such as the Illinois chorus frog, depend on these isolated, temporary ponds. Because the ponds dry up during the summer there are no predatory fish to eat the eggs and tadpoles of these frogs.

In summary, it is the diversity of habitats, ranging from permanent water bodies to temporary ponds and natural levees, that maintained the remarkable diversity of plants and animals in the Illinois River floodplains. These habitats were characterized by different degrees of connectivity with the river and were maintained by natural geomorphic processes.

4. **Goal 4** (*restore aquatic connectivity, including fish passage*) is worthy objective, but with two notable exceptions:
    a. Restoring connectivity may facilitate the dispersal of harmful, **invasive aquatic species**. Risks of spreading harmful species should be carefully assessed before undertaking projects to provide fish passage. Of particular concern is the proposal to enhance fish passage in the Des Plaines River, a tributary of the upper Illinois River. Just upstream of its mouth, the Des Plaines River parallels the Chicago Sanitary Ship Canal, where the Chicago District of the Corps operates an electric dispersal barrier to prevent the exchange of harmful invasive fishes between the Great Lakes and the Illinois River. Passage of unwanted invasive fishes into the Des Plaines would circumvent the electric barrier in the Ship Canal. During heavy rain events, the Des Plaines floods across the relatively narrow strip of land that separates it from the Ship Canal. Water from the Des Plaines pours directly into the Canal, including several locations both upstream and downstream of the electric barrier, so fish eggs, larvae, and small adults could easily be carried into the Canal.
    b. The effects of restoring connectivity on genetically distinct stocks of native fishes likewise should be carefully assessed. The middle Illinois River and its tributaries have **genetically distinct stocks** that may be worthy of conservation. The falls/rapids at Starved Rock and Marseilles were **natural barriers** that allowed some fish species above the falls to diverge into distinct subspecies and that also separated Great Lakes genotypes from Illinois River genotypes (see Dr. David Philipp's paper on genetic structure of sport fish populations in the Upper Mississippi River Basin and Dr. Philip Smith's *Fishes of Illinois* and other papers on the subspecies of long-eared sunfish found only in the upper Illinois River and its tributaries.). There are no falls or other natural barriers in the lower Illinois River, so the reason why the stocks from the middle Illinois River tributaries are distinguishable from those in the lower Illinois River is unknown.

5. **Goal 5** (*Naturalize Illinois River and tributary hydrologic regimes*). "*Measures include*

increasing the volume of storm water storage in the watershed (through the use of various measures including: tile management, detention structures, and extended riparian areas) and directing storm water runoff to areas where it can infiltrate the soil and recharge groundwater (through the use of various measures including: tile management, filterstrips, and grassed fields enclosed with a berm). Reducing fluctuations on the mainstem will be accomplished through the following measures including: performing pool drawdowns, installing automated dam gates, and installing new gates at existing dam sites were evaluated."

The Corps is to be complimented for analyzing the sources of excessive water level fluctuations in the river, thereby addressing one of the main recommendations from the Illinois River Strategy Team. The recommended measures address the major causes of water level fluctuations, including the large contribution from the altered watershed.

One additional analysis, that might be undertaken before funds are irrevocably committed to installing new gates, is the effect of reconnection of the river and its floodplain in reducing the small floods during the summer growing season. Although water level fluctuations would still prevent desirable plants from growing in low parts of the reconnected floodplains, the additional hydraulic storage and conveyance capacity might reduce the small floods sufficiently that there would be a significant gain in moist soil vegetation at higher elevations in the floodplain. Also, the lower floods might not enter some of the smaller water bodies that are "perched" in the floodplain, thereby allowing submersed aquatic plants to grow.

6. **Goal 6** ("*Improve water and sediment quality in the Illinois River and its watershed*"). A particularly important objective is D ("*Achieve USEPA nutrient standards by 2025, following standards to be established by 2008.*"). The beneficial effects of reducing sediment inputs to the river and sediment resuspension in the river and its lakes could be undone if the improved light penetration stimulates harmful algal blooms because of the excessive nutrient levels in the river and its lakes.

IEPA and USEPA need to accelerate nutrient reduction programs in the expectation that light penetration will be improving as the recommended restoration program in the Illinois River Basin is undertaken. If such efforts do not even begin until some unspecified time after 2008, then harmful algal blooms may occur. Although the measures to reduce sediment inputs and smooth water level fluctuations are expected to also reduce nutrient concentrations to some extent, it is not certain that the reductions will be sufficient to prevent algal blooms.

Although algal blooms now occur sporadically in the river and its lakes, the algae are mostly suppressed because the excessive turbidity limits light penetration. If nutrient concentrations remain high, while the light penetration improves because of the measures undertaken by the recommended restoration plan, then massive algal blooms are likely. Excessive algae in the water or floating on the surface could reduce light penetration and thereby prevent desirable submersed aquatic macrophytes from growing. Excessive epiphytic algae can overgrow aquatic macrophytes causing poor growth or even death. Algal blooms also cause daily swings in the dissolved oxygen that impair aquatic life. During the day, the excessive algae may release so much oxygen that the water becomes supersaturated. At night, algal respiration and decaying, dead algae can reduce oxygen concentrations to hypoxic levels that stress or kill fish and other aquatic animals. Finally, several species of nuisance algae (mostly blue-green algae, that are not good food sources for zooplankters and other consumers in the food chains) release growth inhibitors that prevent other, more desirable algae (more desirable because they do support the food chain) from growing.

7. **Scheduling.** In the preferred alternative (Alternative 6) there are no dollars budgeted for adaptive management, system and site-specific monitoring, special studies, and the computerized inventory and analysis system, until 1-3 years after projects have begun. Initial expenditures may be modest, but preparations for these activities need to start when the program starts, because measurements need to be taken of pre-project conditions and of project "as-built" conditions. Without these initial measurements, there will be no basis for comparison.

This concludes my remarks. Again, thank you for the opportunity to comment.

TRI-COUNTY REGIONAL PLANNING COMMISSION

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March 17, 2006

Mr. Brad Thompson
U. S. Army Corps of Engineers
Rock Island District
PO Box 2004
Rock Island, IL 61204

Dear Mr. Thompson:

The Tri-County Regional Planning Commission is pleased to offer this letter of support for the USACE Illinois River Basin Restoration Plan that was presented on March 15 in Peoria. We concur with the USACE's goals of reducing sediment delivery into the Peoria Lakes, restoring 12,000 acres in 60 backwaters on the main stem, 35 side channels, 75,000 acres main stem floodplain, 75,000 acres of tributary floodplain, aquatic life in tributary streams, fish passage, protecting 15 islands, creating 107,000 acres of storage area and 38,400 of infiltration area, increasing water level management at navigation dams and drawdowns in LaGrange or Peoria Pools, and improvements anticipated due to reduced sediment, phosphorus, and nitrogen delivery.

TCRPC also supports the tiered implementation and continuing restoration efforts under the existing authority of Section 519 totaling approximately $153.85 million through 2011. Sixteen of these projects have been identified as follows: Peoria Riverfront, Pekin Lake North, Pekin Lake South, Waubonsie Creek, McKee Creek, Kankakee River, Blackberry Creek, Iroquois River, Alton Pool Side Channels and Island, LaGrange Pool Side Channels and Island, Tenmile Creek, Yellow River, Senachwine Creek, Crow Creek West, Starved Rock Pool Side Channels and Island, and Fox River Fish Passage.

The Tri-County Regional Planning Commission is prepared to assist the USACE with the implementation of these plans in any way possible. Please do not hesitate to contact me or our Executive Director if you have any questions or requests.

Respectfully,

George W. Murray
Chairman

411 Hamilton Boulevard • Suite 2001 • Peoria, IL 61602
Phone (309) 673-9330 • Fax (309) 673-9802 • EMAIL info@tricountypc.org

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County Administration
Peoria County Courthouse, Room 502
324 Main Street, Peoria, Illinois 61602
Phone (309) 672-6056 Fax (309) 672-6054 TDD (309) 672-6073
Email: purich@peoriacounty.org

Patrick Urich
County Administrator

April 6, 2006

Mr. Brad Thompson
U.S. Army Corps of Engineers
Rock Island District
PO Box 2004
Rock Island, Illinois 61204

Dear Mr. Thompson:

Re: USACE Illinois River Basin Restoration Plan

It is with great pleasure that Peoria County offers this letter of support for the USACE Illinois River Basin Restoration Plan that was presented on March 15th in Peoria.

The need for reducing sediment delivery into the Peoria Lakes has been an ongoing concern of Peoria County, and was the catalyst for the development of a regional erosion and stormwater control ordinance in the early 1990's. We agree with the Corp's goals of restoring backwaters, stream estuaries, and the creation of islands for additional compensatory storage in the Illinois River.

We would appreciate your cooperation in advising the County on any regulatory issues that may be involved with the proposed project. Areas located within our watershed (i.e., floodplains) contain a multitude of uses including riverfront residences, commercial businesses, and established open space areas. If for no other reason but to advise the inquiring public on the status of the project, we would like to assist the Corps during this process.

If there is any additional assistance that we can provide you during this long endeavor, please do not hesitate to contact my office at (309) 672-6056.

Thank you for the opportunity to comment.

Very truly yours,

Patrick Urich
Peoria County Administrator

/pu

The March 8 public meeting in Kankakee is the one I attended. One of the PowerPoint slides in Brad Thompson's presentation shows a graph with ecological damage without doing the restoration project. While the proposed restoration plan does an excellent job of addressing the negative impact of sedimentation on water quantity, it fails to address the negative impact of land use practices in close proximity to the Kankakee River on water *quality*.

There seems to be a lack of collaborative effort among various local, state, and federal agencies. The recent approval by the Illinois EPA of a 236-acre regional landfill in Kankakee County (see attachment) near where the Kankakee River watershed meets the Iroquois River watershed would sabotage plans for "protection and restoration of the Kankakee River mainstem." The proposed site lies within a Priority 1 CWS Well Watershed (see attachment). Runoff from the landfill may spill into the waters of Minnie Creek which borders the proposed location on two sides. It also may contaminate private wells when the developers trench through the shallow aquifer into bedrock. The proposed landfill location is upstream from the six-mile pool area of the Kankakee River. Aqua Illinois draws water from this pool to provide drinking water for 80,000 area residents. How ironic is it that during the public meeting, Rich Schultz questioned the ability of the ACE plan to protect the quantity of water in the six-mile pool area when the City of Kankakee (his employer) approved the siting of the landfill in this sensitive area?

Numerous scientific publications, including the Illinois State Geological Survey's "Potential for Contamination of Shallow Aquifers," Circular 532 map details the susceptibility of most of the Kankakee River watershed to contaminants. The USGS publication "Effects of Land Use on Recharge Potential of Surficial and Shallow Bedrock Aquifers in the Upper Illinois River Basin," is a Water-Resources Investigations Report 00-4027 which also estimates aquifer susceptibility to contamination. The scientific panel serving as advisors for the project would perform a great service if they use the data from these and other publications to make sound decisions to protect water quality in the restoration plan.

Sincerely,
Leigh Marcotte
5383 N 11000 W Rd
Bonfield, IL 60913

April 12, 2006

Sherryn Jackson
U.S. Army Corps of Engineers
Clock Tower Building, Box 2004
Rock Island, Illinois 61204-2004

Att: Illinois River Basin Restoration Comprehensive Plan

Dear Sirs:

This comment stems from your public meeting at Starved Rock Lodge, Utica, Illinois, on March 7, 2006.

I wish to nominate the south channel of the Illinois River at Ballards Island in the Upper Pool at Marseilles as a desperately needed restoration project. The channel has silted in from a nine- to 15-foot depth to a depth of two to three feet. The silting directly results from the adverse effect on the water flow created by the earthen dam constructed in the early 1950s by the Corps of Engineers on the west end of Ballards Island south to Illini State Park. The dam was built on the downstream side of the island, 150 feet from the outlet of a large, 30-mile long tributary creek.

The result is 50 years of silting in the channel behind the earthen dam, changing what was once one of the most beautiful natural areas on the Illinois River to a sluggish backwater that supports virtually no aquatic life. The backwater area now serves as an ideal hatching environment for millions upon millions of mosquito larvae.

This mosquito breeding pool is a hazard to public health and safety by virtue of possible transmission of West Nile virus to nearby residents and thousands of tourists who annually visit Illini State Park. It is absolutely incredible and appalling that state and federal authorities continue to allow this condition to exist, despite the many requests through the years from various individuals and entities to do something to help remedy the situation.

Sincerely yours,
Jo Ann Hustis

Jo Ann Hustis, landowner
2446 N. 2659th Road,
Marseilles, Illinois, 61341.

The Nature Conservancy
SAVING THE LAST GREAT PLACES ON EARTH

The Nature Conservancy in Illinois
8 South Michigan Avenue, Suite 900
Chicago, Illinois 60603

tel [312] 580-2100
fax [312] 346-5606

nature.org/illinois

13 April 2006

Duane P. Gapinski, District Engineer
U.S. Army Corps of Engineers
Rock Island District
Attention: CEMVR-PM-R
P.O. Box 2004
Rock Island, IL 61204-2004

Dear Colonel Gapinski:

Congratulations to you, your staff, and the Illinois Department of Natural Resources (IDNR) for completing the February 2006 draft report for the Illinois River Basin Restoration Comprehensive Plan. The report provides an excellent description of the planning process and analyses that have taken place and their outcomes. We enthusiastically support the report's findings and recommendations.

The Nature Conservancy is the largest, private, not-for-profit, member-supported conservation organization in the world. We have over 33 thousand members in Illinois and over 1 million members worldwide. Our mission is to preserve the plants, animals and natural communities that represent the diversity of life on Earth by protecting the lands and waters they need to survive. We use a science-based approach for planning, implementing, and evaluating the effectiveness of our conservation work. Working with partners through various conservation planning efforts, the Illinois River has been identified as a priority freshwater site for conserving biological diversity, and we believe the measures identified in the Plan will provide significant improvements in the ecological health of the river system and the plants, animals and natural communities it supports.

In reviewing the report, we believe No Action and Alternatives 1 through 5 are inadequate and unacceptable. We feel most of the features and quantities identified in Alternative 7 of the plan are both well justified and highly desirable for restoring the ecological integrity of the Illinois River ecosystem. However, we understand there are numerous complexities and realities associated with funding and implementing such a program, and we therefore support the recommended Alternative 6. Fully implemented, Alternative 6 would invest approximately $8 billion over 50 years to significantly restore and enhance the ecological integrity of the Illinois River ecosystem. Among the proposed outcomes are the reduction of sediment delivery by 20% and additional improvements in water quality; restoration of 12,000 acres of backwaters, 35 side channels, 150,000 acres of main stem and tributary floodplains and riparian areas, and 1,000 miles of stream habitat; and significant strides in restoring a more natural hydrology.

The proposed program will benefit from local expertise that will be available through use of Regional Teams to provide input to and review of project plans and evaluations. We strongly support that this program be implemented in an adaptive framework, evaluating and improving, as practical, project designs and prioritization to ensure the most efficient use of available resources. Toward that end, it is imperative that sufficient monitoring be conducted not only at the project level, but at the reach and system levels as well. In addition to project monitoring, the Plan recommends implementation of an Illinois River Basin Monitoring Program in part to provide long-term resource monitoring and a computerized inventory and analysis system as called for in Section 519 of the Water Resources Development Act of 2000. It is important that adequate funding be provided to design, implement, and maintain the monitoring program.

We are pleased that the Plan recommends expansion of the existing program authorization to allow non-governmental organizations to serve as sponsors for restoration projects to be implemented under the Illinois River Basin Restoration Program. Nationally, The Nature Conservancy is the Corps' largest non-federal sponsor of ecosystem restoration projects. In Illinois, the Conservancy has invested over $30 million in floodplain acquisition and restoration planning and implementation over the past decade. We believe that through partnerships with the Corps and other participants in the proposed program, restoration and management dollars can be leveraged to provide the more efficient and effective use of available resources and to ensure conservation outcomes at the needed scale.

Thank you for the opportunity to comment on the draft report of the Illinois River Basin Restoration Comprehensive Plan. Through the proposed program, The Nature Conservancy looks forward to continuing to work with the Corps, IDNR, and other partners to restore and conserve the Illinois River ecosystem and the numerous benefits it provides.

Respectfully yours,

Bruce Boyd
Director

cc: Reuter, Emken, Becker, Illston, Blodgett (Conservancy)
Jim Mick, Acting Director Sam Flood (IDNR)

From: Jim Sweeney [mailto:jpbiod@comcast.net]
Sent: Friday, April 14, 2006 8:48 PM
To: CEMVR IL River Basin-cmts
Cc: info@prairierivers.org; Ed Mullady; Marianne Hahn; Chris Salberg
Subject: Illinois River Basin Restoration Plan

Sirs and madams,

Please add my comments to the record of public input regarding the draft Illinois River Basin Restoration Project and the preferred alternative. I did read the summary of the Plan. Much of it looks quite encouraging. Other areas need improvement.

The Objectives were quite encouraging. It was good to see a goal of protection and restoration of "all habitat types" in the basin and all state and federal endangered species. Often projects such as this one will only focus on the predominant habitat types. To include them all is quite progressive for the Corps of Engineers and I strongly support this.

Sedimentation is one of the more serious and widespread problems in the Illinois basin. The topsoil that made the prairie rich and farmland productive is the curse of the tributaries and rivers in the basin. More has to be done to keep the topsoil where it belongs and out of the water.

I am concerned that the plan focuses more on engineered solutions than on in-stream and floodplain restoration. Obviously, there will be great need for engineered solutions but in areas where this is not mandatory, natural options should be used, such as re-meandering streams, wetland and floodplain restoration, etc.

Backwater, side channel, and island protection and restoration are probably the most important components regarding the biological health of a river. I am glad to see this as a priority but again, engineered solutions seem to be your first priority. My suggestions for natural solutions pertain here as well. 19,000 acres of restored islands and backwaters sound like a lot but in a basin the size of the Illinois, I fear it is not much.

I am not familiar with "sediment compaction" but it does not sound like a process I would like. If this refers to mechanically compacting of sediments in place, I would think this would be more damaging than the silt itself. This should be analyzed closely by biologists to determine its effectiveness and desirability for use in the benthic zone of the river and tributaries.

Floodplain, riparian and aquatic habitat function is what this is all about. 75,000 acres sounds like a lot but is only a small part of the basin. It is so apparent to me that the first thing that should be done in the basin is to stop making the problems worse. Solutions should start in the upper reaches of the watershed and then work downstream. I welcome the acreage to be protected and restored but the number seems to be one of convenience and not necessaruly justified. The number of acres to be restored should be corroborated; my guess is a larger number would be more beneficial to the goals of the project.

Fish passage by engineered and mechanical means does not always work. The best thing to do would be to close and demolish the locks and dams on the Illinois. They are the biggest barrier to a healthy river and are not economically justified, no matter how the numbers are spun for Congress.

As a rule, I will support removal of all locks and dams but if a structure is needed to keep an alien species at bay, then the structure can be kept until other effective means can be found to control invasive aquatic species.

Restoring natural hydrological cycles is very important. It is probably something that can be done as well artificially as it can be naturally. In fact, that might be preferred during high water years.

The plans goals of improved water and sediment quality are laudable and desirable but engineered solutions can only do so much. Re-meandering, re-connecting, wetland and floodplain restoration are the answers to improved clarity. Engineered solutions would be very expensive for unpredictable results.

In the study where the US Fish and Wildlife Service projects are listed, there was no mention of the Grand Kankakee Marsh National Wildlife Refuge. Proposed in 1996, it will restore 20,000 acres of Kankakee River floodplain. This should certainly be considered part of the solution to Illinois River problems and be specifically referenced in the final report.

It does not take a brain surgeon to realize that the more restoration that takes place, the better the river will be so it would be in the best interests of the sponsors of the Illinois River project to support the Grand Kankakee Marsh National Wildlife Refuge and any other project that will restore river and floodplain habitat anywhere in the basin.

You might detect a bias against engineered solutions in my letter and I will not deny it. Natural is better. Engineered solutions should be used only where absolutely necessary because of their cost and their unpredictable results. Natural fixes might also increase cost due to the need for more land but a restored meander or stream will provide a better return on the investment.

Overall, the plan is encouraging but you need to use more than engineering to pull this off. You also badly need the 20,000 acre restored floodplain of the Kankakee National Wildlife Refuge in Indiana.

Thank you and please add me to your mailing list.

Jim Sweeney
1773 Selo Dr.
Schererville, IN 46375
219-322-7239
jpbiod@comcast.net

"As to dredging the river in Indiana, it will be noticed that God never made a straight river, and I don't think man can improve on his general plans."   Edwin Beardsley

From: Marianne Hahn [mailto:mariannehahn@sbcglobal.net]
Sent: Sunday, April 16, 2006 3:46 PM
To: CEMVR IL River Basin-cmts
Subject: Illinois River Basin Restoration Plan

Sirs and madams,

The Friends of the Kankakee is a conservation organization focusing on protection and restoration of natural areas in the Kankakee River basin. We request you add our comments to the record of public input regarding the draft Illinois River Basin Restoration Project.

There are very encouraging objectives listed in the summary. Specifically, protection and restoration of "all habitat types" and all state and federal threatened and endangered species.

Sedimentation in the Illinois River is legendary and one of the more serious problems you face. Topsoil is a precious resource and extraordinary measures are justified to keep topsoil where it belongs and out of the water.

We are leery of the plan's reliance more on engineered solutions than restoration. As much as possible, natural means should be used. By this we mean re-meandering ditches and streams, wetland and floodplain restoration, vegetated filter strips, etc.

The primary mission of the Friends of the Kankakee is to protect biological diversity. Backwater, side channel, and island restoration should be the first priority to protect the biological health of a river. Again, we encourage less engineered solutions and more natural restoration.

Rivers are very dependable by nature. Whatever impacts the river upstream will manifest itself downstream. Solutions should start in the upper reaches of the watershed and then work downstream. The targeted acreage to be restored is impressive but we wonder how the Corps determined 75,000 acres as sufficient. It is possible you might need more acres to meet the lofty goals in the summary.

Restoring natural hydrological cycles is very important. It is probably something that can be done as well artificially as it can be naturally. The plan's goals of improved water quality and decresed sediment load is best achieved by restoration, re-meandering ditches and streams, streambank stabilization, and floodplain restoration.

We ask why there was no mention of the Grand Kankakee Marsh National Wildlife Refuge in the plan? As proposed, it would restore 20,000 acres of Kankakee River floodplain. Would this not help achieve the goals of the Illinois River Restoration project? The more restoration that takes place, the better the river will be. The sponsors of the Illinois River project should strongly promote and work to establish the Grand Kankakee Marsh National Wildlife Refuge.

Your objectives have set some ambitious goals and we support the plan in principle, with reservations and suggestions as stated above. Natural is better than engineered. Developed areas will need structural solutions, the undeveloped areas should be restored.

Sincerely,

Marianne Hahn, President
Friends of the Kankakee
18429 Gottschalk
Homewood, Illinois 60430

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Rock Island Field Office
4469 48th Avenue Court
Rock Island, Illinois 61201
Phone: (309) 793-5800 Fax: (309) 793-5804

IN REPLY REFER TO:

FWS/RIFO

April 19, 2006

Colonel Duane P. Gapinski
District Engineer
U.S. Army Corps of Engineers
Rock Island District
Attn.: Ken Barr
Clock Tower Building, PO Box 2004
Rock Island, Illinois 61204-2004

Dear Colonel Gapinski:

The Rock Island Field Office (RIFO) has reviewed the *Draft Illinois River Basin Restoration Comprehensive Plan with Integrated Environmental Assessment* (February 2006). The draft report recommends a plan (Alternative 6) for restoring the ecological integrity of the Illinois River Basin System under the authority of Section 519 of the Water Resources Development Act of 2000. The U.S. Fish and Wildlife Service (Service) has a vested interest in the fish and wildlife resources of the Illinois River basin and endorses the restoration measures proposed in Alternative 6. This letter provides comments (Enclosure 1) on the draft plan as well as new information which amends our May 2004 Final Fish and Wild Life Coordination Act Report (FWCAR).

In May 2004, RIFO provided the District with a Final Fish and Wildlife Coordination Act Report which is included as Appendix G of the draft plan. In September 2004, another Illinois River habitat restoration plan was completed as part of the Navigation and Ecosystem Sustainability Plan (NESP). It recommends a variety of habitat restoration measures that are complimentary to recommendations proposed under the Section 519 Plan. The 2004 FWCAR emphasized the need to coordinate the preparation of the Section 519 Comprehensive Plan with the Upper Mississippi River System Environmental Management Plan (EMP) and the NESP. However, this draft plan's failure to adequately address this issue is a critical deficiency.

The draft Comprehensive Plan acknowledges the necessity of restoring Illinois River tributary streams in order to improve fish and wildlife habitat on the Illinois River main stem. Watershed stream restoration is a high priority and is a component unique to the Comprehensive Plan. As the draft report recommends, the watershed work should be predominantly facilitated by the State agencies and the U.S. Department of Agriculture programs. The Service supports the watershed plan and looks forward to participating through its Partners for Fish and Wildlife Program (see Enclosure 2).

The Illinois River floodplain restoration components of the plan duplicate several EMP and NESP objectives and their organizational structure. Although the NESP is not yet authorized, the draft Comprehensive Plan should consider this likelihood and propose a strategy to potentially integrate it.

Among the several NESP projects now being planned, there is a study team developing a new coordination framework to implement NESP and strategize its integration with the EMP. Considerations include: project prioritization and selection, science experts guidance, project monitoring, issue resolution, and program administration. All of these are applicable to coordination of the Comprehensive Plan as well. We strongly recommend that the Comprehensive Plan study team review the preliminary conceptual arrangements developed by the NESP Institutional Arrangements study team and determine how the floodplain objectives of Comprehensive Plan implementation could be integrated with NESP and EMP.

These comments are provided under the authority of and in accordance with the provisions of the Fish and Wildlife Coordination Act (16 U.S.C. 661 et seq.; 48 Stat. 401), as amended; and the Endangered Species Act of 1973, as amended. Questions concerning this letter should be directed to Mr. Jon Duyvejonck at the above address or e-mail at Jon_Duyvejonck@fws.gov . The draft report has also been reviewed by the Service's Illinois Private Lands Office. A copy of their comments is enclosed (Enclosure 2).

Sincerely,

Richard C. Nelson
Field Supervisor

Enclosures

cc: Illinois River NWR (Sprenger) w/enclosure
Mark Twain NWR (Steinbach) w/enclosure
ILPLO (Fischer) w/enclosure
ILDNR (Mollihan) w/enclosure
CIFO (Rogner) w/enclosure
IDOT (Clark) w/enclosure

S:\Office Users\Jon\ILR519.doc

Comments on Draft Illinois River Basin Restoration Comprehensive Plan
US Fish and Wildlife Service – Rock Island Field Office

April 14, 2006

General Comments

Several figures and text are unnecessarily repeated throughout the document; (e.g. Figures ES-2, 2-18, 6-6 and 3-1, photographs 2.9 and 3.1, ES-4, 2-14, and 4-13, and Figure 5-1). These could easily be referenced when needed. The six goals and objectives are repeated so often that they become bothersome. In many text locations it would be sufficient to just refer to them as "the six Comprehensive Plan goals and objectives".

Specific Comments

Page ES-4: At several points throughout the report there are statements advocating that the principles of adaptive management (AM) will be applied to the Comprehensive Plan. A discussion of the AM application does not surface until the end of the draft plan on page 6-35. AM principles should be presented much earlier in the report such as in Figure ES-2. This figure should be revised to incorporate the AM principles illustrated in Figure 6-5.

Page ES-5, Overarching Goal: This might more appropriately be labeled as the "Vision" for the Comprehensive Plan.

Page ES-10, Goal 5 Objective D: A similar recommendation was stated in the NESP habitat restoration plan. A preliminary investigation by a NESP interdisciplinary study team examined the feasibility of controlling the wicket gates to minimize river stage fluctuations. That team concluded that any changes that could be made in dam operation would not provide any fish and wildlife benefits to justify the expense/effort.

Page ES-14, Technologies and Innovative Approaches Component: This section would benefit from a discussion of how AM principles would be applied to the Comprehensive Plan. It should also mention how the Illinois River floodplain activities (e.g. monitoring and computerized inventory) would be integrated (or duplication avoided) with similar NESP and EMP activities.

Page ES-16, Recommendations: There should also be a recommendation that facilitates the cooperation of the multiple Federal agencies in funding the Comprehensive Plan. A recommendation that the cooperating Federal agencies utilize "cross-cut budgeting" should be considered.

Page 1-11, Development and implementation of a long-term resource monitoring plan: There is no mention of the existing EMP Long Term Resource Monitoring Plan (LTRMP) and how it could be integrated with the Comprehensive Plan.

Page 1:12-15, Study Organization: The first sentence states that the following organization structure will be used for "further restoration and monitoring activities." The omission of any discussion about how the Comprehensive Plan will be coordinated and/or integrated with the NESP and EMP implies that it will operate independently from these two programs. This is unrealistic and fosters a duplication of effort between the three programs. Page 1-14 refers to a "Regional Team" entity. The NESP also proposes to implement a Regional Team that will represent the Illinois mainstem/floodplain interests. Is this the same team referenced in NESP or a similar, but separate entity?

Page 2-43, Invasive Species: Asian carp are now common up to Starved Rock L/D, if not farther upstream. Round gobies have been collected as far south as Peoria.

Page 3-7, Goal 5, Objective 4, "Remove the dramatic water level changes…": You might want to reconsider eliminating or revising this objective (and discussion on page 3-114, 3-133 etc.)) based on the NESP investigation mentioned earlier.

Page 3-167, Alternative 6: The text under this heading summarizes the benefits of the proposed habitat restoration measures in meeting Comprehensive Plan goals and objectives. This discussion is repeated almost word for word in Chapter 4 (beginning on page 4-1).

Page 4-15, Main Stem Water Level Management: This recommendation should be re-examined in light of the new NESP investigation previously mentioned.

Page 5-3, par. 3: The last sentence which reads "The District has decided that completion of a programmatic BA would not be the most efficient way to comply with the Endangered Species Act" implies that the District has acted in opposition to the Service's recommendations concerning Section 7 Consultation; (i.e. the first sentence reads "…The USFWS states the district must complete a programmatic assessment."). Consider revising this discussion to explain that the Service concurred with this conclusion at that time. Should approval of the Comprehensive Plan look probable, programmatic consultation with the Fish and Wildlife Service should be reconsidered.

Page 5-5, Recommendations: The first two recommendations will be extremely critical to the success of the Comprehensive Plan. However, they come almost as an afterthought. The background for these recommendations should be laid beginning in Section 1 under Study Organization.

Page 5-13, Community Regional Growth: Is it really true that "no significant long-term impacts to the growth of the community or region would be expected to result"? If the full potential of the Comprehensive Plan could be obtained, would not the improved condition of the ecosystem provide an incentive for people to live and work in the region?

Page 5-17, Cumulative Impacts: Rather than presenting a cumulative impacts discussion for each goal and objective, it would be less confusing to combine them under one heading. This section also rambles through topics unrelated to cumulative impacts of the proposed action (e.g. the with and without project condition).

Pages 6-5 to 6-7, Chapter 6, Plan Implementation: This section of the report should outline a strategy for coordinating the floodplain elements of the Comprehensive Plan with the EMP and NESP. Most of the groups shown in Figure 6-1 appear to duplicate a similar NESP entity. Although much of these groups' activities would address watershed projects and issues unique to the Comprehensive Plan, a significant portion of their time would overlap with EMP and NESP floodplain projects.

How would the "Steering Committee" interact with the proposed NESP "River Council," the "Science Advisory Committee" with NESP "Science Panel", the "System Team" and the NESP "Project Delivery Team" and the "Regional Teams" with the NESP "Regional Management Teams"? Each of these groups' roles and responsibilities should include a discussion regarding how they could interact with the NESP and EMP counterparts.

Granted, it might be inefficient to construct a detailed organizational structure for coordination at this early stage of planning. However, the report's somewhat perfunctory reference to these programs displays a lack of foresight with respect to the ecological needs and opportunities of the broader regional scale (e.g. the Upper Mississippi River System).

Page 6-14, U.S. Fish and Wildlife Service: This section should include a discussion of the Service's and Corps of Engineers' responsibilities under the Fish and Wildlife Coordination Act and Section 7 of the Endanger Species Act. It appears that most of the proposed projects will require Service participation for compliance.

Page 6-33, Adaptive Management Principles: At a minimum, the concepts of Adaptive Management should be presented earlier in the report along with a discussion of how the Comprehensive Plan will follow them.

Illinois Private Lands Office
U.S. Fish and Wildlife Service
4469 48th Avenue Court
Rock Island, Illinois 61201

April 12, 2006

To: Jon Duyvejonck

From: Wayne Fischer, Illinois Private Lands Coordinator

Subject: Illinois River Basin Restoration Comprehensive Plan

The following are specific to Partners for Fish and Wildlife activities in Illinois with emphasis on the Illinois River Basin.

General comments

Page 6-15. The Landowner Incentive Program should be placed under the Illinois Department of Natural Resources (DNR). It is a Federal Aid program administered by the Fish and Wildlife Service. The program is directed toward private lands as described, with project development and implementation accomplished by the Illinois DNR within the guidelines of the grant and the priorities established in the Illinois Comprehensive Wildlife Conservation Plan.

Page 6-14. First sentence in PFW description, add "and enhance" after restore. More than 30 percent of PFW projects involve enhancing existing degraded habitat or addressing invasive species issues. For example, an effort to work with duck clubs particularly along the Illinois River that includes installation of water control structures has been ongoing since the mid 1990's. The duck club projects are intended to facilitate moist soil management and by following the spring flood pulse on the Illinois River benefiting a more diverse group of migratory birds.

Page 6-15. The following is updated information through FY 2005 for the PFW program in Illinois.

Wetland Restorations
(1987-2005)

- 414 sites
- 9056 acres

Upland Restorations
(1991-2005)

- 53 sites
- 942 acres

In FY 2005, the local PFW coordinator at Illinois River Refuges restored and enhanced 185 acres of wetland on eight sites and 59 acres of upland habitats on three sites with 11 landowners. PFW provided $58,000 in cost-share funds that were matched by nearly $81,000 in partner and landowner funds and in-kind contributions.

Page 6-15. The PFW program is adequately described in this paragraph. We attribute much of PFW success to our partners and word of mouth marketing by our cooperating landowners. PFW is a truly collaborative effort among the partners to provide landowners with information that will assist them with selection of the most appropriate "tool" or program, or combination of programs to meet their habitat development goals and economic requirements. Participating landowner typically pay for 30 to 50 percent of project implementation costs with technical and financial assistance provided by several partners. Landowners sign a habitat development agreement with the Fish and Wildlife Service that requires maintaining the habitat improvements for a minimum of 10 years, but we are finding that the majority of our cooperating landowners maintain their projects well beyond the requirements of the agreement.

Page 6-15. With respect to the potential role of PFW in implementing the Comprehensive Plan, the PFW program will continue to identify, develop and implement projects that benefit Federal trust resources in collaboration with a diverse group of partners and partner programs. A Strategic Plan for the PFW program is currently being developed that will identify focus areas including much of the Illinois River Basin. PFW local coordinators already work with several locally led watershed planning groups to identify candidate projects that fulfill the mission of the PFW program, and anticipate that many of these projects will compliment the subject plan. We expect funding and staff for the PFW program in Illinois to remain constant in the short term with comparable project accomplishments depending on project complexity and partner collaboration.

Pages 6-3, 4. We note that in the Authorization section, there is a list of authorizations recommended that would allow development of cooperative agreements and fund transfers between the Corps of Engineers and the NRCS, State of Illinois, etc. We encourage discussion with the U.S. Fish and Wildlife Service regarding an authorization similar to the foregoing for outreach, project planning, and project implementation with emphasis on private landowners.

Page 6-20. The Comprehensive Plan represents a significant planning effort on the part of the Corps and many Federal, State, and local agencies. Section c. Allocation of Recommended Section 519 Projects, provides a conceptual breakdown of the estimated $8 billion in restoration needs over an anticipated 50-year period by Federal agencies. Clearly, the assumptions for PFW contributions at a 5% level represent a very significant increase in program as well as partner funding that may or may not be available.

If you have questions about these comments, please feel free to contact me at (309) 793-5800 x214.

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 5
77 WEST JACKSON BOULEVARD
CHICAGO, IL 60604-3590

REPLY TO THE ATTENTION OF

B-19J

Mr. Brad Thompson
Study Manager
Department of the Army
Rock Island District, Corps of Engineers
Clock Tower Building
P.O. Box 2004
Rock Island, Illinois 61204-2004

Dear Mr. Thompson:

The United States Environmental Protection Agency Region 5 (USEPA) has reviewed the Illinois River Basin Restoration Comprehensive Plan with Integrated Environmental Assessment (EA). The purpose of the plan is to develop, evaluate and implement a collaborative and sustainable watershed based approach to ecosystem restoration for the Illinois River. This program will promote ecological restoration while allowing for a comprehensive approach to be established addressing the environmental issues that are present. Overall, we are supportive of the goals of the comprehensive plan and look forward to opportunities to work with your agency. We recommend that your agency if appropriate identify the relationship of these goals with the ecological goals that have been established for the Upper Mississippi River System. This coordination effort could lead to improved management of the river resources, which is a goal for both programs. Based on our review we have several comments to offer. These comments are on TMDLs, measuring results, implementation of the plan, and corrections.

TMDL
At this time, we would like highlight those activities that will restore the beneficial uses to the portions of the Illinois River Basin that are currently on the list of impaired waters ("TMDL list") prepared by the State of Illinois in accordance with 303(d) of the Clean Water Act. Region 5 has just submitted the 2004 TMDL list to the National TMDL Tracking System and the 2004 impairment status for the Illinois River should be available on the internet by summer. The approved 303(d) information for Region 5 is available to the public on the NTTS website (http://www.epa.gov/owow/tmdl/). We suggest that Region 5 and IEPA work with the State to ensure that the Report reflects the most recent impairment information available for the final report.

Measuring Results
In response to the Office of Management and Budget, USEPA is now requiring that States commit to measurable progress in restoring water quality in on a watershed basis. With this in mind, the Illinois EPA and USEPA have committed to reporting measurable improvements in quality of Illinois Waters on a watershed scale. The USEPA and the State Clean Water Act-delegated programs will be making this commitment a major focus for efforts and resources as part of our National Strategic Plan for 2003 - 2008 (http://www.epa.gov/water/waterplan/). We welcome the opportunity to work as partners with the Corps and other stakeholders to restore these waters and report measurable improvements to the public.

Implementation
Your agency and the Illinois DNR should describe the standard operating procedures for how the overall goals of the plan will be coordinated with various permitting and regulatory programs under the Clean water Act such as Section 404 Wetland permitting, and the Section 402 Storm Water program. This should be done to take advantage of synergies between restoration programs and planned regulatory actions, and to protect the investment made through this plan that will be made in areas that are being restored.

Corrections
Executive Summary page 11: Under Goal 6 Water and Sediment Quality, Objective A, 303(d) is not the program that determines the status of the water body. Water body impairments are assessed using a methodology that is described in the State's 305(b) report: a biannual report to Congress on the Status of the Nation's Waters. The impairments are merely tracked in 303(d). Please correct this reference in the executive summary and other parts of the document where the goals are stated.

On the same page, letter D, U.S. EPA doesn't issue State Water Quality Standards. This is a Clean Water Act Program that is delegated to the States. The U.S. EPA issues criteria for water quality and the States adopt these into their administrative code through the Illinois Pollution Control Board.

Thank you for the opportunity to review and comment on the propose restoration plan for the Illinois River. Our agency is interested and looking forward to working your agency and the other stakeholders on the implementation of your restoration plan. If you have any questions or comments, please contact Al Fenedick of my staff at 312 886-6872 or by E-mail fenedick.al@epa.gov.

Sincerely,

Kenneth A. Westlake, Chief
NEPA Implementation Section
Office of Science Ecosystems and Communities

ILLINOIS RIVER BASIN RESTORATION
COMPREHENSIVE PLAN
WITH INTEGRATED ENVIRONMENTAL ASSESSMENT

FINAL

FINDING OF NO SIGNIFICANT IMPACT

I have reviewed the information in this Comprehensive Plan with Integrated Environmental Assessment, along with data obtained from Federal and State agencies having jurisdiction by law or special expertise, and from the interested public. I find that the recommended alternative for systemic ecosystem restoration of the Illinois River Basin would not significantly affect the quality of the human environment. It is anticipated that implementation of the recommended alternative (Alternative 6) would cause the current trend of ecological degradation in the Illinois River Basin to reverse and, in time, result in overall improvement in biodiversity and ecological integrity. Therefore, it is my determination that an Environmental Impact Statement is not required. This determination will be reevaluated if warranted by later developments.

Factors that were considered in making the determination that an Environmental Impact Statement is not required are as follows:

A. All future projects would require separate, site-specific National Environmental Policy Act documents that would follow all procedures and processes required by law.

B. Implementation of the recommended alternative for this Comprehensive Plan should result in a reduction in sediment delivery to the Illinois River Basin as a whole.

C. Implementation of the recommended alternative for this Comprehensive Plan should result in an increase in the quantity and quality of backwaters and side channels in the Illinois River Basin.

D. Implementation of the recommended alternative for this Comprehensive Plan should result in improvements in the quality of floodplain and riparian habitats and improvements in the quality of in-stream (aquatic) habitat.

E. Implementation of the recommended alternative for this Comprehensive Plan should improve access to diverse habitat such as backwaters and tributary habitat in the Illinois River Basin to restore and/or maintain healthy populations of native fish species.

F. Implementation of the recommended alternative for this Comprehensive Plan should naturalize hydrologic regimes on the main stem of the Illinois River and its tributaries, reduce tributary peak flows, and increase tributary baseflows, thereby improving aquatic and riparian habitat.

G. Implementation of the recommended alternative for this Comprehensive Plan should improve water and sediment quality in the Illinois River Basin.

H. Implementation of the recommended alternative for this Comprehensive Plan should provide a level of restoration that would provide a measurable increase in ecological integrity/ecosystem health at the system level in the most cost effective manner.

I. Early and ongoing coordination with the appropriate State and Federal agencies has been maintained during the plan formulation process to address any potential concerns that may arise from implementation of this program

J. Public comments received during either the public meetings or the public review process for the Comprehensive Plan with Integrated Environmental Assessment have been considered prior to signing this Finding of No Significant Impact.

K. The Chicago, Rock Island, and St. Louis Districts of the U.S. Army Corps of Engineers, the State of Illinois Department of Natural Resources, the State Historic Preservation Officer, and the Advisory Council on Historic Preservation executed a Programmatic Agreement (PA) entitled: *Programmatic Agreement Among the Chicago, Rock Island, and St. Louis Districts of the U.S. Army Corps of Engineers, the State of Illinois Department of Natural Resources, the Illinois State Historic Preservation Officer, and the Advisory Council on Historic Preservation, Regarding Implementation of the Illinois River Ecosystem Restoration.* The Programmatic Agreement meets the requirements of Section 106 of the National Historic Preservation act of 1966, as amended, and its implementing regulations 36 CFR Part 800, "Protection of Historic Properties," and is appropriate to address potential concerns to any significant historic properties within the State of Illinois.

5 JUN 06
(Date)

DUANE P. GAPINSKI
Colonel, U.S. Army
District Engineer

ILLINOIS RIVER BASIN RESTORATION
COMPREHENSIVE PLAN
WITH INTEGRATED ENVIRONMENTAL ASSESSMENT

ACRONYMS

ACRONYMS

ACHP	Advisory Council on Historic Preservation
ASA(CW)	Assistant Secretary of the Army (Civil Works)
BA	Biological Assessment
BASINS	Better Assessment Science Integrating point and Nonpoint Sources
BMP	Best Management Practice
BSA	Biologically Significant Area
BSC	Biological Stream Characterization
BSS	Biologically Significant Streams
BW	Backwater
CAP	Continuing Authorities Program
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
CG	Construction General
CIA	Computerized Inventory and Analysis
CREP	Conservation Reserve and Enhancement Program
CRP	conservation Reserve Program
CTAP	Critical Trends Assessment Program
CUP	Chicago Underflow Project
CWA	Clean Water Act
DEC	Demonstration Erosion Control
DNR	Department of Natural Resources
DO	Dissolved Oxygen
DOER	Dredging Operations and Environmental Research
DPR	Definite Project Report
EA	Environmental Assessment
EC	Engineering Circular
EM	Engineering Manual
EMP	Environmental Management Program
EOP	Environmental Operating Principle
EPA	Environmental Protection Agency
EQIP	Environmental Quality Incentives Program
ER	Engineering Regulation
ERDC	Engineering Research and Development Center
FEMA	Federal Emergency Management Agency
FONSI	Finding of No Significant Impact
FQI	Floristic Quality Index
FSA	Farm Service Administration
FY	Fiscal Year
GI	General Investigation
GIS	Geographic Information System
GLO	Government Land Office
HDLD	Hennepin Drainage & Levee District
HEP	Habitat Evaluation Procedure
HGM	Hydro Geomorphic Model
HNA	Habitat Needs Assessment
HQUSACE	Headquarters, USACE
HREP	Habitat Rehabilitation and Enhancement Project
HTRW	Hazardous Toxic and Radioactive Waste
HU	Habitat Unit

HUC	Hydrologic Unit Code
IBI	Index of Biotic Integrity
IDENR	Illinois Department of Energy and Natural Resources
INHS	Illinois Natural History Survey
IRBR	Illinois River Basin Restoration
IRMP	Illinois River Monitoring Program
ISWS	Illinois State Water Survey
ITR	Independent Technical Review
IWW	Illinois Waterway
L/D	Lock and Dam
LERRD	Lands, Easements, Rights-of-way, Relocations of Utilities or Other Existing Structures, And Disposal Areas
LRD	Great Lakes and Ohio River Division of the USACE
LSA	Landform Sediment Assemblage
LTRMP	Long Term Resource Monitoring Program
MCACES	Micro-Computer-Aided Cost Engineering System
MSL	Mean Sea Level
MSMU	Moist Soil Management Units
MVD	Mississippi Valley Division of the USACE
NAWQA	National Water-Quality Assessment
NEPA	National Environmental Policy Act
NERN	National Ecosystem Restoration
NGO	Non-Governmental Organization
NGVD	National Geodetic Vertical Datum
NHPA	National Historic Preservation Act
NPDES	National Pollution Discharge Elimination System
NRC	National Research Council
NRCS	Natural Resources Conservation Service
NRHP	National Register of Historic Places
NRI	National Rivers Inventory
NWI	National Wetlands Inventory
NWR	National Wildlife Refuge
O&M	Operation and Maintenance
OMRR&R	Operation, Maintenance, Repair, Rehabilitation, and Replacement
PA	Programmatic Agreement
PCA	Project Cooperation Agreement
PDT	Project Delivery Team
PFW	Partners for Fish and Wildlife Program
P&G	Planning and Guidance
PMP	Project Management Plan
PQI	Physical Quality Index
RM	River Mile
RNA	Restoration Needs Assessment
SAC	Science Advisory Committee
SHPO	State Historic Preservation Officer
SSRP	Streambank Stabilization and Restoration Program
SWCD	Soil and Water Conservation District

TARP	Tunnel and Reservoir Plan
T&E	Threatened and Endangered
THPO	Tribal Historic Preservation Officer
TMDL	Total Maximum Daily Load
TNC	The Nature Conservancy
TSS	total suspended solids
UMRS	Upper Mississippi River System
USACE	United States Army Corps of Engineers
USDA	United States Department of Agriculture
USFWS	United States Fish and Wildlife Service
USGS	United States Geological Survey
WASCOB	Water and Sediment Control Basin
WES	Waterways Experiment Station
WHIP	Wildlife Habitat Incentives Program
WMC	Watershed Management Committee
WQ	water quality
WRDA	Water Resources Development Act
WRP	Wetland Reserve Program
WY	water year

ILLINOIS RIVER BASIN RESTORATION
COMPREHENSIVE PLAN
WITH INTEGRATED ENVIRONMENTAL ASSESSMENT

GLOSSARY

GLOSSARY

abiotic: non-living; as applied to the physical and chemical components of the ecosystem

adaptive management: an approach to natural resources management that acknowledges the risk and uncertainty of ecosystem restoration and allows for modification of restoration measures to optimize performance. The process of implementing policy decisions as scientifically driven management experiments that test predictions and assumptions in management plans, and using the resulting information to improve the plans. A mechanism for integrating scientific knowledge and experience for the purpose of understanding and managing natural systems. Adaptive management is a continuous, iterative process by which the consequences of management actions and policies are systematically evaluated, and the actions and policies modified in response to the resulting new information.

anthropogenic: caused by humans

area of potential effect: the geographic area or areas within which an undertaking or activity may directly or indirectly cause alterations in the character or use of historic properties, if any such properties exist

backwater: small, generally shallow body of water attached to the main channel, with little or no current of its own; shallow, slow-moving water associated with a river but outside the river's main channel

base flow: stream flow originating entirely from groundwater discharging to the stream

basin: the entire geographical area drained by a river and its tributaries, such as the Illinois River basin

bathymetry: the measurement of water depth across a water body

bed material load: sediment that is generally transported by being rolled or pushed along the bottom of a stream by moving water Portions of the bed material load may become periodically entrained into the flow by turbulence

benthic: refers to the bottom layer of any body of water and the organisms therein

biodiversity: the variety of living organisms considered at all levels of organization, from genetics through species, to higher taxonomic levels, and including the variety of habitats and ecosystems, as well as the process occurring therein. Biodiversity occurs at four levels**:** genetic diversity, species richness, ecosystem diversity, and landscape diversity.

biotic: living; as applied to the components of an ecosystem

catchment: watershed; the area drained by a stream, lake, or other body of water. Frequently used to refer to areas that feed into dams; may also refer to areas served by a sewerage or stormwater system

channel training structure: a man-made flow obstruction (e.g.., wing dam, closing dam or revetment) used to divert river flow to a desired location, usually toward the center of the main channel to increase flow and limit sedimentation or to protect the riverbank from eroding

community: a grouping of populations of different species found living together in a particular environment

conceptual model: a conceptual model in problem formulation is a written description and visual representation of predicted relationships between ecological entities and the stressors to which they may be exposed

conservation: active management to ensure the survival of the maximum diversity of species, and the maintenance of genetic diversity within species; implies the maintenance of ecosystem functions; embraces the concept of long-term sustainability; a careful preservation and protection of something; especially planned management of a natural resource to prevent exploitation, destruction, or neglect

corridor: a relatively narrow strip of habitat that crosses an area of non-habitat land and serves to connect larger areas of habitat

cumulative effects: effects on the environment that result from the incremental impact of any action when added to other past, present or future actions, regardless of which agency or person undertakes such actions

desired future conditions: a description of management goals for an area to achieve optimal conditions; the descriptions should be constructed with the input of all interested parties in the region and should include clear goals for species, communities, and ecosystem composition, structure, and functions across the landscape. For this system study, the desired future condition was based on coordination with resource managers and became the system objectives.

disturbance regime: the spatial and temporal characteristics of disturbances affecting a particular landscape over a particular time (e.g., fire, flood, drought). Any relatively discrete event in time that disrupts the ecosystem, community or population structure and changes resources or the physical environment

drawdown: lowering the level of water in a selected portion of an aquatic system; conducted for habitat management purposes with dams or pumps

ecological (or biological) integrity: a system's wholeness or "health," including presence of all appropriate elements, biotic and abiotic, and occurrence of all processes that generate and maintain those elements at the appropriate rates. The capability of supporting and maintaining a balanced, integrated, adaptive community of organisms having a species composition, diversity, and a functional organization comparable to that of natural, unimpacted habitat of the region

ecological processes: the diversity and complexity of ecosystems seem to depend on a small set of biotic and abiotic, or physical processes, each operating over different scale ranges; the dynamic biological, geological, and chemical interactions that occur among and between the biotic and abiotic components in an ecosystem

ecological restoration: an intentional activity that initiates or accelerates the recovery of an ecosystem with respect to its health, integrity, and sustainability. The ecosystem that requires restoration has been degraded, damaged, transformed or entirely destroyed as the direct or indirect result of human activity Restoration attempts to return an ecosystem to its historic trajectory.

eological stressor: A substance or action that has the potential to cause an adverse effect on an ecosystem

ecosystem: dynamic and interrelating complex of plant and animal communities and their associated nonliving environment; a biological community together with the physical and chemical environment with which it interacts

ecosystem function: processes that drive the ecosystem; any performance attribute or rate function at some level of biological organization (e.g., energy flow, sedimentation, detritus processing, nutrient spiraling)

ecosystem health: a condition when a system's inherent potential is realized, its condition is stable, its capacity for self-repair, when perturbed, is preserved, and minimal external support for management is needed

ecosystem management: protecting, conserving or restoring the function, structure, and species composition of an ecosystem, recognizing that all components are interrelated

ecosystem processes: the aggregate of all interactions among the various biotic components of an ecosystem (e.g., migration, pollination, predation), between the abiotic and biotic components of an ecosystem (e.g., nutrient uptake, erosion, respiration) and natural events and cycles (e.g., fire regimes, hydrologic cycles)

ecosystem restoration: management actions that attempt to accomplish a return of natural areas or ecosystems to a close approximation of their conditions prior to human disturbance, or to less degraded, more natural conditions in terms of structure and function

ecosystem services: all of the goods and services provided to humanity by natural ecosystems; examples include wood products, fertile soils, genetic variation, clean water, and clean air

ecotype: populations adapted to a particular set of environmental conditions; a collection of plants that evolved in response to the specific local environment of an area; a population adapted to a restricted habitat as a result of natural selection within a local environment

edge (or ecotone): the abutment of distinctive vegetation types

enhancement: in the context of restoration ecology, any improvement of a structural or functional attribute

environmental assessment: a document prepared to describe the effects for proposed activities on the environment, in compliance with the National Environmental Policy Act (NEPA) of 1969, as amended

environmental sustainability: the ability of aquatic, wetland, and terrestrial complexes to maintain themselves as self-regulating, functioning systems

Federal Principals Task Force: in conjunction with the Upper Mississippi River-Illinois Waterway System Navigation Feasibility Study, a collaborative and collegial forum for advising the Corps on how to address the National Research Council (NRC) recommendations and other key issues, provided national level balance and guidance on important economic and environmental issues related to the NRC recommendations; made up of senior members of the Department of Interior, Department of Agriculture, Department of Transportation, and Environmental Protection Agency

fish passage: modification or removal of man-made barriers that would otherwise restrict or prevent movement or migration of fish

floodplain: lowlands bordering a river that are subject to flooding, thereby providing flood storage. Floodplains are composed of sediments carried by rivers and deposited on land during flooding and contain a mosaic of habitat types.

funerary object: of, relating to, or for a funeral or burial; an object discovered in close proximity to human remains and interred with the remains

Geographic Information Systems (GIS): a set of computer hardware and software for analyzing and displaying spatially referenced features, such as points, lines or polygons, with non-geographic attributes, such as species, age, etc. utilized for mapping and analysis

geomorphology: the science that deals with land and submerged relief features (landforms) of the earth's surface; the physical structure of the river floodplain environment

habitat: the living place of an organism or community, characterized by its physical or biotic properties; habitats can be described on many scales from microhabitat to ecosystems to biomes

habitat fragmentation: the process whereby a larger, continuous area is both reduced in area and divided into two or more pieces; the disruption of extensive habitats into isolated and small patches; Fragmentation has three negative components**:** loss of total habitat area and smaller, more isolated remaining habitat patches, and increased potential for edge effects.

historic property: any prehistoric or historic district, site, building, structure, or object included in, or eligible for inclusion in, the National Resister of Historic Places; includes artifacts, records, and remains that are related to and located within such properties

hydrologic: pertaining to the cyclic phenomena of waters of the earth; successively as precipitation, runoff, storage and evaporation, and quantitatively as to distribution and concentration

hydrology: a science dealing with the properties, distribution, and circulation of water on the surface of the land, in the soil and underlying rocks, and in the atmosphere

hypoxia: the condition in which dissolved oxygen concentrations are less than two parts per million of water (e.g., zones in the Gulf of Mexico and other estuaries)

impoundment: the volume of standing water that is maintained behind a dam

Index of Biotic Integrity (IBI): The IBI utilizes numerous metrics or measures (often between 10 and 15) to assess aquatic biological integrity using fish community or macroinvertebrate community sampling. There are three broad categories under which the metrics fall**:** species composition; trophic composition; and fish abundance, condition, and tolerance to stressors

indicator: a measurable surrogate for environmental end points, such as biodiversity, that are assumed to be of value to the public; sensitive to changes in the environment can warn that environmental changes are taking place

invasive species: any species that has the tendency to invade or enter a new location or niche; an introduced species that out competes native species for space and resources; an alien species whose introduction does or is likely to cause economic or environmental harm or harm to human health

keystone species: a species whose presence is crucial in maintaining organization and diversity in their communities and who are much more important than the abundance of the species would suggest

landscape: a heterogeneous land area composed of interacting ecosystems that are repeated in similar form throughout; landscapes are variable in size; usually overlaps governmental jurisdictions, thus requiring collaboration from a broad range of participants

landscape ecology: the study of the structure, function, and change in a heterogeneous land area composed on interacting ecosystems

lateral connectivity: the connection of a river and its floodplain, allowing access across aquatic and terrestrial habitats by organisms as well as flood waters

lentic: of, or relating to, or living in still water, such as a pond or lake

levee district: cooperative quasi-governmental organizations that protect areas from floodwaters, primarily for agricultural areas, but may also serve as wildlife areas

levee setback: the process of moving levees away from the riverbank to increase floodplain connectivity, allow for restoration of the riparian corridor, and increase floodwater storage and conveyance capabilities in a river system

life history: an organism's patterns of growth, reproduction, and longevity that are related to specific demands for survival in a particular place at a particular time

limiting factor: the ecologic influence that limits or controls the abundance and/or distribution of a species

litter: an accumulation of dead plant materials on the soil surface

longitudinal connectivity: allows for the upstream and downstream movement and/or migration of aquatic organisms; increases opportunities for aquatic organisms to utilize and move between exiting stream environments, colonize new habitats, or recolonize aquatic habitats following local extinctions

lotic: of, or relating to, or living in flowing water, such as a river or stream

macroinvertebrates: small, but visible with the naked eye, animals without backbones (insects, worms, larvae, etc); water bodies have communities of aquatic macroinvertebrates. The species composition, species diversity and abundance of the macroinvertebrates in a given water body can provide valuable information on the relative health and water quality of a waterway.

management action: a structural or non-structural measure that modifies or adjusts the condition of the ecosystem

mitigation: actions taken to avoid, reduce, or compensate for the effects of environmental damage; among the broad spectrum of possible actions are those that restore, enhance, create, or replace damaged ecosystems

moist soil unit: an area where water levels are controlled to provide a desired mix of moist soil vegetation, generally for use by waterfowl

monoculture: a simplified biotic community dominated by one species

naturalization: establishing a sustainable, varied, yet stable natural area or system that is capable of supporting a healthy, biologically diverse ecosystem within the context of the developed landscape . When abiotic and biotic barriers to survival are surmounted and when various barriers to reproduction are overcome

non-native species: species of plants and animals that are imported or unintentionally transported to a new location where they do not naturally occur

non-point source pollution: water pollution produced by diffuse watershed land-use activities

open river condition: the condition when all dam gates are out of the water and the river water level is no longer controlled by a navigation dam; a condition that minimizes obstructions to fish migration

operation and maintenance (O&M): activities and costs associated with managing and maintaining an area or structure; includes funding for personnel, minor repairs, and supplies

patch: a nonlinear surface area that differs in appearance from its surroundings; the term used for distinct areas, such as ecosystems, on a landscape

performance measures: metrics or indicators that are related to an ecosystem process or function and which are measurable in a natural ecosystem that can be used to judge the performance of restoration actions

planform: the shape or form of an object, as seen from above, as in a plan view

point source pollution: pollution into bodies of water from specific discharge points such as sewer outfalls or industrial-waste pipes

pool: the area of water that is impounded and maintained at a higher level behind a navigation dam; generally refers to the entire length of river between sequential dams

pool reach: a portion of a pool between navigation dams

population: a group of individuals of the same species occupying an area small enough to permit interbreeding among all members of the group

prairie: an area of land of low topographic relief that principally supports grasses and herbs, with few trees, and is generally of a mesic (moderate) climate. Most of the Great Plains, most of Ohio, Indiana, Illinois and Iowa, and much of Missouri and Minnesota, is considered prairie. Almost all of this area has been converted into farmland Fire is an important part of prairie ecology; naturally-occurring and human- induced fires were common in historic prairie areas. Grazing by animals such as the American Bison and Prairie dogs also helped maintain the original prairie environment

preservation: keeping safe from injury, harm, or destruction

pre-settlement: a condition or state prior to European intervention

reach: a continuous stretch or expanse. In reference to rivers, it can be used to define portions of rivers at different scales (i.e. pool reach, reach between two river bends)

reference condition: the range of factors (e.g., hydrology, sediment movement, animal and plant communities, and channel geometry) that is representative of an area or ecosystem prior to significant alteration of its environment

region: a large geographical area that is distinguished by certain characteristics (e.g., biological, ecological, social, political, economic)

rehabilitation: improvements to a natural resource; putting back into good condition or working order

resilience: the ability of a system to maintain its structure and patterns of disturbance in the face of disturbance; pertaining to the boundaries of stable behavior, events far from equilibrium, high variability, and adaptation to change

restoration: reestablishing degraded ecosystem structure, function, and dynamic processes to a less degraded, more natural condition (ER 1105-2-100). As defined under Section 519, in its broadest usage, restoration encompasses the following concepts**:** conservation, enhancement, naturalization, preservation, protection, rehabilitation, restoration, and stabilization

riparian: areas that are contiguous to and affected by surface and subsurface hydrologic features of perennial or intermittent water bodies (e.g., rivers, streams, lakes, or drainage ways); pertaining to the boundary between water and land; normally represents the streamside zone and the area of influence of the stream

river stage: the elevation of the water surface (usually in feet) above an arbitrary datum

savanna: area with a well-developed herbaceous ground cover composed principally of prairie species with scattered trees at densities ranging form 1 per acre to roughly 50% canopy closures The frequency of fire maintains this habitat type by influencing the amount and density of woody vegetation encroaching into the prairie environment

sediment resuspension: the movement of sediment from the river bed into the water column due to a disturbance (e.g., wave action)

sediment transport: the movement of sediment (usually by water)

sedimentation: the process of sediment being deposited in a given location

side channel: aquatic channel connected to the main channel and separated from the main channel by an island; usually has flowing water

spatial: of, relating to, involving, or having the nature of space

species: one or more populations of individuals that can interbreed, but cannot successfully breed with other organisms

species diversity: the richness, abundance, and variability of plant and animal species and communities

species evenness: a measure of diversity that quantifies unequal species representation in a community against a hypothetical community in which all species are equally common; the degree of heterogeneity in the spatial distribution of species in a community or ecosystem

species richness: a simple count of the number of species in an area

stability: the propensity of a system to attain or retain an equilibrium condition of steady state or stable oscillation; having a resistance to departure from that equilibrium condition, and if perturbed, returning rapidly to that equilibrium condition

stabilization: protect from further degradation; restore the original condition when disturbed from a condition of equilibrium or steady motion

stakeholder: those organizations and/or individuals having a vested interest in the outcome of a decision making process

structure: the horizontal and vertical spatial arrangement, or configuration, of a habitat, community or ecosystem; includes biotic and abiotic diversity

sub-basin: a subdivision of a basin, based on hydrology Nineteen major sub-basins have been delineated in the Illinois River Basin**:** Chicago, Des Plaines, Spoon, Upper Sangamon, South Fork Sangamon, Lower Sangamon, Salt Creek, LaMoine, Lower Illinois, Lower Illinois**:** Lake Chautauqua, Lower Illinois**:** Lake Senachwine, Macoupin, Upper Fox, Lower Fox, Upper Illinois, Kankakee, Iroquois, Vermilion and Mackinaw

subwatershed: a subdivision of a watershed, based on hydrology, generally corresponding to the area drained by a small tributary or stream, as opposed to a major river. The Illinois River basin contains approximately 305 subwatersheds

succession: sequential change in the vegetation at a particular location over time

sustainable/sustainability: a level and method of resource use that does not destroy the health and integrity of the systems that provide the resource; thus the long-term resource availability does not ever diminish due to such use

temporal: of, relating to, or limited by time

thalweg: the line defining the lowest points along the length of a riverbed or valley

threat assessment: the identification, evaluation, and ranking of stresses and sources of stress to populations, species, ecological communities or ecosystems at a site or within a landscape

threatened and endangered species: those species that are listed as threatened or endangered under the federal endangered species act (ESA) of 1973, and those species that are candidates or proposed as candidates for listing under the ESA; listing can occur at the federal or state level or both

threshold: the level (duration or intensity) of a stimulus required to produce an effect

total maximum daily load (TMDL): a calculation of the maximum amount of a pollutant that a water body can receive and still meet water quality standards, and an allocation of that amount to the pollutant's sources

tributary: a stream or river whose water flows into a larger stream or river

tributary, major: the larger rivers or streams flowing directly into a larger river There are 10 major tributaries of the Illinois River Basin They are the**:** Chicago, Des Plaines, Spoon, Sangamon, LaMoine, Fox, Kankakee, Vermilion, and Mackinaw Rivers and Macoupin Creek

trust species: USFWS trust species include migratory birds, anadromous and interjurisdictional fish, and endangered species

turbidity: Measure of the "lack of clearness" of water; an expression of the optical property that causes light to be scattered and absorbed rather than transmitted in straight lines through a sample; the measure of relative sample clarity

watershed: the geographic area that naturally drains into a given watercourse such as a stream or river

wicket gate: a rectangular heavily constructed slab of wood and steel hinged in a counterbalanced way so as to be lying flat on the river bed when down, and, when raised, will be held upright by the pressure of the water. Wicket gates are placed in a parallel line across the river and when all are in raised position they form a wall or dam, thus backing up the water and raising it to the pool level On the Illinois River, located at Peoria and La Grange Lock and Dams

**ILLINOIS RIVER BASIN RESTORATION
COMPREHENSIVE PLAN
WITH INTEGRATED ENVIRONMENTAL ASSESSMENT**

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ILLINOIS RIVER BASIN RESTORATION COMPREHENSIVE PLAN WITH INTEGRATED ENVIRONMENTAL ASSESSMENT

US Army Corps of Engineers
Rock Island District
St. Louis District
Chicago District
Detroit District

APPENDICES • FINAL DRAFT
MARCH 2007

ILLINOIS DEPARTMENT OF NATURAL RESOURCES

ILLINOIS RIVER BASIN RESTORATION
COMPREHENSIVE PLAN

WITH INTEGRATED ENVIRONMENTAL ASSESSMENT

APPENDICES

ILLINOIS RIVER BASIN RESTORATION
COMPREHENSIVE PLAN
WITH INTEGRATED ENVIRONMENTAL ASSESSMENT

APPENDIX A

CORRESPONDENCE

ILLINOIS RIVER BASIN RESTORATION
COMPREHENSIVE PLAN
WITH INTEGRATED ENVIRONMENTAL ASSESSMENT

APPENDIX A
CORRESPONDENCE

CONTENTS

All correspondence received in conjunction with the Public Review (February 17, 2006 though April 14, 2006) of the *2006 Draft Illinois River Basin Restoration Comprehensive Plan* is included with the Statement of Findings attached to the Main Report.

Newsletters

News Releases

Historic Properties Correspondence and Executed Programmatic Agreement

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SPORTSMAN'S LETTER

ED MULLADY, EDITOR
726 S. ELM KANKAKEE IL 60901
PHONE/FAX: 815 932 7285
e-mail: SPORTSMANLETTER @ aol.com
Website:http://communities.msn.com/sportsmansletter

COMMENTS ON THE ILLINOIS RIVER ECOSYSTEM RESTORATION FEASIBILITY STUDY ON DEC. 3, 2003

I would like to mention that after many years of my insisting and proposing that any clean up of river sediment of our Kankakee River needs to begin where the river begins others are finally agreeing this is necessary and should be the beginning of correcting any sedimentation program. This would mean from the tributaries, the ditches and creeks flowing into the main stem of the river.

I hear this being mentioned, but I also hear and read that two of the Kankakee River's Key Areas to be worked upon are:

1)Aquatic ecosystem restoration at the IN-IL State Line(That is approximately 80 miles from the start of the Kankakee near South Bend, IN).

2)Remove Sediment from the so-called 6 mile pool above the Kankakee Dam which is over 100 miles from the river's beginning.

Dredging and Channelization here at the IL-IN State Line and in the 6 mile pool will mean a waste of taxpayers monies as these locations will soon fill back up and the process will start over.

As dredging followed by fill up followed by dredging would take place to maintain certain depths, the present ecosystem would not survive, nor could it restore itself with the constant change of the streams biological inventory.

To remove sediment and sand first half way down the river (or further downstream in the Illinois River) before controlling the upstream source is just wasting tax money to please political groups. Along this line I understand money for next year(around 1.5 million)is earmarked for Peoria and Pekin Lake. I realize there is a sedimentation problem at these locations, but to me, removal or digging of holes to trap sand is not going to be the answer until the upstream tributaries of the Kankakee are controlled.

Also included as key areas under the IL River Ecosystem Restoration Feasibility Study(Kankakee River) are:

1)Stop stream bed and bank erosion in Indiana

ED MULLADY'S COMMENTS ON THE IL RIVER ECOSYSTEM RESTORATION FEASIBILITY STUDY........Dec. 3, 2003 Page Two

2)Restore natural conditions of the river in Indiana.

Of course , cooperation will be needed from Indiana to reduce sediment and sand from filling up the Kankakee in Indiana, Illinois and finally the Illinois River.

I know that in Indiana several proposals have been made by different groups. There is a "Yellow River" study progressing now.

The North American Waterfowl Management Plan for northwest Indiana has obtained much Kankakee River basin land and are working for more.

The "Sands" Area that Nature Consevancy is restoring should fit into the sediment stoppage program.

I request that the Corps, the IN and IL DNR work with the U.S. Fish & Wildlife Service to help establish the Grand Kankakee Marsh Fish & Wildlife Refuge. In your Study, please contact the USFW Service and go over the info they have in their Grand Kankakee Marsh Refuge Comprehensive Conservation Plan that is to be finished next year.

In over 70 years of watching and living the Kankakee River, the Grand Kankakee Marsh Refuge is the only government plan I have ever seen that would do something *FOR* the river, not *TO* the river.

Sincerely,

Ed Mullady

Ed Mullady,

Editor, Sportsman's Letter

UPPER MISSISSIPPI, ILLINOIS & MISSOURI RIVERS ASSOCIATION

December 18, 2003

Mr. Brad Thompson
District Engineer
US Army Engineer District, Rock Island
ATTN: CEMVR-PM-M (Thompson)
Clock Tower Building – PO Box 2004
Rock Island, IL 61204-2004

Dear Mr. Thompson:

Thank you for taking time to present your overview of the Illinois River Ecosystem Restoration Feasibility Study that the Corps is now undertaking in cooperation with the State of Illinois. Our members appreciated hearing directly from you about this project.

After carefully listening to your presentation, we are offering the following comments that we encourage you to consider as you move forward.

UMIMRA believes that no land should be condemned under any of the proposed restoration project alternatives. You stated in your presentation that only willing landowners would be included in the restoration and we strongly support that aspect of the plan.

We also believe it is vitally important that navigation channels be maintained. We understand from your presentation that it is the Corps' intention that this project will have no impact on the navigation system. We would encourage you to include representatives of those interests on your Regional Teams so that economic factors can be factored in as this project moves forward.

Additionally, your report outlined concerns with the variable water levels occurring in the Illinois River. We would suggest that you review the impact of water diversion practices from the Lake Michigan watershed which may or may not be of significant impact.

We would also encourage the Corps to do whatever it can to insure that this project is coordinated with other ongoing and related projects such as the Comprehensive Plan and the navigation study. You mentioned in your comments that the scope of this study is limited to an evaluation of ecosystem restoration. Of course, those issues do not exist in a vacuum and we believe that they must be evaluated in concert with flood control, agricultural and navigation issues.

Finally, we are concerned that the Corps is unaware of habitat or the environmentally friendly use of such habitat that already exists within the proposed restoration area. From UMIMRA's perspective, it is important to keep in mind that farmland is also habitat and should be considered as such in your plan.

We appreciate this opportunity to provide input and look forward to working with you as the Ecosystem Restoration project moves forward. Again, thank you for taking the time to meet with us.

Sincerely,

Dave McMurray (KR)

David McMurray
Chairman

Protecting Our Water Environment

Metropolitan Water Reclamation District of Greater Chicago

100 EAST ERIE STREET CHICAGO, ILLINOIS 60611-3154 312·751·5600

John C. Farnan, P.E.
General Superintendent

312·751·7900 FAX 312·751·5681

January 21, 2004

Mr. Bradley Thompson, District Engineer
U.S. Army Engineer District, Rock Island
ATTN: CEMVR-PM-M (Thompson)
Clock Tower Building – P.O. Box 2004
Rock Island, IL 61204-2004

Dear Mr. Thompson:

Subject: Illinois River Ecosystem Restoration Feasibility Study

This is in response to the subject project newsletter dated November 2003 and to the public meeting held on December 4, 2003 in Lisle, Illinois. We wish to congratulate the U.S. Army Corps of Engineers (Corps) in undertaking this project approach to address problems with the Illinois River ecosystem.

We agree that sediment delivery is a serious problem and should primarily be addressed by tributary channel stabilization and upland land management practices. To a limited extent, improved management of backwater lakes and restored riverine wetlands along the main stem of the Illinois River may assist in the removal of suspended sediment.

The degraded condition of backwater lakes connected to the main stem of the Illinois River should be addressed by isolating these lakes from the influence of the river. The relatively constant level of the navigation pools deprives these lakes with the needed pulse of high and low water levels in a natural river. Converting each of these lakes into a carefully managed lake/wetland ecosystem that is disconnected from the river will serve multiple benefits and restore the ecological health of these lakes.

Fish passage connectivity, although laudable, does have a downside. An example is the currant concern for upstream migration of the Asian carp. Two species of Asian carp. Bighead and Silver, have demonstrated the ability to migrate upstream into the Dresden Island pool without connectivity being available. However, it is believed that the higher head dams and locks at Brandon Road and Lockport will serve to retard, if not completely stop, the upstream migration of these two species to Lake Michigan. If they invade the Great Lakes, it is believed that considerable harm will result. Therefore, it is recommended that connectivity projects be planned and designed to minimize the passage of invasive animal and plant species.

We do not believe that efforts to include more of a natural water level pulse through manipulation of the navigation pools will be sufficient in magnitude to demonstrate much ecosystem benefit. We would rather see this management technique applied via the restoration of riverine wetlands where the water levels can be better managed to follow a natural pulse absent the demands of navigation for adequate navigable depths throughout the year.

Water quality in the Illinois River has seen significant improvement in the past three decades, primarily through improved wastewater treatment brought about through the NPDES permit system and the federal construction grants program and the state revolving loan program. Tributary sediment control and the restoration of wetlands on the tributaries and main stem will contribute further improvement in the long term.

Perhaps the opportunities are limited for significant ecosystem restoration in the urban area of northeast Illinois. However, we invite the Corps to pay special attention to the potential for small-scale projects in this area. The exposure of these projects to the large urban population will have significant public education and public support benefits to the work in other parts of the Illinois River Basin.

Please direct all concerns to Mr. Richard Lanyon, Director of Research and Development at (312)751-5190.

Very truly yours,

John C. Farnan
General Superintendent

RL:dl

OFFICE OF THE GOVERNOR
207 STATE CAPITOL, SPRINGFIELD, ILLINOIS 62706

ROD BLAGOJEVICH
GOVERNOR

June 30, 2004

Colonel Duane G. Gapinski
U.S. Army Engineer District, Rock Island
Clock Tower Building
P.O. Box 2004
Rock Island, Illinois 61204-2004

Re: LETTER OF INTENT - Illinois River Basin Restoration Feasibility and Comprehensive Plan & Critical Restoration Projects

The State of Illinois has long been involved with the US Army Corps of Engineers (USACE) as the non-federal sponsor of the Illinois River Basin Restoration Feasibility Study and the Illinois River Ecosystem Restoration Study. We are pleased to extend full support for Alternative 6 and recommendations set forth in the Executive Summary of the Feasibility Report and Comprehensive Plan. The State understands that the restoration efforts will be accomplished through critical projects developed by Regional Teams made up of a wide range of stakeholders. These projects are funds-matched; 65% Federal, 35% non-Federal dollars. As with the Federal contributions, the State of Illinois' commitment to funding each year of the planned project costs will be dependent upon annual appropriations from the Illinois General Assembly.

This letter also confirms that the State of Illinois has the legal authority to enter into Project Cooperation Agreements (PCAs) for the implementation of critical restoration projects and to fulfill all financial obligations for completion of those projects. Currently there are three critical restoration projects that are ready to have PCAs developed and signed: Peoria Islands, Pekin Lake North, and Pekin Lake South. The State wishes to sign PCAs for these projects this fall and has appropriated the dollars, committing resources to begin implementation of these projects this calendar year.

The Illinois River Basin Restoration is important to the vitality of the Illinois environment and economy. This effort is a priority for the State of Illinois, and we look forward to cooperating with USACE in this successful State-Federal partnership.

Sincerely,

Julie A. Curry
Deputy Chief of Staff
Labor and Economy

Kankakee River Basin Commission

6100 Southport Road Portage, Indiana 46368 (219) 763-0696 Fax (219) 762-1653

September 10, 2004

Col. Duane P. Gapinski, District Engineer
U.S. Army Corps of Engineers, Rock Island District
Clock Tower Building
P.O. Box 2004
Rock Island, Illinois 61204-2004

Dear Colonel Gapinski:

The Kankakee River Basin Commission (KRBC) was created by the Indiana General Assembly in 1977 to coordinate water resource management in the Kankakee Basin in Indiana. The Commission is a 24 member board consisting of an appointed representative of the County Commissioners, a supervisor of the County Soil and Water Conservation District Board, and the County Surveyor or his employed designee from each of the eight main counties in the basin (Jasper, Lake, LaPorte, Marshall, Newton, Porter, St. Joseph and Starke Counties).

We have received information and a briefing about the Illinois River Basin Restoration project and want to express our interest in potential partnerships along the Kankakee and Yellow Rivers in Indiana with the U.S. Army Corps of Engineers in planning, designing, and constructing restoration projects under Section 519 of the Water Resources Development Act of 2000.

Our immediate priority is the Yellow River in Indiana where there is a tremendous sand sediment problem. In fact, much of the sand found in the Kankakee River comes from the Yellow River. The sand sediment in the Yellow River is now about 7 to 9 feet deep and is continuing to accumulate. Large cottonwoods and other trees grow on islands within the river channel. Logjams and large sand islands impede the normal flow of water. The elevation of the Yellow River bottom is above most of the surrounding 10,000 acres of private farm land and above the elevation of the 1500 acre wetlands located between the Yellow River and the Kankakee River. The possibility of flooding in the English Lake Basin increases each year as more sediment is deposited in the Yellow River bottom. The levees that were constructed to control the flood waters are slowly losing their effectiveness because of the increased sediment load of the river. The sand in the Yellow River pours into the famed 1500 acre Kankakee Fish and Wildlife Area wetland during flood periods and during fall flooding for the waterfowl season. Each year the Indiana Department of Natural Resources, Division of Fish and Wildlife spends about $25,000 to clean the accumulating sand from the Yellow River water intake culvert prior to flooding for the waterfowl season. The need for some immediate action to remove some sediment and the need for a long term plan that provides some permanent solution to the sedimentation problem is crucial.

We understand that, if a feasible project were identified and constructed, the non-federal sponsor's responsibility would be to provide 35 percent of the total restoration costs including feasibility study, all lands needed, and future operation and maintenance.

We look forward to a working relationship through the Illinois River Basin restoration initiative. If you have additional question, please contact Mr. Jody Melton, Director.

Sincerely,

Jody Melton

for Brad Lawrence
Chairman

cc: John Goss, Director, Indiana DNR

Joseph E. Kernan, Governor
John R. Goss, Director

DNR Indiana Department of Natural Resources

402 W. Washington W256
Indianapolis, IN 46204

September 16, 2004

Col. Duane P. Gapinski, District Engineer
U.S. Army Corps of Engineers, Rock Island District
Clock Tower Building
P.O. Box 2004
Rock Island, Illinois 61204-2004

Dear Col. Gapinski,

The Indiana Department of Natural Resources (IDNR) was asked to express our interest in participating in the Illinois River Basin Restoration Plan, a proposed effort by the Illinois Department of Natural Resources and the Corps of Engineers. As you know the Restoration Plan would be a final response to a Comprehensive Plan prepared under the authority of the Water Resources Development Act 2000, and to the Illinois River Ecosystem Restoration Feasibility Study. This proposed plan encompasses the entire Illinois River Basin, its backwaters, side channels, and all tributaries including their watersheds. In Indiana, approximately 3,200 square miles of the Kankakee and Iroquois Rivers watersheds would be included. It is our understanding that Indiana can be involved in restoration activities under this Congressional Authority with a 65/35 cost share.

The Indiana Department of Natural Resources (IDNR) has participated as a non-federal sponsor with the U.S. Army Corps of Engineers on various projects throughout the state. The IDNR supports and encourages projects, which restore the ecological function and diversity of habitats to our rivers. The IDNR would like to offer our staff and resources to participate as a full partner by initiating projects within our portion of the Illinois River Basin. Indiana, like many states, is experiencing a very tight budget. Therefore, funding for these projects may take a little time and creativity. The fact that the value of the land can be credited to the federal matching dollars and there is no major land acquisition necessary makes this restoration plan very attractive.

Your staff along with the Illinois Department of Natural Resources and Illinois State Water Survey should be commended for their work on the informative presentation given on August 25, 2004, regarding the Illinois River Basin Restoration. We will be contacting our congressional representatives to gain further support for an increase in funding.

Sincerely,

John R. Goss

John Goss
Director
Indiana Department of Natural Resources

cc: Illinois DNR
Kankakee River Basin Commission

ILLINOIS RIVER ECOSYSTEM RESTORATION FEASIBILITY STUDY NEWSLETTER

US Army Corps of Engineers
Rock Island District

Notice of Study Initiation and Public Open Houses

ILLINOIS DEPARTMENT OF NATURAL RESOURCES

November 2000

CORPS OF ENGINEERS & DEPARTMENT OF NATURAL RESOURCES COST-SHARING SIGNING CEREMONY PLANNED

The U.S. Army Corps of Engineers, Rock Island District, and the Illinois Department of Natural Resources entered into a feasibility study cost-sharing agreement in August 2000 and became "partners" in a combined effort to identify opportunities to implement ecosystem restoration and to evaluate recommendations made in the State of Illinois' *Integrated Management Plan for the Illinois River Watershed* and determine if there is a Federal interest (environmental benefits exceeding costs) in their implementation.

The public is invited to attend a 9 a.m. ceremony on November 29, 2000, as Colonel William J. Bayles, Rock Island District Commander, and Mr. Brent Manning, Illinois Department of Natural Resources Director, formally initiate the study and their agencies' partnership throughout the feasibility study. The ceremony is sponsored by Congressman Ray LaHood, who has provided Congressional support for the study and has a strong interest in Illinois River Basin restoration. The ceremony will be held at the Gateway Center, 200 North East Water Street, Peoria, Illinois. The study is scheduled for completion in 2004.

OPEN HOUSE TO FOLLOW

Seven public open houses will be held throughout the study area. The purpose of the open houses is to provide the public the opportunity to learn about the Illinois River Ecosystem Restoration Study by visiting numerous study displays and to exchange information with study team members.

The first open house will be held at the Gateway Center after the Federal and State signing ceremony. Representatives from the Corps of Engineers and the Department of Natural Resources, as well as other participating Federal and State agencies, will be available *at any time* from 9:30 a.m. to noon and 4 p.m. to 7 p.m. to meet with the public to discuss on a one-to-one basis information on the range of alternatives for restoring the environment in the Illinois River watershed and to gather comments on the alternatives and problems in the area.

Several displays will be available to explain the Illinois River Ecosystem Restoration Study. All interested members of the public are encouraged to attend the open house, visit the displays, talk to agency representatives, and provide comments. The comments received at this open house will be considered during the study and will be part of the official NEPA scoping process.

Open houses also will be held in Bloomington, Kankakee, Yorkville, Utica, Macomb, and Grafton. Please see page 3 of this announcement for more information.

US Army Corps of Engineers
Rock Island District

ILLINOIS RIVER ECOSYSTEM RESTORATION FEASIBILITY STUDY SUPPLEMENTAL NEWSLETTER

ILLINOIS DEPARTMENT OF NATURAL RESOURCES

Remaining Three Public Open Houses Rescheduled

January 2001

Corps & DNR Formally Initiate Study

On November 29, 2000, Colonel William J. Bayles, Rock Island District, Corps of Engineers, Commander, and Mr. Brent Manning, Illinois Department of Natural Resources Director, formally initiated the Illinois River Ecosystem Restoration feasibility study in a cost-sharing signing ceremony. Congressman Ray LaHood sponsored and attended the event. This ceremony confirmed the agencies' commitment as "partners" to identify opportunities to implement ecosystem restoration and to evaluate recommendations made in the State of Illinois' *Integrated Management Plan for the Illinois River Watershed* and determine if there is a Federal interest (environmental benefits exceeding costs) in their implementation.

The first in a series of seven public open houses followed the signing ceremony. Six additional open houses were planned to be held throughout the study area during the month of December. Open houses were held in Bloomington, IL, on December 4, Kankakee, IL, on December 5, and Yorkville, IL, on December 6. The last three open houses were cancelled due to inclement weather.

** Open Houses Rescheduled **

The cancelled open houses have now been rescheduled. The public is invited to attend an open house *at any time* between the hours of 3:30 p.m. and 7:30 p.m. at one of the following locations:

<u>Tuesday, February 20</u>
Pere Marquette State Park
Grand Ballroom
Route 100, Great River Road
Grafton, IL

<u>Monday, February 26</u>
Starved Rock Lodge & Conference Center
Starved Rock State Park
Route 178 & Route 71
Utica, IL

<u>Tuesday, February 27</u>
Western Illinois University
Lamoine Room in University Union
Murray Street
Macomb, IL

(NOTE: Because of construction, the University recommends that visitors enter the campus by taking University Drive to Western Avenue. Lot 17 (south of the library) is recommended for parking.)

The purpose of the open houses is to provide the public with the opportunity to learn about the Illinois River Ecosystem Restoration Study. Study team members will be available to meet with the public to discuss on a one-to-one basis information on the range of alternatives for restoring the environment in the Illinois River watershed and to gather comments on the alternatives and problems in the area.

Several displays will be set up to explain the Illinois River Ecosystem Restoration Study. All interested members of the public are encouraged to attend an open house, visit the displays, talk to agency representatives, and provide comments. The comments received at this open house will be considered during the study and will be part of the official NEPA scoping process.

If you know of someone who may have an interest in this study and who did not receive this announcement, please encourage him/her to attend an open house. (Also, please see the "Study's Mailing List Continues to Grow" paragraph on the reverse side of this sheet.)

US Army Corps of Engineers
Rock Island District

ILLINOIS RIVER ECOSYSTEM RESTORATION FEASIBILITY STUDY NEWSLETTER

ILLINOIS DEPARTMENT OF NATURAL RESOURCES

November 2003

CORPS OF ENGINEERS & DEPARTMENT OF NATURAL RESOURCES SCHEDULE PUBLIC MEETINGS

The public is invited to attend one of a series of public meetings in December to learn about the goals and alternatives being considered to restore the ecosystem in the Illinois River Basin. See page 6 for public meeting details.

This newsletter is the second newsletter for the Illinois River Ecosystem Restoration Feasibility Study. The purpose of this newsletter is to report on the efforts and findings of the study team during the last three years and to invite the public to attend a December public meeting.

STUDY BACKGROUND

The U.S. Army Corps of Engineers, Rock Island District, and the Illinois Department of Natural Resources entered into a feasibility study cost-sharing agreement in August 2000 and became "partners" in a combined effort to identify opportunities to implement ecosystem restoration and to evaluate recommendations made in the State of Illinois' *Integrated Management Plan for the Illinois River Watershed* and determine if there is a Federal interest (environmental benefits exceeding costs) in their implementation. This effort has since been expanded as specified in the Illinois River Basin Restoration authority provided in Section 519 of the Water Resources Development Act (WRDA) 2000.

Additional information on the Illinois River efforts can be found on the Rock Island District webpage at: http://www.mvr.usace.army.mil/ILRiverEco/default.htm

STUDY TEAM DEVELOPS VISION AND MILESTONES FOR RESTORATION

The Illinois River Basin has experienced the loss of ecological integrity due to sedimentation of backwaters and side channels, degradation of tributary streams, increased water level fluctuations, reduction of floodplain and tributary connectivity, and other adverse impacts caused by human activities. A restoration vision was developed for the Illinois River in 1997 as part of the development of the State of Illinois' *Integrated Management Plan for the Illinois River Watershed*. The vision is for:

> *A naturally diverse and productive Illinois River Basin that is sustainable by natural ecological processes and managed to provide for compatible social and economic activities.*

This vision for the Illinois River Basin has been accepted by the Federal, State, and local stakeholders involved in the development of the Illinois River Ecosystem Restoration and Illinois River Basin Restoration programs. With the *Integrated Management Plan* providing context, the following list of Illinois River Basin system-wide ecosystem restoration goals were developed during the Illinois River Ecosystem Restoration Study (not listed in priority order, except for the first goal):

1. Maintain and restore biodiversity and sustainable populations of native species;
2. Reduce sediment delivery to the Illinois River from upland areas and tributary channels with the aim of eliminating excessive sediment load;
3. Restore aquatic habitat diversity of side channels and backwaters, including Peoria Lakes, to provide adequate volume and depth for sustaining native fish and wildlife communities;
4. Improve floodplain, riparian, and aquatic habitats and functions;
5. Restore and maintain longitudinal connectivity (fish passage at dams) on the Illinois River and its tributaries, where appropriate, to restore or maintain healthy populations of native species;
6. Naturalize Illinois River and tributary hydrologic regimes to reduce the incidence of water level conditions that degrade aquatic and riparian habitat; and
7. Improve water and sediment quality in the Illinois River and its watershed.

STUDY TEAM LOOKS AT VARIOUS ALTERNATIVES

The study team has developed various draft alternatives which will address the loss of fish and wildlife habitat.

Developing system alternatives started by considering the measures available (e.g., bed and bank stabilization, backwater dredging, wetland creation, etc.) to address the problems and objectives developed under each goal category. For each of the measures, the relative cost and system benefits were identified.

US Army Corps of Engineers ®
Rock Island District

ILLINOIS RIVER BASIN RESTORATION

SECTION 519, WATER RESOURCES DEVELOPMENT ACT OF 2000

ILLINOIS DEPARTMENT OF NATURAL RESOURCES

February 2006

CORPS OF ENGINEERS & DEPARTMENT OF NATURAL RESOURCES COMPLETE DRAFT PLAN

The loss of habitat and system degradation throughout the Illinois River Basin has long been documented. In particular, the Illinois River Basin has experienced the loss of ecological integrity due to sedimentation of backwaters and side channels, degradation of tributary streams, increased water level fluctuations, reduction of floodplain and tributary connectivity, and other adverse impacts caused by human activities.

As a result, the U.S. Army Corps of Engineers, Rock Island District (Corps), and the Illinois Department of Natural Resources (DNR) entered into a cost-sharing agreement in August 2000 and, with other agencies, identified opportunities for ecosystem restoration in the Illinois River Basin.

The study is now complete and the findings are contained in the Draft Illinois River Basin Restoration Comprehensive Plan. The team identified six ecosystem restoration goals and evaluated eight alternatives, including the no action alternative. The attached brochure summarizes the problems and proposed solutions for each of the goals. The plan includes the study team's draft recommendation for a phased implementation of Alternative 6. This draft recommendation is now subject to public and agency review and comment.

OPPORTUNITIES FOR PUBLIC COMMENT

We are now in the public review period for the Draft Illinois River Basin Restoration Comprehensive Plan. The plan is available for viewing in several ways.

The plan is posted on the Rock Island District website at http://www.mvr.usace.army.mil/ILRiverEco/default.htm.

A paper copy of the plan will soon be located at public libraries in Beardstown, Bloomington, Chicago (Harold Washington Library Center), Galesburg, Havana, Jerseyville, Joliet, Kankakee, Macomb, Mount Sterling, Naperville (Nichols Library), Oswego, Ottawa, Peoria, Pontiac, Springfield (Lincoln Library, Main Branch), and Watseka.

A CD of the report may be requested by calling Ms. Sue Simmons, Corps of Engineers, at 309-794-5573.

Public comments on the draft recommended plan will be accepted through April 14, 2006. Comments may be submitted via a link on the website, by mail (see Project Manager Brad Thompson's mailing address on the attached brochure), or by attending a public meeting and completing a comment sheet.

MARCH 2006 PUBLIC MEETINGS PLANNED

From November 2000 through February 2001, the Corps and the DNR hosted seven public open houses to discuss with the public the purpose of the ecosystem restoration study and the range of alternatives for restoring the environment in the Illinois River Watershed, and to gather public comments on the alternatives and problems in the area.

In December 2003, the Corps and the DNR held four public meetings to discuss the draft alternatives being considered at that point in the study and the level of restoration for areas within the Illinois River Basin, and to gather the public's comments on the draft alternatives.

The Corps and the DNR have now developed a draft recommended plan to restore the ecosystem in the Illinois River Basin. ***You are invited to attend*** a public meeting in March to discuss and provide feedback on the draft plan.

Meetings will be held from 2-4 p.m. and 6-8 p.m. The meeting format will be identical at each location.

Corps of Engineers and Illinois Department of Natural Resources staff will be present to speak to the public one-on-one. Doors will open in the afternoon at 2 p.m., with a formal presentation at 2:30 p.m. A question and answer session will follow the presentation until 4 p.m. Doors will open again at 6 p.m., and the formal presentation will begin at 6:30 p.m. The question and answer session will follow until 8 p.m.

Meeting information follows:

Tuesday, March 7
Starved Rock Lodge and Conference Center
LaSalle Room
Starved Rock State Park
Route 178 and Route 71
Utica, Illinois
815-667-4211

Wednesday, March 8
Hilton Garden Inn
Rock Creek Ballroom
455 Riverstone Parkway
Kankakee, Illinois
815-932-4444

Thursday, March 9
Holiday Inn Express Hotel & Suites
Meeting Room
2055 Weisbrook Drive
Oswego, Illinois
630-844-4700

Tuesday, March 14
Gateway Center
2nd Floor Conference Room
200 Northeast Water Street
Peoria, Illinois
309-689-3019

Wednesday, March 15
Pere Marquette State Park
Marquette and Piasa Rooms
13653 Lodge Boulevard
Grafton, Illinois
618-786-2331

Thursday, March 16
Dickson Mounds Museum
Activity Room (2nd Floor)
10956 North Dickson Mounds Road
Lewistown, Illinois
309-547-3721

All members of the public are encouraged to attend one of the meetings and to provide comments on the draft recommended plan. If you are unable to attend a meeting, please use the link on study's website at http://www.mvr.usace.army.mil/ILRiverEco/default.htm to submit your comments. Comments will be accepted through April 14, 2006.

If you are aware of someone who did not receive a copy of this announcement, please invite him or her to attend one of the meetings.

WHAT'S NEXT?

After the public review period is closed, the study team will review agency and public comments and consider them in the final report. The finalized report will be submitted to the Corps of Engineers' higher headquarters in Washington, DC, for approval.

WE LOOK FORWARD TO SEEING YOU AT THE PUBLIC MEETINGS

Rock Island District Internet

News Release

US ARMY CORPS OF ENGINEERS Rock Island District	00-11-45 **Release No.** Immediate **For Release**	**Public Affairs Office Justine Dodge (309) 794-5204**

ILLINOIS CONGRESSMAN RAY LAHOOD HOSTS ILLINOIS RIVER ECOSYSTEM RESTORATION SIGNING

ROCK ISLAND, ILL. -

Congressman Ray LaHood, Peoria, Ill., kicks off the development of an environmental blueprint for the Illinois River when he hosts a signing ceremony, which officially joins the forces of the U.S. Army Corps of Engineers and the Illinois Department of Natural Resources to create the action plan needed to battle environmental degradation of the Illinois River.

The ceremony is being held at the Gateway Building, Peoria, Ill., at 9 a.m., Nov. 29. The signing will officially begin the cost-shared feasibility study phase of the Illinois River Ecosystem Restoration Feasibility Study.

"Initiatives such as this one could very well be more important to future generations than to even our own. A healthy, sustainable Illinois River ecosystem is a legacy we owe our children and our children's children," said Congressman LaHood.

The $5.2 million effort will create a blueprint for the restoration efforts. It is a joint project, cost-shared 50/50 between the Rock Island District U.S. Army Corps of Engineers and the Illinois Department of Natural Resources, which will address four broad categories:

(1) Watershed/Tributary Restoration - evaluate options to address tributary degradation and instability looking at stream restoration, wetlands creation/restoration, water retention, conservation easements, and riparian buffers.

(2) Side Channel and Backwater Restoration - consider opportunities to restore aquatic habitats in these areas including off-channel deep-water habitat, backwater lakes, side channels, islands, etc.

(3) Water Level Management - evaluate options to reduce rapid fluctuations and naturalize flows.

(4) Floodplain Restoration and Protection - evaluate floodplain use, potential restoration of floodplain function, and value and potential for acquisition of conservation easements.

For years, the Illinois River has been a vital part of the regions' economy and is depended upon for navigation, recreation, water supply, irrigation, fish and wildlife habitat, and many other uses. The action plan will explore opportunities to address sediment deposition and restore environmental conditions on this vital river and its tributaries.

The signing ceremony is open to the public and will be followed by an open house about the project.

For more information contact project manager Brad Thompson, at (309) 794-5256.

News Release

	00-11-46	
US ARMY CORPS	**Release No.**	**Public Affairs Office**
OF ENGINEERS	Immediate	**Justine Dodge**
Rock Island District	**For Release**	**(309) 794-5204**

DO YOUR PART TO RESTORE THE ILLINOIS RIVER AND THE PEORIA RIVERFRONT

ROCK ISLAND, ILL. -

The Corps of Engineers and Department of Natural Resources are asking the public to join them at an Open House to discuss alternatives and problems associated with restoring the environment of the Illinois River and to update the public on the status of the ongoing Peoria Riverfront action plan.

The Open House is being held at the Gateway Building, Peoria, Ill., on Nov. 29, from 9:30 a.m. to noon and from 4 to 7 p.m. Participants will meet with representatives from both agencies to learn about, provide comments, and discuss the recently initiated Illinois River Ecosystem Restoration Study and the ongoing Peoria Riverfront Development (Environmental Restoration) Study.

The initiatives officially join the forces of the U.S. Army Corps of Engineers and the Illinois Department of Natural Resources. These projects will create the action plans needed to battle environmental degradation on the Illinois River and at the Peoria riverfront.

"Initiatives such as this one could very well be more important to future generations than to even our own. A healthy, sustainable Illinois River ecosystem is a legacy we owe our children and our children's children," said Congressman Ray LaHood, Peoria, Ill., who will officially kick off the Illinois River Ecosystem Restoration Study at a signing ceremony being held that morning.

The Illinois River Ecosystem Restoration Study is a $5.2 million effort to create a blueprint for restoration efforts. It is a joint project, cost-shared 50/50 between the Rock Island District U.S. Army Corps of Engineers and the Illinois Department of Natural Resources, which will address four broad categories:

(1) Watershed/Tributary Restoration - evaluate options to address tributary degradation and instability looking at stream restoration, wetlands creation/restoration, water retention, conservation easements, and riparian buffers.

(2) Side Channel and Backwater Restoration - consider opportunities to restore aquatic habitats in these areas including off-channel deep-water habitat, backwater lakes, side channels, islands, etc.

(3) Water Level Management - evaluate options to reduce rapid fluctuations and naturalize flows.

(4) Floodplain Restoration and Protection - evaluate floodplain use, potential restoration of floodplain function, and value and potential for acquisition of conservation easements.

The Peoria Riverfront Study is a $1.9 million effort to initiate a plan for restoration efforts. It is also a joint project that is cost-shared 50/50. The study is addressing two broad categories:

(1) River restoration measures to address sediments deposited in the lakes and create deep-water aquatic habitats. These options fall into two general categories:

(a) Dredging to create islands and side channels/backwaters. The most promising locations to date have been in the upstream end of Lower Peoria Lake. Concepts are being explored to create deep-water (>6-foot) backwater and flowing side channel habitats for fisheries benefits.

(b) Dredging with placement of sediment removed outside of the lakes. In combination with islands, additional dredging with placement in uplands areas is being evaluated. Potential placement areas include the Tenmile Creek delta, brownfields or mine lands in the Peoria area, or loading material on barges for placement on brownfields in the Chicago area.

(2) Watershed restoration measures to address current and future sediment delivery to the lakes. Farm Creek was selected as the tributary focus area based on the study authority and local interest. The study team is looking at watershed stabilization options, including buffers, water and sediment control basins, riparian habitat restoration, and stream bed and bank stabilization.

For years, the Illinois River has been a vital part of the region?s economy and is depended upon for navigation, recreation, water supply, irrigation, fish and wildlife habitat, and many other uses. These action plans will explore opportunities to address sediment deposition and restore environmental conditions.

The public is also invited to attend the signing ceremony being held at the Gateway Center at 9 a.m., Nov. 29.

For more information contact project manager Brad Thompson, at (309) 794-5256.

News Release

	00-12-48	
US ARMY CORPS	**Release No.**	**Public Affairs Office**
OF ENGINEERS	Immediate	**Justine Barati**
Rock Island District	**For Release**	**(309) 794-5204**

DO YOUR PART TO RESTORE THE ILLINOIS RIVER

ROCK ISLAND, ILL -

The Corps of Engineers and Department of Natural Resources are asking the public to join them at a series of Open Houses to discuss alternatives and problems associated with restoring the environment of the Illinois River.

The Open Houses are being held on the following dates at the following locations. Dec. 12 at the Starved Rock Lodge and Conference Center in the Starved Rock State Park, Route 178 & Route 71, Utica, Ill. Dec. 13 at Western Illinois University in the University Union Grand Ballroom, 1 University Cr., Macomb, Ill. (Because of the construction, the University recommends that visitors enter the campus by taking University Drive to Western Avenue.) Dec. 14 at the Pere Marquette State Park in the Grand Ballroom, Route 100, Great River Rd., Grafton, Ill.

Participants at the open houses will meet with representatives from both agencies to learn about, provide comments, and discuss the recently initiated Illinois River Ecosystem Restoration Study.

The Illinois River Ecosystem Restoration Study is a $5.2 million effort to create a blueprint for restoration efforts. It is a joint project, cost-shared 50/50 between the Rock Island District U.S. Army Corps of Engineers and the Illinois Department of Natural Resources, which will address four broad categories:

(1) Watershed/Tributary Restoration - evaluate options to address tributary degradation and instability looking at stream restoration, wetlands creation/restoration, water retention, conservation easements, and riparian buffers.

(2) Side Channel and Backwater Restoration - consider opportunities to restore aquatic habitats in these areas including off-channel deep-water habitat, backwater lakes, side channels, islands, etc.

(3) Water Level Management - evaluate options to reduce rapid fluctuations and naturalize flows.

(4) Floodplain Restoration and Protection - evaluate floodplain use, potential restoration of floodplain function, and value and potential for acquisition of conservation easements.

For years, the Illinois River has been a vital part of the region?s economy and is depended upon for navigation, recreation, water supply, irrigation, fish and wildlife habitat, and many other uses. This study will explore opportunities to address sediment deposition and restore environmental conditions.

For more information contact project manager Brad Thompson, at (309) 794-5256.

Rock Island District Internet

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News Release

US ARMY CORPS OF ENGINEERS Rock Island District

01-01-09
Release No.
Immediate **For Release**

Public Affairs Office
Justine Barati
(309) 794-5204

ILLINOIS RIVER OPEN HOUSES RESCHEDULED DO YOUR PART TO RESTORE THE ILLINOIS RIVER

ROCK ISLAND, ILL. -

The Corps of Engineers and Department of Natural Resources are asking the public to join them at a series of Open Houses to discuss alternatives and problems associated with restoring the environment of the Illinois River.

The Open Houses are being held on the following dates at the following locations. Feb. 20 at Pere Marquette State Park in the Grand Ballroom at Route 100, Great River Road in Grafton, Ill.; Feb. 26 at Starved Rock Lodge and Conference Center in Starved Rock State Park at Route 178 and Route 71 in Utica, Ill.; Feb. 27 at Western Illinois University in the Lamoine Room in University Union on Murray Street in Macomb, Ill. The public is invited to attend any time between the hours of 3:30 p.m. and 7:30 p.m.

Because of the construction at Western Illinois University, the University recommends that visitors enter the campus by taking University Drive to Western Avenue. Lot 17 (south of the library) is recommended for parking.

Participants at the open houses will meet with representatives from both agencies to learn about, provide comments, and discuss the recently initiated Illinois River Ecosystem Restoration Study.

The Illinois River Ecosystem Restoration Study is a $5.2 million effort to create a blueprint for restoration efforts. It is a joint project, cost-shared 50/50 between the Rock Island District U.S. Army Corps of Engineers and the Illinois Department of Natural Resources, which will address four broad categories:
(1) Watershed/Tributary Restoration - evaluate options to address tributary degradation and instability looking at stream restoration, wetlands creation/restoration, water retention, conservation easements, and riparian buffers.
(2) Side Channel and Backwater Restoration - consider opportunities to restore aquatic habitats in these areas including off-channel deep-water habitat, backwater lakes, side channels, islands, etc.
(3) Water Level Management - evaluate options to reduce rapid fluctuations and naturalize flows.
(4) Floodplain Restoration and Protection - evaluate floodplain use, potential restoration of floodplain function, and value and potential for acquisition of conservation easements.

For years, the Illinois River has been a vital part of the region?s economy and is depended upon for navigation, recreation, water supply, irrigation, fish and wildlife habitat, and many other uses. This study will explore opportunities to address sediment deposition and restore environmental conditions.

For more information about the project contact project manager Brad Thompson at bradley.e.thompson@usace.army.mil or call him at (309) 794-5256. For logistical information about the open houses contact Sue Simmons at suzanne.r.simmons@usace.army.mil or call her at (309) 794-5573.

Rock Island District Internet

News Release

04-11-02

US ARMY CORPS	**Release No.**	**Public Affairs Office**
OF ENGINEERS	Immediate	**Justine Barati**
Rock Island District	**For Release**	**309-794-5204**

PUBLIC INPUT SOUGHT ON RIVER IMPROVEMENT PLANS

ROCK ISLAND, ILL. -

Future plans for the restoration of the Illinois River Basin are the spotlight of discussion during a series of four public meetings as the U.S. Army Corps of Engineers and the Illinois Department of Natural Resources seek public input on the Illinois River Ecosystem and Basin Restoration Study.

The U.S. Army Corps of Engineers and the Illinois Department of Natural Resources are seeking input at a critical decision point in this complex study that seeks to define the future environmental needs of the Illinois River Basin.

The public has an opportunity to see, learn about, and comment on the study goals and preliminary alternative plans designed to restore the environment of the Illinois River Basin including its backwaters, floodplain, and tributaries.

The study team will consider these comments, along with the input of other stakeholders in the river watershed, to narrow the list of options to a single recommended plan. Details of that plan will be documented in the Illinois River Ecosystem and Basin Restoration Feasibility Report scheduled for release in the spring.

The meetings continue the study's collaboration with the public.

Meeting Locations, Dates and Times

All Meetings:

2:00 – 4:00 p.m. – Open House
4:00 – 6:00 p.m. – Dinner Break for Public Meeting Staff
6:00 – 8:00 p.m. – Corps Presentation, Questions & Answers, & Statements

Dec. 1 – Mt. Sterling, Ill. (Lower Illinois River Area)
Knights of Columbus Hall
Route 24 West
Mt. Sterling, Ill.
Phone: (217) 773-4100

Dec. 2 – Hanna City, Ill. (Peoria Area)
Wildlife Prairie Park
3826 N. Taylor Rd.

Hanna City, Ill.
Phone: (309) 676-0998

Dec. 3 – Bradley, Ill.
Quality Inn & Suites
800 N. Kinzie Ave.
Bradley, Ill.
Phone: (815) 939-3501

Dec. 4 – Lisle, Ill. (Greater Chicago Area)
Hilton Lisle/Naperville
3003 Corporate W. Dr.
Lisle, Ill.
Phone: (630) 245-7644

The meeting structure allows for informal discussion with study team members in the afternoon. A formal presentation will begin at 6 p.m., followed by a question-and-answer session, and the opportunity to make a brief statement. All comments will be compiled and considered during the process of finalizing the range of alternatives and selecting a recommended plan for environmental improvements in the Illinois River Basin.

Additional information on the Illinois River efforts can be found on the Rock Island District's web page at:

Illinois River Ecosystem Restoration

For more information about the Illinois River Ecosystem and Basin Restoration Feasibility Study, contact the Project Manager, Brad Thompson, at (309) 794-5256; or the Rock Island District Public Affairs Office at (309) 794-5204.

For more information on the meeting formats or location, contact Sue Simmons at (309) 794-5573.

# # #

News Release

	06-02-08	
US ARMY CORPS	**Release No.**	**Public Affairs Office**
OF ENGINEERS	Immediate	**Justine Barati**
Rock Island District	**For Release**	**309-794-5204**

PUBLIC INPUT SOUGHT ON RIVER IMPROVEMENT PLANS

-

ROCK ISLAND, ILL. - Future plans for the restoration of the Illinois River Basin are the spotlight of discussion during a series of six public meetings as the U.S. Army Corps of Engineers and the Illinois Department of Natural Resources seek public input on the Draft Illinois River Basin Restoration Comprehensive Plan.

The U.S. Army Corps of Engineers and the Illinois Department of Natural Resources are seeking input on the draft plan that identifies six ecosystem restoration goals and evaluates eight alternatives for Illinois River Basin restoration. The recommended plan is Alternative Six. If fully implemented during the next 50 years, the plan would provide measureable increases in system ecological integrity and sustainability. A phased implementation approach is proposed with initial efforts to include $153.85 million in restoration through 2011. The plan can be found online at: http://www.mvr.usace.army.mil/ILRiverEco/default.htm

The study team wants comments from the public about the recommended plan to ensure that the needs of the Illinois River Basin are met. The meetings continue the study's collaboration with the public.

Meeting Locations, Dates and Times

All Meetings:

2 p.m. - Doors Open
2:30 p.m. - Formal Presentation
3 -4 p.m. - Question & Answer Session
4 - 6 p.m. - Dinner Break for Public Meeting Staff
6 p.m. - Doors Open
6:30 p.m. - Formal Presentation
7-8 p.m. - Question & Answer Session

March 7 - Utica, Ill.

Starved Rock Lodge and Conference Center
LaSalle Room
Starved Rock State Park
Route 178 and Route 71
Utica, Ill.
Phone: (815) 667-4211

March 8 - Kankakee, Ill
Hilton Garden Inn
Rock Creek Ballroom
455 Riverstone Parkway
Kankakee, Ill.
Phone: (815) 932-4444

March 9 - Oswego, Ill.
Holiday Inn Express Hotel & Suites
Meeting Room
2055 Weisbrook Drive
Oswego, Ill.
Phone: (630) 844-4700

March 14 - Peoria, Ill.
Gateway Center
2nd Floor Conference Room
200 Northeast Water Street
Peoria, Ill.
Phone: (309) 689-3019

March 15 - Grafton, Ill.
Pere Marquette State Park
Marquette and Piasa Rooms
13653 Lodge Boulevard
Grafton, Ill.
Phone: (618) 786-2331

March 16 - Lewistown, Ill.
Dickson Mounds Museum
Activity Room (2nd Floor)
10956 North Dickson Mounds Road
Lewistown, Ill.
Phone: (309) 547-3721

--end--

DEPARTMENT OF THE ARMY
ROCK ISLAND DISTRICT. CORPS OF ENGINEERS
CLOCK TOWER BUILDING - P.O. BOX 2004
ROCK ISLAND, ILLINOIS 61204-2004

REPLY TO
ATTENTION OF

October 5, 2001

Planning, Programs, and
Project Management Division

SEE DISTRIBUTION LISTS

The Chicago, Rock Island, and St. Louis Districts of the U.S. Army Corps of Engineers (Corps) and the State of Illinois Department of Natural Resources (DNR) have entered into a partnership for the purposes of implementing the Illinois River Ecosystem Restoration (IRER) project, authorized by Section 216 of the 1970 Flood Control Act and Section 519 (Illinois River Basin Restoration) of Water Resources Development Act of 2000.

The Corps and the DNR have determined that the implementation of the IRER may have an effect upon properties listed on, or eligible for listing on, the National Register of Historic Places (NRHP), and will consult with the Advisory Council on Historic Preservation (Council) and the Illinois State Historic Preservation Officer (SHPO) pursuant to Section 800.14(b) of the regulations (36 CFR Part 800) implementing Section 106 of the National Historic Preservation Act (16 U.S.C. 470[f]) (NHPA), and Section 110(f) of the same Act (16 U.S.C. 470h-2[f]). The Corps and the DNR invite you, your agency, the SHPO, Council, Tribal Historic Preservation Officers, and any other interested parties to participate in the consultation process and in the development of a Programmatic Agreement (PA) for the IRER (see enclosed draft PA, Enclosure 1).

The IRER encompasses the reach of the Illinois River watershed located in the State of Illinois (54 counties) (see enclosed map, Enclosure 2) with two types of efforts: (1) system evaluations focused on assessing the overall watershed needs and general locations for restoration and (2) site-specific evaluations focused on developing detailed restoration options for possible implementation at specific sites by project planning, engineering, construction, and monitoring, with interdisciplinary and collaborative planning for habitat restoration, preservation, and enhancement. The Corps and the DNR will manage the IRER throughout all stages of individual habitat project development, restoration, construction, and management. Several other Federal agencies, as well as non-government entities and individual citizens, also will regularly participate in the development of projects within the IRER.

The Corps and the DNR propose to execute the PA, as stipulated by 36 CFR Part 800.14(b)(ii) of the NHPA to afford protection to known and unknown historic properties accorded by the NHPA. The appropriate and/or pertinent comments of all parties will be addressed, then one final PA will be provided for execution by the signatories to this PA. The executed PA will be in every National Environmental Policy Act (NEPA) document resulting from the IRER, as evidence of Corps and DNR compliance promulgated by the NHPA and the consulting process.

Pursuant to Section 800.3 of the Council's regulations and to meet the responsibilities under the NEPA of 1969, the Corps and the DNR have developed a preliminary **Consulting Parties List**. Only those consulting parties that respond to this correspondence will remain on the final Consulting Parties List. The request to remain on the final Consulting Parties List allows for agencies, tribes, individuals, organizations, and other interested parties an opportunity to provide views on any effects of this undertaking on historic properties resulting from the IRER and to participate in the review of the PA. Response will allow the Corps and the DNR to formulate a final Consulting Parties List for all, or any portion, of the Illinois Watershed that lies in the State of Illinois.

Those on the final Consulting Parties List will be provided with study newsletters, public meeting announcements, special releases, and notifications of the availability of report(s), including all draft agreement documentation, as stipulated by 36 CFR Part 800.14(b)(ii) of the NHPA. Comments received by the Corps and the DNR will be taken into account when finalizing plans for the IRER, as promulgated by the NHPA. Consulting parties may request correspondence on future topics relevant to compliance concerning the IRER. Although the IRER presently lies entirely within the State of Illinois, consulting parties from elsewhere in the United States are given equal and due consideration. Since the Corps remains unaware of any lands held in Federal trust or of any Federal trust responsibilities for Native American Indians within the Illinois River watershed, the Corps requests any information concerning our Federal trust responsibilities.

The NHPA recognizes that properties of traditional religious and cultural importance to a tribe may be determined eligible for inclusion on the NRHP. In order to preserve, conserve, and encourage the continuation of the diverse traditional prehistoric, historic, ethnic, and folk cultural traditions within the Illinois watershed, the IRER will be implemented in compliance with Executive Order No. 13007, specifically:

> **Section 1.** *Accommodation of Sacred Sites.* (a) In managing Federal lands, each executive branch agency with statutory or administrative responsibility for the management of Federal lands shall, to the extent practicable, permitted by law, and not clearly inconsistent with essential agency functions, (1) accommodate access to and ceremonial use of Indian sacred sites by Indian religious practitioners and (2) avoid adversely affecting the physical integrity of such sacred sites. Where appropriate, agencies shall maintain the confidentiality of sacred sites.

The Secretary of the Interior's **Standards and Guidelines for Federal Agency Historic Preservation Programs** pursuant to the NHPA states that a:

> Traditional Cultural Property is defined as a property that is associated with cultural practices or beliefs of a living community that (1) are rooted in that community's history, and (2) are important in maintaining the continuing cultural identity of the community.

Allowing for tribal review and comment contributes to fulfilling our obligations as set forth in the NHPA (Public Law [PL] 89-665), as amended; the NEPA of 1969 (PL 91-190); Executive Order (EO) 11593 for the "Protection and Enhancement of the Cultural Environment" (Federal Register, May 13, 1971); the Archaeological and Historical Preservation Act of 1974 (PL 93-291); the Advisory Council on Historic Preservation "Regulations for the Protection of Historic and Cultural Properties" (36 CFR, Part 800); and the applicable National Park Service and Corps regulations and guidance.

The Corps is concerned about impacts to those traditional cultural properties and sacred sites recognized by Native Americans, tribes, ethnic and religious organizations, communities, and other groups as potentially affected by the IRER. Presently, the Corps is unaware of any traditional cultural properties or sacred sites within the Illinois River watershed. If there are concerns or potential effects known or identified, please complete the enclosed "**Traditional Cultural Property and Sacred Site Form"** (Enclosure 3). To facilitate tribal coordination, the Corps asks those on the Consulting Parties Lists to refer to the National Park Service, NRHP Bulletin 38, Guidelines for Evaluating and Documenting Traditional Cultural Properties, available for internet viewing at (http://www.cr.nps.gov/nr/publications/bulletins.htm). Locations of traditional cultural properties or sacred sites, consisting of architecture, landscapes, objects, or surface or buried archaeological sites, identified in this coordination effort can be considered to be sensitive information, pursuant to Section 304 of the NHPA. Upon request from any consulting parties not to disclose locations, the Corps and the DNR will secure this information from the general public.

Please provide any information, requests, views, or comments within 30 days, or the Corps and the DNR will remove your address from the final Consulting Parties List. If no response is provided to the Corps and the DNR, we will assume that you agree with our proposal of drafting and executing the PA and we will proceed with further coordination with the SHPO, the Council, and those interested parties that did respond to this correspondence.

If you have questions concerning the IRER, the PA, the preliminary and final Consulting Parties List, the **Traditional Cultural Property and Sacred Site Form,** or the Corps and the DNR coordination procedures and efforts promulgated by the NHPA, please call Mr. Ron Deiss of our Economic and Environmental Analysis Branch, telephone 309/794-5185, or write to our address above, ATTN: Planning, Programs, and Project Management Division (Ron Deiss).

Sincerely,

Kenneth A. Barr
Chief, Economic and Environmental
Analysis Branch

Enclosures

Copies Furnished:

Dr. Harold Hansen
Illinois Department of Natural Resources
Lincoln Tower Plaza, Room 310
524 South Second Street
Springfield, Illinois 62701-1787 (w/enclosures)

Ms. Anne Haaker
Deputy State Historic Preservation Officer
Illinois Historic Preservation Agency
Old State Capitol
Springfield, Illinois 62701 (w/enclosures)

Copies Furnished (Continued):

ATTN: Mr. Thomas McCullouch
c/o Mr. Don L. Klima
Director
Eastern Office of Project Review
The Old Post Office Building
1100 Pennsylvania Avenue, NW Suite 809
Washington, DC 20004 (w/enclosures)

ATTN: CEMVD-PM-R (Ms. Carroll Kleinhans)
U.S. Army Engineer Division, Mississippi Valley
1400 Walnut Street
P.O. Box 80
Vicksburg, Mississippi 39180-0080 (w/enclosures)

ATTN: CEMVS-PD-A (Mr. Terry Norris)
Commander
U.S. Army Engineer District, St. Louis
1222 Spruce Street
St. Louis, Missouri 63101-2833 (w/enclosures)

ATTN: CELRC-PD-S (Mr. Keith G. Ryder)
Commander
U.S. Army Engineer District, Chicago
111 North Canal Street
Chicago, Illinois 60606 (w/enclosures)

IL VETERANS HOME
ALL WARS MUSEUM
1701 N 12TH ST
QUINCY IL 62301
COUNTY: ADAMS

VILLA KATHRINE
FRIENDS OF THE CASTLE
PO BOX 732
QUINCY IL 62306
COUNTY: ADAMS

FRIENDS OF THE DR RICHARD EELLS HOUSE
PO BOX 628
QUINCY IL 62306
COUNTY: ADAMS

GARDNER MUSEUM OF ARCHITECTURE & DESIG
332 MAINE ST
QUINCY IL 62306
COUNTY: ADAMS

GOLDEN HISTORICAL SOCIETY
PO BOX 148
QUINCY IL 62306
COUNTY: ADAMS

QUINCY PUBLIC LIBRARY
GREAT RIVER GENEALOGICAL SOCIETY
526 JERSEY
QUINCY IL 62306
COUNTY: ADAMS

HISTORICAL SOCIETY OF QUINCY&ADAMS CNTY
425 S 12TH ST
QUINCY IL 62301
COUNTY: ADAMS

LINCOLN DOUGLAS VALENTINE MUSEUM
101 N 4TH ST
QUINCY IL 62306
COUNTY: ADAMS

PALATINES TO AMERICA CHAPTER
PO BOX 3884
QUINCY IL 62306
COUNTY: ADAMS

QUINCY ART CTR
1515 JERSEY ST
QUINCY IL 62306
COUNTY: ADAMS

QUINCY MUSEUM
1601 MAINE ST
QUINCY IL 62301
COUNTY: ADAMS

QUINCY SOCIETY OF FINE ARTS
300 CIVIC CTR PL STE 244
QUINCY IL 62306
COUNTY: ADAMS

QUINCY UNIVERSITY-BRENNER LIBRARY
1800 COLLEGE AVE
QUINCY IL 62306
COUNTY: ADAMS

RAIL ROAD MUSEUM
103-105 QUINCY ST
GOLDEN IL 62339
COUNTY: ADAMS

TRI STATE LIVING HISTORY ASSOCIATION
RR 3 BOX 79
QUINCY IL 62301
COUNTY: ADAMS

WINDMILL MUSEUM
902 PRAIRIE MILLS RD
GOLDEN IL 62339
COUNTY: ADAMS

VERSAILLES AREA GEN & HIST SOCIETY
113 W FIRST ST PO BOX 92
VERSAILLES IL 62378
COUNTY: BROWN

BUREAU CNTY HISTORICAL SOCIETY
109 PARK AVE W
PRINCETON IL 61356
COUNTY: BUREAU

CAMPBELL CTR FOR HISTORIC PRES STUDIES
PO BOX 66
MT CARROLL IL 61053
COUNTY: BUREAU

OWEN LOVEJOY HOMESTEAD
PO BOX 220
PRINCETON IL 61356
COUNTY: BUREAU

SHEFFIELD HISTORICAL SOCIETY
WASHINGTON & COOK STS
SHEFFIELD IL 61361
COUNTY: BUREAU

SPRING VALLEY COAL MINE #1 PROJ
E ST PAUL ST PO BOX 170
SPRING VALLEY IL 61362
COUNTY: BUREAU

WYANET HISTORICAL SOCIETY
109 E MAIN
WYANET IL 61379
COUNTY: BUREAU

CALHOUN COUNTY HISTORICAL SOCIETY
PO BOX 46
HARDIN IL 62047
COUNTY: CALHOUN

CTR FOR AMERICAN ARCHEOLOGY
PO BOX 366
KAMPSVILLE IL 62053
COUNTY: CALHOUN

CASS CNTY HISTORICAL SOCIETY
PO BOX 11
VIRGINIA IL 62691
COUNTY: CASS

LINCOLN COURTROOM
CITY OF BEARDSTOWN
101 W 3RD ST
BEARDSTOWN IL 62618
COUNTY: CASS

ANCIENT TECH & ARCH MATERIALS
901 S MATHEWS AVE
URBANA IL 61801
COUNTY: CHAMPAIGN

ANITA PURVES NATURE CENTER
1505 N BROADWAY
URBANA IL 61801
COUNTY: CHAMPAIGN

BELLFLOWER GENEALOGICAL & HISTORICAL SC
RR1 BOX 17
BELLFLOWER IL 61724
COUNTY: CHAMPAIGN

HOMER HISTORICAL SOCIETY
605 S MAIN ST
HOMER IL 61849
COUNTY: CHAMPAIGN

IL HERITAGE ASSOC
602 1/2 E GREEN ST
CHAMPAIGN IL 61820
COUNTY: CHAMPAIGN

IL HISTORICAL SURVEY
1408 W GREGORY DR
URBANA IL 61801
COUNTY: CHAMPAIGN

PRESERVATION & CONSERVATION ASSOCIATIOI
PO BOX 2555 STATION A
CHAMPAIGN IL 61825
COUNTY: CHAMPAIGN

SIDNEY HISTORICAL SOCIETY
PO BOX 87
SIDNEY IL 61877
COUNTY: CHAMPAIGN

UNIV OF IL MUSEUM OF NAT HIST
1301 GREEN ST
URBANA IL 61801
COUNTY: CHAMPAIGN

WORLD HERITAGE MUSEUM
702 S WRIGHT ST
URBANA IL 61801
COUNTY: CHAMPAIGN

DIRECTOR
CHRISTIAN CNTY HIST MUSEUM
C/O TAYLORVILLE PUBLIC LIBRARY
PO BOX 28
TAYLORVILLE 62568
COUNTY: CHRISTIAN

DIRECTOR
MORRISONVILLE HISTORICAL SOCIETY
606 CARLIN ST PO BOX 227
MORRISONVILLE 62546
COUNTY: CHRISTIAN

ARLINGTON HEIGHTS HISTORICAL SOCIETY
110 W FREMONT ST
ARLINGTON HEIGHTS IL 6004
COUNTY: COOK

BARLETT HISTORICAL SOCIETY
228 S MAIN ST PO BOX 8257
BARLETT IL 60103
COUNTY: COOK

BERWYN HISTORICAL SOCIETY
PO BOX 479
BERWYN IL 60402
COUNTY: COOK

CALUMET CITY HIST SOCIETY
760 WENTWORTH AVE PO BOX 1917
CALUMET CITY IL 60409
COUNTY: COOK

CHICAGO & NW HISTORICAL SOCIETY
8703 N OLCOTT AVE
NILES IL 60648
COUNTY: COOK

CHICAGO ACADEMY OF SCIENCES
2060 N CLARK ST
CHICAGO IL 60614
COUNTY: COOK

CHICAGO HISTORICAL SOCIETY
1601 N CLARK ST
CHICAGO IL 60614
COUNTY: COOK

FOREST PRESERVE DIST OF COOK CNTY
CHICAGO PORTAGE NATIONAL HISTORIC SITE
536 N HARLEM
RIVER FOREST IL 60305
COUNTY: COOK

FOREST RESERVE DISTRICT OF COOK CNTY
CRABTREE NATURE CENTER
RTE 3 STOVER RD
BARRINGTON IL 60010
COUNTY: COOK

DES PLAINES HISTORICAL SOCIETY
789 PEARSON
DES PLAINES IL 60016-4506
COUNTY: COOK

EAST SIDE HISTORICAL SOCIETY
3658 E 106TH ST
CHICAGO IL 60617
COUNTY: COOK

EDGEBROOK HISTORICAL SOCIETY
6173 N MC CLELLAN
CHICAGO IL 60646
COUNTY: COOK

ELGIN PUBLIC MUSEUM
225 GRAND BLVD
ELGIN IL 60120
COUNTY: COOK

EVANSTON HISTORICAL SOCIETY
225 GREENWOOD ST
EVANSTON IL 60201
COUNTY: COOK

FIELD MUSEUM OF NATURAL HISTORY
1200 S LAKE SHORE DR
CHICAGO IL 60605-2496
COUNTY: COOK

FLAGG CREEK HISTORICAL SOCIETY
7965 BIELBY
LAGRANGE IL 60521
COUNTY: COOK

GLENCOE HISTORICAL SOCIETY
999 GREEN BAY RD
GLENCO IL 60022
COUNTY: COOK

GLENVIEW AREA HISTORICAL SOCIETY
1121 WAUKEGAN RD
GLENVIEW IL 60025
COUNTY: COOK

GROVE HERITAGE ASSOC
PO BOX 484
GLENVIEW IL 60025
COUNTY: COOK

HISTORIC PRESERVATION COMMISSION OF OAK
1 VILLAGE HALL PL
OAK PARK IL 60302
COUNTY: COOK

HISTORIC PRESERVATION REVIEW COMMISSION
14700 RAVINIA AVE
ORLAND PARK IL 60462
COUNTY: COOK

HISTORICAL SOC OF OAK PARK & RIV FOREST
217 HOME PO BOX 771
OAK PARK IL 60303
COUNTY: COOK

HISTORICAL SOCIETY OF CICERO
2423 S AUSTIN BLVD
CICERO IL 60650
COUNTY: COOK

HISTORICAL SOCIETY OF ELMWOOD PARK
2823 N 77TH AVE
ELMWOOD PARK IL 60635-1408
COUNTY: COOK

HISTORICAL SOCIETY OF FOREST PARK
519 JACKSON BLVD
FOREST PARK IL 60130
COUNTY: COOK

HOMEWOOD HISTORICAL SOCIETY
PO BOX 1144
HOMEWOOD IL 60430
COUNTY: COOK

HOOSIER GROVE MUSEUM STREAMWOOD PARK
700 W IRVING PARK RD
STREAMWOOD IL 60107
COUNTY: COOK

HYDE PARK HISTORICAL SOCIETY
5529 S LAKE PARK AVE
CHICAGO IL 60637
COUNTY: COOK

IRVING PARK HISTORICAL SOCIETY
PO BOX 34749
CHICAGO IL 60634
COUNTY: COOK

KENILWORTH HISTORICAL SOCIETY
PO BOX 181
KENILWORTH IL 60043
COUNTY: COOK

KOHL CHILDRENS MUSEUM
165 GREEN BAY RD
WILMETTE IL 60091
COUNTY: COOK

LAGRANGE AREA HISTORICAL SOCIETY
444 S LAGRANGE RD
LAGRANGE IL 60525
COUNTY: COOK

LANDMARKS PRESERVATION COUNCIL OF IL
53 W JACKSON BLVD STE 752
CHICAGO IL 60604
COUNTY: COOK

LANSING HISTORICAL MUSEUM
PO BOX 1776
LANSING IL 60438
COUNTY: COOK

LEMONT AREA HISTORICAL SOCIETY
306 LEMONT ST PO BOX 126
LEMONT IL 60439
COUNTY: COOK

LITTLE RED SCHOOLHOUSE NAT CTR
9800 S 104TH AVE
WILLOW SPRINGS IL 60480
COUNTY: COOK

LYONS HISTORICAL COMMISSION
3910 BARRY POINT RD PO BOX 392
LYONS IL 60534
COUNTY: COOK

MATTESON HISTORICAL MUSEUM
813 SCHOOL AVE
MATTESON IL 60443
COUNTY: COOK

MAYWOOD HISTORICAL SOCIETY
202 S 2ND AVE
MAYWOOD IL 60153
COUNTY: COOK

MIDLOTHIAN HISTORICAL SOCIETY
14801 PULASKI
MIDLOTHIAN IL 60445
COUNTY: COOK

MORTON GROVE HISTORICAL MUSEUM
PO BOX 542
MORTON GROVE IL 60053
COUNTY: COOK

MT GREENWOOD HIST SOCIETY
11010 S KEDZIE AVE
CHICAGO IL 60655
COUNTY: COOK

MT PROSPECT HISTORICAL SOCIETY
101 S MAPLE ST
MT PROSPECT IL 60056
COUNTY: COOK

MUSEUM OF SCIENCE AND INDUSTRY
57TH ST & LAKE SHORE DR
CHICAGO IL 60637
COUNTY: COOK

NATURAL TRUST FOR HISTORIC PRESERVATION
53 W JACKSON BLVD STE 1135
CHICAGO IL 60604
COUNTY: COOK

NATURE OF IL FOUNDATION
208 S LADALLE ST STE 1666
CHICAGO IL 60604-1003
COUNTY: COOK

NILES HISTORICAL SOCIETY
8970 MILWAUKEE AVE
NILES IL 60714
COUNTY: COOK

NORTH EASTERN IL HISTORICAL COUNCIL
1720 B WILDBERRY DR
GLENVIEW IL 60025
COUNTY: COOK

NORTHBROOK HISTORICAL SOCIETY
1776 WALTERS AVE PO BOX 2021
NORTHBROOK IL 60065
COUNTY: COOK

NORWOOD PARK HISTORICAL SOCIETY
5624 N NEWARK AVE
CHICAGO IL 60631
COUNTY: COOK

OAK PARK CONSERVATORY
617 GARFIELD
OAK PARK IL 60304
COUNTY: COOK

ORLAND HISTORICAL SOCIETY
PO BOX 324
ORLAND PARK IL 60462
COUNTY: COOK

PALATINE HISTORICAL SOCIETY
224 E PALATINE RD PO BOX 134
PALATINE IL 60078
COUNTY: COOK

PALOS HISTORICAL SOCIETY
12332 SA FOREST GLEN BLVD
PALOS PARK IL 60464
COUNTY: COOK

PARK FOREST HISTORICAL SOCIETY
400 LAKEWOOD BLVD
PARK FOREST IL 60466
COUNTY: COOK

PARK RIDGE HISTORICAL SOCIETY
41 W PRAIRIE AVE
PARK RIDGE IL 60068
COUNTY: COOK

RAVENSWOOD-LAKE VIEW HISTORICAL ASSOC
4455 N LINCOLN AVE
CHICAGO IL 60625
COUNTY: COOK

RIDGE HISTORICAL SOCIETY
10621 S SEELEY AVE
CHICAGO IL 60643
COUNTY: COOK

RIVER TRAIL NATURE CTR
3120 N MILWAUKEE AVE
NORTHBROOK IL 60062
COUNTY: COOK

RIVERDALE HISTORICAL SOCIETY
208 W 144TH ST
RIVERDALE IL 60827
COUNTY: COOK

ROBBINS HISTORICAL SOCIETY
13820 S CENTRAL PARK AVE PO BOX 1561
ROBBINS IL 60472-1561
COUNTY: COOK

SAND RIDGE NATURE CTR
15890 PAXTON AVE'
S HOLLAND IL 60473
COUNTY: COOK

SCHILLER PARK HISTORICAL SOCIETY
9526 W IRVING PARK RD
SCHILLER PARK IL 60176
COUNTY: COOK

SPRING VALLEY NATURE CTR
235 E BEECH DR
SCHAUMBURG IL 60193
COUNTY: COOK

THORNTON TOWNSHIP HISTORICAL SOCIETY
66 WATER ST
PARK FOREST IL 60466
COUNTY: COOK

TINLEY PARK HISTORICAL SOCIETY
PO BOX 325
TINLEY PARK IL 60477
COUNTY: COOK

UPTOWN HISTORICAL SOCIETY
4531 N DOVER ST
CHICAGO IL 60640
COUNTY: COOK

WEST RIDGE HISTORICAL SOCIETY
6424 NORTHWESTERN
CHICAGO IL 60645
COUNTY: COOK

WESTCHESTER HISTORICAL SOCIETY
10332 BOND ST
WESTCHESTER IL 60154
COUNTY: COOK

WESTERN SPRINGS HISTORICAL SOCIETY
PO BOX 139
WESTERN SPRINGS IL 60558
COUNTY: COOK

WHEELING HISTORICAL SOCIETY
PO BOX 3
WHEELING IL 60090
COUNTY: COOK

WINNETKA HISTORICAL SOCIETY
1140 ELM ST
WINNETKA IL 60093
COUNTY: COOK

BLACKWELL HISTORY OF ED MUSEUM
GABEL HALL 08 NORTHERN IL UNIVERSITY
DEKALB IL 60115
COUNTY: DEKALB

REG HISTORY CENTER
NIU -SWEN PARSON HALL 155
DEKALB IL 60115
COUNTY: DEKALB

LAFAYETTE & RAILROAD STS
SANDWICH HISTORICAL SOCIETY
PO BOX 82
SANDWICH IL 60548
COUNTY: DEKALB

DEWITT CNTY MUSEUM ASSOC
219 E WOODLAWN
CLINTON IL 61727
COUNTY: DEWITT

FARMER CITY GENEALOGICAL & HIST SOCIETY
224 S MAIN PO BOX 173
FARMER CITY IL 61842
COUNTY: DEWITT

CABIN NATURE PROGRAM CTR
111 S WOOD DALE RD
WOOD DALE IL 60191
COUNTY: DUPAGE

DARIEN HISTORICAL SOCIETY
7422 S CASS AVE PO BOX 2178
DARIEN IL 60561
COUNTY: DUPAGE

DOWNERS GROVE HISTORICAL SOCIETY
831 MAPLE AVE
DOWNERS GROVE IL 60515-4904
COUNTY: DUPAGE

DOWNERS GROVE MUSEUM
831 MAPLE AVE
DOWNERS GROVE IL 60515-4904
COUNTY: DUPAGE

DUPAGE CNTY HISTORICAL SOCIETY
102 E WESLEY ST
WHEATON IL 60187
COUNTY: DUPAGE

GLEN ELLYN HISTORICAL SOCIETY
557 GENEVA RD PO BOX 283
GLEN ELLYN IL 60137
COUNTY: DUPAGE

HINSDALE HISTORICAL SOCIETY
15 S CLAY ST PO BOX 336
HINSDALE IL 60522
COUNTY: DUPAGE

ITASCA HISTORICAL SOCIETY
101 N CATALPA AVE
ITASCA IL 60143
COUNTY: DUPAGE

JURICA NATURE MUSEUM BENEDICTINE UNIV
5700 COLLEGE RD
LISLE IL 60532
COUNTY: DUPAGE

LISLE HERITAGE SOCIETY
919 BURLINGTON
LISLE IL 60532
COUNTY: DUPAGE

OAK BROOK HISTORICAL SOCIETY
PO BOX 3821
OAK BROOK IL 60522
COUNTY: DUPAGE

WEST CHICAGO HISTORICAL SOCIETY
PO BOX 246
WEST CHICAGO IL 60185
COUNTY: DUPAGE

WESTMONT HISTORICAL SOCIETY
75 E RICHMOND ST
WESTMONT IL 60559
COUNTY: DUPAGE

WHEATON HISTORY CTR
PO BOX 373
WHEATON IL 60189
COUNTY: DUPAGE

WILLOWBROOK WILDLIFE HAVEN
525 S PARK BLVD
GLEN ELLYN IL 60137
COUNTY: DUPAGE

WOODRIDGE AREA HISTORICAL SOCIETY
2628 MITCHELL DR
WOODRIDGE IL 60517
COUNTY: DUPAGE

FORD CNTY HISTORICAL SOCIETY
10 MERIDIAN TERRACE
PAXTON IL 60957
COUNTY: FORD

PIPER CITY COMMUNITY HISTORICAL SOCIETY
39 W MAIN
PIPER CITY IL 60959
COUNTY: FORD

AVON HISTORICAL SOCIETY
PO BOX 483
AVON IL 61415
COUNTY: FULTON

DICKSON MOUNDS STATE MUSEUM
10956 N DICKSON MOUNDS RD
LEWISTOWN IL 61542
COUNTY: FULTON

FULTON COUNTY HISTORICAL & GEN SOCIETY
45 ASPEN DR
CANTON IL 61520
COUNTY: FULTON

DUANE ESAREY
DICKSON MOUNDS MUSEUM
RR 1 BOX 185
LEWISTON IL 61542
COUNTY: FULTON

ALAN HARN
DEPT OF ANTHROPOLOGY
DICKSON MOUNDS MUSEUM
10956 N DICKSON MOUNDS RD
LEWISTON IL 61542
COUNTY: FULTON

GREENE CNTY HIST & GENEALOGICAL SOCIETY
PO BOX 137 532 N MAIN ST
CARROLLTON IL 62016
COUNTY: GREENE

GOOSE LAKE PRAIRIE STAT NATURAL AREA
5010 N JUGTOWN RD
MORRIS IL 60450
COUNTY: GRUNDY

GRUNDY COUNTY HISTORICAL SOCIETY
PO BOX 224
MORRIS IL 60450
COUNTY: GRUNDY

HANCOCK CNTY HISTORICAL SOCIETY
PO BOX 68
CARTHAGE IL 62321
COUNTY: HANCOCK

LAHARPE HISTORICAL & GENEAL SOC
111 E MAIN PO BOX 289
LAHARPE IL 61450
COUNTY: HANCOCK

NAUVOO CHAMBER OF COMMERCE
PO BOX 41
NAUVOO IL 62354
COUNTY: HANCOCK

NAUVOO HISTORICAL SOCIETY MUSEUM
PO BOX 69
NAUVOO IL 62354
COUNTY: HANCOCK

WARSAW HISTORICAL SOCIETY AND MUSEUM
401 MAIN ST
WARSAW IL 62379
COUNTY: HANCOCK

JOHN H ALLAMAN
HENDERSON COUNTY HISTORICAL SOCIETY
RTE 1
BIGGSVILLE IL 61418
COUNTY: HENDERSON

BISHOP HILL STATE HISTORIC SITE
PO BOX 104
BISHOP HILL IL 61419
COUNTY: HENRY

CAMBRIDGE HISTORICAL SOCIETY
RR 2 BOX 96
CAMBRIDGE IL 61238
COUNTY: HENRY

GALVA HISTORICAL SOCIETY
2141 COUNTY HWY 5
GALVA IL 61434
COUNTY: HENRY

HENRY COUNTY HISTORICAL SOCIETY
PO BOX 48
BISHOP HILL IL 61419
COUNTY: HENRY

KEWANEE HISTORICAL SOCIETY
211 N CHESTNUT ST
KEWANEE IL 61443
COUNTY: HENRY

EAST CAMPUS
LEARNING RESOURCES CTR BLACK HAWK COLL
1501 IL HWY 78
KEWANEE IL 61443
COUNTY: HENRY

IROQUOIS CNTY HISTORICAL SOCIETY
103 W CHERRY ST OLD COURHOUSE MUSEUM
WATSEKA IL 60970
COUNTY: IROQUOIS

JERSEY CNTY HIST SOCIETY
PO BOX 12
JERSEYVILLE IL 62052
COUNTY: JERSEY

JERSEY COUNTY HISTORICAL SOCIETY
PO BOX 12
JERSEYVILLE IL 62052
COUNTY: JERSEY

AURORA HISTORICAL SOCIETY
317 CEDAR ST
AURORA IL 60506
COUNTY: KANE

AURORA PRESERVATION COMMISSION
44 E DOWNER PL
AURORA IL 60507
COUNTY: KANE

BATAVIA HISTORICAL SOCIETY
PO BOX 14
BATAVIA IL 60510
COUNTY: KANE

BIG ROCK HISTORICAL SOCIETY
PO BOX 206
BIG ROCK IL 60511
COUNTY: KANE

CHICAGO AREA CONSERVATION GROUP
2600 KESLINGER RD
GENEVA IL 60134
COUNTY: KANE

DUNDEE TOWNSHIP HISTORICAL SOCIETY
426 HIGHLAND AVE
DUNDEE IL 60118
COUNTY: KANE

ELBURN & COUNTY HISTORICAL SOCIETY
525 N MAIN PO BOX 115
ELBURN IL 60119
COUNTY: KANE

ELGIN AREA HISTORICAL SOCIETY & MUSEUM
360 PARK ST
ELGIN IL 60120
COUNTY: KANE

GENEVA HISTORICAL SOCIETY
PO BOX 345
GENEVA IL 60134
COUNTY: KANE

KANE CNTY FOREST PRESERVE DIST
1511 S BATAVIA AVE
GENEVA IL 60134
COUNTY: KANE

PRESERVATION PARTNERS OF FOX VALLEY
8 INDIANA PO BOX 903
ST CHARLES IL 60174
COUNTY: KANE

RED OAK NATURE CENTER
2343 S RIVER ST
BATAVIA IL 60510
COUNTY: KANE

ST CHARLES HERITAGE CENTER
2 E MAIN ST
ST CHARLES IL 60174
COUNTY: KANE

SUGAR GROVE HISTORICAL SOCIETY
259 MAIN ST PO BOX 102
SUGAR GROVE IL 60554
COUNTY: KANE

BOURBONNAIS GROVE HIST SOCIETY
PO BOX 311
BOURBONNAIS IL 60914
COUNTY: KANKAKEE

KANKAKEE CNTY HISTORICAL SOCIETY
801 S 8TH ST
KANKAKEE IL 60901
COUNTY: KANKAKEE

MANTENO HISTORICAL SOCIETY
192 W 3RD
MANTENO IL 60950
COUNTY: KANKAKEE

RIVERVIEW HISTORIC DIST
PO BOX 1787
KANKAKEE IL 60901
COUNTY: KANKAKEE

FERN DELL HISTORIC ASSOC
PO BOX 254
NEWARK IL 60541
COUNTY: KENDALL

KENDALL CNTY HISTORICAL SOCIETY
PO BOX 123
YORKVILLE IL 60560
COUNTY: KENDALL

OSWEGOLAND HERITAGE ASSOC
PO BOX 23
OSWEGO IL 60543
COUNTY: KENDALL

CARL SANDBURG STATE HISTORIC SITE
313 E 3RD ST
GALESBURG IL 61401
COUNTY: KNOX

GALESBURG HISTORICAL SOCIETY
1166 N PRAIRIE
GALESBURG IL 61401
COUNTY: KNOX

KNOX COUNTY HISTORICAL SITES INC
PUBLIC SQUARE
KNOXVILLE IL 61448
COUNTY: KNOX

MAQUON HISTORICAL ASSOCIATION
PO BOX 171
MAQUON IL 61458
COUNTY: KNOX

MUSEUM CENTER
BARRINGTON AREA HISTORICAL SOCIETY
212-218 W MAIN ST
BARRINGTON IL L0010
COUNTY: LAKE

DEERFIELD AREA HISTORICAL SOCIETY
450 KIPLING PL PO BOX 520
DEERFIELD IL 60015
COUNTY: LAKE

HIGHLAND PARK CONSERVATION SOCIETY
1729 BERKELEY RD
HIGHLAND PARK IL 60035
COUNTY: LAKE

HISTORICAL SOCIETY OF FORT HIL CNTY
PO BOX 582
MUNDELEIN IL 60060
COUNTY: LAKE

LAKE COUNTY MUSEUM ASSOC
27277 N FOREST PRESERVE DR
WAUCONDA IL 60084
COUNTY: LAKE

LIBERTYVILLE-MUNDELEIN HIST SOCIETY
413 N MILWAUKEE AVE
LIBERTYVILLE IL 60048
COUNTY: LAKE

LONG GROVE HISTORICAL SOCIETY
3110 RFD
LONG GROVE IL 60047
COUNTY: LAKE

PRAIRIE GRASS NATURE MUSEUM
860 HART RD
ROUND LAKE IL 60073
COUNTY: LAKE

RAUPP MEM MUSEUM/BUFFALO GROVE PARK DIST
530 BERNARD DR
BUFFALO GROVE IL 60089
COUNTY: LAKE

WAUCONDA TOWNSHIP HISTORICAL SOCIETY
PO BOX 256
WAUCONDA IL 60084
COUNTY: LAKE

EARLVILLE COMM HISTORICAL SOCIETY
205 WINTHROP ST PO BOX 420
EARLVILLE IL 60518
COUNTY: LASALLE

LASALLE CNTY HISTORICAL SOCIETY
PO BOX 278
UTICA IL 61373
COUNTY: LASALLE

MENDOTA HISTORICAL SOCIETY
PO BOX 433
MENDOTA IL 61342
COUNTY: LASALLE

STARVED ROCK HIST & ED FOUNDATION
PO BOX 116
UTICA IL 61373
COUNTY: LASALLE

STARVED ROCK STATE PARK
PO BOX 509
UTICA IL 61373
COUNTY: LASALLE

STREATORLAND HISTORICAL SOCIETY
306 S VERMILLION
STREATER IL 61364
COUNTY: LASALLE

SAUK VALLEY COMMUNITY COLLEGE
LEARNING RESOURCE CTR (SVCC)
173 IL RTE 2
DIXON IL 61021
COUNTY: LEE

LEE COUNTY HISTORICAL SOCIETY
113 MADISON AVE PO BOX 58
DIXON IL 61021
COUNTY: LEE

CHATSWORTH HISTORICAL SOCIETY
424 E LOCUST ST PO BOX 755
CHATSWORTH IL 60921
COUNTY: LIVINGSTON

DWIGHT HISTORICAL SOCIETY
119 W MAIN ST
DWIGHT IL 60420
COUNTY: LIVINGSTON

LIVINGSTON CNTY HISTORICAL SOCIETY
PO BOX 680
PONTIAC IL 61764
COUNTY: LIVINGSTON

ELKHART HISTORICAL SOCIETY
116 N LATHAM PO BOX 225
ELKHART IL 62634
COUNTY: LOGAN

LOGAN CNTY GENEALOGY & HIST SOCIETY
11 ARCADE BLDG PO BOX 283
LINCOLN IL 62656
COUNTY: LOGAN

MT PULASKI TOWNSHIP HISTORICAL SOCIETY
108 S WASHINGTON ST
MT PULASKI IL 62548
COUNTY: LOGAN

MACON COUNTY CONSERVATION DIST
1495 BROZIO LN
DECATUR IL 62521
COUNTY: MACON

MACON COUNTY HIST SOCIETY
5580 N FORK RD
DECATUR IL 62521
COUNTY: MACON

ROCK SPRINGS CTR FOR ENVIRON DISCOVERY
1495 BROZIO LN
DECATUR IL 62521
COUNTY: MACON

MACOUPIN COUNTY HISTORICAL SOCIETY
PO BOX 432
CARLINVILLE IL 62626
COUNTY: MACOUPIN

HENRY COMMUNITY HIST & GENE SOCIETY
610 NORTH ST
HENRY IL 61537
COUNTY: MARSHALL

MARSHAL COUNTY HISTORICAL SOCIETY
PO BOX 123
LACON IL 61540
COUNTY: MARSHALL

MANITO HISTORICAL SOCIETY
PO BOX 304
MANITO IL 61546
COUNTY: MASON

IL GREAT RIVERS CONFERENCE HIST SOCIETY
1211 N PARK ST PO BOX 515
BLOOMINGTON IL 61702
COUNTY: MC LEAN

MC LEAN COUNTY HIST SOCIETY
200 N MAIN
BLOOMINGTON IL 61701
COUNTY: MC LEAN

BUSHNELL REC & CULTURAL CTR
BUSHNELL HIST SOCIETY MUSEUM
300 MILLER ST
DUSHNELL IL 61422
COUNTY: MCDONOUGH

MCDONOUGH CNTY HISTORICAL SOCIETY
1200 E GRANT ST
MACOMB IL 61455
COUNTY: MCDONOUGH

GREATER HARVARD AREA HISTORICAL SOCIETY
308 N HART BLVD PO BOX 505
HARVARD IL 60033
COUNTY: MCHENRY

MCHENRY PRESERVATION
306 N RIVER RD
MCHENRY IL 60050
COUNTY: MCHENRY

DANVERS HISTORICAL SOCIETY
102 S W ST PO BOX 613
DANVERS IL 61732
COUNTY: MCLEAN

MENARD COUNTY HISTORICAL SOCIETY
125 S 7TH ST
PETERSBURG IL 62675
COUNTY: MENARD

HISTORICAL SOCIETY OF MONTGOMERY CNTY
904 S MAIN ST
HILLSBORO IL 62049
COUNTY: MONTGOMERY

ART ASSOC OF JACKSONVILLE
331 W COLLEGE AVE PO BOX 213
JACKSONVILLE IL 62651
COUNTY: MORGAN

GOVERNOR DUNCAN MANSION
4 DUNCAN PL
JACKSONVILLE IL 62650
COUNTY: MORGAN

JACKSON AREA GENEALOGICAL & HIST SOCIETY
416 S MAIN ST
JACKSONVILLE IL 62650
COUNTY: MORGAN

JACKSONVILLE HERITAGE CULTURAL CENTER
200 W DOUGLAS
JACKSONVILLE IL 62650
COUNTY: MORGAN

MOULTRIE CNTY HIST & GEN SOCIETY
117 E HARRISON PO BOX 588
SULLIVAN IL 61951
COUNTY: MOULTRIE

CENTRAL IL LANDMARKS FOUNDATION
PO BOX 495
PEORIA IL 61651
COUNTY: PEORIA

CHILLICOTHE HISTORICAL SOCIETY
PO BOX 181
CHILLICOTHE IL 61523
COUNTY: PEORIA

LAKEVIEW MUSEUM
GREENWAYS BOARD
1125 W LAKE AVE
PEORIA IL 61614
COUNTY: PEORIA

HISTORICAL ASSOC OF PRINCEVILLE
130 N WALNUT PO BOX 608
PRINCEVILLE IL 61559
COUNTY: PEORIA

IL HISTORICAL WATER MUSEUM
123 S W WASHINGTON
PEORIA IL 61602
COUNTY: PEORIA

PEORIA HISTORICAL SOCIETY
942 NE GLENOAK AVE
PEORIA IL 61603
COUNTY: PEORIA

WILDLIFE PRAIRIE PARK
3826 N TAYLOR RD RR2 BOX 50
PEORIA IL 61615
COUNTY: PEORIA

PERRY COUNTY HISTORICAL SOCIETY
108 W JACKSON ST
PINKNEYVILLE IL 62274
COUNTY: PERRY

PIATT COUNTY HISTORICAL & GENEAL SOCIETY
PO BOX 111
MONTICELLO IL 61856
COUNTY: PIATT

PIKE COUNTY HISTORICAL SOCIETY MUSEUM
400 BLOCK E JEFFERSON PO BOX 44
PITTSFIELD IL 62363
COUNTY: PIKE

PUTNAM COUNTY HISTORICAL SOCIETY
PO BOX 74
HENNEPIN IL 61327
COUNTY: PUTNAM

HISTORIC PRESERVATION ASSOC
PO BOX 1632
SPRINGFIELD IL 62705
COUNTY: SANGAMON

IL ASSOC OF MUSEUMS
1 OLD STATE CAPITOL PLAZA
SPRINGFIELD IL 62701
COUNTY: SANGAMON

IL HISTORIC PRESERVATION AGENCY
1 OLD STATE CAPITOL
SPRINGFIELD IL 62701
COUNTY: SANGAMON

IL STATE HISTORICAL SOCIETY
1 OLD STATE CAPITOL
SPRINGFIELD IL 62701
COUNTY: SANGAMON

IL STATE MUSEUM
SPRING AND EDWARDS STS
SPRINGFIELD IL 62701
COUNTY: SANGAMON

ROCHESTER HISTORICAL PRESERV SOCIETY
PO BOX 13
ROCHESTER IL 62563-0013
COUNTY: SANGAMON

C/O ROBINSON'S ADVERTISING
SANGAMON CNTY HISTORICAL SOCIETY
308 E ADAMS ST
SPRINGFIELD IL 62701
COUNTY: SANGAMON

SPRINGFIELD HISTORICAL SITES COMMISSION
1331 S DIAL CT
SPRINGFIELD IL 62704
COUNTY: SANGAMON

SCHUYLER JAIL MUSEUM
200 S CONGRESS ST
RUSHVILLE IL 62681
COUNTY: SCHUYLER

SCOTT COUNTY HIST SOCIETY
PO BOX 85
WINCHESTER IL 62694
COUNTY: SCOTT

MOWEAQUA AREA HISTORICAL SOCIETY
103 BIRCH ST
MOWEAQUA IL 62550
COUNTY: SHELBY

SHELBY CNTY HISTORICAL SOCIETY
151 S WASHINGTON PO BOX 286
SHELBYVILLE IL 62565
COUNTY: SHELBY

STARK CNTY HISTORICAL SOCIETY
PO BOX 524
TOULON IL 61483
COUNTY: STARK

DELAVAN COMMUNITY HIST SOCIETY
LOCUST ST
DELAVAN IL 61734
COUNTY: TAZEWELL

TAZEWELL CNTY GENEAL & HIST SOCIETY
PO BOX 312
PEKIN IL 61555
COUNTY: TAZEWELL

TREMONT MUSEUM & HISTORICAL SOCIETY
PO BOX 5
TREMONT IL 61568
COUNTY: TAZEWELL

WASHINGTON HISTORICAL SOCIETY
PO BOX 54
WASHINGTON IL 61571
COUNTY: TAZEWELL

HOOPESTON HISTORICAL SOCIETY
617 E WASHINGTON
HOOPESTON IL 60942
COUNTY: VERMILION

SIDELL COMMUNITY HISTORICAL SOCIETY
PO BOX 74
SIDELL IL 61876
COUNTY: VERMILION

TILTON HISTORICAL SOCIETY
201 W 5TH ST
TILTON IL 61833
COUNTY: VERMILION

VERMILION CNTY CONSERVATION DIST MUSEUM
22296-A HENNING RD
DANVILLE IL 61834
COUNTY: VERMILION

FAIRMOUNT-JAMAICA HISTORICAL SOCIETY
116 S MAIN ST
FAIRMOUNT IL 61841
COUNTY: VERMILLION

ROSSVILLE HISTORICAL SOCIETY
108 W ATTICA ST PO BOX 263
ROSSVILLE IL 60963
COUNTY: VERMILLION

WARREN CNTY HISTORICAL MUSEUM
200 E PENN AVE PO BOX 325
ROSEVILLE IL 61473
COUNTY: WARREN

BEECHER COMMUNITY HISTORICAL SOCIETY
673 PENFIELD ST PO BOX 1469
BEECHER IL 60401
COUNTY: WILL

BOLINGBROOK HISTORICAL SOCIETY
162 N CANYON DR
BOLINGBROOK IL 60440
COUNTY: WILL

FRANKFORT AREA HIST SOCIETY OF WILL CNTY
132 KANSAS ST PO BOX 546
FRANKFORT IL 60423
COUNTY: WILL

I&M CANAL MUSEUM
803 S STATE ST
LOCKPORT IL 60441
COUNTY: WILL

I&M CANAL NATIONAL HERITAGE CORRIDOR
15701 S INDEPENDENCE BLVD
LOCKPORT IL 60441
COUNTY: WILL

IL CANAL SOCIETY
1109 GARFIELD
LOCKPORT IL 60441
COUNTY: WILL

JOLIET AREA HISTORICAL SOCIETY
17 E VAN BUREN ST PO BOX 477
JOLIET IL 60434
COUNTY: WILL

MANHATTAN TOWNSHIP HISTORICAL SOCIETY
PO BOX 53
MANHATTAN IL 60442
COUNTY: WILL

PILCHER PARK NATURE CENTER
227 N COUGAR RD
JOLIET IL 60432
COUNTY: WILL

PLAINSFIELD HISTORICAL SOCIETY MUSEUM
217 E MAIN ST
PLAINSFIELD IL 60544
COUNTY: WILL

WILL CNTY HISTORICAL SOCIETY
803 S STATE ST
LOCKPORT IL 60441
COUNTY: WILL

WILMINGTON AREA HISTORICAL SOCIETY
PO BOX 1
WILMINGTON IL 60481
COUNTY: WILL

ROBERT HOLMES
SLOVENIAN HERITAGE MUSEUM
431 N CHICAGO ST
JOLIET IL 60432
COUNTY: WILL

ROBERT PADDOCK
LOCKPORT TOWNSHIP PARK DIST
GLADYS FOX MUSEUM
1911 S LAWRENCE
LOCKPORT IL 60441
COUNTY: WILL

JIM ZIMMER
IL STATE MUSEUM LOCKPORT GALLERY
200 W 8TH ST 3RD FLOOR
LOCKPORT IL 60441
COUNTY: WILL

IL MINNONITE HERITAGE CTR
PO BOX 1007
MINIER IL 61759
COUNTY: WOODFORD

TRIBAL CHAIRPERSON
OKLAHOMA BUSINESS COMMITTEE
CITIZEN BAND POTAWATOMI INDIAN TRIBE
1901 S GORDON COOPER DR
SHAWNEE OK 74801

TRIBAL CHAIRMAN
OF OKLAHOMA BUSINESS COMMITTEE
CITIZEN BAND POTAWATOMI INDIAN TRIBE
1601 S GORDON COOPER DR
SHAWNEE OK 74801

JOHN A BARRETT
CHAIRMAN
OKLAHOMA BUSINESS COMMITTEE
CITIZEN BAND POTAWATOMI INDIAN TRIBE
1901 S GORDON COOPER DR
SHAWNEE OK 74801

LISA KRAFT
CULTURAL RESOURCES MANAGEMENT CONSUL
OF OKLAHOMA BUSINESS COMMITTEE
CITIZEN BAND POTAWATOMI INDIAN TRIBE
1901 S GORDON COOPER DR
SHAWNEE OK 74801

HARTFORD SHEGONEE
CHAIRMAN
FOREST CNTY POTAWATOMI EXECUTIVE COUNCIL
PO BOX 346
CRANDON WI 54520

AL MILHAM
CHAIRMAN
FOREST COUNTY POTAWATOMI EXE COUNCIL
PO BOX 340
CRANDON WI 54520

TERRY CHIVIS
CHAIRMAN
HURON POTAWATOMI NATION
2221 1 1/2 MILE RD
FULTON MI 49052

TRIBAL CHAIRPERSON
KICKAPOO OF KANSAS TRIBAL COUNCIL
ROUTE 1 BOX 157
HORTON KS 66349

CAROL ANSKE
CHAIRPERSON
KICKAPOO OF KANSAS TRIBAL COUNCIL
PO BOX 271
HORTON KS 66349

NANCY BEAR
CHAIR
KICKAPOO OF KANSAS TRIBAL COUNCIL
RTE 1 BOX 157
HORTON KS 66439

TRIBAL CHAIRPERSON
KICKAPOO OF OKLAHOMA BUS COUNCIL
BOX 70
MC CLOUD OK 74851

RICHARD SALAZAR
CHAIRMAN
KICKAPOO OF OKLAHOMA BUSINESS COUNCIL
PO BOX 70
MC CLOUD OK 74851

TRIBAL CHAIRPERSON
KICKAPOO TRADITIONAL TRIBE OF TEXAS
HC 1 PO BOX 9700
EAGLE PASS TX 78853

RAUL GARZA
CHAIRPERSON
KICKAPOO TRADITIONAL TRIBE OF TEXAS
HC 1 BOX 9700
EAGLE PASS TX 78853

TRIBAL CHAIRPERSON
KICKAPOO TRIBE OF INDIANS OF THE KICKAPO
PO BOX 270
HORTON KS 66439

CURTIS SIMON
KICKAPOO RESERVATION IN KANSAS
KICKAPOO TRIBE OF INDIANS OF THE KICKAPO
PO BOX 270
HORTON KS 66439

EMERY NEGONSOTT
CHAIRMAN
KICKAPOO TRIBE OF KANSAS
PO BOX 271
HORTON KS 66439

KATHY SCHUETZ
DELEGATE
KICKAPOO TRIBE OF KANSAS
RR 1 BOX 225
HORTON KS 66439

FRED THOMAS
KICKAPOO TRIBE OF KANSAS
RR 1 BOX 157A
HORTON KS 66439

TRIBAL CHAIRPERSON
PEORIA INDIAN TRIBE OF OKLAHOMA
PO BOX 1527
MIAMI OK 74355

CHARLA K REEVES
NAGPRA REPRESENTATIVE
PEORIA INDIAN TRIBE OF OKLAHOMA
PO BOX 1527
MIAMI OK 74355

JOHN MILLER
CHAIRMAN
POKAGON BAND OF POTAWATOMI INDIANS
PO BOX 180
DOWAGIAC MI 49047

JOSEPH B WINCHESTER
CHAIRMAN
POKAGON BAND OF POTAWATOMI INDIANS
53237 TOWN HALL RD
DOWAGIAC MI 49047

TRIBAL CHAIRPERSON
PRAIRIE BAND OF POTAWATOMI
BOX 97
MAYETTA KS 66509

LUTHER WAHWASUCK
DELEGATE
PRAIRIE BAND OF POTAWATOMI
14880 K RD
MAYETTA KS 66509

GEORGE WCHQUAHBOSHKUK
PRAIRIE BAND POTAWATOMI
PO BOX 97
MAYETTA KS 66509

MAMIE RUPNICKI
CHAIRMAN
PRAIRIE BAND POTAWATOMI TRIBAL COUNCIL
PO BOX 97
MAYETTA KS 66509

SANDRA MASSEY
NAGPRA COORDINATOR
SAC & FOX NATION
RT 2 BOX 246
STROUD OK 74079

DEANNE BAHR
NAGPRA COORDINATOR
SAC & FOX NATION OF MO IN KS & NB
RR 1 BOX 60
RESERVE KS 66434-9723

EXECUTIVE DIRECTOR
SAC & FOX NATION OF THE MISSI IN IOWA
349 MESKWAKI RD
TAMA IA 52339-9629

JOHNATHAN BUFFALO
HISTORIC PRESERVATION COORDINATOR
SAC & FOX NATION OF THE MISSI IN IOWA
349 MESKWAKI RD
TAMA IA 52339-9629

CURTIS GILFILLAN
SAC & FOX OF MISSOURI
RR1 BOX 60
RESERVE KS 66434

SANDRA KEO
DELEGATE
SAC & FOX OF MISSOURI
RR 1 BOX 60
RESERVE KS 66434

JOAN REBAR
TRIBAL CHAIRPERSON
SAC & FOX OF MISSOURI
RR1 BOX 60
RESERVE KS 66434

YVONNE SCHEKAHOSE
SAC & FOX OF MISSOURI
PO BOX 38
RESERVE KS 66434

ELMER MANATOWA JR
PRINCIPAL CHIEF
SAC & FOX OF OK BUSINESS COUNCIL
RTE 2 BOX 246
STROUD OK 74079

TRIBAL CHAIRPERSON
SAC & FOX OF OKLAHOMA BUSINESS COUNCIL
ROUTE 2 BOX 246
STROUD OK 74079

TALBERT DAVENPORT
SAC & FOX TRIBE OF THE MISSISSIPPI IN IA
349 MESKWAKI RD
TAMA IA 52339-9629

GAILEY WANATEE
ACTING CHIEF
SAC AND FOX TRIBAL COUNCIL
3137 F AVE
TAMA IA 52339

CHAR THOMPSON
SAC AND FOX TRIBE FOR THE MISS RIV IN IA
349 MESKWAKI RD
TAMA IA 52339-9629

RONALD FROMAN
CHIEF
THE PEORIA TRIBE OF OKLAHOMA
PO BOX 1527
MIAMI OK 74355

JOANN JONES
CHAIRPERSON
WI WINNEBAGO BUSINESS COMMITTEE
PO BOX 667
TOMAH WI 54660

TRIBAL CHAIRPERSON
WINNEBAGO TRIBAL COUNCIL
PO BOX 687
WINNEBAGO NE 68701

JOHN BLACKHAWK
CHAIRMAN
WINNEBAGO TRIBAL COUNCIL
WINNEBAGO NE 68071

TRIBAL CHAIRPERSON
WINNEBAGO TRIBE
PO BOX 687
WINNEBAGO NE 68071

DAVID LEE SMITH
CULTURAL PRESERVATION OFFICER
WINNEBAGO TRIBE OF NB TRIBAL COUNCIL
PO BOX 687
WINNEBAGO NE 68071

MONA ELK SHOULDER
DELEGATE
WINNEBAGO TRIBE OF NEBRASKA
PO BOX AE
SLOAN IA 51055

DRAFT

PROGRAMMATIC AGREEMENT

Among the
Chicago, Rock Island, and St. Louis Districts of the U.S. Army Corps of Engineers,
the State of Illinois Department of Natural Resources,
the Illinois State Historic Preservation Officer,
and the Advisory Council on Historic Preservation,
Regarding Implementation of the
Illinois River Ecosystem Restoration

WHEREAS, the Chicago, Rock Island, and St. Louis Districts of the U.S. Army Corps of Engineers (hereafter, Corps) and the State of Illinois Department of Natural Resources (hereafter DNR) determined that the Illinois River watershed exhibits loss of aquatic habitat and have entered into a partnership for the purpose of implementing the Illinois River Ecosystem Restoration (IRER) authorized by Section 216 of the 1970 Flood Control Act and Section 519 (Illinois River Basin Restoration) of the Water Resources Development Act of 2000; and

WHEREAS, the Corps and the DNR have determined that the implementation of the IRER may have an effect upon properties listed on, or eligible for listing on, the National Register of Historic Places (National Register), and has consulted with the Advisory Council on Historic Preservation (Council) and the Illinois State Historic Preservation Officer (SHPO) pursuant to Section 800.14(b) of the regulations (36 CFR Part 800) implementing Section 106 of the National Historic Preservation Act (16 U.S.C. 470[f]), and Section 110(f) of the same Act (16 U.S.C. 470h-2[f]); and

WHEREAS, the IRER study area encompasses the entire Illinois River watershed located in Illinois (54 counties) with two types of efforts (1) system evaluations focused on assessing the overall watershed needs and general locations for restoration and (2) site-specific evaluations focused on developing detailed restoration options for possible implementation at specific sites by project planning, engineering, construction, and monitoring with interdisciplinary and collaborative planning for habitat restoration, protection, preservation, and enhancement. The Corps and the DNR will manage the IRER throughout all stages of individual habitat project development, restoration, and management. Several other Federal agencies, as well as non-government entities and individual citizens, also will regularly participate in the development of projects within the IRER; and

WHEREAS, the study area includes four IRER areas identified as (1) watershed stabilization, (2) side channel and backwater modification, (3) water level management, and (4) floodplain restoration and protection. The focus areas will be implemented by habitat creation (islands, ponds, wetlands, potholes, channels, backwaters, etc), flow control structures (grade controls,

ENCLOSURE 1

dams, dikes, detention basins, weirs, riffles, fish passage, levees, etc,), habitat enhancements (anchor trees stumps, plantings, management of timber and forest stands, regulation of water levels, etc.), and structure removals/modifications (snagging, clearing, dikes, borrowing, trenching, dredging, etc); and

WHEREAS, pursuant to Section 800.3 of the Council's regulations, and to meet the Corps' and DNR's responsibilities under the National Environmental Policy Act of 1969, the Corps has developed a **Consulting Party List** which was developed in consultation with the SHPO/Tribal Historic Preservation Officers (THPOs), Tribes, and other parties that may have an interest in the effects of this undertaking on historic properties. Those on the **Consulting Party List** will be provided with study newsletters, public meeting announcements, special releases, and notify-cations of the availability of report(s), including all draft agreement documentation, as stipulated by 36 CFR Part 800.14(b)(ii) of the National Historic Preservation Act. Comments received by the Corps will be distributed to the consulting parties to this Agreement and taken into account in finalizing plans for the undertaking; and

WHEREAS, the Corps has provided scholarly evidence of stewardship in the recordation, protection, and management of historic properties along the Illinois Waterway System through systemic research and studies which have been finalized and approved, then placed in the permanent files of the Corps and SHPO as evidence of compliance promulgated under Section 106 of the National Historic Preservation Act, as amended, and its implementing regulations, 36 CFR Part 800: "Protection of Historic Properties." [These studies included: (1) archeological studies (management of documented and undocumented historic properties), (2) architectural and engineering studies (buildings, structures, and objects associated with Multiple Property National Register Districts), (3) erosion studies, (4) land form sediment assemblage studies (geomorphology) and (5) submerged historic property study (historic shipwrecks and other underwater or previously inundated historic properties)]; and

NOW, THEREFORE, the Corps, the DNR, the SHPO, and the Council agree that the undertakings shall be implemented in accordance with the following stipulations to satisfy the Corps' and the DNR's Section 106 responsibilities for all individual actions of this undertaking:

I. IDENTIFICATION AND EVALUATION OF HISTORIC PROPERTIES

The Corps and the DNR will ensure that the following measures are implemented:

A. The Corps and the DNR will take all measures necessary to discover, preserve, and avoid significant historic properties listed on, or eligible for listing on, the National Register, burials, cemeteries, or sites likely to contain human skeletal remains/artifacts and objects associated with interments or religious activities, and provide this information, studies, and/or reports to the SHPO/THPO. Under consultation with the SHPO/THPO(s), the Corps and the

DNR will describe and define the Area of Potential Effect (hereafter referred to as the APE) in accordance with the definition contained in 36 CFR Part 800.16(d). The APE may be modified upon consultation with the appropriate SHPO(s)/THPO(s) through avoidance documented through the implementation of historic property surveys and testing, documentary research, recordation, and other investigation data.

B. Unless recent and modern ground surface disturbances and/or historic use can be documented and a determination made by the Corps and the DNR, in consultation with the SHPO/ THPO(s), that there is little likelihood that historic properties will be adversely affected, the Corps and the DNR will then conduct a historic property (reconnaissance) survey in (1) areas with the potential for containing submerged or deeply buried historic properties and (2) areas indirectly and directly affected by construction, use, maintenance, and operation during the implementation of the IRER program.

C. The Corps and the DNR will ensure that all reconnaissance surveys and subsurface testing are conducted in a manner consistent with the Secretary of the Interior's Standards and Guidelines for Identification and Evaluation (48 FR 44720-23) and take into account the National Park Service publication The Archaeological Survey: Methods and Uses (1978) and any extant or most recent version of appropriate SHPO(s)/THPO(s) guidelines for historic properties reconnaissance surveys/reports, related guidance, etc. The reconnaissance surveys and subsurface testing will be implemented by the Corps and the DNR and monitored by the SHPO/THPO(s).

D. In consultation with the SHPO, and appropriate THPO(s), the Corps and the DNR will evaluate for eligibility all significant historic properties by applying the National Register criteria (36 CFR Part 60.4). The Corps will use its archival documentation as a context in which to make National Register evaluations of historic properties.

1. For those properties that the Corps, the DNR, and the SHPO/THPO(s) agree are not eligible for inclusion in the National Register, no further historic properties investigations will be required, and the project may proceed in those areas.

2. If the survey results in the identification of properties that the Corps, the DNR, and the SHPO/THPO(s) agree are eligible for inclusion on the National Register, the Corps and the DNR shall treat such properties in accordance with Part II below.

3. If the Corps, DNR, and SHPO/THPO(s) do not agree on National Register eligibility, or if the Council or the National Park Service so request, the Corps and DNR will request a formal determination of eligibility from the Keeper of the National Register, National Park Service, whose determination shall be final.

4. Relative to the treatment of historic properties and the identification of traditional cultural properties, the Corps and the DNR will continue to provide the appropriate Tribe(s) and the THPO(s) information related to treatment measures proposed by the Corps and DNR.

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Consideration of comments received by the Corps and the DNR can be considered by the signatories to be measures to assist the Corps and the DNR in meeting its responsibilities under the National Historic Preservation Act of 1966, as amended (Public Law 89-665), and the regulations of the Advisory Council on Historic Preservation, "Regulations for the Protection of Historic and Cultural Properties" (36 CFR, Part 800).

II. TREATMENT OF HISTORIC PROPERTIES

Those individual historic properties and multiple property districts that the Corps, DNR, and SHPO/THPO(s) agree are eligible for nomination to, or that the Keeper has determined eligible for inclusion on, the National Register, will be treated by the Corps and the DNR in the following manner:

A. Archival Documentation of the Construction and Operation of the Historic Locks and Dams and Management of Historic Properties: The Corps has provided scholarly evidence of stewardship in the recordation, protection, and management of historic properties along the Illinois Waterway System through systemic research and studies which have been finalized and approved, then placed in the permanent files of the Corps and SHPO. These studies included: (1) archeological studies (management of documented and undocumented historic properties), (2) architectural and engineering studies (buildings, structures, and objects associated with Multiple Property National Register-eligible **Chicago to Grafton, Illinois, Navigable Water Link, 1839-1945 and the Upper Mississippi River 9-Foot Navigation Project 1931-1948**, (3) land form sediment assemblage studies (geomorphology), and (4) submerged historic property study (historic shipwrecks and other underwater or previously inundated historic properties).

B. Treatment of Archaeological Historic Properties:

1. If the Corps and the DNR determine, in consultation with the SHPO/THPO(s), that no other actions are feasible to avoid and minimize effects to archaeological historic properties, then the Corps and the DNR will develop a treatment plan, which may include various levels of data recovery, recordation, documentation, and active protection measures. The Corps and the DNR will implement the treatment plan in consultation with the SHPO/THPO(s).

2. If data recovery is the agreed upon treatment, the data recovery plan will address substantive research questions developed in consultation with the SHPO/ THPO(s). The treatment plan shall be consistent with the Secretary of the Interior's Standards and Guidelines for Archaeological Documentation (48 FR 44734-37) and take into account the Council's publication, Treatment of Archaeological Properties (Advisory Council on Historic Preservation, 1980) and SHPO/THPO(s) guidance. It will specify, at a minimum, the following:

a. The property, properties, or portions of properties where the treatment plan is to be carried out;

b. The research questions to be addressed, with an explanation of research relevance and importance;

c. The methods to be used, with an explanation of methodological relevance to the research questions;

d. Proposed methods of disseminating results of the work to the interested public; and,

e. A proposed schedule for the submission of progress reports to the SHPO/THPO(s).

3. The Corps and the DNR will submit the treatment plan to the SHPO/THPO(s) for 30 days' review and comment. The Corps and the DNR will take into account SHPO/THPO(s) comment(s), and will ensure that the data recovery plan is implemented. The SHPO/THPO(s) may monitor this implementation.

4. The Corps and the DNR will ensure that the treatment plan is carried out by or under the direct supervision of an archaeologist(s), architectural historian(s) and/or other appropriate cultural resource specialist that meets, at minimum, the Secretary of the Interior's Professional Qualifications Standards (48 FR 44738-9).

5. The Corps and the DNR will ensure that adequate provisions, including personnel, time, and laboratory space are available for the analysis and curation of recovered materials from historic properties.

6. The Corps and the DNR will develop and implement an adequate program in consultation with the SHPO/THPO(s) to secure archaeological historic properties from vandalism during data recovery.

III. TREATMENT OF HUMAN REMAINS, FUNERARY OBJECTS, SACRED OBJECTS, OR OBJECTS OF CULTURAL PATRIMONY, AND CURATED ITEMS

A. When human remains, funerary objects, sacred objects, or objects of cultural patri-mony are encountered or collected, the Corps and the DNR will comply with all provisions outlined in the appropriate state acts, statutes, guidance, provisions, etc., and any decisions regarding the treatment of human remains will be made recognizing the rights of lineal descendants, Tribes, and other Native American Indians and under consultation with the SHPO/THPO(s), designated Tribal Coordinator, and/or other appropriate legal authority for future and expedient disposition or curation. When finds of human remains, funerary objects, sacred objects, or objects of cultural patrimony are encountered or collected from Federal lands or federally recognized tribal lands, the Corps and the DNR will coordinate with the appropriate federally recognized Native Americans, as promulgated by the Native American Graves Protection and Repatriation Act of 1990 (25 U.S.C. § 3001 *et seq.*).

B. Collected artifacts, samples, and other physical objects will be returned to the landowner as real estate, unless owners donate their rights to the Corps or the DNR. In consultation with the SHPO/THPO(s), the Corps and DNR will ensure that all donated artifacts, samples, and other physical objects with related and associated research materials and records resulting from the historic properties studies are curated at a repositories within States of Illinois in accordance with 36 CFR Part 79.

IV. REPORTS

The Corps and the DNR will ensure that all final historic property reports resulting from the actions pursuant to this Agreement will be provided in a format acceptable to the appropriate SHPO(s)/THPO(s). The Corps and DNR will ensure that all such reports are responsive to contemporary standards, and to the Department of the Interior's Format Standards for Final Reports of Data Recovery (42 FR 5377-79). Precise locations of significant historic properties may be provided only in a separate appendix if it appears that the release of this data could jeopardize historic properties. Locations of traditional cultural properties or sacred sites, consisting of architectural, landscapes, objects, or surface or buried archaeological sites, identified in coordination with Tribes and THPO(s), will be considered to be sensitive information and, pursuant to Section 304 of the National Historic Preservation Act, the Corps and the DNR will not make this information available for public disclosure. The Corps and DNR will make available for publication and public dissemination the reports and associated data, minus precise aforementioned locations and sensitive information.

V. PROVISION FOR POST-REVIEW DISCOVERIES

In accordance with 36 CFR Section 800.13, if previously undetected or undocumented historic properties are discovered during project activities, the Corps and the DNR will cease, or cause to stop, any activity having an effect and consult with the SHPO/THPO(s) to determine if additional investigation is required. If further archaeological investigations are warranted or required, the Corps will perform any treatment plan in accordance with Part II - TREATMENT OF HISTORIC PROPERTIES, Part III - TREATMENT OF HUMAN REMAINS, FUNERARY OBJECTS, SACRED OBJECTS, OR OBJECTS OF CULTURAL PATRIMONY, AND CURATED ITEMS, Part IV - REPORTS, and Part V - PROVISION FOR POST-REVIEW DISCOVERIES, all of this Agreement. If the Corps, the DNR, and the SHPO/THPO(s) determine that further investigation is not necessary or warranted, activities may resume with no further action required. Any disagreement between the Corps, the DNR, and the SHPO/THPO(s) concerning the need for further investigations will be handled pursuant to Part VI - DISPUTE RESOLUTION of this Agreement.

VI. DISPUTE RESOLUTION

Should the SHPO/THPO(s) or the Council object within 30 days to any plans or actions provided for review pursuant to this Agreement, the Corps and the DNR will consult with the objecting party to resolve the objection. If the Corps and the DNR determine that the disagreement cannot be resolved, the Corps will request further comment from the Council in accordance with the applicable provisions of 36 CFR Part 800.7. The Corps and the DNR, in accordance with 36 CFR Part 800.7(c)(4), will take any Council comment provided in response into account, with reference only to the subject of the dispute. The Corps' and the DNR's responsibility to carry out all actions under this Agreement that are not the subjects of the dispute will remain unchanged.

VII. TERMINATION

Any of the signatories to this Agreement may request a reconsideration of its terms or revoke the relevant portions of this Agreement upon written notification to the other signatories, by providing 30 days' notice to the other signatories, provided that these signatories will consult during the period prior to termination to seek agreement on amendments or other actions that would avoid termination. In the advent of termination, the Corps and the DNR will comply with 36 CFR Parts 800.3 through 800.7 with regard to individual undertakings covered by this Agreement.

VIII. AMENDMENTS

Any signatories to this Agreement may request that it be amended, whereupon the other signatories parties will consult in accordance with 36 CFR Part 800.13 to consider such amendment.

IX. REPORTING AND PERIODIC REVIEW

The Corps and the DNR will provide the SHPO/THPO(s) with evidence of compliance with this Agreement by letter on January 30, 2002, and once every 2 years thereafter said date. This documentation shall contain the name of the project, title of the documents that contained the Agreement, historic properties identified, determinations of effect, avoidance procedures, level of investigation(s) and/or mitigation(s) conducted with titles of all project reports related to such investigation(s) and/or mitigation(s) which have been completed. Every 5 years starting from the date of January 30, 2002, the Corps and the DNR will provide the SHPO/THPO(s) a review report of the overall IRER to determine this Agreement's effectiveness, accuracy, and economy. Based upon this review, the Corps, the DNR, the SHPO/ THPO(s), and the Council will determine whether the Agreement shall continue in force, be amended, or be terminated.

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X. EXECUTION AND IMPLEMENTATION

A. Nothing in this Agreement is intended to prevent the Corps and the DNR from consulting more frequently with the SHPO/THPO(s) or the Council concerning any questions that may arise or on the progress of any actions falling under or executed by this Agreement. Any resulting modifications to this Agreement will be coordinated in accordance with Section 800.5(e)(5).

B. The undersigned concur that the Corps and the DNR have satisfied their Section 106 responsibilities for all individual undertakings through this Agreement regarding the implementation of IRER.

This Agreement allows the executing parties, agents, and contractors ingress/egress to all the Corps or the DNR lands and/or properties for all IRER related investigations, as promulgated by the NHPA.

XI. SIGNATORIES TO THIS AGREEMENT

A. **CHICAGO DISTRICT, U.S. ARMY CORPS OF ENGINEERS:**

BY: ______________________________ Date: ____________________

Colonel Mark A. Roncoli
District Engineer
U. S. Army Corps of Engineers
Rock Island District

B. **ROCK ISLAND DISTRICT, U.S. ARMY CORPS OF ENGINEERS:**

BY: ______________________________ Date: ____________________

Colonel William J. Bayles
District Engineer
U. S. Army Corps of Engineers
Rock Island District

DRAFT

XI. SIGNATORIES TO THIS AGREEMENT (Continued)

C. **ST. LOUIS DISTRICT, U.S. ARMY CORPS OF ENGINEERS:**

BY: ______________________________ Date: __________________

Colonel Michael R. Morrow
District Engineer
U. S. Army Corps of Engineers
St. Louis District

D. **ILLINOIS DEPARTMENF OF NATURAL RESOURCES:**

BY: ______________________________ Date: __________________

Brent Manning
Director
Illinois Department of Natural Resources

E. **ILLINOIS STATE HISTORIC PRESERVATION OFFICER:**

BY: ______________________________ Date: __________________

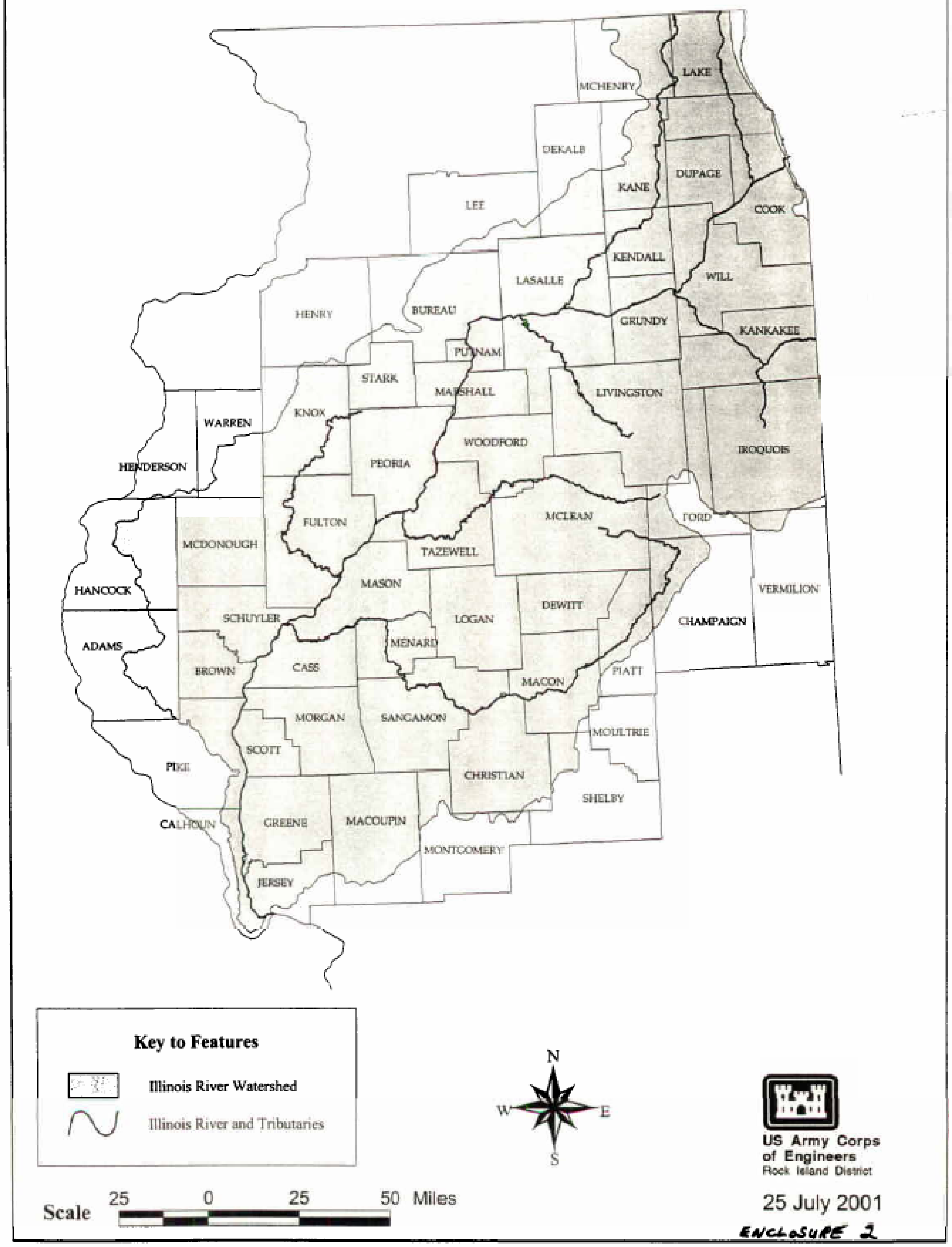
Anne E. Haaker
Illinois Deputy State Historic Preservation Officer
Illinois Historic Preservation Agency

F. **ADVISORY COUNCIL ON HISTORIC PRESERVATION:**

BY: ______________________________ Date: __________________

John M. Fowler
Executive Director
Advisory Council on Historic Preservation

Illinois River Ecosystem Restoration



TRADITIONAL CULTURAL PROPERTY AND SACRED SITE FORM*

The purpose of this form is to document a traditional cultural property and/or sacred site, which may be affected by a project currently proposed. Provided below is information on our proposed project.

1. PROJECT DESCRIPTION: The Chicago, Rock Island, and St. Louis Districts of the U.S. Army Corps of Engineers (Corps) and the Illinois Department of Natural Resources (DNR) have entered into a partnership for the purposes of implementing the Illinois River Ecosystem Restoration (IRER), authorized by Section 216 of the 1970 Flood Control Act and Section 519 (Illinois River Basin Restoration) of Water Resources Development Act of 2000. The Corps and the DNR have determined that the implementation of the IRER may have an effect upon properties listed on, or eligible for inclusion in, the National Register of Historic Places (National Register), and will consult with the Advisory Council on Historic Preservation (Council) and the Illinois State Historic Preservation Officer (SHPO) pursuant to Section 800.14(b) of the regulations (36 CFR Part 800) implementing Section 106 of the National Historic Preservation Act (16 U.S.C. 470[f]), and Section 110(f) of the same Act (16 U.S.C. 470h-2[f]).

2. GENERAL INFORMATION:

2.1. Site or Property Name (if applicable): ____________________

2.2. Address: ____________________

2.3. County: ____________ City: ____________ Zip: ____________

2.4. Federal Agency(s) Responsible: United States Army Corps of Engineers.

2.5. Contact Person on Project: Mr. Ron Deiss, CEMVR-PM-AR, telephone: 1-309-794-5185.

2.6. Return Address: Clock Tower Building, PO Box 2004, Rock Island, Illinois, 61204-2004.

3. TRADITIONAL CULTURAL PROPERTY OR SACRED SITE:

3.1. Check box(es) as appropriate:

☐ **ARCHITECTURE,** ☐ **LANDSCAPE,** ☐ **OBJECT, and/or** ☐ **SURFACE OR ARCHEOLOGY SITE**

3.2 ☐ Yes, ☐ No The project will directly or visually affect an area, building, structure, landscape, object, element, feature, or object 50 years of age or older.

<u>If Yes</u>, please submit this completed form on each such property/site and check below the kinds of project activities which would affect cultural property and/or sacred site :

☐ Rehabilitation ☐ New Construction (e. g., addition); ☐ Yard, sidewalks, plantings;

☐ Demolition; ☐ Vacate/Abandon/Sell;

☐ Other: ____________________

3.3. ☐ Yes ☐ No The project will be affected by excavation and/or ground disturbance.

<u>If yes</u>, please submit all of the following information with this form:

☐ Precise project location map (preferably USGS 7.5 min Quad with name, date, & location);

☐ Site plan showing property or site shape with map legend;

☐ Number of acres or dimensions ____________;

☐ Legal location: Section(s)__________, Township(s)__________ Range(s)__________

☐ Description of historical, architectural, archeological, or cultural significance ____________________

4. DISCLOSURE INFORMATION: The undersigned maintains that the completed information on this form is true and accurate and ☐ can or ☐ cannot be provided as public information; write name ____________________

date __________, affiliation______________, and address____________________

*We are seeking your comments to fulfill cultural resources obligations as set forth in the National Historic Preservation Act of 1966 (Public Law [PL]89-665) as amended: the National Environmental Policy Act of 1969 (PL 91-190); Executive Order (EO) 11593 for the "Protection and Enhancement of the Cultural Environment" (Federal Register, May 13, 1971); the Archaeological and Historical Preservation Act of 1974 (PL 93-291); the Advisory Council on Historic Preservation "Regulations for the Protection of Historic and Cultural Properties" (36 CFR, Part 800); and the applicable National Park Service and Corps of Engineers regulations. ENCLOSURE 3

Illinois River Ecosystem Restoration (IRER)

I (Ron Deiss, PM-A, ext 5185) received a telephone call from Preservation Partners, located in Kane County, Illinois. They desire to be involved in, and be included on, all correspondence regarding the implementing the Illinois River Ecosystem Restoration (IRER) project, authorized by Section 216 of the 1970 Flood Control Act and Section 519 (Illinois River Basin Restoration) of Water Resources Development Act of 2000. In the October 15, 2001 Corps letter to consulting parties, and pursuant to Section 800.3 of the Council's regulations and to meet the responsibilities under the NEPA of 1969, the Corps and the DNR developed a preliminary **Consulting Parties List**. Only those consulting parties that responded to this correspondence will remain on the final Consulting Parties List. Those on the final Consulting Parties List will be provided with study newsletters, public meeting announcements, special releases, and notifications of the availability of report(s), including all draft agreement documentation, as stipulated by 36 CFR Part 800.14(b)(ii) of the NHPA.

The address for Preservation Partners is:

c/o Ms. Liz Safanda
Preservation Partners
P.O. Box 903
St. Charles, Illinois 60174

University of Illinois
at Urbana-Champaign

UNIVERSITY LIBRARY
Illinois Historical Survey
346 Main Library
1408 West Gregory Drive
Urbana, IL 61801

217 333-1777

October 15, 2001

Mr. Ron Deiss
Planning, Programs, and Project Management Division
Rock Island District
Corps of Engineers
Department of the Army
Clock Tower Bldg., P.O. Box 2004
Rock Island, Il. 61204-2004

Dear Mr. Deiss:

Having received a letter of October 5 from Mr. Kenneth A. Barr, regarding plans for the Illinois River Ecosystem Restoration, I would like to request that the Illinois Historical Survey be placed on your mailing list.

I find the project of interest especially because I read in manuscript Professor John Thompson's fascinating study of the history of changes in the Illinois River ecosystem, a study soon to be published.

Thank you,

John Hoffmann

John Hoffmann

LEWIS UNIVERSITY

October 16,2001

Ron Deiss
Planning,Programs ,and Project Management Division
Dept. of the Army
Rock Island District Corps of Engineers
Rock Island ,Ill.61204-2004

Dear Mr. Deiss:

I recently recieved the Army Corps Distribution on the Illinois River Project called IRER.It was addressed to the Illinois Canal Society. That organization has turned its files etc. over to the Lewis University Canal & Regional History Collection. This large collection has many maps etc. relating to the Illinois River,also reports dating back to the constuction of the Illinois and Michigan Canal.From this collection I recently wrote an article on the mapping of the Illinois River 1674 to 1951 to be published in the Wetlands Initiative sometime soon.

For all these reasons we would like to be placed on your mailing list in regard to the Illinois Ecosystem Restoration in place of the Illinois Canal Society.

Yours truly,

John Lamb

John Lamb, Director
Canal and Regional History Collection
Ext. 2279

One University ~~Place~~ Parkway
[redacted] · Romeoville, IL 60446.2298 · 815.838.0500 · FAX 815.838.9456
A Christian Brothers University

United States Department of the Interior

ILLINOIS & MICHIGAN CANAL
National Heritage Corridor Commission
201 West Tenth Street, #1-SE
Lockport, Illinois 60441
(815) 588-6040

IN REPLY REFER TO:

H24-15(ILMI)

October 18, 2001

Department of the Army
Rock Island District, Corps of Engineers
Clock Tower Building
P.O. Box 2004
Rock Island, IL 61204-2004

Attention: Planning, Programs, and Project Management Division (Ron Deiss)

Thank you for the information provided on plans to implement the Illinois River Ecosystem Restoration (IRER). The Illinois & Michigan Canal National Heritage Corridor Commission wishes to be included on the final Consulting Parties List for this undertaking, as the Illinois & Michigan Canal forms a significant part of the historical water resources of the region.

We have only one comment at the time on the draft PA, regarding Section II., Treatment of Historic Properties. If paragraph A of that section is intended to identify the major known historical properties and districts in the project area, then it should also include the Illinois & Michigan Canal, which is a National Historic Landmark, and which functioned between Chicago and LaSalle/Peru. Extensive documentation is available on this resource and its components, including documentation by the Historic American Engineering Record (HAER) and Historic American Buildings Survey (HABS).

Sincerely,

Phyllis M. Ellin
Executive Director

cc: Anne Haaker, IHPA

FORD COUNTY HISTORICAL SOCIETY

October 20, 2001

DEPARTMENT OF THE ARMY
U.S.Army Engineering District, Rock Island
Clock Tower Bldg, - P.O. Box 2004
Rock Island, IL 61204-2004

ADDRESS CORRECTION:

Thank you for your mailing of Oct. 9, 2001, DISTRIBUTION LISTS, etc.

FORD CNTY HISTORICAL SOCIETY
~~10 MERIDIAN TERRACE~~
PAXTON IL 60957

Please correct your record of our address, for the one you have was the residence of our Executive Director who is deceased, and none of our members live at that address.

Please use address:
FORD CNTY HISTORICAL SOCIETY
201 West State St.
P.O. BOX 115
Paxton, IL 60957-0115

Thank you.

James F. Anderson
James F. Anderson

RECEIVED
OCT 22 2001
CEMVR-OD-P

POST OFFICE BOX ~~215~~ 115 PAXTON, ILLINOIS 60957

TRADITIONAL CULTURAL PROPERTY AND SACRED SITE FORM*

The purpose of this form is to document a traditional cultural property and/or sacred site, which may be affected by a project currently proposed. Provided below is information on our proposed project.

1. PROJECT DESCRIPTION: The Chicago, Rock Island, and St. Louis Districts of the U.S. Army Corps of Engineers (Corps) and the Illinois Department of Natural Resources (DNR) have entered into a partnership for the purposes of implementing the Illinois River Ecosystem Restoration (IRER), authorized by Section 216 of the 1970 Flood Control Act and Section 519 (Illinois River Basin Restoration) of Water Resources Development Act of 2000. The Corps and the DNR have determined that the implementation of the IRER may have an effect upon properties listed on, or eligible for inclusion in, the National Register of Historic Places (National Register), and will consult with the Advisory Council on Historic Preservation (Council) and the Illinois State Historic Preservation Officer (SHPO) pursuant to Section 800.14(b) of the regulations (36 CFR Part 800) implementing Section 106 of the National Historic Preservation Act (16 U.S.C. 470[f]), and Section 110(f) of the same Act (16 U.S.C. 470h-2[f]).

2. GENERAL INFORMATION:

2.1. Site or Property Name (if applicable): La Salle County Historical Museum

2.2. Address: Mill + Canal st, P.O. Box 278

2.3. County: La Salle City: Utica, Il. Zip: 61373

2.4. Federal Agency(s) Responsible: United States Army Corps of Engineers.

2.5. Contact Person on Project: Mr. Ron Deiss, CEMVR-PM-AR, telephone: 1-309-794-5185.

2.6. Return Address: Clock Tower Building, PO Box 2004, Rock Island, Illinois, 61204-2004.

3. TRADITIONAL CULTURAL PROPERTY OR SACRED SITE:

3.1. Check box(es) as appropriate:

☒ **ARCHITECTURE,** ☐ **LANDSCAPE,** ☐ **OBJECT, and/or** ☐ **SURFACE OR ARCHEOLOGY SITE**

3.2 ☒ Yes, ☐ No The project will directly or visually affect an area, building, structure, landscape, object, element, feature, or object 50 years of age or older.

If Yes, please submit this completed form on each such property/site and check below the kinds of project activities which would affect cultural property and/or sacred site :

☐ Rehabilitation ☐ New Construction (e. g., addition); ☐ Yard, sidewalks, plantings;

☐ Demolition; ☐ Vacate/Abandon/Sell;

☒ Other: Historic site located on Il. + Michigan Canal, Heritage Corridor

3.3. ☐ Yes ☐ No The project will be affected by excavation and/or ground disturbance.

If yes, please submit all of the following information with this form:

☐ Precise project location map (preferably USGS 7.5 min Quad with name, date, & location);

☐ Site plan showing property or site shape with map legend;

☐ Number of acres or dimensions____________;

☐ Legal location: Section(s)______, Township(s)______ Range(s)______

☐ Description of historical, architectural, archeological, or cultural significance ____________

4. DISCLOSURE INFORMATION: The undersigned maintains that the completed information on this form is true and accurate and ☐ can or ☐ cannot be provided as public information; write name Mary Tornasson

date 10-23-01, affiliation Director, and address____________

*We are seeking your comments to fulfill cultural resources obligations as set forth in the National Historic Pres- (Public Law [PL]89-665) as amended: the National Environmental Policy Act of 1969 (PL 91-190); Executive Orc "Protection and Enhancement of the Cultural Environment" (Federal Register, May 13, 1971); the Archaeolo Preservation Act of 1974 (PL 93-291); the Advisory Council on Historic Preservation "Regulations for the Protecti Cultural Properties" (36 CFR, Part 800); and the applicable National Park Service and Corps of Engineers regulations.

PALOS HISTORICAL SOCIETY
c/o PALOS PARK PUBLIC LIBRARY
12330 Forest Glen Boulevard
Palos Park, Illinois 60464

October 24, 2001

Department of the Army
Attention: Planning, Programs, and Project Management Division
Rock Island Corps of Engineers
Clock Tower Building – PO Box 2004
Rock Island, Illinois 61204-2004

Gentlemen:

With reference to your letter of October 5, 2001 concerning your project to implement the Illinois River Ecosystem Restoration Act, please place the Palos Historical Society on your final Consulting Parties List. Thank you.

Sincerely,

William Poore
Secretary

cc: Robert Hazel
President, Palos Historical Society

Illinois Historic
Preservation Agency

1 Old State Capitol Plaza • Springfield, Illinois 62701-1507 • (217) 782-4836 • TTY (217) 524-7128

Various County
Illinois
Illinois River Ecosystem Restoration
Illinois River Watershed (54 counties)
IHPA LOG #0110100006WVA

October 25, 2001

Mr. Kenneth A. Barr
U.S. Army Corps of Engineers, Rock Island District
Chief, Economic & Environmental Analysis Branch
Clock Tower Building/P.O. Box 2004
Rock Island, IL 61204-2004

Dear Sir:

We have reviewed the Draft Programmatic Agreement (P.A.) regarding the implementation of the Illinois River Ecosystem Restoration. We concur that undertakings implemented under this program in accordance with the stipulations of the P.A. will adequately take into account the Corps' and IDNR's responsibilities under Section 106 of the National Historic Preservation Act of 1966, as amended. We look forward to receiving the Final P.A. for signature and the subsequent implementation of this agreement.

Sincerely,

Anne E. Haaker

Anne E. Haaker
Deputy State Historic
Preservation Officer

AEH:CW

SAC AND FOX NAGPRA CONFEDERACY

"MESKWAKI"
Sac and Fox of the Mississippi in Iowa
349 Meskwaki Rd
Tama, IA 52339-9629
515-484-4678
Fax: 515-484-5358
Contact:
Johnathan L. Buffalo

Sac and Fox Nation of Missouri in Kansas and Nebraska
305 N Main
Reserve, KS 66434
785-742-7471
Fax: 785-742-2979
Contact: Deanne Bahr

Sac and Fox Nation of Oklahoma
Rt. 2 Box 246
Stroud, OK 74079
918-968-2353
Fax: 918-968-2353
Contact: Sandra Massey

November 26, 2001

Department of the Army
Rock Island District, Corps of Engineers
Clock Tower Building – P.O. Box 2004
Rock Island, Illinois 61204-2004
ATTN: Planning, Programs, and Project Management Division
(Ron Deiss)

Dear Mr. Diess:

Thank you for your letter, which is in compliance with Section 106 of the National Historic Preservation Act, and Section 110.

The main contact group of the Sac and Fox in issues that result in inadvertent finds of human remains or funerary objects pertaining to:

The Chicago, Rock Island, and St. Louis Districts of the U.S. Army Corps of Engineers (Corps) and the State of Illinois Department of Natural Resources (DNR) have entered into a partnership for the purposes of implementing the Illinois River Ecosystem Restoration (IRER) project,

will be Johnathan Buffalo of the Sac and Fox Tribe of Mississippi in Iowa. Mr. Buffalo's number is 515-484-4678.

Sincerely,

Deanne Bahr
Deanne Bahr
Sac and Fox Nation of Missouri
NAGPRA Contact Representative

Illinois
Department of
Natural Resources

http://dnr.state.il.us

524 South Second Street, Springfield, Illinois 62701-1787

George H. Ryan, Governor • Brent Manning, Director

December 13, 2001

Mr. Ron Diess
Economic and Environmental Analysis Branch
Department of the Army
Rock Island District, Corps of Engineers
Clock tower Building
P.O. Box 2004
Rock Island, Illinois 61204-2004

Dear Ron,

Enclosed is a modified version of the draft Programmatic Agreement for the Illinois River Ecosystem Restoration project. Essentially, the Illinois Department of Natural Resources desires to be a participant to the Programmatic Agreement but does not think it should have responsibility for the administration of Historic Properties. Consequently, I have deleted appropriate references to DNR. As we discussed, it is expected that DNR will be consulted when archaeological investigations are conducted on DNR property. It is also expected that DNR will have an opportunity to review and comment on all archaeological work conducted on DNR property.

Under separate cover I will provide you with a permit to conduct archaeological work on DNR property that will apply to the Illinois River Ecosystem Restoration project.

If I can be of further assistance, please let me know.

Sincerely,

Harold Hassen, Ph.D.
Cultural Resource Coordinator
Division of Resource Review and Coordination

PEORIA TRIBE OF INDIANS OF OKLAHOMA
118 S. Eight Tribes Trail (918) 540-2535 FAX (918) 540-2538
P.O. Box 1527
MIAMI, OKLAHOMA 74355

CHIEF
John P. Froman

SECOND CHIEF
Joe Goforth

February 19, 2002

Kenneth A. Barr
Chief, Economic & Environmental Analysis Branch
Rock Island District Corps of Engineers
Clock Tower Building PO Box 2004
Rock Island, Ill 61204-2004

RE: Illinois River Ecosystem Restoration Project

Thank you for notice of the referenced project. The Peoria Tribe of Indians of Oklahoma is currently unaware of any documentation directly linking Indian Religious Sites to the Illinois River Ecosystem Project. In the event any items falling under the Native American Graves Protection and Repatriation Act (NAGPRA) are discovered during construction, the Peoria Tribe request notification and further consultation.

The Peoria Tribe has no objection to the proposed construction. However, if any human skeletal remains and/or any objects falling under NAGPRA are uncovered during construction, the construction should stop immediately, and the appropriate persons, including state and tribal NAGPRA representatives contacted.

John P. Froman
Chief

xc: Bud Ellis, Repatriation/NAGPRA Committee Chairman

DEPARTMENT OF THE ARMY
ROCK ISLAND DISTRICT. CORPS OF ENGINEERS
CLOCK TOWER BUILDING - P.O. BOX 2004
ROCK ISLAND, ILLINOIS 61204-2004

REPLY TO
ATTENTION OF

October 16, 2002

Planning, Programs, and
Project Management Division (310-2d)

Mr. Brent Manning
Director
Illinois Department of Natural Resources
One Natural Resources Way
Springfield, Illinois 62702-1271

Dear Mr. Manning:

The Chicago, Rock Island, and St. Louis Districts of the U.S. Army Corps of Engineers (Corps) and the State of Illinois Department of Natural Resources (DNR) have entered into a partnership for the purposes of implementing the Illinois River Ecosystem Restoration (IRER) project, authorized by Section 216 of the 1970 Flood Control Act and Section 519 (Illinois River Basin Restoration) of the Water Resources Development Act of 2000.

The Corps and the Illinois DNR have determined that the implementation of the IRER may have an effect upon properties listed on, or eligible for listing on, the National Register of Historic Places (NRHP). The Corps and the Illinois DNR have consulted with the Advisory Council on Historic Preservation (Council) and the Illinois State Historic Preservation Officer (SHPO) pursuant to Section 800.14(b) of the regulations (36 CFR Part 800) implementing Section 106 of the National Historic Preservation Act (16 U.S.C. 470[f]) (NHPA), and Section 110(f) of the same Act (16 U.S.C. 470h-2[f]) (see enclosed Fact Sheet, Enclosure 1).

Pursuant to Section 800.3 of the Council's regulations and to meet the responsibilities under the National Environmental Policy Act of 1969 (NEPA), the Corps and the Illinois DNR developed a preliminary **Consulting Parties List** comprised of 325 parties, including 47 federally recognized Native American Tribes. Only those consulting parties that responded to the initial correspondence (dated October 5, 2001) to participate in the consultation process remained on the final **Consulting Parties List** (Enclosure 2). The final **Consulting Parties List** allows for agencies, tribes, individuals, organizations, and other interested parties an opportunity to provide views on any effects of this undertaking on historic properties resulting from the IRER and implementation of the ***PROGRAMMATIC AGREEMENT*** *Among the Chicago, Rock Island, and St. Louis Districts of the U.S. Army Corps of Engineers, the State of Illinois Department of Natural Resources, the Illinois State Historic Preservation Officer, and the Advisory Council on Historic Preservation, Regarding Implementation of the Illinois River Ecosystem Restoration* (PA).

Enclosure 3 is correspondence received from the Illinois DNR, the Illinois Historic Preservation Agency (IHPA), and other consulting parties (in chronological order). All comments were taken in consideration during the development of the final draft of the PA.

Those on the enclosed final **Consulting Parties List** will be provided with study news-letters, public meeting announcements, special releases, and notifications of the availability of report(s), as stipulated by 36 CFR Part 800.14(b)(ii) of the NHPA. The Corps and the Illinois DNR will execute the PA, as stipulated by 36 CFR Part 800.14(b)(ii) of the NHPA, to afford protection to known and unknown historic properties accorded by the NHPA. The executed PA will be in every NEPA document resulting from the IRER, as evidence of the Corps and the Illinois DNR's compliance promulgated by the NHPA and the consulting process.

The enclosed PA (Enclosure 4) has been signed by the Commanders of the Corps' Chicago, Rock Island, and St. Louis Districts participating with the Illinois DNR in the IRER program. The Corps requests Mr. Brent Manning, Director of the Illinois DNR, to sign the PA in support of the IRER program in partnership with the Corps. Following signature, the Corps requests that the Illinois DNR forward the PA to the IHPA (in the envelope provided). The Corps appreciates the efforts of the Illinois DNR and the IHPA in executing this PA and in fulfilling our require-ments promulgated under the NHPA and NEPA.

By copy of this letter forwarding the original executed PA to the Illinois DNR, the Corps requests that the IHPA refer to past compliance correspondence on this subject (IHPA LOG #0110100006WVA) and that Deputy SHPO Ms. Anne Haaker please sign the PA when it is forwarded from the Illinois DNR. The Corps and the Illinois DNR appreciate the contributions of the IHPA and Ms. Haaker. Upon signature of the original PA by the Deputy SHPO, the Corps directs the IHPA to return the original signed PA to Mr. Ron Deiss at the Corps' Rock Island District (in the envelope provided) for final execution by the Council.

If you have questions concerning the IRER and the execution of the PA, or the Corps and the Illinois DNR's coordination procedures and efforts promulgated by the NHPA, please call Mr. Ron Deiss of our Economic and Environmental Analysis Branch, telephone 309/794-5185, or write to our address above, ATTN: Planning, Programs, and Project Management Division (Ron Deiss).

Sincerely,

ORIGINAL SIGNED BY
John P. Carr
Acting Chief, Economic and
Environmental Analysis Branch

Enclosures

Copies Furnished:

Ms. Anne Haaker
Deputy State Historic Preservation Officer
Illinois Historic Preservation Agency
1 Old State Capitol Plaza
Springfield, Illinois 62701 (with/enclosures 1-3)

Dr. Harold Hassen
Illinois Department of Natural Resources
One Natural Resource Way
Springfield, Illinois 62702-1271 (with enclosures 1-3)

ATTN: Mr. Thomas McCullouch
C/o Mr. Don L. Klima, Director
Eastern Office of Project Review
The Old Post Office Building
1100 Pennsylvania Avenue, NW., Suite 809
Washington, D.C. 20004 (with enclosures 1-3)

ATTN: CEMVD-MD-PR (Ms. Carroll Johnson)
Commander
U.S. Army Engineer Division, Mississippi Valley
1400 Walnut Street
P.O. Box 80
Vicksburg, Mississippi 39181-0080 (with enclosures 1-3)

ATTN: CEMVS-PM-EA (Mr. Terry Norris)
Commander
U.S. Army Engineer District, St. Louis
1222 Spruce Street
St. Louis, Missouri 63101-2833 (with enclosures 1-3)

ATTN: CELRC-PM-PS (Mr. Keith G. Ryder)
Commander
U.S. Army Engineer District, Chicago
111 North Canal Street
Chicago, Illinois 60606 (with enclosures 1-3)

FACT SHEET
Illinois River Ecosystem Restoration (IRER) Project

The Chicago, Rock Island, and St. Louis Districts of the U.S. Army Corps of Engineers (Corps) and the State of Illinois Department of Natural Resources (DNR) have prepared for execution the final *Programmatic Agreement Among the Chicago, Rock Island, and St. Louis Districts of the U.S. Army Corps of Engineers, the State of Illinois Department of Natural Resources, the Illinois State Historic Preservation Officer, and the Advisory Council on Historic Preservation, Regarding Implementation of the Illinois River Ecosystem Restoration.* The execution of this Programmatic Agreement by the signatories forms a partnership for the purposes of implementing the Illinois River Ecosystem Restoration (IRER) project, authorized by Section 216 of the 1970 Flood Control Act and Section 519 (Illinois River Basin Restoration) of the Water Resources Development Act of 2000.

The Corps and the Illinois DNR have determined that the implementation of the IRER may have an effect upon properties listed on, or eligible for listing on, the National Register of Historic Places (NRHP), and will consult with the Advisory Council on Historic Preservation (Council), the Illinois State Historic Preservation Officer (SHPO), and other consulting parties pursuant to Section 800.14(b) of the regulations (36 CFR Part 800) implementing Section 106 of the National Historic Preservation Act (NHPA) (16 U.S.C. 470[f]), and Section 110(f) of the same Act (16 U.S.C. 470h-2[f]). The Corps and the Illinois DNR have previously invited the SHPO, Council, Tribal Historic Preservation Officers, and any other interested parties to participate in the consultation process and in the development of the final Programmatic Agreement for the IRER.

The IRER encompasses the reach of the Illinois River watershed located in the State of Illinois (54 counties) (see enclosed map) with two types of efforts: (1) system evaluations focused on assessing the overall watershed needs and general locations for restoration and (2) site-specific evaluations focused on developing detailed restoration options for possible implementation at specific sites by project planning, engineering, construction, and monitoring, with interdisciplinary and collaborative planning for habitat restoration, preservation, and enhancement. The Corps and the Illinois DNR will manage the IRER throughout all stages of individual habitat project development, restoration, construction, and management. Several other Federal agencies, as well as non-government entities and individual citizens, also will regularly participate in the development of projects within the IRER.

Pursuant to Section 800.3 of the Council's regulations and to meet the responsibilities under the National Environmental Policy Act of 1969 (NEPA), the Corps and the Illinois DNR developed a preliminary Consulting Parties List. The preliminary Consulting Parties List, comprised of 325 parties, included 47 federally recognized tribes. Although the IRER presently lies entirely within the State of Illinois, consulting parties from elsewhere in the United States are given equal and due consideration. Since the Corps remains unaware of any lands held in Federal trust or of any Federal trust responsibilities for Native American Indians within the Illinois River watershed, the Corps requested any information concerning our Federal trust responsibilities.

Enclosure 1

Those on the list were asked to comment on earlier drafts of the Programmatic Agreement and submit a request to be placed on the final Consulting Parties List. Those on the final Consulting Parties List will be provided with study newsletters, public meeting announcements, special releases, and notifications of the availability of report(s), including all draft agreement documentation, as stipulated by 36 CFR Part 800.14(b)(ii) of the NHPA. Consulting parties may request correspondence on future topics relevant to compliance concerning IRER and to provide comments. Comments on the IRER program or projects received by the Corps and the Illinois DNR will be taken into account when finalizing plans for the IRER, as promulgated by the NHPA.

The Corps is concerned about impacts to those traditional cultural properties and sacred sites recognized by Native Americans, tribes, ethnic and religious organizations, communities, and other groups as potentially affected by the IRER. Presently, the Corps is unaware of any traditional cultural properties or sacred sites within the Illinois River watershed. Those on the preliminary Consulting Parties List were asked to notify the Corps about traditional cultural properties or potential effects known or identified. To facilitate tribal coordination, the Corps asked those on the preliminary Consulting Parties List to refer to the National Park Service, NRHP Bulletin 38, Guidelines for Evaluating and Documenting Traditional Cultural Properties and were provided with a Traditional Cultural Property and Sacred Site Form developed by the Corps for the IRER. Traditional Cultural Property location and ancillary information may not be disclosed to the public pursuant to Section 304 of the NHPA.

The Corps and the Illinois DNR propose to execute the Programmatic Agreement, as stipulated by 36 CFR Part 800.14(b)(ii) of the NHPA to afford protection to known and unknown historic properties accorded by the NHPA. As regulated by 36 CFR Part 800.8(c)(1), the executed Programmatic Agreement will be used within reports promulgated under NEPA.

Questions concerning the IRER Programmatic Agreement, the final Consulting Parties List, or the Corps and the Illinois DNR coordination procedures and efforts promulgated by the NHPA, can be addressed to Mr. Ron Deiss of the Rock Island District's Economic and Environmental Analysis Branch, by telephoning 309/794-5185, or by writing to the following address: ATTN: Planning, Programs, and Project Management Division (Ron Deiss), U.S. Army Engineer District, Rock Island, Clock Tower Building, P.O. Box 2004, Rock Island, Illinois 61204-2004.

END

Consulting Parties List

Illinois River Ecosystem Restoration (IRER)

Mr. John Hoffman
University of Illinois at Urbana-Champaign
University Library
Illinois Historical Survey
346 Main Library
1408 West Gregory Drive
Urbana, Illinois 61801

Mr. John Lamb
Director
Canal and Regional History Collection
Lewis University
One University Parkway
Romeoville, Illinois 60446-2298

Ms. Phyllis M. Ellin
Executive Director
United States Department of the Interior
Illinois & Michigan Canal
National Heritage Corridor Commission
201 West Tenth Street, #1-SE
Lockport, Illinois 60441

Mr. James F. Anderson
Ford County Historical Society
201 West State Street
P.O. Box 115
Paxton, Illinois 60957-0115

Director
La Salle County Historical Museum
Mill & Canal Street
P.O. Box 278
Utica, Illinois 61373

Mr. William Poore
Secretary
Palos Historical Society
c/o Palos Public Library
12330 Forest Glen Boulevard
Palos Park, Illinois 60464

Mr. Johnathan Buffalo
Sac and Fox Tribe of the Mississippi in Iowa
349 Meskwaki Road
Tama, Iowa 52339-9629

Mr. John P. Froman
Chief
Peoria Tribe of Indians of Oklahoma
118 S. Eight Tribes Trail
P.O. Box 1527
Miami, Oklahoma 74355

Ms. Liz Safanda
Preservation Partners
P.O. Box 903
St. Charles, Illinois 60174

Enclosure 2

PROGRAMMATIC AGREEMENT

Among the
Chicago, Rock Island, and St. Louis Districts of the U.S. Army Corps of Engineers,
the State of Illinois Department of Natural Resources,
the Illinois State Historic Preservation Officer,
and the Advisory Council on Historic Preservation,
Regarding Implementation of the
Illinois River Ecosystem Restoration

WHEREAS, the Chicago, Rock Island, and St. Louis Districts of the U.S. Army Corps of Engineers (hereafter, Corps) and the State of Illinois Department of Natural Resources (hereafter DNR) determined that the Illinois River watershed exhibits loss of aquatic habitat and have entered into a partnership for the purpose of implementing the Illinois River Ecosystem Restoration (IRER) authorized by Section 216 of the 1970 Flood Control Act and Section 519 (Illinois River Basin Restoration) of the Water Resources Development Act of 2000; and

WHEREAS, the Corps and the DNR have determined that the implementation of the IRER may have an effect upon properties listed on, or eligible for listing on, the National Register of Historic Places (National Register), and have consulted with the Advisory Council on Historic Preservation (Council) and the Illinois State Historic Preservation Officer (SHPO) pursuant to Section 800.14(b) of the regulations (36 CFR Part 800) implementing Section 106 of the National Historic Preservation Act (16 U.S.C. 470[f]), and Section 110(f) of the same Act (16 U.S.C. 470h-2[f]); and

WHEREAS, the IRER study area encompasses the entire Illinois River watershed located in Illinois (54 counties) with two types of efforts: (1) system evaluations focused on assessing the overall watershed needs and general locations for restoration and (2) site-specific evaluations focused on developing detailed restoration options for possible implementation at specific sites by project planning, engineering, construction, and monitoring with interdisciplinary and collaborative planning for habitat restoration, protection, preservation, and enhancement. The Corps and the DNR will manage the IRER throughout all stages of individual habitat project development, restoration, and management. Several other Federal agencies, as well as non-government entities and individual citizens, also will regularly participate in the development of projects within the IRER; and

WHEREAS, the study area includes four IRER areas identified as (1) watershed stabilization, (2) side channel and backwater modification, (3) water level management, and (4) floodplain restoration and protection. The focus areas will be implemented by habitat creation (islands, ponds, wetlands, potholes, channels, backwaters, etc.), flow control structures (grade

Enclosure 4

controls, dams, dikes, detention basins, weirs, riffles, fish passage, levees, etc.), habitat enhancements (anchor trees, stumps, plantings, management of timber and forest stands, regulation of water levels, etc.), and structure removals/modifications (snagging, clearing, dikes, borrowing, trenching, dredging, etc.); and

WHEREAS, pursuant to Section 800.3 of the Council's regulations, and to meet the Corps' and DNR's responsibilities under the National Environmental Policy Act of 1969, the Corps has developed a **Consulting Parties List** which was developed in consultation with the SHPO/Tribal Historic Preservation Officers (THPOs), Tribes, and other parties that may have an interest in the effects of this undertaking on historic properties. Those on the **Consulting Parties List,** comprised of 325 parties, including 47 federally recognized Tribes, were asked to comment on earlier drafts of this Programmatic Agreement or be provided with study newsletters, public meeting announcements, special releases, and notifications of the availability of report(s), including all draft agreement documentation, as stipulated by 36 CFR Part 800.14(b)(ii) of the National Historic Preservation Act. Comments received by the Corps were taken under consideration in developing this Programmatic Agreement; and

WHEREAS, the Corps has provided scholarly evidence of stewardship in the recordation, protection, and management of historic properties along the Illinois Waterway System through systemic research and studies which have been finalized and approved, then placed in the permanent files of the Corps and SHPO as evidence of compliance promulgated under Section 106 of the National Historic Preservation Act, as amended, and its implementing regulations, 36 CFR Part 800: "Protection of Historic Properties." [These studies included: (1) archeological studies (management of documented and undocumented historic properties), (2) architectural and engineering studies (buildings, structures, and objects associated with Multiple Property National Register Districts), (3) erosion studies, (4) land form sediment assemblage studies (geomorphology) and (5) submerged historic property study (historic shipwrecks and other underwater or previously inundated historic properties)]; and

NOW, THEREFORE, the Corps, the DNR, the SHPO, and the Council agree that the undertakings authorized under Section 216 of the 1970 Flood Control Act and Section 519 (Illinois River Basin Restoration) of the Water Resources Development Act of 2000 shall be implemented in accordance with the following stipulations:

I. IDENTIFICATION AND EVALUATION OF HISTORIC PROPERTIES

The Corps will ensure that the following measures are implemented:

A. The Corps will take all measures necessary to discover, preserve, and avoid significant historic properties listed on, or eligible for listing on, the National Register, burials, cemeteries, or sites likely to contain human skeletal remains/artifacts and objects associated with interments or religious activities, and provide this information, studies, and/or reports to the SHPO/THPO.

Under consultation with the SHPO/THPO(s) and the other consulting parties, the Corps will describe and define the Area of Potential Effect (hereafter referred to as the APE) in accordance with the definition contained in 36 CFR Part 800.16(d). The APE may be modified upon consultation with the appropriate SHPO(s)/THPO(s) through avoidance documented through the implementation of historic property surveys and testing, documentary research, recordation, and other investigation data.

B. Unless recent and modern ground surface disturbances and/or historic use can be documented and a determination made by the Corps, in consultation with the SHPO/THPO(s) and the other consulting parties, that there is little likelihood that historic properties will be adversely affected, the Corps will then conduct a historic property (reconnaissance) survey in (1) areas with the potential for containing submerged or deeply buried historic properties and (2) areas indirectly and directly affected by construction, use, maintenance, and operation during the implementation of the IRER program.

C. The Corps will ensure that all reconnaissance surveys and subsurface testing are conducted in a manner consistent with the Secretary of the Interior's Standards and Guidelines for Identification and Evaluation (48 FR 44720-23) and take into account the National Park Service publication The Archaeological Survey: Methods and Uses (1978) and any extant or most recent version of appropriate SHPO(s)/THPO(s) guidelines for historic properties reconnaissance surveys/reports, related guidance, etc. The reconnaissance surveys and subsurface testing will be implemented by the Corps and monitored by the SHPO/THPO(s).

D. In consultation with the SHPO, the appropriate THPO(s), and the other consulting parties, the Corps will evaluate for eligibility all significant historic properties by applying the National Register criteria (36 CFR Part 60.4). The Corps will use its archival documentation as a context in which to make National Register evaluations of historic properties.

1. For those properties that the Corps, the SHPO/THPO(s), and the other consulting parties agree are not eligible for inclusion on the National Register, no further historic properties investigations will be required, and the project may proceed in those areas.

2. If the survey results in the identification of properties that the Corps, the SHPO/THPO(s), and the other consulting parties agree are eligible for inclusion on the National Register, the Corps shall treat such properties in accordance with Part II below.

3. If the Corps, the SHPO/THPO(s), and the other consulting parties do not agree on National Register eligibility, or if the Council or the National Park Service so request, the Corps will request a formal determination of eligibility from the Keeper of the National Register, National Park Service, whose determination shall be final.

4. Relative to the treatment of historic properties and the identification of traditional cultural properties, the Corps will continue to provide the appropriate Tribe(s), the THPO(s), and the other consulting parties information related to treatment measures proposed by the Corps. Consideration of comments received by the Corps can be considered by the signatories to be measures to assist the Corps in meeting its responsibilities under the National Historic Preservation Act of 1966, as amended (Public Law 89-665), and the regulations of the Advisory Council on Historic Preservation, "Regulations for the Protection of Historic and Cultural Properties" (36 CFR, Part 800).

II. TREATMENT OF HISTORIC PROPERTIES

Those individual historic properties and multiple property districts that the Corps, the SHPO/ THPO(s), and the other consulting parties agree are eligible for nomination to, or that the Keeper has determined eligible for inclusion on, the National Register, will be treated by the Corps in the following manner:

A. Archival Documentation of the Construction and Operation of the Historic Locks and Dams and Management of Historic Properties: The Corps has provided scholarly evidence of stewardship in the recordation, protection, and management of historic properties along the Illinois Waterway System through systemic research and studies which have been finalized and approved, then placed in the permanent files of the Corps and SHPO. These studies included: (1) archeological studies (management of documented and undocumented historic properties), (2) architectural and engineering studies (buildings, structures, and objects associated with Multiple Property National Register-eligible **Illinois Waterway Navigation System Facilities**, (3) land form sediment assemblage studies (geomorphology), and (4) submerged historic property study (historic shipwrecks and other underwater or previously inundated historic properties).

B. Treatment of Archaeological Historic Properties:

1. If the Corps determines, in consultation with the SHPO/THPO(s) and the other consulting parties, that no other actions are feasible to avoid and minimize effects to archaeological historic properties, then the Corps will develop a treatment plan, which may include various levels of data recovery, recordation, documentation, and active protection measures. The Corps will implement the treatment plan in consultation with the SHPO/THPO(s) and the other consulting parties.

2. If data recovery is the agreed upon treatment, the data recovery plan will address substantive research questions developed in consultation with the SHPO/ THPO(s) and the other consulting parties. The treatment plan shall be consistent with the Secretary of the Interior's Standards and Guidelines for Archaeological Documentation (48 FR 44734-37) and take into

account the Council's publication, Treatment of Archaeological Properties (Advisory Council on Historic Preservation, 1980) and SHPO/THPO(s) guidance. It will specify, at a minimum, the following:

a. The property, properties, or portions of properties where the treatment plan is to be carried out;

b. The research questions to be addressed, with an explanation of research relevance and importance;

c. The methods to be used, with an explanation of methodological relevance to the research questions;

d. Proposed methods of disseminating results of the work to the interested public; and,

e. A proposed schedule for the submission of progress reports to the SHPO/THPO(s).

3. The Corps will submit the treatment plan to the SHPO/THPO(s) and the other consulting parties for 30 days' review and comment. The Corps will take into account SHPO/THPO(s) and the other consulting parties' comment(s), and will ensure that the data recovery plan is implemented. The SHPO/THPO(s) and the other consulting parties may monitor this implementation.

4. The Corps will ensure that the treatment plan is carried out by or under the direct supervision of an archaeologist(s), architectural historian(s) and/or other appropriate cultural resource specialist that meets, at minimum, the Secretary of the Interior's Professional Qualifications Standards (48 FR 44738-9).

5. The Corps will ensure that adequate provisions, including personnel, time, and laboratory space are available for the analysis and curation of recovered materials from historic properties.

6. The Corps will develop and implement an adequate program in consultation with the SHPO/THPO(s) and the other consulting parties to secure archaeological historic properties from vandalism during data recovery.

III. TREATMENT OF HUMAN REMAINS, FUNERARY OBJECTS, SACRED OBJECTS, OR OBJECTS OF CULTURAL PATRIMONY, AND CURATED ITEMS

A. When human remains, funerary objects, sacred objects, or objects of cultural patrimony are encountered or collected, the Corps will comply with all provisions outlined in the appropriate state acts, statutes, guidance, provisions, etc., and any decisions regarding the treatment of human remains will be made recognizing the rights of lineal descendants, Tribes, and other Native American Indians and under consultation with the SHPO/THPO(s) and the other consulting parties, designated Tribal Coordinator, and/or other appropriate legal authority for future and expedient disposition or curation. When finds of human remains, funerary objects, sacred objects, or objects of cultural patrimony are encountered or collected from Federal lands or federally recognized tribal lands, the Corps will coordinate with the appropriate federally recognized Native American Tribes, pursuant to the Native American Graves Protection and Repatriation Act of 1990 (25 U.S.C. § 3001 *et seq.*) and its implementing regulations (43 CFR Part 10).

B. Cemeteries.

1. Any project activities that affect burials shall comply with state and local burial and cemetery laws. The county coroner shall be notified of the discovery of any human remains within 48 hours (5ILCS 5/2 and 20 ILCS 3440). The City shall notify the SHPO in order to obtain the proper permit prior to removal of remains. Burials, grave markers, and burial artifacts will not be disturbed or removed without this authorization.

2. Burials in cemeteries registered with the State Comptroller's Office are subject to the Cemetery Care Act (760 ILCS 100). A number of state laws may apply to burials that are less than 100 years old but that are not in registered cemeteries. These laws include, but are not limited to, the Cemetery Protection Act (765 ILCS 835), the Public Graveyards Act (50 ILCS 610), and several laws applying to municipalities (see 65 ILCS 5/11-49 through 65 ILCS 5/11-52.2). Authorization for removal of burials shall be as required under the applicable statute.

3. Burials over 100 years old that are not in registered cemeteries are subject to the Human Skeletal Remains Protection Act (HSRPA) (20 ILCS 3440 and its rule 17 Ill.Adm.Code 4170). This agreement constitutes authorization under Section 16 of HSRPA for removal of any burials that will be affected by the project at locations the SHPO agrees cannot be easily avoided. However, review and approval of specific data recovery plans are still required under 17 Ill.Adm.Code 4170.300(d)(3).

4. Disposition of any discovered human skeletal remains, burial markers, burial artifacts, and documentation of the removal project shall be completed as required by the applicable statute and shall be fully coordinated with the SHPO pursuant to 17 IAC 4147.

C. Collected artifacts, samples, and other physical objects shall be returned to the land-owner as real estate upon request. Owners can donate or transfer their ownership rights to the Corps. In consultation with the SHPO/THPO(s), the Corps will ensure that all donated artifacts, samples, and other physical objects with related and associated research materials and records resulting from the historic properties studies are curated at repositories within the State of Illinois in accordance with 36 CFR Part 79.

IV. REPORTS

The Corps will ensure that all final historic property reports resulting from the actions pursuant to this Agreement will be provided in a format acceptable to the appropriate SHPO(s)/THPO(s). The Corps will ensure that all such reports are responsive to contemporary standards, and to the Department of the Interior's Format Standards for Final Reports of Data Recovery (42 FR 5377-79). Precise locations of significant historic properties may be provided only in a separate appendix if it appears that the release of this data could jeopardize historic properties. Locations of traditional cultural properties or sacred sites, consisting of architectural, landscapes, objects, or surface or buried archaeological sites, identified in coordination with Tribes and THPO(s), will be considered to be sensitive information and, pursuant to Section 304 of the National Historic Preservation Act, the Corps will not make this information available for public disclosure. The Corps will make available for publication and public dissemination the reports and associated data, minus precise aforementioned locations and sensitive information.

V. PROVISION FOR POST-REVIEW DISCOVERIES

In accordance with 36 CFR Section 800.13, if previously undetected or undocumented historic properties are discovered during project activities, the Corps will cease, or cause to stop, any activity having an effect and consult with the SHPO/THPO(s) to determine if additional investigation is required. If further archaeological investigations are warranted or required, the Corps will perform any treatment plan in accordance with Part II - TREATMENT OF HISTORIC PROPERTIES, Part III - TREATMENT OF HUMAN REMAINS, FUNERARY OBJECTS, SACRED OBJECTS, OR OBJECTS OF CULTURAL PATRIMONY, AND CURATED ITEMS, Part IV - REPORTS, and Part V - PROVISION FOR POST-REVIEW DISCOVERIES, all of this Agreement. If the Corps and the SHPO/THPO(s) determine that further investigation is not necessary or warranted, activities may resume with no further action required. Any disagreement between the Corps and the SHPO/THPO(s) concerning the need for further investigations will be handled pursuant to Part VI - DISPUTE RESOLUTION of this Agreement.

VI. DISPUTE RESOLUTION

Should the SHPO/THPO(s) or the Council object within 30 days to any plans or actions provided for review pursuant to this Agreement, the Corps will consult with the objecting party to resolve the objection. If the Corps determines that the disagreement cannot be resolved, the Corps will request further comment from the Council in accordance with the applicable provisions of 36 CFR Part 800.7. The Corps, in accordance with 36 CFR Part 800.7(c)(4), will take any Council comment provided in response into account, with reference only to the subject of the dispute. The Corps' responsibility to carry out all actions under this Agreement that are not the subjects of the dispute will remain unchanged.

VII. TERMINATION

Any of the signatories to this Agreement may request a reconsideration of its terms or revoke the relevant portions of this Agreement upon written notification to the other signatories, by providing 30 days' notice to the other signatories, provided that these signatories will consult during the period prior to termination to seek agreement on amendments or other actions that would avoid termination. In the advent of termination, the Corps will comply with 36 CFR Parts 800.3 through 800.7 with regard to individual undertakings covered by this Agreement.

VIII. AMENDMENTS

Any signatories to this Agreement may request that it be amended, whereupon the other signatories will consult in accordance with 36 CFR, Parts 800.6(c)(7) and 800.14(b)(3), to consider such amendment.

IX. REPORTING AND PERIODIC REVIEW

The Corps will provide the SHPO/THPO(s) with evidence of compliance with this Agreement by letter on January 30, 2003, and once every 2 years thereafter said date. This documentation shall contain the name of the project, title of the documents that contained the Agreement, historic properties identified, determinations of effect, avoidance procedures, level of investigation(s) and/or mitigation(s) conducted with titles of all project reports related to such investigation(s) and/or mitigation(s) which have been completed. Every 5 years starting from the date of January 30, 2003, the Corps will provide the SHPO/THPO(s) a review report of the overall IRER to determine this Agreement's effectiveness, accuracy, and economy. Based upon this review, the Corps, the SHPO/THPO(s), and the Council will determine whether the Agreement shall continue in force, be amended, or be terminated.

X. EXECUTION AND IMPLEMENTATION

A. Nothing in this Agreement is intended to prevent the Corps from consulting more frequently with the SHPO/THPO(s) or the Council concerning any questions that may arise or on the progress of any actions falling under or executed by this Agreement.

B. The undersigned concur that the Corps has satisfied its Section 106 responsibilities for all individual undertakings through this Agreement regarding the implementation of IRER.

C. The stipulations of this Agreement are limited solely to undertakings authorized under Section 216 of the 1970 Flood Control Act and Section 519 (Illinois River Basin Restoration) of the Water Resources Development Act of 2000.

XI. SIGNATORIES TO THIS AGREEMENT

A. **CHICAGO DISTRICT, U.S. ARMY CORPS OF ENGINEERS:**

BY: Mark A. Roncoli — Date: 4 SEP 02

Colonel Mark A. Roncoli
District Engineer
U. S. Army Corps of Engineers
Chicago District

B. **ROCK ISLAND DISTRICT, U.S. ARMY CORPS OF ENGINEERS:**

BY: [signature] — Date: 30 Aug 2002

Colonel William J. Bayles
District Engineer
U. S. Army Corps of Engineers
Rock Island District

C. **ST. LOUIS DISTRICT, U.S. ARMY CORPS OF ENGINEERS:**

BY: C. Kevin Williams — Date: 2 OCT 02

Colonel C. Kevin Williams
District Engineer
U. S. Army Corps of Engineers
St. Louis District

XI. SIGNATORIES TO THIS AGREEMENT (Continued)

D. ILLINOIS DEPARTMENT OF NATURAL RESOURCES:

BY:____________________________________ Date: ______________________

Brent Manning
Director
Illinois Department of Natural Resources

E. ILLINOIS STATE HISTORIC PRESERVATION OFFICER:

BY:____________________________________ Date: ______________________

Anne E. Haaker
Illinois Deputy State Historic Preservation Officer
Illinois Historic Preservation Agency

F. ADVISORY COUNCIL ON HISTORIC PRESERVATION:

BY:____________________________________ Date: ______________________

John M. Fowler
Executive Director
Advisory Council on Historic Preservation

DEPARTMENT OF THE ARMY
ROCK ISLAND DISTRICT. CORPS OF ENGINEERS
CLOCK TOWER BUILDING - P.O. BOX 2004
ROCK ISLAND, ILLINOIS 61204-2004

REPLY TO
ATTENTION OF

December 4, 2002

Planning, Programs, and
Project Management Division (310-2d)

Mr. Thomas McCullouch
c/o Mr. Don L. Klima, Director
Eastern Office of Project Review
The Old Post Office Building
1100 Pennsylvania Avenue, NW., Suite 809
Washington, DC 20004

Dear Mr. McCullouch:

The Chicago, Rock Island, and St. Louis Districts of the U.S. Army Corps of Engineers (Corps), the State of Illinois Department of Natural Resources (DNR), and the Illinois State Historic Preservation Officer (SHPO) have entered into a partnership for the purposes of implementing the Illinois River Ecosystem Restoration (IRER) project, authorized by Section 216 of the 1970 Flood Control Act and Section 519 (Illinois River Basin Restoration) of the Water Resources Development Act of 2000. This protection requires the execution of a ***PROGRAMMATIC AGREEMENT*** *Among the Chicago, Rock Island, and St. Louis Districts of the U.S. Army Corps of Engineers, the State of Illinois Department of Natural Resources, the Illinois State Historic Preservation Officer, and the Advisory Council on Historic Preservation, Regarding Implementation of the Illinois River Ecosystem Restoration* (PA) to afford protection to historic properties during the implementation of the IRER.

The Corps and the Illinois DNR have determined that the implementation of the IRER may have an effect upon properties listed on, or eligible for listing on, the National Register of Historic Places (NRHP), and has consulted with the Advisory Council on Historic Preservation (Council) and the Illinois State Historic Preservation Officer (SHPO) pursuant to Section 800.14(b) of the regulations (36 CFR Part 800) implementing Section 106 of the National Historic Preservation Act (NHPA) (16 U.S.C. 470[f]), and Section 110(f) of the same Act (16 U.S.C. 470h-2[f]) (see enclosed Fact Sheet, Enclosure 1).

Pursuant to Section 800.3 of the Council's regulations and to meet the responsibilities under the National Environmental Policy Act of 1969 (NEPA), the Corps and the Illinois DNR developed a preliminary Consulting Parties List comprised of 325 parties, including 47 federally recognized Native American Tribes. Only those consulting parties that responded to the initial correspondence to participate in the consultation process, dated October 5, 2002, remained on the final Consulting Parties List (Enclosure 2). The final Consulting Parties List allows for agencies, tribes, individuals, organizations, and other interested parties an opportunity to provide views on any effects of this undertaking on historic properties resulting from the IRER and implementation of the PA.

The enclosed comments (see Correspondence, Enclosure 3) were received from the Illinois DNR, the Illinois Historic Preservation Agency, and nine other consulting parties comprising the final Consulting Parties List. All comments were taken into consideration during the development of the final draft of the PA. Those on the enclosed final Consulting Parties List will be provided with study newsletters, public meeting announcements, special releases, and notifications of the availability of report(s), as stipulated by 36 CFR Part 800.14(b)(ii) of the NHPA. The Corps and the Illinois DNR will execute the PA, as stipulated by 36 CFR Part 800.14(b)(ii) of the NHPA to afford protection to known and unknown historic properties accorded by the NHPA. The executed PA will be in every NEPA document resulting from the IRER, as evidence of the Corps and the Illinois DNR compliance promulgated by the NHPA and the consulting process.

The enclosed PA (Enclosure 4) has been signed by the Corps Commanders (Chicago, Rock Island, and St. Louis Districts); Mr. Brent Manning, Director of the Illinois DNR; and Ms. Anne Haaker, Illinois Deputy SHPO. By execution, the signatories agree that the PA is an appropriate document to afford protection to significant historic properties during implementation of the IRER. The Corps and the Illinois DNR request that the Director of the Council sign the PA for full execution of the IRER PA. The Corps and the Illinois DNR appreciate your contributions and that of the Council in commenting on drafts of the PA, providing consultation, and in meeting our request to sign the PA. After the Council Director signs the PA, we ask that you please forward a copy of the fully executed PA to all signatories.

If you have questions concerning the IRER and the execution of the PA, or the Corps and the Illinois DNR coordination procedures and efforts promulgated by the NHPA, please call Mr. Ron Deiss of our Economic and Environmental Analysis Branch, telephone 309/794-5185, or write to our address above, ATTN: Planning, Programs, and Project Management Division (Ron Deiss).

Sincerely, ORIGINAL SIGNED BY

RICHARD FRISTIK

for Dorene A. Bollman
Acting Chief, Economic and
Environmental Analysis Branch

Enclosures

Copies Furnished:

Dr. Harold Hassen
Illinois Department of Natural Resources
One Natural Resources Way
Springfield, Illinois 62702-1271 (with enclosures 1-3)

Ms. Anne Haaker
Deputy State Historic Preservation Officer
Illinois Historic Preservation Agency
Old State Capitol
Springfield, Illinois 62701 (with enclosures 1-3)

ATTN: CEMVD-PM-R (Ms. Carroll Kleinhans)
U.S. Army Engineer Division, Mississippi Valley
1400 Walnut Street
P.O. Box 80
Vicksburg, Mississippi 39180-0080 (with enclosures 1-3)

ATTN: CEMVS-PD-A (Mr. Terry Norris)
Commander
U.S. Army Engineer District, St. Louis
1222 Spruce Street
St. Louis, Missouri 63101-2833 (with enclosures 1-3)

ATTN: CELRC-PD-S (Mr. Keith G. Ryder)
Commander
U.S. Army Engineer District, Chicago
111 North Canal Street
Chicago, Illinois 60606 (with enclosures 1-3)

FACT SHEET

Illinois River Ecosystem Restoration
and
Illinois River Basin Restoration

The Chicago, Rock Island, and St. Louis Districts of the U.S. Army Corps of Engineers (Corps) and the State of Illinois Department of Natural Resources (DNR) desire to execute the final *Programmatic Agreement Among the Chicago, Rock Island, and St. Louis Districts of the U.S. Army Corps of Engineers, the State of Illinois Department of Natural Resources, the Illinois State Historic Preservation Officer, and the Advisory Council on Historic Preservation, Regarding Implementation of the Illinois River Ecosystem Restoration.* The execution of this Programmatic Agreement (PA) by the signatories forms a partnership for the purposes of implementing the Illinois River Ecosystem Restoration (IRER), authorized by Section 216 of the 1970 Flood Control Act and Section 519 (Illinois River Basin Restoration) of the Water Resources Development Act of 2000.

The Corps and the Illinois DNR have determined that implementation of the IRER may have an effect upon properties listed on, or eligible for listing on, the National Register of Historic Places (NRHP), and will consult with the Advisory Council on Historic Preservation (Council), the Illinois State Historic Preservation Officer (SHPO), and other consulting parties pursuant to Section 800.14(b) of the regulations (36 CFR Part 800) implementing Section 106 of the National Historic Preservation Act (NHPA) (16 U.S.C. 470[f]), and Section 110(f) of the same Act (16 U.S.C. 470h-2[f]). The Corps and the Illinois DNR have previously invited the SHPO, Council, Tribal Historic Preservation Officers, and any other interested parties to participate in the consultation process and in the development of a final PA for the IRER.

The IRER encompasses the reach of the Illinois River watershed located in the State of Illinois (54 counties) (see attached map) with two types of efforts: (1) system evaluations focused on assessing the overall watershed needs and general locations for restoration and (2) site-specific evaluations focused on developing detailed restoration options for possible implementation at specific sites by project planning, engineering, construction, and monitoring, with interdisciplinary and collaborative planning for habitat restoration, preservation, and enhancement. The Corps and the Illinois DNR will manage the IRER throughout all stages of individual habitat project development, restoration, construction, and management. Several other Federal agencies, as well as non-government entities and individual citizens, also will regularly participate in the development of projects within the IRER.

Pursuant to Section 800.3 of the Council's regulations and to meet the responsibilities under the National Environmental Policy Act (NEPA) of 1969, the Corps and the Illinois DNR developed a preliminary Consulting Parties List. Those on the preliminary Consulting Parties List, comprised of 325 parties, including 47 federally recognized Tribes, were provided an opportunity to comment on a draft of the PA. Although the IRER presently lies entirely within the State of Illinois, consulting parties from elsewhere in the United States are given equal and due consideration. Since the Corps remains unaware of any lands held in Federal trust or of any Federal trust responsibilities for Native American Indians within the Illinois River watershed, the Corps requested any information concerning our Federal trust responsibilities.

The NHPA recognizes that properties of traditional religious and cultural importance to a tribe may be determined eligible for inclusion on the NRHP. In order to preserve, conserve, and encourage the continuation of the diverse traditional prehistoric, historic, ethnic, and folk cultural traditions within the Illinois watershed, the IRER will be implemented in compliance with Executive Order No. 13007, specifically:

> **Section 1.** *Accommodation of Sacred Sites.* (a) In managing Federal lands, each executive branch agency with statutory or administrative responsibility for the management of Federal lands shall, to the extent practicable, permitted by law, and not clearly inconsistent with essential agency functions, (1) accommodate access to and ceremonial use of Indian sacred sites by Indian religious practitioners and (2) avoid adversely affecting the physical integrity of such sacred sites. Where appropriate, agencies shall maintain the confidentiality of sacred sites.

The Secretary of the Interior's **Standards and Guidelines for Federal Agency Historic Preservation Programs** pursuant to the NHPA states that a:

> Traditional Cultural Property is defined as a property that is associated with cultural practices or beliefs of a living community that (1) are rooted in that community's history, and (2) are important in maintaining the continuing cultural identity of the community.

Allowing for tribal review and comment contributes to fulfilling our obligations as set forth in the NHPA (Public Law [PL] 89-665), as amended; the NEPA of 1969 (PL 91-190); Executive Order (EO) 11593 for the "Protection and Enhancement of the Cultural Environment" (Federal Register, May 13, 1971); the Archaeological and Historical Preservation Act of 1974 (PL 93-291); the Advisory Council on Historic Preservation "Regulations for the Protection of Historic and Cultural Properties" (36 CFR, Part 800); and the applicable National Park Service and Corps regulations and guidance.

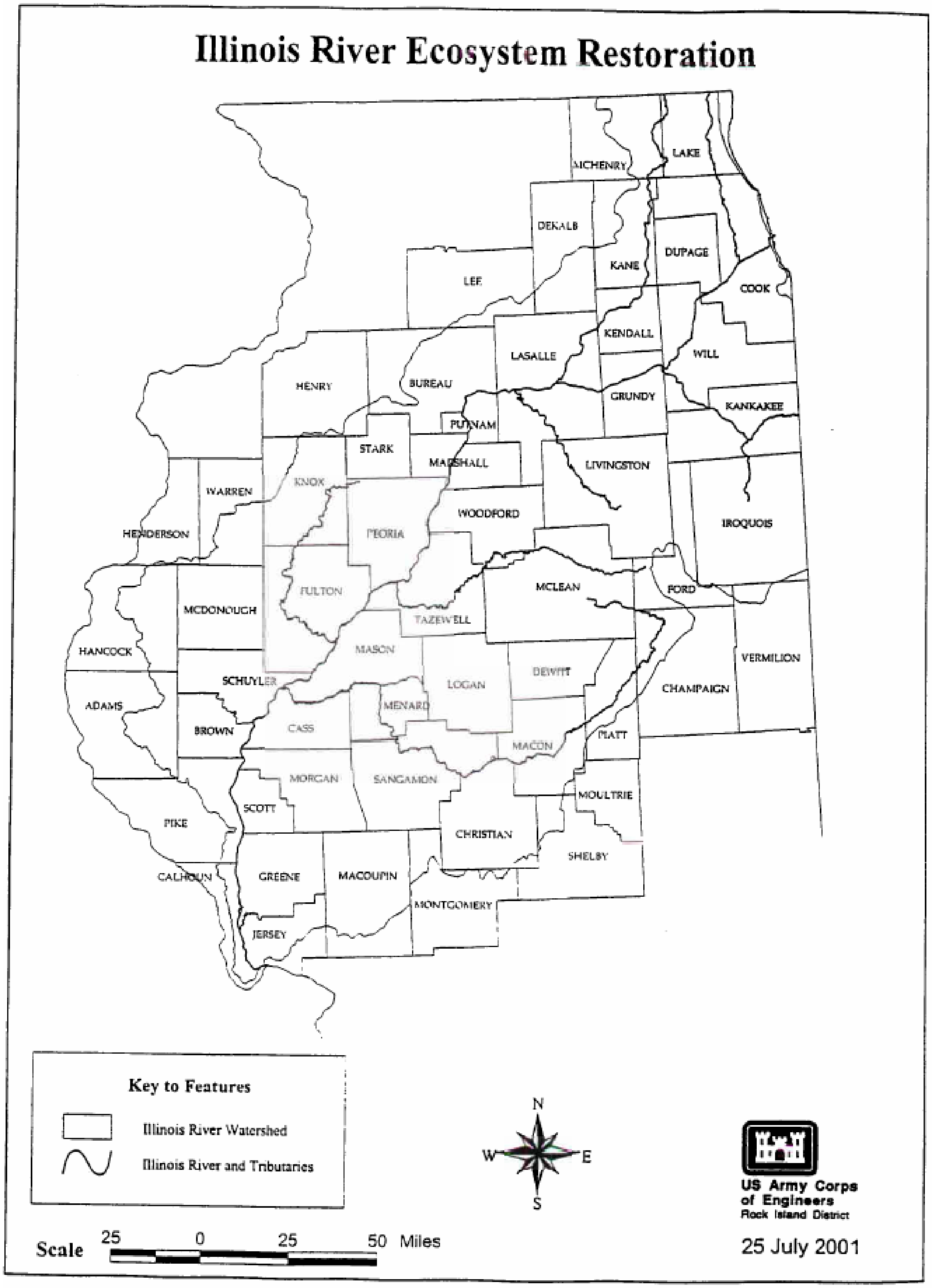
The Corps is concerned about impacts to those traditional cultural properties and sacred sites recognized by Native Americans, tribes, ethnic and religious organizations, communities, and other groups as potentially affected by the IRER. Presently, the Corps is unaware of any traditional cultural properties or sacred sites within the Illinois River watershed. If there are concerns or potential effects known or identified, please complete a "**Traditional Cultural Property and Sacred Site Form.**" To facilitate tribal coordination, the Corps asks those on the Consulting Parties List to refer to the National Park Service, NRHP Bulletin 38, Guidelines for Evaluating and Documenting Traditional Cultural Properties, available for internet viewing at (http://www.cr.nps.gov/nr/publications/bulletins.htm). Locations of traditional cultural properties or sacred sites, consisting of architecture, landscapes, objects, or surface or buried archaeological sites, identified in this coordination effort, can be considered to be sensitive information, pursuant to Section 304 of the NHPA. Upon request from any consulting parties not to disclose locations, the Corps and the Illinois DNR will secure this information from the general public.

Those on the list were asked to comment on earlier drafts of this PA and submit a request to be placed on the final Consulting Parties List. Those on the final Consulting Parties List will be provided with study newsletters, public meeting announcements, special releases, and notifications of the availability of report(s), including all draft agreement documentation, as stipulated by 36 CFR Part 800.14(b)(ii) of the NHPA. Consulting parties may request correspondence on future topics relevant to compliance concerning IRER and to provide comments. Comments on the IRER program or projects received by the Corps and the Illinois DNR will be taken into account when finalizing plans for the IRER, as promulgated by the NHPA.

The Corps and the Illinois DNR propose to execute the PA, as stipulated by 36 CFR Part 800.14(b)(ii) of the NHPA to afford protection to known and unknown historic properties accorded by the NHPA. As regulated by in 36 CFR Part 800.8(c)(1), the executed PA will be used within reports promulgated under the National Environmental Policy Act (NEPA).

Questions concerning the IRER PA, the final Consulting Parties List, or the Corps and the Illinois DNR coordination procedures and efforts promulgated by the NHPA, can be addressed to Mr. Ron Deiss of the Rock Island District, Economic and Environmental Analysis Branch, by telephoning 309/794-5185, or by writing to the following address, ATTN: Planning, Programs, and Project Management Division (Ron Deiss), U.S. Army Engineer District, Rock Island, Clock Tower Building, P.O. Box 2004, Rock Island, Illinois 612604-2004.

END


Illinois River Ecosystem Restoration
MCHENRY
LAKE
DEKALB
KANE
DUPAGE
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COOK
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BUREAU
GRUNDY
KANKAKEE
PUTNAM
STARK
MARSHALL
LIVINGSTON
KNOX
WARREN
PEORIA
WOODFORD
IROQUOIS
HENDERSON
FULTON
MCLEAN
FORD
MCDONOUGH
TAZEWELL
HANCOCK
MASON
VERMILION
SCHUYLER
DEWITT
LOGAN
CHAMPAIGN
ADAMS
MENARD
BROWN
CASS
PIATT
MACON
MORGAN
SANGAMON
MOULTRIE
SCOTT
PIKE
CHRISTIAN
SHELBY
CALHOUN
GREENE
MACOUPIN
MONTGOMERY
JERSEY
Key to Features
Illinois River Watershed
Illinois River and Tributaries
N
W
E
S
US Army Corps of Engineers
Rock Island District
Scale 25 0 25 50 Miles
25 July 2001

Consulting Parties List

Illinois River Ecosystem Restoration
and
Illinois River Basin Restoration

Mr. William Poore
Secretary
Palos Historical Society
c/o Palos Public Library
12330 Forest Glen Boulevard
Palos Park, Illinois 60464

Ms. Phyllis M. Ellin
Executive Director
United States Department of the Interior
Illinois & Michigan Canal
National Heritage Corridor Commission
201 West Tenth Street, #1-SE
Lockport, Illinois 60441

Mr. Johnathan Buffalo
Sac and Fox Tribe of the Mississippi
in Iowa
349 Meskwaki Road
Tama, Iowa 52339-9629

Mr. John Lamb
Director
Canal and Regional History Collection
Lewis University
One University Parkway
Romeoville, Illinois 60446-2298

Ms. Liz Safanda
Preservation Partners
P.O. Box 903
St. Charles, Illinois 60174

Mr. John F. Anderson
Ford Country Historical Society
201 West State Street
P.O. Box 115
Paxton, Illinois 60957-0115

Mr. John Hoffman
University of Illinois at Urbana-Champaign
University Library
Illinois Historical Survey
346 Main Library
1408 West Gregory Drive
Urbana, Illinois 61801

Mr. Charles Clark
Director of NAGPRA
Citizen Potawatomi Nation
1601 Gordon Cooper Drive
Shawnee, Oklahoma 74801

DEPARTMENT OF THE ARMY
ROCK ISLAND DISTRICT CORPS OF ENGINEERS
CLOCK TOWER BUILDING - P.O. BOX 2004
ROCK ISLAND, ILLINOIS 61204-2004

REPLY TO
ATTENTION OF

February 7, 2003

Planning, Programs, and
Project Management Division (310-2d)

Ms. Anne Haaker
Deputy State Historic Preservation Officer
Illinois Historic Preservation Agency
1 Old State Capitol
Springfield, Illinois 62701

Dear Ms. Haaker:

The Chicago, Rock Island, and St. Louis Districts of the U.S. Army Corps of Engineers (Corps), the State of Illinois Department of Natural Resources (DNR), and the Illinois State Historic Preservation Officer (SHPO) have entered into a partnership for the purposes of implementing the Illinois River Ecosystem Restoration (IRER) project, authorized by Section 216 of the 1970 Flood Control Act and Section 519 (Illinois River Basin Restoration) of the Water Resources Development Act of 2000.

The Corps and the Illinois DNR have determined that the implementation of the IRER may have an effect upon properties listed on, or eligible for listing on, the National Register of Historic Places (NRHP), and have consulted with the Advisory Council on Historic Preservation (Council) and the Illinois SHPO pursuant to Section 800.14(b) of the regulations (36 CFR Part 800) implementing Section 106 of the National Historic Preservation Act (NHPA) (16 U.S.C. 470[f]), and Section 110(f) of the same Act (16 U.S.C. 470h-2[f]). This protection requires the executed ***PROGRAMMATIC AGREEMENT*** *Among the Chicago, Rock Island, and St. Louis Districts of the U.S. Army Corps of Engineers, the State of Illinois Department of Natural Resources, the Illinois State Historic Preservation Officer, and the Advisory Council on Historic Preservation, Regarding Implementation of the Illinois River Ecosystem Restoration* (PA) to afford protection to historic properties during the implementation of the IRER.

The PA (copy enclosed) has been signed by the Corps Commanders (Chicago, Rock Island, and St. Louis Districts); Mr. Brent Manning, Director of the Illinois DNR; Ms. Anne Haaker, Illinois Deputy SHPO; and Mr. John Fowler, Executive Director of the Council. The Corps and the Illinois DNR appreciate your contributions and that of the Council in commenting on drafts of the PA, providing consultation, and in meeting our request to execute the PA. Please place this final copy of the PA in your permanent files as evidence of our partial fulfillment of the NHPA.

By copy of this letter, those on the **Consulting Parties List** are copied the executed PA and will be provided with study newsletters, public meeting announcements, special releases, and notifications of the availability of report(s), as stipulated by 36 CFR Part 800.14(b)(ii) of the NHPA. The Corps and the Illinois DNR will execute the PA, as stipulated by 36 CFR Part 800.14(b)(ii) of the NHPA, to afford protection to known and unknown historic properties accorded by the NHPA. When necessary, the executed PA will be in every National Environmental Policy Act (NEPA) document resulting from the IRER, as evidence of the Corps and the Illinois DNR's compliance promulgated by the NHPA and the consulting process.

If you have questions concerning the IRER and the executed PA, please call Mr. Ron Deiss of our Economic and Environmental Analysis Branch, telephone 309/794-5185, or write to our address above, ATTN: Planning, Programs, and Project Management Division (Ron Deiss).

Sincerely,

ORIGINAL SIGNED BY

Dorene A. Bollman
Acting Chief, Economic and
Environmental Analysis Branch

Enclosure

Copies Furnished:

Dr. Harold Hassen
Illinois Department of Natural Resources
One Natural Resources Way
Springfield, Illinois 62702-1271 (with enclosure)

ATTN: CEMVD-MD-PR (Ms. Carroll Johnson)
U.S. Army Engineer Division, Mississippi Valley
1400 Walnut Street
P.O. Box 80
Vicksburg, Mississippi 39181-0080 (with enclosure)

ATTN: CEMVS-PD-A (Mr. Terry Norris)
Commander
U.S. Army Engineer District, St. Louis
1222 Spruce Street
St. Louis, Missouri 63101-2833 (with enclosure)

Copies Furnished (Continued):

ATTN: CELRC-PD-S (Mr. Keith G. Ryder)
Commander
U.S. Army Engineer District, Chicago
111 North Canal Street
Chicago, Illinois 60606 (with enclosure)

Consulting Parties (See List) (with enclosure)

Consulting Parties List

Illinois River Ecosystem Restoration
and
Illinois River Basin Restoration

Mr. William Poore
Secretary
Palos Historical Society
c/o Palos Public Library
12330 Forest Glen Boulevard
Palos Park, Illinois 60464

Ms. Phyllis M. Ellin
Executive Director
United States Department of the Interior
Illinois & Michigan Canal
National Heritage Corridor Commission
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349 Meskwaki Road
Tama, Iowa 52339-9629

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Canal and Regional History Collection
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University of Illinois at Urbana-Champaign
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Mr. Charles Clark
Director of NAGPRA
Citizen Potawatomi Nation
1601 Gordon Cooper Drive
Shawnee, Oklahoma 74801

PROGRAMMATIC AGREEMENT

Among the
Chicago, Rock Island, and St. Louis Districts of the U.S. Army Corps of Engineers,
the State of Illinois Department of Natural Resources,
the Illinois State Historic Preservation Officer,
and the Advisory Council on Historic Preservation,
Regarding Implementation of the
Illinois River Ecosystem Restoration

WHEREAS, the Chicago, Rock Island, and St. Louis Districts of the U.S. Army Corps of Engineers (hereafter, Corps) and the State of Illinois Department of Natural Resources (hereafter DNR) determined that the Illinois River watershed exhibits loss of aquatic habitat and have entered into a partnership for the purpose of implementing the Illinois River Ecosystem Restoration (IRER) authorized by Section 216 of the 1970 Flood Control Act and Section 519 (Illinois River Basin Restoration) of the Water Resources Development Act of 2000; and

WHEREAS, the Corps and the DNR have determined that the implementation of the IRER may have an effect upon properties listed on, or eligible for listing on, the National Register of Historic Places (National Register), and have consulted with the Advisory Council on Historic Preservation (Council) and the Illinois State Historic Preservation Officer (SHPO) pursuant to Section 800.14(b) of the regulations (36 CFR Part 800) implementing Section 106 of the National Historic Preservation Act (16 U.S.C. 470[f]), and Section 110(f) of the same Act (16 U.S.C. 470h-2[f]); and

WHEREAS, the IRER study area encompasses the entire Illinois River watershed located in Illinois (54 counties) with two types of efforts: (1) system evaluations focused on assessing the overall watershed needs and general locations for restoration and (2) site-specific evaluations focused on developing detailed restoration options for possible implementation at specific sites by project planning, engineering, construction, and monitoring with interdisciplinary and collaborative planning for habitat restoration, protection, preservation, and enhancement. The Corps and the DNR will manage the IRER throughout all stages of individual habitat project development, restoration, and management. Several other Federal agencies, as well as non-government entities and individual citizens, also will regularly participate in the development of projects within the IRER; and

WHEREAS, the study area includes four IRER areas identified as (1) watershed stabilization, (2) side channel and backwater modification, (3) water level management, and (4) floodplain restoration and protection. The focus areas will be implemented by habitat creation (islands, ponds, wetlands, potholes, channels, backwaters, etc.), flow control structures (grade controls, dams, dikes, detention basins, weirs, riffles, fish passage, levees, etc.), habitat enhancements (anchor trees, stumps, plantings, management of timber and forest stands, regulation of water levels, etc.), and structure removals/modifications (snagging, clearing, dikes, borrowing, trenching, dredging, etc.); and

WHEREAS, pursuant to Section 800.3 of the Council's regulations, and to meet the Corps' and DNR's responsibilities under the National Environmental Policy Act of 1969, the Corps has developed a **Consulting Parties List** which was developed in consultation with the SHPO/Tribal Historic Preservation Officers (THPOs), Tribes, and other parties that may have an interest in the effects of this undertaking on historic properties. Those on the **Consulting Parties List**, comprised of 325 parties, including 47 federally recognized Tribes, were asked to comment on earlier drafts of this Programmatic Agreement or be provided with study newsletters, public meeting announcements, special releases, and notifications of the availability of report(s), including all draft agreement documentation, as stipulated by 36 CFR Part 800.14(b)(ii) of the National Historic Preservation Act. Comments received by the Corps were taken under consideration in developing this Programmatic Agreement; and

WHEREAS, the Corps has provided scholarly evidence of stewardship in the recordation, protection, and management of historic properties along the Illinois Waterway System through systemic research and studies which have been finalized and approved, then placed in the permanent files of the Corps and SHPO as evidence of compliance promulgated under Section 106 of the National Historic Preservation Act, as amended, and its implementing regulations, 36 CFR Part 800: "Protection of Historic Properties." [These studies included: (1) archeological studies (management of documented and undocumented historic properties), (2) architectural and engineering studies (buildings, structures, and objects associated with Multiple Property National Register Districts), (3) erosion studies, (4) land form sediment assemblage studies (geomorphology) and (5) submerged historic property study (historic shipwrecks and other underwater or previously inundated historic properties)]; and

NOW, THEREFORE, the Corps, the DNR, the SHPO, and the Council agree that the undertakings authorized under Section 216 of the 1970 Flood Control Act and Section 519 (Illinois River Basin Restoration) of the Water Resources Development Act of 2000 shall be implemented in accordance with the following stipulations:

I. IDENTIFICATION AND EVALUATION OF HISTORIC PROPERTIES

The Corps will ensure that the following measures are implemented:

A. The Corps will take all measures necessary to discover, preserve, and avoid significant historic properties listed on, or eligible for listing on, the National Register, burials, cemeteries, or sites likely to contain human skeletal remains/artifacts and objects associated with interments or religious activities, and provide this information, studies, and/or reports to the SHPO/THPO.

Under consultation with the SHPO/THPO(s) and the other consulting parties, the Corps will describe and define the Area of Potential Effect (hereafter referred to as the APE) in accordance with the definition contained in 36 CFR Part 800.16(d). The APE may be modified upon consultation with the appropriate SHPO(s)/THPO(s) through avoidance documented through the implementation of historic property surveys and testing, documentary research, recordation, and other investigation data.

B. Unless recent and modern ground surface disturbances and/or historic use can be documented and a determination made by the Corps, in consultation with the SHPO/THPO(s) and the other consulting parties, that there is little likelihood that historic properties will be adversely affected, the Corps will then conduct a historic property (reconnaissance) survey in (1) areas with the potential for containing submerged or deeply buried historic properties and (2) areas indirectly and directly affected by construction, use, maintenance, and operation during the implementation of the IRER program.

C. The Corps will ensure that all reconnaissance surveys and subsurface testing are conducted in a manner consistent with the Secretary of the Interior's Standards and Guidelines for Identification and Evaluation (48 FR 44720-23) and take into account the National Park Service publication The Archaeological Survey: Methods and Uses (1978) and any extant or most recent version of appropriate SHPO(s)/THPO(s) guidelines for historic properties reconnaissance surveys/reports, related guidance, etc. The reconnaissance surveys and subsurface testing will be implemented by the Corps and monitored by the SHPO/THPO(s).

D. In consultation with the SHPO, the appropriate THPO(s), and the other consulting parties, the Corps will evaluate for eligibility all significant historic properties by applying the National Register criteria (36 CFR Part 60.4). The Corps will use its archival documentation as a context in which to make National Register evaluations of historic properties.

1. For those properties that the Corps, the SHPO/THPO(s), and the other consulting parties agree are not eligible for inclusion on the National Register, no further historic properties investigations will be required, and the project may proceed in those areas.

2. If the survey results in the identification of properties that the Corps, the SHPO/THPO(s), and the other consulting parties agree are eligible for inclusion on the National Register, the Corps shall treat such properties in accordance with Part II below.

3. If the Corps, the SHPO/THPO(s), and the other consulting parties do not agree on National Register eligibility, or if the Council or the National Park Service so request, the Corps will request a formal determination of eligibility from the Keeper of the National Register, National Park Service, whose determination shall be final.

4. Relative to the treatment of historic properties and the identification of traditional cultural properties, the Corps will continue to provide the appropriate Tribe(s), the THPO(s), and the other consulting parties information related to treatment measures proposed by the Corps. Consideration of comments received by the Corps can be considered by the signatories to be measures to assist the Corps in meeting its responsibilities under the National Historic Preservation Act of 1966, as amended (Public Law 89-665), and the regulations of the Advisory Council on Historic Preservation, "Regulations for the Protection of Historic and Cultural Properties" (36 CFR, Part 800).

II. TREATMENT OF HISTORIC PROPERTIES

Those individual historic properties and multiple property districts that the Corps, the SHPO/ THPO(s), and the other consulting parties agree are eligible for nomination to, or that the Keeper has determined eligible for inclusion on, the National Register, will be treated by the Corps in the following manner:

A. Archival Documentation of the Construction and Operation of the Historic Locks and Dams and Management of Historic Properties: The Corps has provided scholarly evidence of stewardship in the recordation, protection, and management of historic properties along the Illinois Waterway System through systemic research and studies which have been finalized and approved, then placed in the permanent files of the Corps and SHPO. These studies included: (1) archeological studies (management of documented and undocumented historic properties), (2) architectural and engineering studies (buildings, structures, and objects associated with Multiple Property National Register-eligible **Illinois Waterway Navigation System Facilities**, (3) land form sediment assemblage studies (geomorphology), and (4) submerged historic property study (historic shipwrecks and other underwater or previously inundated historic properties).

B. Treatment of Archaeological Historic Properties:

1. If the Corps determines, in consultation with the SHPO/THPO(s) and the other consulting parties, that no other actions are feasible to avoid and minimize effects to archaeological historic properties, then the Corps will develop a treatment plan, which may include various levels of data recovery, recordation, documentation, and active protection measures. The Corps will implement the treatment plan in consultation with the SHPO/THPO(s) and the other consulting parties.

2. If data recovery is the agreed upon treatment, the data recovery plan will address substantive research questions developed in consultation with the SHPO/ THPO(s) and the other consulting parties. The treatment plan shall be consistent with the Secretary of the Interior's Standards and Guidelines for Archaeological Documentation (48 FR 44734-37) and take into

account the Council's publication, Treatment of Archaeological Properties (Advisory Council on Historic Preservation, 1980) and SHPO/THPO(s) guidance. It will specify, at a minimum, the following:

a. The property, properties, or portions of properties where the treatment plan is to be carried out;

b. The research questions to be addressed, with an explanation of research relevance and importance;

c. The methods to be used, with an explanation of methodological relevance to the research questions;

d. Proposed methods of disseminating results of the work to the interested public; and,

e. A proposed schedule for the submission of progress reports to the SHPO/THPO(s).

3. The Corps will submit the treatment plan to the SHPO/THPO(s) and the other consulting parties for 30 days' review and comment. The Corps will take into account SHPO/THPO(s) and the other consulting parties' comment(s), and will ensure that the data recovery plan is implemented. The SHPO/THPO(s) and the other consulting parties may monitor this implementation.

4. The Corps will ensure that the treatment plan is carried out by or under the direct supervision of an archaeologist(s), architectural historian(s) and/or other appropriate cultural resource specialist that meets, at minimum, the Secretary of the Interior's Professional Qualifications Standards (48 FR 44738-9).

5. The Corps will ensure that adequate provisions, including personnel, time, and laboratory space are available for the analysis and curation of recovered materials from historic properties.

6. The Corps will develop and implement an adequate program in consultation with the SHPO/THPO(s) and the other consulting parties to secure archaeological historic properties from vandalism during data recovery.

III. TREATMENT OF HUMAN REMAINS, FUNERARY OBJECTS, SACRED OBJECTS, OR OBJECTS OF CULTURAL PATRIMONY, AND CURATED ITEMS

A. When human remains, funerary objects, sacred objects, or objects of cultural patrimony are encountered or collected, the Corps will comply with all provisions outlined in the appropriate state acts, statutes, guidance, provisions, etc., and any decisions regarding the treatment of human remains will be made recognizing the rights of lineal descendants, Tribes, and other Native American Indians and under consultation with the SHPO/THPO(s) and the other consulting parties, designated Tribal Coordinator, and/or other appropriate legal authority for future and expedient disposition or curation. When finds of human remains, funerary objects, sacred objects, or objects of cultural patrimony are encountered or collected from Federal lands or federally recognized tribal lands, the Corps will coordinate with the appropriate federally recognized Native American Tribes, pursuant to the Native American Graves Protection and Repatriation Act of 1990 (25 U.S.C. § 3001 *et seq.*) and its implementing regulations (43 CFR Part 10).

B. Cemeteries.

1. Any project activities that affect burials shall comply with state and local burial and cemetery laws. The county coroner shall be notified of the discovery of any human remains within 48 hours (5ILCS 5/2 and 20 ILCS 3440). The City shall notify the SHPO in order to obtain the proper permit prior to removal of remains. Burials, grave markers, and burial artifacts will not be disturbed or removed without this authorization.

2. Burials in cemeteries registered with the State Comptroller's Office are subject to the Cemetery Care Act (760 ILCS 100). A number of state laws may apply to burials that are less than 100 years old but that are not in registered cemeteries. These laws include, but are not limited to, the Cemetery Protection Act (765 ILCS 835), the Public Graveyards Act (50 ILCS 610), and several laws applying to municipalities (see 65 ILCS 5/11-49 through 65 ILCS 5/11-52.2). Authorization for removal of burials shall be as required under the applicable statute.

3. Burials over 100 years old that are not in registered cemeteries are subject to the Human Skeletal Remains Protection Act (HSRPA) (20 ILCS 3440 and its rule 17 Ill.Adm.Code 4170). This agreement constitutes authorization under Section 16 of HSRPA for removal of any burials that will be affected by the project at locations the SHPO agrees cannot be easily avoided. However, review and approval of specific data recovery plans are still required under 17 Ill.Adm.Code 4170.300(d)(3).

4. Disposition of any discovered human skeletal remains, burial markers, burial artifacts, and documentation of the removal project shall be completed as required by the applicable statute and shall be fully coordinated with the SHPO pursuant to 17 IAC 4147.

C. Collected artifacts, samples, and other physical objects shall be returned to the land-owner as real estate upon request. Owners can donate or transfer their ownership rights to the Corps. In consultation with the SHPO/THPO(s), the Corps will ensure that all donated artifacts, samples, and other physical objects with related and associated research materials and records resulting from the historic properties studies are curated at repositories within the State of Illinois in accordance with 36 CFR Part 79.

IV. REPORTS

The Corps will ensure that all final historic property reports resulting from the actions pursuant to this Agreement will be provided in a format acceptable to the appropriate SHPO(s)/THPO(s). The Corps will ensure that all such reports are responsive to contemporary standards, and to the Department of the Interior's Format Standards for Final Reports of Data Recovery (42 FR 5377-79). Precise locations of significant historic properties may be provided only in a separate appendix if it appears that the release of this data could jeopardize historic properties. Locations of traditional cultural properties or sacred sites, consisting of architectural, landscapes, objects, or surface or buried archaeological sites, identified in coordination with Tribes and THPO(s), will be considered to be sensitive information and, pursuant to Section 304 of the National Historic Preservation Act, the Corps will not make this information available for public disclosure. The Corps will make available for publication and public dissemination the reports and associated data, minus precise aforementioned locations and sensitive information.

V. PROVISION FOR POST-REVIEW DISCOVERIES

In accordance with 36 CFR Section 800.13, if previously undetected or undocumented historic properties are discovered during project activities, the Corps will cease, or cause to stop, any activity having an effect and consult with the SHPO/THPO(s) to determine if additional investigation is required. If further archaeological investigations are warranted or required, the Corps will perform any treatment plan in accordance with Part II - TREATMENT OF HISTORIC PROPERTIES, Part III - TREATMENT OF HUMAN REMAINS, FUNERARY OBJECTS, SACRED OBJECTS, OR OBJECTS OF CULTURAL PATRIMONY, AND CURATED ITEMS, Part IV - REPORTS, and Part V - PROVISION FOR POST-REVIEW DISCOVERIES, all of this Agreement. If the Corps and the SHPO/THPO(s) determine that further investigation is not necessary or warranted, activities may resume with no further action required. Any disagreement between the Corps and the SHPO/THPO(s) concerning the need for further investigations will be handled pursuant to Part VI - DISPUTE RESOLUTION of this Agreement.

VI. DISPUTE RESOLUTION

Should the SHPO/THPO(s) or the Council object within 30 days to any plans or actions provided for review pursuant to this Agreement, the Corps will consult with the objecting party to resolve the objection. If the Corps determines that the disagreement cannot be resolved, the Corps will request further comment from the Council in accordance with the applicable provisions of 36 CFR Part 800.7. The Corps, in accordance with 36 CFR Part 800.7(c)(4), will take any Council comment provided in response into account, with reference only to the subject of the dispute. The Corps' responsibility to carry out all actions under this Agreement that are not the subjects of the dispute will remain unchanged.

VII. TERMINATION

Any of the signatories to this Agreement may request a reconsideration of its terms or revoke the relevant portions of this Agreement upon written notification to the other signatories, by providing 30 days' notice to the other signatories, provided that these signatories will consult during the period prior to termination to seek agreement on amendments or other actions that would avoid termination. In the advent of termination, the Corps will comply with 36 CFR Parts 800.3 through 800.7 with regard to individual undertakings covered by this Agreement.

VIII. AMENDMENTS

Any signatories to this Agreement may request that it be amended, whereupon the other signatories will consult in accordance with 36 CFR, Parts 800.6(c)(7) and 800.14(b)(3), to consider such amendment.

IX. REPORTING AND PERIODIC REVIEW

The Corps will provide the SHPO/THPO(s) with evidence of compliance with this Agreement by letter on January 30, 2003, and once every 2 years thereafter said date. This documentation shall contain the name of the project, title of the documents that contained the Agreement, historic properties identified, determinations of effect, avoidance procedures, level of investigation(s) and/or mitigation(s) conducted with titles of all project reports related to such investigation(s) and/or mitigation(s) which have been completed. Every 5 years starting from the date of January 30, 2003, the Corps will provide the SHPO/THPO(s) a review report of the overall IRER to determine this Agreement's effectiveness, accuracy, and economy. Based upon this review, the Corps, the SHPO/THPO(s), and the Council will determine whether the Agreement shall continue in force, be amended, or be terminated.

X. EXECUTION AND IMPLEMENTATION

A. Nothing in this Agreement is intended to prevent the Corps from consulting more frequently with the SHPO/THPO(s) or the Council concerning any questions that may arise or on the progress of any actions falling under or executed by this Agreement.

B. The undersigned concur that the Corps has satisfied its Section 106 responsibilities for all individual undertakings through this Agreement regarding the implementation of IRER.

C. The stipulations of this Agreement are limited solely to undertakings authorized under Section 216 of the 1970 Flood Control Act and Section 519 (Illinois River Basin Restoration) of the Water Resources Development Act of 2000.

XI. SIGNATORIES TO THIS AGREEMENT

A. **CHICAGO DISTRICT, U.S. ARMY CORPS OF ENGINEERS:**

BY: *Mark A. Roncoli* Date: 4 SEP 02

Colonel Mark A. Roncoli
District Engineer
U. S. Army Corps of Engineers
Chicago District

B. **ROCK ISLAND DISTRICT, U.S. ARMY CORPS OF ENGINEERS:**

BY: *[signature]* Date: 30 Aug 2002

Colonel William J. Bayles
District Engineer
U. S. Army Corps of Engineers
Rock Island District

C. **ST. LOUIS DISTRICT, U.S. ARMY CORPS OF ENGINEERS:**

BY: *C. Kevin Williams* Date: 2 OCT 02

Colonel C. Kevin Williams
District Engineer
U. S. Army Corps of Engineers
St. Louis District

XI. SIGNATORIES TO THIS AGREEMENT (Continued)

D. ILLINOIS DEPARTMENT OF NATURAL **RESOURCES:**

BY: ______________________ Date: 11-12-02

Brent Manning
Director
Illinois Department of Natural Resources

E. ILLINOIS STATE HISTORIC PRESERVATION OFFICER:

BY: ______________________ Date: 11-14-02

Anne E. Haaker
Illinois Deputy State Historic Preservation Officer
Illinois Historic Preservation Agency

F. ADVISORY COUNCIL ON HISTORIC PRESERVATION:

BY: ______________________ Date: 1/21/03

John M. Fowler
Executive Director
Advisory Council on Historic Preservation

Final Consulting Parties List

Illinois River Ecosystem Restoration and Illinois River Basin Restoration

Mr. William Poore
Secretary
Palos Historical Society
c/o Palos Public Library
12330 Forest Glen Boulevard
Palos Park, Illinois 60464

Ms. Phyllis M. Ellin
Executive Director
United States Department of the Interior
Illinois & Michigan Canal
National Heritage Corridor Commission
201 West Tenth Street, #1-SE
Lockport, Illinois 60441

Mr. Johnathan Buffalo
Sac and Fox Tribe of the Mississippi
in Iowa
349 Meskwaki Road
Tama, Iowa 52339-9629

Mr. John Lamb
Director
Canal and Regional History Collection
Lewis University
One University Parkway
Romeoville, Illinois 60446-2298

Ms. Liz Safanda
Preservation Partners
P.O. Box 903
St. Charles, Illinois 60174

Mr. John F. Anderson
Ford Country Historical Society
201 West State Street
P.O. Box 115
Paxton, Illinois 60957-0115

Mr. John Hoffman
University of Illinois at Urbana-Champaign
University Library
Illinois Historical Survey
346 Main Library
1408 West Gregory Drive
Urbana, Illinois 61801

Mr. Charles Clark
Director of NAGPRA
Citizen Potawatomi Nation
1601 Gordon Cooper Drive
Shawnee, Oklahoma 74801

Peoria Tribe of Indians of Oklahoma
c/o Bud Ellis, Repatriation/NAGPRA
118 S. Eight Tribes Trail
P.O. Box 1527
Miami, OK 74355

Dr. Harold Hassen
Illinois Department of Natural Resources
One Natural Resources Way
Springfield, Illinois 62702-1271

ATTN: Mr. Thomas McCullouch
C/o Mr. Don L. Klima, Director
Eastern Office of Project Review
The Old Post Office Building 1100
Pennsylvania Avenue, NW Suite 809
Washington, D.C. 20004

Ms. Anne Haaker
Deputy State Historic Preservation Officer
Illinois Historic Preservation Agency
Old State Capitol
Springfield, Illinois 62701

ILLINOIS RIVER BASIN RESTORATION
COMPREHENSIVE PLAN
WITH INTEGRATED ENVIRONMENTAL ASSESSMENT

APPENDIX B

SYSTEM ECOLOGY

ILLINOIS RIVER BASIN RESTORATION
COMPREHENSIVE PLAN
WITH INTEGRATED ENVIRONMENTAL ASSESSMENT

APPENDIX B

SYSTEM ECOLOGY

INTRODUCTION

This appendix summarizes several investigations used in the preparation of the Comprehensive Plan for the Illinois River Basin Restoration. Some of the reports summarized below were prepared by contract. The reports are available at the Corps of Engineers, Rock Island District office in Rock Island, Illinois.

I. RESTORATION NEEDS ASSESSMENT

A major focus of the system study was to determine the problems, opportunities, and resource conditions using a Restoration Needs Assessment (RNA) approach. The RNA evaluated the needs for restoration in the entire basin, with a focus on the tributaries and sub-watersheds feeding into the main stem of the Illinois River. It provided a practical and scientific basis for assessing the large study area and identifying potential restoration project types and general locations for the Illinois River and its tributaries. The RNA also defined the critical data gaps hindering the ability to determine habitat needs and focus the study, planning, and construction efforts on the areas of critical need. The RNA provided a comprehensive, basin-wide assessment of historic ecological change, existing conditions, predicted future conditions, and desired future conditions. The information gathered for this effort has been incorporated throughout the Comprehensive Plan. The RNA aspect of the study was designed to:

- evaluate existing data availability;
- compile existing data in a Geographic Information Systems (GIS) application;
- describe physiographic characteristics of the basin;
- evaluate stream channel dynamics;
- evaluate rapid watershed assessment techniques;
- evaluate existing, predicted, and desired future conditions; and
- compile a list of information needs.

The RNA provided information that significantly contributed to the development of the Illinois River Basin Restoration Comprehensive Plan and monitoring program.

Several research investigations were initiated to compile information for preparation of the RNA. Summaries of the following products are included in this appendix:

Illinois River Restoration Needs Assessment GIS
ArcIMS Web Site for Serving Historical Aerial Photographs
Native Ecotype and Historic Change Assessment
Rapid Watershed Assessments

Additional research for the RNA is summarized in Appendix D, *Geomorphology, Sediment Delivery, Sediment Removal and Beneficial Use,* under Section 1, *Summary of Illinois River Basin Landforms and Physiographic Regions*; Section 2, *Stream Dynamics Assessment*; and Section 3, *Sediment Budget*. The RNA and the research investigations listed above were used to prepare the Illinois River Basin Restoration Comprehensive Plan. Much of this information will continue to be used well into the next phases of the Illinois River Basin Restoration project.

II. ILLINOIS RIVER RESTORATION NEEDS ASSESSMENT GIS

Scott A. Tweddale, Corps of Engineers, Construction Engineering Research Laboratory (CERL), Champaign, IL

The Illinois River RNA-GIS application and geospatial database were developed as a tool to support the Illinois River Ecosystem Restoration Feasibility Study - RNA. Its purpose is to assist in the evaluation of historic, existing (primarily), predicted future, and desired future conditions of the Illinois River Watershed by providing an extensive geospatial database and customized GIS analytical capabilities. The study area and extent of the associated geospatial database includes the main stem Illinois River, its tributaries, and watershed in the State of Illinois.

The application is structured to provide access to GIS themes at three different scales: (1) the Illinois River Watershed, (2) the major tributary watersheds [United States Geological Survey (USGS) Hydrologic Unit Code-8 (HUC 8)], and (3) the subwatersheds [USGS Hydrologic Unit Code-12 (HUC12)]. A large number of geospatial data layers in the GIS have been summarized for each HUC-8 and HUC-12 watershed within the Illinois River Watershed. There are 19 HUC-8 and 944 HUC-12 watersheds in the basin. This method of organizing the application and geospatial database supports data browsing, data queried, and summaries at all scales in support of large-scale planning and smaller-scale, site-specific project formulation. The Illinois River RNA-GIS application was created using Environmental Systems Research Institute (ESRI) ArcGIS8.X software and Microsoft's Visual Basic for Applications (VBA), which is included in ArcGIS8.X products.

III. ArcIMS WEB SITE FOR SERVING HISTORICAL AERIAL PHOTOGRAPHS

Dr. Donald E. Luman, Office of the Chief, Illinois State Geological Survey
Champaign, Illinois

The photographic record provided by aerial photographs offers information that may be used for estimating baseline conditions and evaluating changes through time. Aerial photographs can serve as an important resource for geomorphological analyses (e.g., movement of nick points or changes in stream alignment) of physical and cultural landscapes. The first statewide collection of aerial photography of Illinois landscapes was acquired in the late 1930s and early 1940s as part of the U.S. Department of Agriculture, Agricultural Adjustment Administration (USDA-AAA) program. In the 1980s, for safety reasons, the National Archives and Records Administration destroyed the silver nitrate film negatives of this collection. The only remaining records of this photographic collection are the photographic paper prints made from the original film negatives.

Today, there exist more than 27,000 photographic paper prints of this first collection of aerial photographs of Illinois. These photographs represent the earliest and only remaining detailed, historical, aerial photographic record of Illinois' physical and cultural landscapes. The photographs are stored in several university library archives within Illinois and are in nearly pristine condition. However, because of their unique historic value, the photographs are not accessible to the public, planners, or researchers.

The Illinois State Geological Survey initiated a project to digitize these historical aerial photographs. The Survey has scanned more than 7,200 vintage photographs—dating from the 1930s and 1940s—of

Illinois, including photographs from approximately 10 counties having areas that lie within the Illinois River Basin. Photos from an additional four counties have recently been completed. Historical aerial photographs from additional counties within the Illinois River Basin need to be digitized. For each of the counties, an Excel spreadsheet was created that details the relevant information concerning the print collection, including county name, USDA-AAA county prefix code, acquisition date, total number of photographs, scale, number of flight lines, orientation of flight lines, type of county index (photo or line), date of county index, and an area for comments.

The index sheets for the 14 project counties were georeferenced to form the basis of an ArcIMS navigation map for each county. Each scanned county index sheet was geometrically corrected to a standard cartographic map projection using the USGS 1:100,000-scale Digital Raster Graphic (DRG) maps as the georeferencing base. ArcView 3.2 was used to create point data maps that indicate the approximate center point for each aerial photograph. The end product is a vector-based shape file used in ArcIMS as the navigation framework for searching and selecting images for download.

For the county-level and sub-county views, vector-based reference data layers including labeled Illinois counties, municipalities, interstate, U.S. highways, and state highways would be used in conjunction with the historical aerial photography center points. Recent Landsat Thematic Mapper ™ satellite imagery was used as the navigation raster image base, which provides a higher level of surface feature resolution. In addition, all of the vector and raster-based data used for the navigation maps were transformed to Lambert Conformal Conic projection, using the NAD27 datum.

All of the final scanned images for the 14 project counties were formally archived onto the Illinois State Geological Survey's UNIX-based system by county and flight line. This archive was added to the Survey's long-term data storage and back-up routines to ensure permanence for retrieval and access for the project web site.

Although some historical aerial photographs have been digitized and others are being digitized, the digitized images are not available for distribution. An Internet web interface was needed to make the scanned images freely and readily accessible to Federal and State planners and researchers. ESRI's Arc Interactive Map Service software was used for the development of the interactive portion of the Illinois Historical Aerial Photography (ILHAP) web site. This interactive web interface incorporates all of the above information and data layers. These digitized historic aerial photographs are now available at: http://crystal.isgs.uiuc.edu/nsdihome/webdocs/ilhap/

IV. NATIVE ECOTYPE AND HISTORIC CHANGE ASSESSMENT (DRAFT)

Dr. Michael Wiant, Illinois State Museum and Susan Post, Illinois Natural History Survey

Understanding the native ecotypes in the Illinois River Basin is important in establishing restoration endpoints. Restoration to presettlement conditions throughout the Basin is certainly not the goal of this program, but the knowledge helps define the limits, or expectations, for restoration in areas that are selected for restoration.

A. Native Ecotypes by Physiographic Regions. Upland habitats, tributary streams, and main stem floodplains and channels throughout the Illinois River watershed have been altered for a wide variety of reasons using many different methods. Knowledge of the natural potential habitats is important in order to establish a baseline for what could potentially be restored. There is not an expectation that the

Basin will be returned to a pristine condition, but native ecotypes can serve as targets for restoration activities. The first objective was to compile a short, well-illustrated summary of the potential native ecotypes found in the various physiographic regions of the Illinois River Basin, with representative photographs.

Each ecotype was identified, described, and illustrated with photographs for the major natural ecotypes present in the Illinois River Basin. The discussion included the major land cover classes—forest, prairie, marsh, and aquatic habitats—and the different types of those major classes likely to have been found in the Illinois River Basin. Topographic features were mentioned to provide an overview of the broad landscape patterns throughout the Basin. Statewide Government Land Office (GLO) survey records and GIS presettlement land cover maps were referenced for baseline natural community characteristics.

Natural Divisions of Illinois, Principal Natural Features

- I. Terrestrial Plant Communities
    - A. Forest
        1. Dry upland
        2. Mesic upland
        3. Wet upland
        4. Floodplain
        5. Bottomland
        6. Tamarack swamp
        7. Scrub oak
    - B. Prairie
        1. Prairie grove
        2. Prairie
            - a. Dry
            - b. Mesic
            - c. Wet
        3. Sand prairie
            - a. Dry
            - b. Mesic
            - c. Wet
        4. Loess hill prairie
    - C. Wetlands
        1. Fen
        2. Marsh
        3. Sedge meadow
        4. Bog

- II. Aquatic Habitats
    - A. Lakes
    - B. Creeks
    - C. Rivers
    - D. Sloughs
    - E. Backwater lakes
    - F. Oxbow lakes
    - G. Prairie potholes

B. Historic Change Assessment (Timeline). The second objective was to obtain a short summary of the anthropogenic factors that created the highly developed landscape of the modern Illinois River Basin. The pertinent literature and documents describing environmental change in the Illinois River Basin were reviewed, and a concise summary of historical change to native ecotypes and ecosystem function was provided. The analysis began with native cultures' landscape management and continued through European expansion into the Illinois Basin, conversion of upland savannas to crops, upland wetland draining, and levee construction during the 1800s. A second time step to be considered was the early 1900s waterway and urban development, sewage and other pollution discharge to rivers, and further development of the uplands to crops. A third time step began after WWII and emphasized agricultural specialization toward row crops, increased agricultural mechanization, increased use of chemicals, and continued urbanization. A final time step was the post-1970s conservation movement and the success of recent efforts to improve farming practices, control water pollution, and increase conservation practices and habitat restoration. A timeline of major events (legislation, improvements in tools or techniques, cultural factors, etc.) was developed.

V. RAPID WATERSHED ASSESSMENTS

A. Watershed Assessment Methods for Illinois Streams

Dr. Chester C. Watson, Don Roseboom, and Michael Robeson, Colorado State University

Channel modification or channelization activities are listed among the top 10 sources for non-point pollution impacts to rivers. Activities such as straightening, widening, deepening, and clearing debris from channels can be considered modification activities. These activities can severely impact major river projects such as navigation and flood control, as well as alter or reduce the diversity of instream and riparian habitats. The streams within the Illinois River Basin have experienced many of these channel modification activities. As such, a watershed assessments program was developed to mitigate these concerns. Stream restoration would reduce sediment input into the Illinois River and restore riparian and instream habitats, helping achieve ecosystem restoration goals for the Illinois River Basin.

The primary objective of the watershed assessment report is to develop and improve procedures that direct the focus for best management practice (BMP) design and implementation. This report presents the watershed systems analysis planning procedure for channel rehabilitation, using two Illinois watersheds, McKee Creek and Sugar Creek, as case studies. Both McKee and Sugar Creeks were initially proposed as potential restoration projects as part of the Illinois River Basin Restoration and Ecosystem Restoration Feasibility Study, though only McKee Creek was selected as one of the initial Critical Restoration Projects.

A key factor for a successful project is to identify the causal problems. Within the watershed system, problems generally fit into two categories—watershed and channel problems. These problems result in a set of impacts that act upon the channel and watershed, and it is these impacts that must be addressed. Watershed problems result from deforestation, intensive agriculture, urbanization, climate change, and stream base level change. Channel problems occur from channelization, dredging, meander cut-off, dams, inter-basin water transfer, navigation, levees, clearing and snagging, gravel mining, and stabilization structures.

The methodologies outlined represent a systematic and organized process for planning and designing regional sediment management projects that can be applied to lessen impacts of erosion on aquatic habitat and reduce the damage to land and infrastructure in the Basin. A comprehensive and systematic approach must be taken to solve stream and watershed problems. Strong emphasis is placed on evaluating the complete watershed and channel system. While all projects do not include the resource to construct full-system rehabilitation, it is essential to incorporate planning and analysis to identify opportunities, benefits, and potential problems related to piecemeal implementation.

Monitoring and feedback of the performance data for stream rehabilitation features are essential for establishing operations and maintenance requirements, determining performance measures, and providing feedback for future projects. In addition, when habitat restoration is a project goal, biotic sampling is the only true measure of success.

B. Watershed and Pool Assessments

William P. White and Dr. Nani Bhowmik, University of Illinois

Central to the implementation of the Illinois River Basin Restoration Comprehensive Plan is a methodology to rapidly assess individual watersheds and pools to help identify the most immediate restoration needs. This effort focuses on the watershed scale analysis of stream instability, and includes hydrologic analyses of selected watersheds.

The scope of this rapid watershed assessment project will be to perform pool and watershed assessments along the Illinois River and several watersheds of the river in the next 5 years to identify potential restoration project locations that meet the goals of the Illinois River Basin Restoration Study. The following locations have been identified as priorities within the Basin:

Peoria Pool	Tenmile Creek
Partridge Creek	Marseilles Pool
Dresden Pool	Kankakee River main stem
Upper Fox River	Iroquois River (including Sugar Creek)
McKee Creek	Vermilion River

The assessment techniques generally consist of the following:

1. Acquisition and analysis of aerial imagery from fly-overs using GPS for location information
2. In-air and office examination of imagery for channel process identification
3. “Ground-truthing” for verifying identification and general characteristics of potential target sites
4. Hydrologic analysis of selected watershed and pools
5. Sediment transport analysis of selected watersheds and pools
6. Geomorphic assessment of selected watersheds and pools
7. Biological assessment of selected watersheds and pools

After these assessments identify the most critical bed, bank, and erosion sites, more thorough field assessments will be performed. These field assessments will provide more data on site conditions and serve as baseline information to understand and document restoration efforts monitoring. The Illinois State Water Survey will collaborate with the Regional Teams within the Illinois DNR and with other

Scientific Survey offices for these efforts. The Illinois Natural History Survey will coordinate the assessments and inventory of the aquatic and riparian biota. The Illinois State Geological Survey will coordinate the assessments and inventory of the basic geological and geomorphological settings.

This initial assessment phase is expected to take 5 years. During the first year, at least one report for a single pool or watershed—identifying possible restoration project locations—will be completed. The remaining reports will be prepared in subsequent years, summarizing the work completed for that specific year.

ILLINOIS RIVER BASIN RESTORATION
COMPREHENSIVE PLAN
WITH INTEGRATED ENVIRONMENTAL ASSESSMENT

APPENDIX C

SUMMARY OF HYDROLOGY AND HYDRAULICS INVESTIGATIONS

ILLINOIS RIVER BASIN RESTORATION
COMPREHENSIVE PLAN
WITH INTEGRATED ENVIRONMENTAL ASSESSMENT

APPENDIX C

SUMMARY OF HYDROLOGY AND HYDRAULICS INVESTIGATIONS

INTRODUCTION

This appendix summarizes the hydrologic and hydraulic investigations undertaken as a part of this Comprehensive Plan. Some of the reports and efforts summarized in this appendix were prepared by contract and are indicated as such. The reports are available at the Corps of Engineers, Rock Island District office in Rock Island, Illinois.

1. GENERAL

The Illinois River Basin enjoys a continental-type climate characterized by frequent penetrations throughout the year of different types of air masses and their associated weather disturbances (USACE 1996). The basin lies in the path of low- and high-pressure areas that pass from west to east at more or less frequent intervals of about three to five days. Great variations in temperature occur from day-to-day, month-to-month, and year-to year, and in annual precipitation from year-to-year. The seasons are conspicuously distinct. Summers are commonly warm to hot and often humid. Winters are moderately cold. July is the warmest month, with mean monthly temperatures of 72 to 78 degrees F (north to south), and January the coldest, with mean monthly temperatures of 16 to 28 degrees F (north to south). Lake Michigan moderates temperatures locally in the Chicago area and causes relatively heavy snowfall in a narrow band adjacent to the lake. The growing season varies from about 200 days near the mouth of the Illinois River to about 160 days in the Fox River Watershed west of Chicago.

Storms in the Illinois River Basin are commonly of two types: the widespread frontal type and the local thermal convection (thunderstorm) type. There are no orographic storms because of the low relief. Total annual precipitation is fairly uniform throughout the basin, averaging from 34 to 36 inches. Flood-producing storms can occur at any time, but their frequency is greatest from late winter to early fall. During the cold season, large-area storms of from two to five days' duration predominate. In the warm season, storms are shorter but more intense. The average number of thunderstorms per year varies from about 40 in the northeast to about 55 in the downstream end of the basin. June is the month of maximum thunderstorm activity. Thunderstorms account for about 40 to 45 percent of the annual precipitation.

Because of its flat gradient and copious channel and flood plain storage, floods on the Lower Illinois River rise slowly, persist for long periods and recede slowly. A simple direct relationship between stage and discharge does not pertain because of these conditions and the effects of changing discharge and variable flows from tributaries. Quite often, flood-peak discharges actually diminish as a flood proceeds down the river. Since records have been kept, the average flood year has resulted in water being out of banks about 90 days.

The two hydrologic conditions that have the greatest effect on the ecosystem integrity of the main stem Illinois River are rapid water level fluctuations and lack of pool drawdown (Section 2, Illinois River Ecosystem Restoration Study Water Level Management Analysis). High peak flows and low base flows are the primary ecosystem stressors in the tributaries to the Illinois River. A suite of models was used to analyze the current hydrologic conditions and the effects of proposed restoration alternatives on the main stem Illinois River and its tributaries.

A hydrologic model of the Illinois River Basin was developed by the Illinois State Water Survey using the USEPA's Better Assessment Science Integrating Point and Nonpoint Sources (BASINS) model (Section 3, Hydrologic Model Development for the Illinois River Basin Using Basins 3.0). This hydrologic model was utilized by the USACE to evaluate restoration alternatives proposed for the tributary watersheds to the Illinois River. The two types of restoration alternatives studied were: increasing floodplain storage volume and increasing floodplain infiltration area. Increasing floodplain storage volume was analyzed by modeling storage areas adjacent to the main channels of the tributaries. This added storage volume was to be utilized at a water elevation in the channel that is achieved three or four times per year during high runoff events. Increasing floodplain infiltration area was analyzed by converting a portion of existing agricultural land areas in each tributary basin to land areas with higher infiltration characteristics within the model. The simulations implementing each alternative independently resulted in decreased peak flows and a general attenuation of the storm volume occurring at the respective tributaries confluences with the Illinois River. The effects of the basin restoration efforts on the water level conditions in the Illinois River main stem were evaluated by using the tributary model results as input to the hydraulic model of the Illinois River and comparing the fluctuation characteristics of the various scenario combinations.

A hydraulic model of the Illinois River main stem was developed using the One-Dimensional Unsteady Flow Through a Full Network of Open Channels (UNET) model. The UNET model of the Illinois River is routinely used for management of the Illinois River and can simulate the interaction between channel and floodplain flows; channel and storage areas; levee failures; and flow-through navigation dams, gated spillways, weir overflow structures, bridges and culverts, and pumped diversions. The Hydrologic Engineering Center Data Storage System (HEC-DSS) database was used for managing input and output hydrographs with various time intervals, such as weekly, daily, hourly, 2-hour, 30-minute, etc. The hydrographs resulting from the BASINS model described above were input to the UNET model using HEC-DSS. The UNET model was used during the course of this study to evaluate the benefits from various restoration alternatives on water level conditions along the Illinois River. The output hydrographs at specified locations along the main stem were developed for each restoration alternative by the UNET model.

A FORTRAN program was developed by the Rock Island District to calculate the number of water level fluctuations at specified locations along the main stem for the observed data and the alternative restoration scenarios studied. Using HEC-DSS, the output hydrographs from the UNET analysis described above, were input to FORTRAN program. The three time windows that were analyzed with the FORTRAN program are 6 hours; 24 hours; and 120 hours (5 days). Each fluctuation was categorized by the magnitude of water level change: 0.5 to 1.0 feet, 1.0 to 2.0 feet, and greater than 2.0 feet. The fluctuation regime at each location of interest was defined by the number of water level fluctuations that occurred over the specified time windows. Nine different classes of fluctuation were determined for each location; and the characteristics are as follows:

- Time window = 6 hours
    - Water level fluctuations greater than or equal to 0.5-foot and less than or equal to 1.0-foot
    - Water level fluctuations greater than 1.0-foot and less than or equal to 2.0-feet
    - Water level fluctuations greater than 2.0-feet
- Time window = 24 hours
    - Water level fluctuations greater than or equal to 0.5-foot and less than or equal to 1.0-foot
    - Water level fluctuations greater than 1.0-foot and less than or equal to 2.0-feet
    - Water level fluctuations greater than 2.0-feet
- Time window = 120 hours (5 days)
    - Water level fluctuations greater than or equal to 0.5-foot and less than or equal to 1.0-foot
    - Water level fluctuations greater than 1.0-foot and less than or equal to 2.0-feet
    - Water level fluctuations greater than 2.0-feet

The benefit for each of the proposed restoration alternatives was quantified as the reduced incidence of fluctuation.

2. ILLINOIS RIVER ECOSYSTEM RESTORATION STUDY WATER LEVEL MANAGEMENT ANALYSIS. (U.S. Army Corps of Engineers 2004a). This analysis was conducted by the Rock Island District to investigate the potential for ecosystem benefits arising from possible changes in water level management activities on the Illinois Waterway, primarily in terms of reduced incidence of rapid water level fluctuations. Since 1900, alterations in the Illinois River Basin have resulted in an increased incidence of water level fluctuations at many points along the Illinois Waterway. Water level management was determined to contribute to some of these fluctuations due in part to the hydraulic nature of the flat pools, the methods of operation, and the highly variable inflows from the watershed. Hydraulic modeling results indicate that certain management changes have the potential to reduce water level fluctuations in the system.

Twenty water level records were analyzed to evaluate the current and historic fluctuation regimes in the Illinois River system. Data from recent records were compared with available historic records to investigate various influences on fluctuation patterns, including season and climate. Water level fluctuation regimes differ by location on the river and location relative to dams; gages a short distance downstream of dams exhibit many more fluctuations than do gages immediately upstream of dams, but the differences tend to be less pronounced at the dams farther downstream. Some of the downstream differentiation arises because from Lockport to Starved Rock the dams control the navigation pools throughout the year whereas the Peoria and La Grange Dams maintain water levels only during lower flow periods. Comparable records indicate that the river experiences more fluctuations now than it did pre-1900, but in most locations the period 1989 through 2000 contained fewer fluctuations per year than did the period 1979 through 1988.

Although a number of water level management activities are conducted in the canal system of the upper Illinois Waterway, most of the fluctuations in the upper portion of the waterway arise due to storm water flows. At times, gate changes at the run-of-river dams contribute to water level fluctuation in dam tailwaters and areas immediately downstream. Downstream, wicket dam operation also causes some water level fluctuations, but these are largely due to the hydraulic nature of changing between impounded and unimpounded conditions and are not controllable by changes in operations.

In general, the run-of-river water level management increases the magnitudes of water level fluctuations immediately downstream of dams as a response to the changing flows from the basin.

Hydraulic modeling suggests that a number of management changes could reduce the fluctuations occurring along the Illinois Waterway. A management scenario simulating smaller but more frequent gate changes at the dams in response to a more complete knowledge of inflows is likely to significantly reduce total fluctuations. These benefits would occur almost solely during times of low water. Storm water detention has the potential to reduce the fluctuations due to storm events in the reaches immediately downstream of the detention facilities. In order to be fully successful, storm water control would have to be implemented throughout the basin, as improvements at one point can be masked by fluctuating inflows downstream. Improved coordination in anticipation of storm operations would likely reduce water level fluctuations associated with release of flows from Lockport. Finally, use of the limited storage in the system to reduce fluctuations by centralizing control and optimizing management might also provide benefits, but at this time the technology required for system optimization has not yet been sufficiently developed.

This report also investigated the potential to lower the water level in the Peoria and La Grange Pools in order to stabilize sediments and allow plant establishment. Without additional action, including overdredging, drawing pool water levels down would have significant effects on navigation, recreation and infrastructure, the extent of which and mitigation costs would increase with drawdown depth. Flow conditions that allow maintenance of 30-consecutive-day drawdowns are most likely to occur during the months of September or October, or if attempted over an extended period of time in the late summer, but navigational and recreational users would be greatly affected during those times. Drawdowns in December are less likely to succeed but may be desirable due to the reduced conflicts during that month. From a biological perspective, optimal drawdowns would start in late June or early July and extend for at least 60 days, but flow conditions during that period would allow a drawdown in fewer than 1 in 5 years. The area exposed by a given drawdown is directly related to the depth below flat pool that is maintained at the downstream dam.

3. HYDROLOGIC MODEL DEVELOPMENT FOR THE ILLINOIS RIVER BASIN USING BASINS 3.0 (Demissie et al. 2003)

The objective of this study was to initiate the development of a continuous hydrologic model of the entire Illinois River Basin. This model was developed by the Illinois State Water Survey (ISWS). This model may be used to assist in the development of critical restoration projects conducted as part of the Illinois River Basin Restoration Program. The model will also be useful in assessing the flow characteristics throughout the basin, the effects of changes in land use and climate, changes due to project alternatives, and potential problem areas and restoration alternatives.

The BASINS modeling system, developed by the U.S. Environmental Protection Agency, was selected for this study because it:

- is designed for multiple purposes in environmental and hydrological practices,
- is based on state-of-the-art ARCVIEW technology for easy data processing,
- incorporates the widely-accepted HSPF and SWAT models to simulate watershed hydrology and the transport of nutrients, pesticides and sediments,

- utilizes a user-friendly interface to generate hydrological parameters,
- has an existing database of DEMs, land use, streams, and soils for the Illinois River Basin.

The Hydrologic Simulation Program – FORTRAN (HSPF, version 12) was used in this study to simulate daily watershed stream flow. It was accessed through WinHSPF, a graphical user interface, which interacts with the BASINS 3.0 utilities and data sets to aid in the development of an HSPF project. The HSPF requires spatial information about watershed topography, river/stream reaches, land use, and meteorology to accurately simulate the stream flow. It uses hourly precipitation, potential evapotranspiration, temperature, wind speed, and solar radiation time series data for performing hydrologic simulations when snow is also simulated. HSPF is a comprehensive and dynamic watershed scale model that simulates nonpoint source hydrology and water quality, combines it with point source contributions, and performs flow and water quality routing in the watershed reaches. It has been widely used for watershed scale hydrologic simulations and for assessing the effects of land-use changes on watershed scale hydrology and water quality.

The study plan to develop a calibrated and verified HSPF model for the entire Illinois River Basin involved tasks that were performed in different phases. The initial phase involved preparation of data that would be used for model development throughout the study. In the second phase, the HSPF model was developed and parameters were calibrated for the Kankakee River and Spoon River watersheds. In that process, the Kankakee River watershed was subdivided into two portions, the upper-Kankakee and Iroquois River watersheds, with parameters calibrated for each. Thus, calibration was performed for three areas: the upper-Kankakee, Iroquois, and Spoon River watersheds. In the third phase of study, a model for the entire Illinois River Basin was developed, parameters from the three calibrated watersheds were tested in other tributary watersheds, appropriate parameter values were adopted, and the HSPF model was run to simulate flows for the entire Illinois River watershed. This report discusses the work performed in all three phases.

A. Preparation of Input Data. Of the USEPA-WDM stations for which meteorological data are given in the BASINS database, only 17 stations are located in the general vicinity of the Illinois River Basin. More precipitation data stations were needed in order to reduce the effect of spatial variability of rainfall over the large area of the watersheds studied. Numerous additional weather stations in the Illinois River Basin with daily precipitation data available for the period of the study were identified and daily data was extracted from the Midwestern Climate Center database for those stations. Hourly precipitation data for sixteen more stations located in the watershed was also extracted from the NOAA-NCDC database. All hourly stations were used as reference stations for disaggregating daily precipitation data available at local stations into hourly precipitation.

B. Model Calibration and Verification for Two Watersheds. In the second phase of this study, hydrologic component of HSPF was calibrated and validated separately for Kankakee and Spoon River watersheds. The entire Kankakee River watershed was modeled in three sections: the upper Kankakee River watershed upstream of Momence, Illinois; the Iroquois River watershed upstream of Chebanse, Illinois; and the remainder of the watershed. During calibration of the Kankakee and Spoon watersheds, values of several sensitive model parameters were varied within a reasonable range to obtain an optimal agreement between the observed and simulated stream flow data. Calibration and verification were based on data from the 25-year period—1970 to 1995—for which complete stream flow and meteorological data records were available. Data from the 11-year period—1985 through 1995—was used to calibrate HSPF, and the calibrated model was verified separately for the 16-year period of 1971 to1986. Agreement between observed and simulated stream flow data, on an annual, seasonal (monthly), and continuous (daily) basis was determined objectively (by plotting the time series) as well as quantitatively. This was done to determine any trends due to seasonality and to have an idea of any discrepancies in long-term data values. Quantitative comparison was based on calculation of objective functions such as Nash-Sutcliffe efficiency (NSE), and coefficient of determination (R^2), intercept and slope of linear regression fit between observed and simulated data. For monthly and annual time scales, relative percent difference between observed and simulated flows was also calculated and reported.

C. Development of a Model for the Entire Illinois River Basin. In the third phase of this study, hydrologic simulations were performed using HSPF for the entire Illinois River Basin using two different approaches: an HSPF model using a single UCI data file; and an HSPF model using modular approach. In the first approach, the entire Illinois River Basin was delineated into 60 sub-watersheds using meteorological data from 56 gaging stations. The 60 sub-watersheds represent the practical limit that can be developed and still be able to model the entire Illinois River Basin in a single HSPF project. In the second approach, individual HSPF projects were created for the watersheds of seven additional major tributaries—Des Plaines, Fox, Vermilion, Mackinaw, Sangamon, La Moine and Macoupin—and the main stem Illinois River. In the modular approach, the entire Illinois River Basin was divided into approximately 250 sub-watersheds, and data from all 95 available precipitation gages were used in the simulation.

Model calibration was not performed for the entire Illinois River Basin for either of the two approaches. Instead, calibrated parameters from the three previously calibrated watersheds—the upper-Kankakee, Iroquois, and Spoon River watersheds—were tested over the entire Illinois River Basin to determine which set of parameters worked best for various portions of the basin. Out of the three parameter sets, the best results were consistently obtained by using calibrated parameters of Spoon River watershed for all remaining portions of the Illinois River Basin.

For both approaches, much of the Des Plaines watershed was removed from the HSPF model and replaced by an inlet location, by which flows from the Des Plaines River and Chicago Sanitary and Ship Canal are represented by observed flows instead of model simulation. This was done for two reasons:

1. The Chicago area is highly urbanized and the watershed characteristics are totally different from the three calibrated watersheds; thus, it would not be appropriate to use any one of the three calibrated sets of the parameters directly for the Chicago area.

2. The Lake Michigan flow diversion provides an additional source of flow to the Chicago Sanitary and Ship Canal. In the future, a detailed HSPF model that includes the Des Plaines River watershed and Chicago-Calumet drainage could potentially be linked with the model for the remainder of the Illinois River Basin.

The modular approach for modeling the entire Illinois River Basin is preferred for this project because it provides a broader framework for future modeling work, leading to more detailed applications in the major tributaries and sub-watersheds, such as may be needed for the evaluation of watershed management practices and other applications.

4. FLOODPLAIN ANALYSIS

One of the major restoration concepts is the reconnection of the Illinois River with its floodplain, since much of the floodplain has been disconnected from the river using levees. Reconnection involves managing available areas for purposes such as flood storage, water level management, and ecosystem restoration. Hydraulic modeling is used to better understand the influence of restoration efforts on river hydraulics. The UNET model was used to evaluate the impacts of different floodplain management alternatives on water level conditions in the Peoria and La Grange Pools along the Illinois River.

The Hennepin Drainage & Levee District (HDLD) at river mile (RM) 206 is the only significant contiguous area of disconnected floodplain within the Peoria Pool. That area is 2,900 acres protected from the river by an agricultural levee system. UNET modeling indicated that making use of the leveed area to attenuate high flows could reduce maximum water levels at Henry, approximately 7 miles downstream, by as much as 0.5 feet, although benefits depend on the design of the structure that would be used to divert flows into the district. Hydraulic modeling indicates that the area would be most effective at reducing fluctuations if its inlet weir is set just above level pool elevation (440 feet NGVD). With this design, the HDLD would reduce 5-day fluctuations downstream to the Peoria Lock and Dam (RM 158) by approximately 5 percent. Upstream reductions would be less (2 percent at Starved Rock Tail, RM 231), and downstream of the Peoria Lock and Dam, the river would display 1 percent reduction or less. These benefits would be roughly additive when combined with work to restore tributary hydrologic regimes; if storage is added in the basin at levels of 10 acre-feet per square mile or greater, additional fluctuation benefits can be expected, but combinations with infiltration alternatives or low levels of storage are unlikely to display additional benefits beyond those attributable to the HDLD alone.

Modeling of floodplain storage in the La Grange Pool indicates somewhat smaller reductions in water level fluctuations from added storage area than the modeling of the HDLD. For this report, the Illinois State Water Survey used the UNET model to simulate a number of scenarios wherein different combinations of floodplain areas in the La Grange Pool were made available to attenuate low-level fluctuations, in the same way that the HDLD was modeled in Peoria Pool. Changes in the water level fluctuation regime were quantified at Kingston Mines, Copperas Creek, Havana, and Beardstown. The results of this effort suggest that although location-specific effects are significant, the fluctuation reductions due to the storage areas are roughly additive. The effects also depend on area at each site, diminish quickly with distance, and are much greater downstream of the added storage than upstream.

5. INVESTIGATION OF FLOW HYDRAULICS AND SEDIMENT TRANSPORT PROCESSES AT THE CONFLUENCE OF THE KANKAKEE AND IROQUOIS RIVERS WITH THE EnSed2D MODEL (Duan, 2003)

This report summarizes the results of computational modeling for the confluence of the Kankakee and the Iroquois rivers. It consists of three parts: (1) post-processing of the survey data and generation of the computational mesh; (2) technical descriptions of the hydrodynamic, mass dispersion, and sediment transport model, which are included in Appendices A and B; and (3) modeling results of flow hydrodynamics and sediment transport at the confluence of the Kankakee and the Iroquois Rivers. This project aims to study the effectiveness of engineering alternatives on reducing sedimentation at the confluence. The hydraulics and sediment transport patterns of three management scenarios, which are maintain in a natural state without engineering structures, construction of three short dikes on the left banks of the Kankakee River, and construction of three longer dikes on the left banks, are studied by applying the EnSed2D model.

The sediment transported in the Kankakee and Iroquois Rivers is primarily suspended sediment. The channel bed has a thin layer of bed material, and occasionally be rocks are exposed. Therefore, this study focused on the simulation of suspended sediment transport in the system. Two methods were applied to simulating suspended sediment deposition and erosion processes. One method assumes that the bed material layer is not thick enough for entrainment so that only deposition occurs; the other method assumes there is a sufficient amount of sediment that can be entrained from the channel bed so that the change of bed elevation is the difference between the rate of deposition and entrainment.

The simulated results showed that if the bed material layer is very thin, there is no scour in front of the dikes, while if there is an entrainment, the scouring in front of the dikes is very apparent. In case of no construction, the deposition at the confluence will spread at the confluence as well as immediately downstream. The construction of three short dikes will reduce the deposition of suspended sediment at the confluence and facilitate the passage of suspended sediment from the Iroquois River to the Kankakee River. However, increasing the dike lengths will potentially block flow from the Iroquois River to the Kankakee River, and worsen deposition at the confluence. Therefore, the results of this study recommended that dikes with a reasonable length could be the most cost-effective alternative to reduce sedimentation at the confluence. However, the locations, alignments, and dimensions of these dikes should be determined through another detailed computational modeling study. To ensure the mechanical stability and minimize the negative environmental effect of these dikes, flow hydrodynamics and sediment transport at the near-dike region should be investigated by applying an advanced computational model or conducting physical laboratory experiments.

ILLINOIS RIVER BASIN RESTORATION
COMPREHENSIVE PLAN
WITH INTEGRATED ENVIRONMENTAL ASSESSMENT

APPENDIX D

GEOMORPHOLOGY, SEDIMENT DELIVERY, SEDIMENT REMOVAL AND BENEFICIAL USE

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ILLINOIS RIVER BASIN RESTORATION
COMPREHENSIVE PLAN
WITH INTEGRATED ENVIRONMENTAL ASSESSMENT

APPENDIX D

GEOMORPHOLOGY, SEDIMENT DELIVERY, SEDIMENT REMOVAL AND BENEFICIAL USE

INTRODUCTION

This appendix summarizes several investigations undertaken as part of the Comprehensive Plan efforts related to geomorphology, sediment delivery, sediment removal, and beneficial use. The reports and efforts summarized below in sections 1 through 6 were prepared by contract. The reports are available at the Corps of Engineers, Rock Island District office in Rock Island, Illinois. Section 7 provides an overview of sediment removal and beneficial use options that have either been tested or could be tested in the basin.

1. SUMMARY OF ILLINOIS RIVER BASIN LANDFORMS AND PHYSIOGRAPHIC REGIONS

The goals of this study were to provide summaries of the geomorphology and surficial geology of the Illinois River Basin and to characterize the variability of such properties that are important for ecosystem restoration assessments. The three products developed were intended to facilitate discussions among the public, managers, and scientists.

A. ***Geological History of the Illinois River Watershed.*** This paper describes the development of landforms and surficial deposits during the Pleistocene Epoch. It focuses on glacial sedimentary processes and the complexity of glacial environments, but also discusses contemporary sediment-related problems. The paper was presented at the 2001 Governor's Conference on the Management of the Illinois River System (Phillips and Shilts 2001).

B. Revision of *Physiographic Divisions of Illinois* (Leighton et al. 1948). The product of this investigation was an updated map of the physiographic divisions of Illinois. Physiographic divisions are regions with distinctive landforms distinguished by slope and relief. The many influences on landforms/development include pre-existing variations in topography; the texture and thickness of surficial materials; relative age of the surface; and glacial, fluvial, or lacustrine molding of the surface. Recognition of the regions may be useful in identifying the expected range of geomorphological parameters for a given site. Leighton et al.'s (1948) map updated and refined Fenneman's (1928) national boundaries for Illinois and was published at a scale of 1:3,000,000. This revision is intended to create a GIS layer more useful at larger scales and to incorporate four decades of new mapping and digital elevation models to provide more accurate regional views. Models of geomorphology and landform evolution have changed considerably over the last 4 decades, so it is wise to reconsider the definition and use of the divisions. Table D-1 summarizes the updates, by division, from the 1948 map to the recent map.

Leighton et al.'s (1948) map was first digitized by Abert (1996). This digital coverage was updated to 1:500,000—the scale of most Illinois State Geological Survey (ISGS) statewide maps—by overlaying it upon a new painted relief map of Illinois (Luman et al., in press). The criteria that defined Leighton et al.'s divisions were reevaluated and manually redrawn to fit topographic features on Luman et al. (in press). These boundaries were refined where appropriate using surficial geological features (Stiff 2000) and elevation contours determined from Abert (1996). The original physiographic divisions largely hold up to new analysis, although all boundaries were moved significantly and made more complex. In addition, two new regions (the Ancient Illinois Floodplain and the Griggsville Plain) were subdivided from existing regions by virtue of several distinctive features.

C. Lexicon Map. The product of this effort was an updated map of the landforms of Illinois. Bier's (1980) interpretive landform map was successfully georeferenced to an ISGS coverage of county boundaries (http://www.isgs.uiu.c.edu/ndsihome/browse/statewide/counties.e00) and draped on Abert's (1996) shaded relief map. Although georeferencing of the Bier map was not perfect, distortions based on the county boundaries are typically less than 500 m and, more importantly, interpreted landforms generally overlie corresponding features on Abert (1996).

Table D-1. Revision of the Physiographic Classifications of Illinois

Classification by Leighton, Ekblaw, and Horberg	Classification Criteria by Leighton, Ekblaw, and Horberg	Classification Criteria by Phillips
I. GREAT LAKES SECTION		
I-A. Chicago Lake Plain	• Defined by highest lake level, the Glenwood Phase at ~ 640 ft • Includes headlands	• Elevation determined from DEM (Abert 1996) • Includes headlands and some Equality Formation (Stiff 2000)
I-B. Wheaton Morainal Country	• Includes northern portion of Marengo Moraine, arbitrary(?) eastward jog in Kane county to join Valparaiso Moraine, followed Rockdale-Manhattan Moraine east to Indiana (Tazewell and Carey substages) • Includes some Illinois Episode drift in McHenry and Kane counties • Highest elevation, complex topography; knob and kettle topography, small filled lake basins, eskers, and kames relatively common though not abundant	• Includes Wadsworth Formation and excludes Lemont Formation (Stiff 2000). This significantly modifies northern reach. Surface is kettled west to farthest moraine, but much less so than to east. • Portions of Rockdale Moraine dissected by sluiceways excluded; surrounded by Kankakee flood-related deposits and have smoother surface than moraine to east
II. TILL PLAINS SECTION		
II-A. Kankakee Plain	• Level to gently undulatory including low morainic islands, glacial terraces, fluviglacial bars and dunes, some lake deposits (though lakes short-lived) • Modified morainic basin • Enclosed by Iroquois, Manhattan, Minooka moraines (on E), and Marseilles and Chatsworth moraines (W & S) • Thick drift to exposed bedrock (in valleys)	• Lake Wauponsee Stage, highest level of the Kankakee Flood, at ~650 ft. Elevation from Abert (1996) • Includes fluvially modified (flat-topped to smoothed) bits of Minooka, Rockdale, Wilton Center, and Manhattan moraines • Excludes hummocky plain along Marseilles and Chatsworth moraines

Classification by Leighton, Ekblaw, and Horberg	Classification Criteria by Leighton, Ekblaw, and Horberg	Classification Criteria by Phillips
II-B. Bloomington Ridged Plain	• Wisconsin moraines of Tazewell age • Low, broad morainic ridges separated by flat to gently undulating ground moraine • Moraine slopes are gentle • Outer boundary follows Shelbyville, Bloomington moraines	• Some Henry Formation along Marseilles and Chatworth morains included because (a) relatively steep slope, (b) coarser-textured than most of Illinois Till Plain, (c) genetically linked to moraine • Near Peoria, Bloomington Moraine has straighter, less dendritic (less developed?) drainages than beyond moraine
II-C. Rock River Hill Country	• Subdued rolling hills • Bedrock controls most landforms • Thin Illinois and Wisconsin Episode drift	• Primarily defined by being *not* Green River Lowland or Wisconsin Driftless Area • Sharp ridges, relatively well-developed drainages • Topography slightly subdued relative to Wisconsin Driftless Area
II-D. Green River Lowland	• Bounded by Shelbyville Moraine, Green River Lobe, on north and south, and Bloomington Moraine on east • Merges with Cary valley-train of Rock River in west • Includes remnants of Shelbyville Moraine • Remnant of old bedrock valley forms bluff on south	• Fluvial and lacustrine landforms of the Henry and Equality Formations • Portions of sluiceways through western uplands included because they are physiographically continuous
II-E. Galesburg Plain	• Western segment of Illinoian drift sheet • Level to undulatory; few morainic ridges • Bounded by Meredosia Valley and Wisconsin drift border (NE); Illinoian drift boundary (SW) • Continues across Mississippi River into Iowa	• Southeastern boundary drawn along base of western bluff of the Illinois Valley • Distinguished from Bloomington Ridged Plain in NE by more complex drainages; boundary otherwise drawn at base of moraine ridge • Separated out Griggsville Plain in S, where uplands are less extensive, valleys are more deeply eroded, and drainages more complex

Classification by Leighton, Ekblaw, and Horberg	Classification Criteria by Leighton, Ekblaw, and Horberg	Classification Criteria by Phillips
II-F. Springfield Plain	• Western half of Illinoian till plain • Level to undulatory till plain • Shallow drainages • Southern boundary where drift thins and bedrock control becomes more predominant	• Includes smooth features with several clearly glacial landforms, i.e., moraines • Flatter uplands than the subdued ridges in Mount Vernon Hill Country • Southern drainages controlled by Kaskaskia R., Little Wabash R., or Embarras R.; MVHC drainages reach ridge crests and drain southward • In Monroe County (west), division excludes Mississippi R. drainages and boundary follows structural ridge
II-G. Mount Vernon Hill Country	• "Mature" topography of low relief • Restricted upland prairies • Broad alluviated valleys along larger streams • No glacial landforms except for portion of Jacksonville Moraine • Southern and western boundaries along outer limits of glaciation or outer margin of Carbondale Group, Pennsylvanian System	• Rounded upland ridges contrast with flatter, broader uplands of Springfield Plain • Drainages reach ridge crests and drain southward • Southern and western boundaries along outer limits of glaciation or outer margin of Carbondale Group, Pennsylvanian System
II-H. Griggsville Plain (NEW)		• More dissected than Galesburg Plain • Highly restricted uplands, though peaks more subdued than Lincoln Hills • Boundary drawn up center of McKee Creek valley, then westward following distinct linear features along ridge • Drainages less "feathery" than Galesburg Plain • Drainages more dendritic and more "feathery" than Lincoln Hills Section • May represent pre-Illinois drainages little modified by thin drift and minimal glacial erosion of Illinois Episode

Classification by Leighton, Ekblaw, and Horberg	Classification Criteria by Leighton, Ekblaw, and Horberg	Classification Criteria by Phillips
II-I Ancient Illinois Floodplain (NEW)		• Contains erosional and depositional features from Wisconsin Episode jökulhlaups (outburst floods) • Boundaries primarily follow escarpments, although southern boundary is arbitrary intersection with Lincoln Hills province • Areas with genetically-related features in southeast Mason, Loan, and Menard counties excluded because of topographic affinities with Springfield Plain
III. DISSECTED TILL PLAINS SECTION	• "Kansan" drift in area of high relief • Eastern boundary along Illinoian drift margin • Southern boundary where "Kansan" drift becomes too patchy to be significant, but arbitrary • Modified from Fenneman who drew eastern boundary at the Mississippi River	• Northern boundary distinguishes more crenulated (Griggsville Plain) from less crenulated topography
IV. WISCONSIN DRIFTLESS SECTION	• "Submaturely" dissected, low plateau bordering outwash-filled upper Mississippi Valley • Eastern boundary follows edge of Illinoian drift	• Eastern boundary follows edge of Illinoian drift
V. OZARK PLATEAUS PROVINCE		
V-A. Lincoln Hills Section	• Partially drift-covered dissected plateau above junction of Mississippi and Illinois rivers • "Maturely" dissected central ridge • Eastern boundary follows Illinoian drift border • Northern boundary arbitrary • Southern boundary along Cap au Grès flexure	• Southern part of eastern boundary drawn along limit of Illinoian drift • Includes long, oddly curved, wide-bottomed valleys with markedly steep walls and sharp ridges • Drainages less dendritic and less "feathery" than Griggsville Plain • Northern boundary arbitrary, but tangent to Pennsylvanian-Ordovician contact • Southern boundary on contact between Orodovician rocks and the Devonian Rocks of the Salem Plateau

Classification by Leighton, Ekblaw, and Horberg	Classification Criteria by Leighton, Ekblaw, and Horberg	Classification Criteria by Phillips
V-B. Salem Plateau Section	• Two segments of part of Ozark Dome • "Maturely" dissected, partially truncated cuestas dominated by single central ridge • Northern segment covered by Illinoian drift • Northern segment: arbitrary boundary with Salem Hills where coarser Pennsylvanian rocks give way to finer; east margin along overlapping edge of Pennsylvanian strata; northern boundary on Cap au Grès flexure • Southern segment: includes pre-Carboniferous	• Northern segment: moved boundary eastward to include karstic regions; northern portion at Devonian-Ordovician contact • Southern segment: includes pre-Carboniferous rocks
VI. INTERIOR LOW PLATEAUS PROVINCE		
VI-A. Shawnee Hills Section	• Complex dissected upland underlain by Carboniferous rocks • Northern boundary along inner flank of lower Pennsylvanian (Caseyville LS) cuesta within Illinoian glacial drift boundary • Southern boundary along northern edge of overlapping coastal plain sediments	• Northern boundary slightly redrawn to separate more subdued topography in MVHC; actual Caseyville contact still significantly northward • Southern boundary along northern edge of overlapping coastal plain sediments
VII. COASTAL PLAIN PROVINCE	• Underlain by Cretaceous and Tertiary sediments overlapping on Paleozoic rocks to the north • Alluvial plains of Cache and Mississippi valleys • Hills between Cache Valley and Ohio River sculpted in Cretaceous rocks	• Northern boundary follows contact between coastal plain sediments and older rocks

2. STREAM DYNAMICS ASSESSMENT IN THE ILLINOIS RIVER BASIN

Andrew C. Phillips [1], Bruce L. Rhoads [2], Thomas J. McTighe, [1] and Courtney A. Klaus[1]

Dynamical behavior in planform of representative stream reaches from across the Illinois River Basin was assessed by analysis of aerial photographs in time series from 1938 to present. The analysis sought to identify mechanisms and rates of planform change, assess the variability of these behaviors across the watershed, and determine the suitability of the method for watershed-scale assessments. The analysis gives an essential historical context to modern stream conditions and provides insight into the concept of stream channel "stability" in particular. The analysis also helps to focus future field investigations by identifying important processes and targets for study.

Study reaches 1.6 km (1 mile) long were selected along 10 streams. Aerial photographs (photograph D-1) at approximately 10-year intervals were obtained for each site. Channel centerlines (threads) of each reach were digitally traced from scanned, georeferenced images in a GIS environment. Threads were buffered to the georeferencing error of their source photographs and then digitally compared with a customized tool to identify overlapping and non-overlapping polygons (figure D-1). Non-overlapping polygons were considered to represent significant change and were assigned into dynamic classes distinguishing "natural" and human-influenced change. The polygon area is the parameter for quantifying change. These changes were evaluated in context of stream power calculations from gauge data, geology and soils data, and observed changes in land use and land cover.

Stream planforms changed by lateral migration or downstream translation of meanders, by chute formation and avulsion, and by channelization. Most planform change was caused by channelization. Several channelized reaches were observed to redevelop meandering behavior or change shape as a consequence of the modification. The response of streams to channelization is particularly important because it provides important information on evaluating the feasibility of restoration projects focusing on dechannelization of streams.

At most reaches, the dominant evolutionary mode excluding channelization was by meander migration, with avulsion playing a significantly smaller role. Extent and rate of change varied considerably, but change occurred along every reach studied. McKee Creek in the southwestern portion of the Illinois River Basin exhibited singularly high rates of change with extensive meander migration and pervasive avulsion.

Average monthly stream power was calculated from USGS flow data and remote measurements of stream geometry. Streams exhibited either relatively low stream power with low variability, or relatively high power with high variability. Stream power increased with time by factor of approximately two on most reaches in watersheds that experienced extensive development; stream power on dominantly agricultural reaches showed no particular trend. A simple correlation between planform change and stream power was not identified. Although several reaches exhibited the progressive increases in change with stream power and time as expected for "unstable" stream channels, most did not. Correlation between stream power and planform change is not expected for

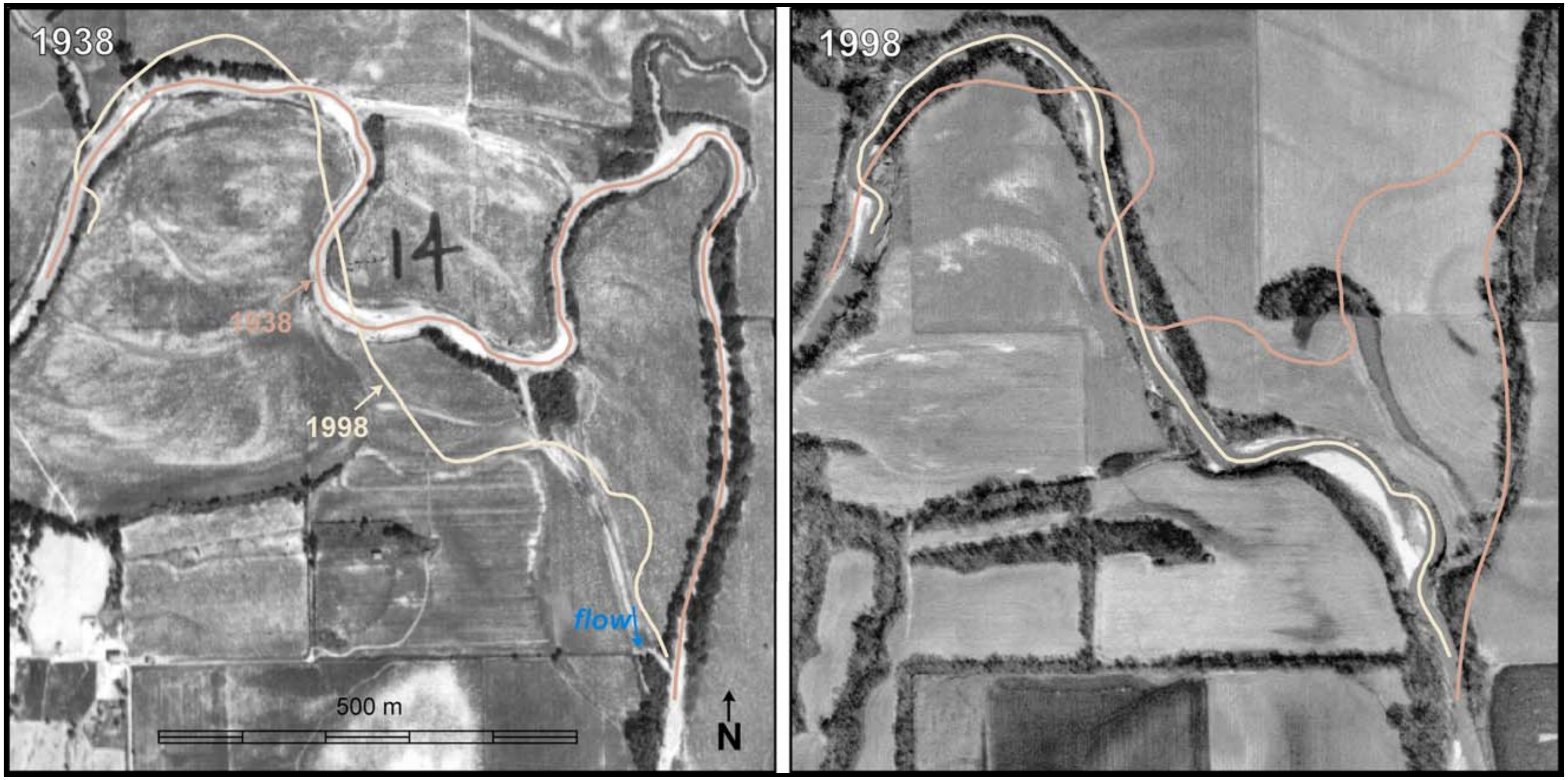
[1] Illinois State Geological Survey, 615 E. Peabody Dr., Champaign, IL 61820, 217-333-2513
[2] Department of Geography, University of Illinois at Urbana-Champaign

either avulsion or channelization, but is expected for meander migration. The lack of correlation demonstrates that geomorphology of entire watersheds must be assessed to give spatial and temporal context to stream dynamical behavior.

3. SEDIMENT BUDGET

Sediment yield from tributary streams of the Illinois River was calculated based on suspended sediment load data collected by the USGS (Demissie et al. 2004). Sediment rating curves that relate daily sediment load and daily water discharge were developed for each of the sediment monitoring stations based on existing data. Because rating curves often underestimate sediment yield, a refined rating curve procedure was developed to minimize the underestimation. The sediment rating curves were then used to calculate annual sediment yields from all the tributary streams with available sediment load data. The annual sediment yields were then plotted against the annual water discharge to develop regional equations for annual sediment yields. The data points coalesced into four different annual sediment yield equations, which were then used to calculate annual sediment yields by tributary streams into the Illinois River Valley. A 20-year period (1981 through 2000) was used for the analysis. Tributary streams of the Spoon and LaMoine Rivers were determined to have the highest sediment yield rates. The main stems of the Spoon, LaMoine, and Vermilion Rivers had the second highest sediment yield rates, followed by the Sangamon, Iroquois, and Des Plaines Rivers.

The sediment yield calculations were used to construct a quantitative sediment budget for the Illinois River Valley. By using the four regional equations, the sediment inflow into the Illinois River Valley from tributary streams was calculated. The sediment outflow from the Illinois River Valley was determined from data collected by the USGS at the Valley City monitoring station. On the average, 12.1 million tons of sediment is delivered to the Illinois River Valley annually, and the average annual outflow of sediment from the Illinois River at Valley City is 5.4 million tons. This results in an average of 6.7 million tons of sediment delivered from tributary streams being deposited in the Illinois River Valley annually. The total amount of sediment deposited in the Illinois River Valley is probably higher than the 6.7 million tons because of the contribution of bank and bluff erosion, which is not included in these calculations.



Photograph D-1. Aerial photographs of the same 1-mile stream reach showing channel locations changes from 1938 to 1998.

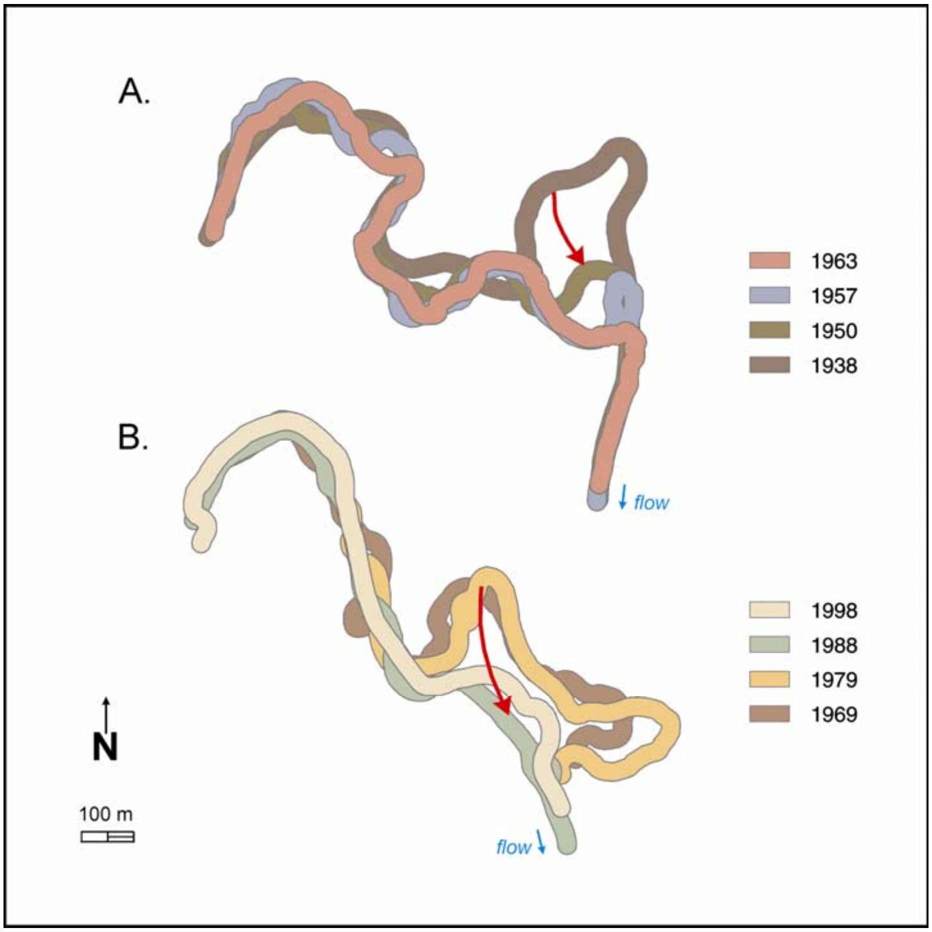


Figure D-1. Comparison of Channel Centerline Changes. Figure A: 1938 to 1963; Figure B: 1969 to 1998

4. DIGITIZE HISTORIC MAPS AND SEDIMENT RATE ANALYSIS

Sedimentation rates between 1903 and 2001 for four backwater rates on the Illinois River—Babb's Slough, Sawyer Slough, Meadow Lake, and Wightman Lake—ranged from 0.18 inch per year to 0.40 inch per year, and the percentage reduction in storage capacity varied from 87 percent (0.9 percent per year) to 98 percent (1.0 percent per year). In general, deeper areas have filled more quickly than shallow areas, resulting in a higher and more uniform bottom surface in 2001 as compared to 1903. The annual rates of capacity loss and sedimentation calculated between 1903 and 2001 compare closely to rates calculated in other publications between 1903 and the mid 1970s, indicating that sedimentation rates and rates of annual percent capacity loss have remained nearly constant since 1975. These recent rates are higher than expected given that the bottom surface has been progressively rising, which should result in decreased rates of sedimentation. However, water elevation duration curves from 1903 through 1975 and from 1975 through 2001 show that more recent water flow rates and corresponding water surface elevations have been higher, promoting continued high rates of sedimentation.

5. SEDIMENT CORINGS AND ANALYSIS

Determining the appropriate sediment removal technology, how that sediment is handled, and where it is placed depends on the type and quality of the sediment. As such, the Illinois State Water Survey conducted a study to characterize the sediments found in the Peoria Pool of the Illinois River. Thirty-seven deep sediment cores were collected during the course of the study. Each of the cores was split, and a lithology was developed for each. Radiographs for 25 of the cores were performed. The cores were sub-sampled in 10 cm intervals to the top of the original floodplain soil, if present. When original floodplain soils were present, larger intervals of about 25 cm were taken to the base of the core. Sub-samples were air dried and are being stored until such time as additional chemical and physical analysis can be performed.

6. SUMMARY OF INNOVATIVE TECHNOLOGIES AND TESTS FROM 2003

Three tests of innovative dredging technologies and beneficial uses were conducted in 2003. The following paragraphs briefly describe the efforts and results.

A. Sediment Handling Demonstration. Sediment excavated from an Illinois River backwater with a clamshell bucket was stockpiled on a field. The following day the sediment was loaded into concrete handling trucks. A concrete pump and placing boom had little difficulty handling the material. A telescoping conveyor also handled the material with little difficulty. The sediment stayed on the belts and negotiated the transfer point. The belt cleaners performed well. Minor problems, such as bridging in hoppers and splatter at some fittings designed for concrete, can be addressed with some operational or other changes. The pumps, booms, belts, and scrapers satisfactorily handled this material.

The sediment typical of Illinois River backwaters consists primarily of silt and clay with little sand. This material will cause little wear on belts, pumps, and pipes. As with other dredging equipment, potential objects in the sediment, such as tree branches, lumber, cables, metal parts and bricks of certain sizes, will have to be screened or avoided in order to prevent plugging or damaging the equipment. Trash racks with mechanical rakes or a grinder pump may prove useful in situations where debris is encountered.

This demonstration shows that conveyors and positive displacement pumps can move and place fine-grained sediment. The decision to use of this equipment on the Illinois River system will depend on numerous factors, including the distance material must be moved, availability of dredged material placement sites, configuration of dredge cuts, water depth, and cost. Both systems could move sediment at or near *in situ* moisture content to sites without costly containment dikes, onto islands, or into barges. The pump could also fill geotextile tubes.

B. Transport of Dredged Material Demonstration. A barge load of sediment excavated by clamshell dredge from Lower Peoria Lake was shipped to Chicago, Illinois. The barge was moved 163 miles and waited 10 days to unload. The sediment was loaded onto trucks with a large excavator and placed at a conservation area and at the Paxton I landfill reclamation site. The material handled well and maintained its consistency in the barge and after placing. It readily dumped from the trucks and formed piles about 2.5 feet high. The demonstration showed that this material can be transported and handled with conventional equipment and placed on fields without the necessity of using engineered containment structures.

A 3-cubic-yard conventional excavator bucket and semi dump trucks readily handled sediment at the destination site. The material in the trucks was cohesive, but gently rocked back and forth when the vehicles stopped and started. Although no spillage was observed from moving trucks, the potential for spillage should be considered when trucks are loaded and routed. Sediment poured from the trucks and formed thick dome-shaped piles rather than flowing across the ground and forming shallow pools.

The transport and placement of large quantities of dredged material on brownfields along waterways is technically feasible. Thick material can be unloaded from barges with an excavator or clamshell bucket into trucks, a positive displacement (concrete) pump hopper, or to a conveyor system for movement to a placement site. The material can be placed at a desired thickness and allowed to weather and gain soil structure. Alternatively, material could be placed in thin layers that would quickly dry. The dry soil could then be piled to the desired thickness by conventional earthmoving equipment.

There are other options for unloading and moving sediment to a placement site. Large off-road mining trucks could be used at sites adjacent to waterways where use of public roads is not required. It is also possible to add modest amounts of water to a barge to allow a slurry pump to move the material at a consistency similar to thick fuel oil. This would require some sort of low containment dike, as the mixture would flow. Alternatively the slurry could be sprayed in thin layers over the area and gradually built up.

C. Beneficial Use Demonstration. A proposed dredging project to improve wildlife habitat and recreation in the Peoria Lakes reach of the Illinois River will generate a large quantity of dredged sediment. The objective of this study was to investigate a possible beneficial use of the sediment as topsoil. Sediment was mixed with various amounts of biosolids, municipal compost, and horse manure. Barley and snapbeans were grown in the mixtures in the greenhouse. The plants grew well in all treatments, except snapbeans were stunted by salts in unleached biosolid mixtures. The highest overall yield for barley was obtained in the treatment composed of 50 percent sediment and 50 percent biosolid. For snapbeans, the highest yield was the treatment composed of 70 percent sediment and 30 percent biosolid. Heavy metals in plants tissue are within ranges considered normal, except for molybdenum (Mo) in snapbeans, which is at a level of concern if the plants were used exclusively as animal fodder. Addition of biosolids to sediments decreased Mo plant availability. Based on these results, this sediment has no inherent chemical or physical properties that would preclude use as topsoil substitute.

In terms of standard agronomic parameters such as plant growth, results confirm previous work that established that sediments from the Peoria Lakes reach of the Illinois River make excellent topsoil material. Both legume and grass plants grew well in all sediment mixtures and improved the plant growth potential of unleached biosolids. Addition of biosolids to sediment mitigates some of the problem with growing plants directly in sediments or biosolids. Pure sediments may have poor physical characteristics, at least initially under some field conditions. Pure biosolids have excessive salts that inhibit plant growth, particularly legumes, as evidenced by death of some snapbean plants on 100 percent biosolids. The sediments may experience improved tilth and higher plant nutrient content under field conditions when mixed with biosolids. The biosolids release less of their load of potentially toxic heavy metals, and the injurious salt content is diluted by sediment addition. Molybdenum uptake from sediments is decreased by biosolid addition.

An optimum sediment-to-biosolid ratio would range from 80:20 to 70:30 on a volume basis. This mixing ratio was also shown to reduce uptake of metals by crops, perhaps due to dilution as well as to modifications of soil properties, such as pH.

7. SEDIMENT REMOVAL AND BENEFICIAL USE

The Illinois River Basin Authority (WRDA 2000) calls for a component to address Section 519, the development and implementation of a program for sediment removal technology, sediment characterization, sediment transport, and beneficial uses of sediment. Much of the restoration effort will involve dredging outside of the navigation channel for environmental enhancement and will, therefore, differ in some respects from the more traditional navigation dredging.

The U.S. Army Corps of Engineers Dredging Operations and Environmental Research (DOER) Program conducts research that is designed to balance operational and environmental initiatives and to meet complex economic, engineering, and environmental challenges of dredging and disposal in support of the navigation mission. Research results provide dredging project managers with technology for cost-effective operation, evaluation of risks associated with management alternatives, and environmental compliance. The Corps of Engineers also operates the Regional Sediment Management (RMS) program. The RMS program is focused on managing sediment regionally in a manner that saves money, allows use of natural processes to solve engineering problems, and improves the environment. The Illinois DNR has developed dredging and beneficial use techniques suitable for Illinois River Restoration, including projects with the Corps under the Section 519 authority.

It is anticipated that Illinois DNR will continue as a partner in future efforts under this Illinois River Basin Restoration component, and that the efforts will be coordinated with the DOER and RMS program.

The scope of the work to date has been limited by fiscal constraints, particularly in relation to chemical characterization, demonstrations, and equipment testing and development. Funding and other support was provided by the State of Illinois and some local interests. Much of this work is described in Marlin 1999, 2001, 2002, 2003a, 2003b, and Darmody and Marlin 2002. Most of these documents are available at http://www.wmrc.uiuc.edu/special_projects/il_river/publications.cfm.

The following sections describe the background of this component; various technologies and beneficial use options that are available and have been tested in the basin; further technologies, testing, and applications that should be explored; and ends with recommendations regarding further work.

A. Background. Illinois River restoration efforts will require the removal and placement of several million cubic yards of sediment. There is great variation in the size and physical setting of the many backwaters (including side channels and the Peoria Lakes) within the floodplain. Additionally, the amount of material to be dredged to meet restoration objectives at specific sites will vary dramatically.

These factors make it necessary to consider innovative dredging techniques, innovative methods of handling and transport, and beneficial use options and techniques in addition to conventional methods.

Manipulations in the river system have caused most backwaters to become shallow with nearly flat bottom profiles, while islands and much of the floodplain experience increased flooding and higher groundwater levels. These changes have dramatically reduced aquatic habitat values and made it difficult for floodplain trees and other plants to maintain their historic species mix. Ecological restoration in the backwaters and the floodplain includes the need for dredging shallow backwaters to various depths and elevating certain islands and floodplain areas. The current plan for backwater dredging envisions 5 percent of a typical site being at least 9 feet, 10 percent between 6 and 9 feet, 25 percent between 3 and 6 feet, with the remaining 60 percent left undredged, with existing depths ranging from 0 to 3 feet.

Conventional hydraulic dredging is an efficient and cost-effective method of removing sediment where suitable sites exist for constructing diked areas to dewater and store sediment. Sediment mixed with water can be pumped a short distance or several miles depending upon the number of pumps used and availability of placement sites. Mechanical dredging is commonly used for small jobs and projects where the dredged material can be placed within the reach of a crane or excavator arm, or where construction of a dewatering containment facility is not desired. Additional steps such as loading and unloading barges or trucks, mechanical dewatering, and transport from drying beds and mixing with other soil components all add costs to sediment management efforts.

Most Illinois River sediment washes from streambeds and banks, bluffs and farmland. Heavier sand and gravel particles that enter the floodplain tend to form deltas at stream mouths or move down the main channel. Backwater sediment is largely composed of fine-grained silt and clay particles that are carried farther and settle in slow moving backwaters. Thus, much of the sediment in the backwaters and side channels is similar in physical characteristics to native topsoil. It should, therefore, be possible to use these sediments as soil barring contamination.

Until recently, the placement of dredged material in the United States has generally been viewed as a disposal problem. Sediment from ocean ports and channels is usually sandy, salty, and often seriously contaminated. Material dredged from inland navigation channels also tends to have a high sand content. Such material is often placed in confined disposal areas. Efforts to find beneficial use for dredged material often focus on the construction of islands or wetland habitat in coastal areas. In some areas, sediment has been used as soil or a soil amendment. Large-scale restoration requires finding publicly acceptable ways of placing huge quantities of sediment in stockpiles as well as determining how to use it beneficially for economic or habitat purposes.

Many Illinois River backwaters are large or located far from areas suitable for placing dredged material. Lower Peoria Lake, for example, is surrounded by urbanized land. Other backwaters are large or in broad floodplains where only limited amounts of sediment can be placed without causing hydrologic or ecological problems. In areas where relatively small amounts of material need to be removed for fish access and over wintering, dike construction or equipment mobilization can make the cost per cubic yard removed prohibitive.

Beneficial use of sediment involves moving it from the water body, transporting it, and placing it where it will be used. Additionally it may be necessary to dewater, dry, or pulverize the sediment or blend it with other materials prior to final placement. Each step adds cost and economies of scale are often significant.

B. Summary of Available Technologies for Sediment Removal. Corps projects in Midwestern large rivers (e.g., Illinois, Mississippi) have typically utilized mechanical clamshell and hydraulic cutterhead dredges. However, an ever-increasing range of technologies is available to remove sediment. This section summarizes conventional and more recent technologies that could be utilized in future projects.

Traditional hydraulic dredging and mechanical dredging with clamshells or draglines have several limitations. These include resuspension of sediments at the point of excavation and free water entrainment in sediments, which require extensive, and potentially expensive, dewatering and return water treatment (Duke et al. 2000).

i. Mechanical Dredging. Mechanical dredges employ a bucket to excavate and lift material from the bottom. The advantages of mechanical dredging are that a minimum of additional water is added to the sediment during dredging and the dredging unit is not used to transport material, permitting uninterrupted operation. For a mechanical dredge to be efficient, the cut thickness must be sufficient to fill the bucket. In non-cohesive, fine-grained sediment, sediment will wash out of the bucket.

The clamshell dredge, using a wire rope connection, is the most common of the mechanical dredges. The mechanical dredge is able to work in confined areas and can remove many different sized materials. The clamshell is not suitable for free flowing material (like unconsolidated sediment) and may be unable to dig into extremely firm materials. Typical bucket sizes used in the Illinois River Basin would range from 1 to 4 cubic meters, though clamshells as large as 16 cubic meters are in use.

ii. Hydraulic Dredging. Hydraulic dredges remove sediment hydraulically, in the form of a slurry. Types of hydraulic dredges are straight suction and cutterhead, pipeline dredges, dustpan dredges, hopper dredges, and auger dredges.

C. Summary of Tests. A large number of placement and use options in various combinations could be used to accommodate millions of cubic yards of dredged sediment over the next 50 years. Some can be readily implemented with conventional dredging equipment, while others require innovative applications of new or existing equipment. An ideal development would be a device that could remove and transport sediment as readily as hydraulic dredges and place it with the consistency and water content of mechanical buckets. Given that areas outside the main channel are often a foot or less deep and the desired depth of much of the restoration is 3 to 6 feet, the ability to operate in shallow water is also desirable. Another factor is the fine-grained nature of most of the sediment that requires removal.

Innovative approaches to design and implementation are as necessary as innovative technology in a restoration project of this magnitude. The river system has degraded over more than a century, and several feet of sediment has accumulated in most areas.

D. Innovative Sediment Removal Technology - Hydraulic Dredging. Hydraulic dredges could be used in a number of innovative ways. It is possible to pump material for miles if suitable areas are not available near the dredging location. A pipeline over 20 miles long was used when the White Rock Reservoir was dredged in Dallas. The material went into an old mining pit. When quantities are great enough, such distances are not out of the question along the Illinois River. Corridors could follow existing highways, railways, streams, storm sewers, and the river itself. Such a system could deliver dredged material to a number of mined areas in Illinois. It may also be possible to use out-of-service gas or oil pipelines to transport slurried dredged material. For example, a 12-inch pipeline currently extends from near Chillicothe to Galesburg, which is near strip-mined land owned by the Department of Natural Resources.

Several companies, including Black and Veatch, Brennan Marine, and Phoenix Process Equipment Co. have used mechanical dewatering systems in conjunction with hydraulic dredges. The systems separate most of the water from the sediment and then run it through a belt press. It can then be placed directly into trucks or stockpiles. Brennan has also operated its system without the belt press by placing the treated material in geotextile tubes to further dewater and consolidate the dredged material. These systems could be used to dewater sediment piped from miles away for island construction, loading into barges or trucks, placing on fields or other purposes.

Polymers are used in the mechanical processes to speed thickening in the tanks. Similar polymers are in use to help settle hydraulically dredged solids in dewatering ponds. Among other things, the polymers allow the discharge to meet regulatory standards with less holding time. The polymer mixture is matched to the properties of sediment at particular sites.

E. Sediment Handling and Transport Technology

i. Conveyors. Conveyor belts have the potential to effectively extend the reach of excavator and crane mounted clamshell buckets. Backwater sediment excavated with these buckets is cohesive and contains very little free water. The sediment can be placed on islands, on shore, or in trucks that are within reach of the excavator. In order to use large buckets in backwaters, it is necessary to dig deep enough to bring in a floating crane. If material is to be moved beyond the arm's reach, it must generally be loaded onto a barge that may require additional depth. A floating conveyor could operate in shallow water and transport material considerable distances to islands, the shore or barges in the channel. Dredged material excavated by a machine on a shallow float could be placed in a hopper feeding a belt.

In order for conveyors to operate successfully in the restoration effort, they must be able to convey freshly excavated sediment over distances and up modest inclines, transfer it from belt to belt, and the belts clean themselves during operation. Belt cleaning is essential to prevent dredged material from sticking to the belt and then falling into the shallow water and miring the floats. Some trial demonstrations were conducted to evaluate this transport and handling option.

The first demonstration occurred in March of 2002 at a gravel pit and is described in Marlin (2003b). Sediment was removed from a typical location in Upper Peoria Lake with a small clamshell bucket and placed on a deck barge. The bucket was heaped so that free water drained prior to placement on the deck. During the 8-mile trip to the gravel pit, the sediment held its shape and did not liquefy despite vibrations and rough water.

A series of three 36-inch conveyors was used for a series of tests. Sediment was placed on the first belt by the clamshell bucket, run about 50 feet before it dropped 7 feet through the first transfer point, was conveyed 100 feet up a 6 percent slope, and then transferred to a 50-foot stacking conveyor with a 25 percent slope. Because the conveyors normally handled sand, there were no belt scrapers and the transfer points had no fittings to control splatter. Various options were tried, including dropping sediment on a moving belt, starting the belt both dry and wet from a stop, and adding extra water to the sediment. In another test, an endloader took sediment to another belt where it was run 600 feet and stopped on an incline. Sediment placed into the hopper of the stacker readily climbed the belt.

The sediment stayed on the belts without difficulty. It did not liquefy and maintained a reasonably solid consistency over the belt idlers and across the transfers. Minor slumping occurred on the long belt, but the sediment cross section remained constant on the belts. The sediment did not exhibit excessive stickiness or build up on the belts or chutes after eight runs. As expected, some of the wet sediment was carried back past the transfer points on the belts and fell to the ground. This confirmed the need for belt scrapers. Likewise, a conveyor system for handling sediment will need to prevent spatter at transfer points and other locations.

In a second test, a Putzmeister truck-mounted concrete conveyor handled sediment in a September 2002 demonstration. Details of this demonstration are contained in Marlin (2003a) in the appendix. The system includes a 40-foot feeder conveyor fed by a hopper that carries material to the top of the truck where it is transferred to a 105-foot telescoping conveyor. Sediment excavated with a clam shell bucket and stockpiled in a field the day before was used for the demonstration. The equipment is designed for concrete and was not modified for this demonstration. Under ideal conditions, the system can handle 300 cubic yards per hour.

Sediment was removed from the stockpile with a skidder and placed in the hopper. The thick sediment had a tendency to bridge over the hopper bottom and was occasionally pushed through with shovels. The moving belt pulled the sediment from the bottom of the hopper. Raising the hopper a few inches greatly improved the situation. The sediment readily stayed on the belt and was compressed as it passed thorough the transfer point that had a four-inch clearance. It easily rode the extended conveyor and fell vertically off the end of the belt. Scrapers cleaned the belt and prevented drag back along the underside of the belt.

In another test, sediment was fed to the conveyor by a concrete pump. This material, that lost some of its cohesiveness during pumping, had no difficulty passing through the hopper to the belt. It, too, conveyed easily and cleared the transfer point. At one point, the extended conveyor was inclined to 30 degrees and the sediment traveled the belt without difficulty. The conveyor can be precisely controlled and made 20- by 60-foot plots of wet sediment 6 and 12 inches deep. It also made a circular pile 2 feet high at the center with a radius of 9.3 feet. The edge of the pile was about a foot high.

These demonstrations show that backwater sediment can be conveyed with conventional equipment. A system dedicated to sediment should have some modifications from the concrete system. Such features as the hopper and transfer points could have more clearance and splatter could be better controlled.

Floating conveyors over 2,000 feet long are used in the sand and gravel industry and presumably could be designed for use on the Illinois River backwaters. Given the shallow nature of the backwaters, the floating conveyor would be most useful if it drew a foot or less of water.

Pipe conveyors are another option. These systems use additional rollers to fold the conveyor belt over itself so that material is contained inside. It unfolds at each end for loading and discharging. These conveyors can curve without using a transfer point.

ii. Positive Displacement Pumps. Positive displacement pumps are commonly used for handling concrete and various slurries. They have been used for to handle sediment in several situations. Their main advantage is the ability to deliver sediment without adding large volumes of water. Large pumps can handle over 500 cubic yards per hour and pumping distances in excess of 2,500 yards are attainable. The quantity pumped generally decreases with distance. Marine sediment was pumped over 200 yards at a harbor dredging project at Ishinomaki in Japan. Sediment from the Schlichem Dam in West Germany was pumped through 5,000 feet of pipe. The reservoir was drained and the wet sediment loaded into a hopper with endloaders. This displacement pump operated at an effective rate of 78 cubic yards per hour (Putzmeister, Inc. literature). Two demonstrations of these pumps were conducted with Illinois River sediment.

The first used the DryDredge ™ that incorporates a concrete pump and sealed clamshell bucket capable of handling about 70 yards per hour (Marlin 2002). This dredge was developed in conjunction with the Corps of Engineers Waterways Experiment Station. The demonstration was conducted in Upper Peoria Lake near the EMP islands in the spring of 2001. The dredge was delivered to the area on a lowboy trailer, placed in the river with a crane and pushed to the site with jon boats. Once on site, the dredge maneuvered using walking spuds and its excavator arm. Water levels at the site fluctuated and occasionally were slightly less than 2 feet.

During the demonstration, excavated soft lake sediment was pumped through 120 feet of pipe. The operator was instructed to minimize the amount of free water entering the hopper in order to stay as close as possible to *in situ* moisture content. The dredge placed material at several locations on the overburden island and in shallow water. Sixteen sediment samples were taken from the discharge pipe over a 2-hour period. Their moisture content (water weight/sample weight) averaged 41.5 percent. Four shallow cores representative of *in situ* conditions averaged 43.5 percent.

The pumped material was cohesive and readily formed cone shaped piles about 2 feet high with a slope of 9:1. When an attempt was made to fill a wooden form 18 inches high and 8 feet square, the material stacked up to the height of the pipe lip instead of flowing across the form like concrete. The pumped sediment was too stiff to be dragged across the form with a shovel. At one point, water was added to the hopper to increase the flowability of the discharged sediment.

The dredge also filled four 15-foot circumference geotextile tubes placed in a trapezoidal pattern in shallow water. Then the area inside the tubes was filled with pumped sediment to form a small island. The pipe was moved several times because the sediment was too stiff to flow to the sides of the containment. Within a week, researchers could stand on 18-inch-wide plywood on the sediment. After 3 weeks, the sediment had a crust and easily supported researchers.

The second demonstration was in September of 2002 at Lacon, Illinois (Marlin 2003a). A Putzmeister concrete pump truck with a 32-meter articulated boom and a 5-inch line was used. The excavated sediment was the same used for the conveyor demonstration described above. The pump and boom experienced no difficulty handling the sediment. It pumped easily and could be precisely placed as it exited the discharge pipe. When pumped on the field, it formed a cone that after 2 hours of settling was about 2 feet high with a radius of 10.3 feet. The pump boom also discharged sediment to the conveyor truck.

The hopper feeding the pump is designed to handle concrete and has a 2-inch grate. The stiff sediment bridged over the grate and was slowly drawn into the pump. In order to improve flow, the grate was removed. The pump operated at about 10 percent of its capacity because of the skidder's limited ability to load sediment.

For use in backwater restoration, existing concrete pumps could be placed on floats or work barges and fed with an excavator or crane. The material could then be pumped onto an island, to shore, into geotextile tubes, or into barges or trucks. A placing boom could be mounted on a barge or on shore to place the sediment in a specified pattern and depth. Equipment of this type could provide great operational flexibility, especially where shallow depths are desired and building containment berms is not an option.

iii. Barge Transport. Sediment was barged to a Chicago landfill site in the fall of 2002 in order to evaluate the feasibility of moving backwater sediment long distances using conventional equipment. The project is described in Marlin 2003b. Nine hundred tons of material dredged from Lower Peoria Lake was placed in a barge with a clamshell bucket. The bucket was heaped to minimize the amount of free water placed in the barge. The barge was towed 163 miles to a Chicago dock on the waterway and unloaded into trucks for the 1-mile trip to the landfill. The material presented no serious handling difficulty and the trucks and barge cleaned normally after the project.

When dumped from semi-trailers, most loads formed a mound about 32 inches high. The material was cohesive and kept its shape after placement. A load dumped on an 8 percent slope stayed in place.

iv. Mud to Parks. In 2004, the State of Illinois moved 68 barge loads of Peoria Lake sediments to the Chicago Lake front to restore a portion of the 100 acre former U.S. Steel site as part of the State's "Mud to Parks" demonstration. This project further demonstrated the potential feasibility of transporting river sediment relatively long distances to utilize these sediments as a resource

F. Placement Options. Dredged material from the Illinois River historically has come from the main channel, marina access channels, and small harbors. Most material from the main channel is currently placed in designated sites that are diked, especially for large projects. Small harbor and marina maintenance projects generate material that is frequently dewatered in a pit or cell and is then trucked away to a field or hauled away by contractors and homeowners. Before the importance of maintaining floodplains was recognized, a common practice was to fill floodplain and water areas with dredged material. Such placement is now regulated.

A limited amount of material can be used to develop islands and wind and wave breaks in backwaters. Such structures will restore some of the features of the original system that were lost when water levels were increased during the last century. Islands can be high enough to support native floodplain hardwood trees and provide relatively isolated areas for various birds and other animals to rest, forage, or nest. Another option is to build islands with low spots above normal pool elevation that may support aquatic vegetation. Islands can be oriented to minimize impacts on flood storage and conveyance. Smaller structures can break waves and provide some calm and sheltered areas for waterfowl resting. They will also reduce resuspension of the flocculent sediment layer by wave action, which will reduce turbidity and make conditions more favorable for aquatic plants and sight feeding fish and other predators. Breakwaters will provide some protection from wave erosion to both new and existing islands and the shoreline.

Portions of the floodplain can be elevated to allow the return of native plant species that cannot tolerate the altered water levels, caused by the current locks and dams, diversion, drainage projects, and land use changes. This can be accomplished by mounding sediment on existing islands as well as areas between the channel and bluff line that are currently mudflats or covered with willow. The mounds can be located so that they become islands during floods.

Sites capable of holding large quantities of dredged sediment either permanently or for later use exist in the basin, but not always in proximity to backwaters needing restoration. Potential placement options include gravel pits, strip mines, and fields. The material can be dewatered behind a dike or dried and piled to any desired shape. A mound could be several stories high and as long and wide as desired.

The bulk of the material in the backwaters is quite similar to topsoil. Clean sediment could be used for landscaping, landfill cover, restoration of mine land and industrial sites, amending agricultural soil, and as bagged soil. Some sediment is suitable for use as construction fill, levee repair, and other projects depending upon its physical properties. If options with commercial value are found, it may be possible to offset all or part of the cost of some restoration dredging.

i. Unprotected Island Plot Trials. In 1994, the Rock Island District built an island in upper Peoria Lake under the Environmental Management Program. The large island was constructed by a clam shell dredge that cut a channel through sediment and lake bottom as it built the island approximately a mile long and 7 feet high. The distance the crane arm could reach determined the width. The soft top layer of sediment was removed first and cast to the west of the island, creating a low berm known as the overburden or small island. It was expected to rapidly wash away. Both islands are still in place, although the overburden island has lost much of its length and height. Exposed tree roots on the top of the large island indicate that it has lost up to 2 feet of height. It also has a higher sand content than the overburden island, probably because it contains greater amounts of material from the original bottom. Observers are surprised at the longevity of the overburden island and apparent strength of the larger one. A demonstration to determine the ability of the various sediments to serve as island building material is desired, but funding has not been available for a controlled project of reasonable size.

In the spring of 2001, a number of sediment piles were placed in shallow water and on the low EMP islands in Upper Peoria Lake. Some were built using the DryDredge™ and others were placed during high water using a clamshell bucket on a work barge. Portions of all piles that were above the flat pool elevation consolidated to the point where they supported the weight of researchers. The piles in the water and on the low end of the EMP “overburden island” washed away or were seriously eroded after one year. They were frequently subjected to waves striking at different elevations depending upon pool level. The piles on the east side of the large island lasted longer that those on the west that were subject to waves with a long fetch distance. By the fall of 2003, only a clamshelled pile about 2 feet above flat pool remained. It consisted largely of sand and had lost half its height.

These observations indicate that islands can be built with sediments in the area. However, the fluctuating water levels make it difficult for the shore to stabilize and vegetation to become established at lower elevations. Material containing sand or original hard bottom will make a better base than fine-grained sediment. A wave break can help protect an island, as could a geotextile tube, riprap or other armor.

Over 15 earth islands have been constructed in Pools 5 through 10 as part of the UMRS-EMP. These islands generally consist of a low sand base with fine sediments placed on top of the sand base. Shoreline stabilization of islands includes vegetative stabilization, riprap, and biotechnical methods such as groins, vanes, or off-shore mounds combined with a vegetative stabilization measure. Although there is significant variation from project to project, a typical distribution of shoreline stabilization methods is 20 percent riprap, 40 percent biotechnical, and 40 percent vegetative measures. More recent projects tend to have less riprap and more use of biotechnical and vegetative stabilization.

ii. Geotextile Tubes. Tubes made of geotextile fabric are in common use in coastal areas around the world for use in stabilizing beaches and constructing islands and wetlands. The tubes are filled with sand and allow berms, wave breaks, and containment areas to be quickly constructed. The tubes are also used to dewater sediment as well as sludges from wastewater and industrial facilities in situations where space for conventional dewatering is not available. Tubes filled with fine-grained sediment are in use at several projects and may prove useful for backwater restoration on the Illinois and Mississippi River systems.

The Corps' Nashville District used geotextile tubes at the Drake's Creek environmental restoration project near Hendersonville, Tennessee on Old Hickory Lake. The tubes separate a shallow area of a tributary arm from a recreational channel and open water. The tubes create a connected backwater protected from waves and suspended sediment. Fish and other organisms can freely enter and leave the area because the tubes do not extend all around the new backwater.

The Nashville District is experimenting with various options for vegetating the tubes and protecting them from ultraviolet rays that may cause them to deteriorate over time. Trees are planted in slits in some tubes and in other areas soil is placed over them. Vandals and boats have not damaged the tubes. The sediment in the tubes is consolidated and firm. The reservoir in not used for flood control and its water level is fairly stable. It is also not subject to freezing.

In Illinois, the Fox Waterway Authority in northern Illinois used geotextile tubes filled with sediment to form the perimeter of an island habitat restoration project. The tubes were filled using a hydraulic dredge in combination with a polymer that helped settle the solids. Sediment was then pumped into the ring formed by the tubes. Tubes suffered damage in a number of ways. Floating ice driven by wind and waves punctured several tubes. Snowmobiles ran over some tubes and cut the fabric, and recreational boats caused some damage. Duck blinds that escaped their moorings blew into several tubes and ripped the fabric. Waves eroded sediment from over 98 feet of one tube in 2 days. Riprap was placed over severely damaged tubes.

Four 15-foot-circumference tubes were placed in shallow water in Upper Peoria Lake in conjunction with the DryDredge ™ demonstration in May of 2001. They were filled with the DryDredge™. They formed an island about 50 feet on a side that was filled with sediment at near *in situ* moisture content. The tubes were about a foot above flat pool, and the island was frequently submerged by high water and lashed by waves.

Initially the tubes were pumped as full as possible and had no slack in the fabric. In 2001 the elevation of the ends of each tube was recorded with respect to a nearby reference point. Two years later, they were an average of 9 inches lower. The tubes were flatter and the fabric was not as tight. It is not clear whether the fine-grained sediment had consolidated, was passing through the fabric, or if the bags were sinking into the bottom sediment. These tubes suffered no ice or boat damage or vandalism during 3 years.

The tubes held the island in place while it consolidated. The sediment was initially mounded inside the island higher than the tubes. Grass seed planted on the sediment was consumed by geese and killed by flooding. Waves washed sediment from the top of the island until it was essentially level with the tubes.

Geotextile tubes will likely prove useful in Illinois River restoration projects. They can be used to hold dredged material in place while it consolidates, serve as wind and wave breaks, and as the edge of islands. In areas where ice, debris, or vandalism may be a problem, it may be necessary to use riprap or other protection in conjunction with the tubes. The tubes and their scour aprons could be used to reduce the amount of riprap required and to keep it from sinking in soft sediments. It will also be necessary to determine the best fabric for the sediment in a given area.

G. Beneficial Use

i. Dredged Sediments as Soil. Landscaping soil is a potential beneficial use of large quantities of sediment removed from water bodies, and the chemical and physical properties of the dredged material will largely determine its suitability. Sediment from the Illinois River valley has properties that indicate that it would make excellent landscaping soil. Much of the sediment found in the Illinois River valley originated from eroded fertile rural areas. Consequently, it contains less pollution in the form of heavy metals and other chemical contaminants than is typically found in sediments from urban or industrial areas. Some compounds found in sediments, such as ammonia, that are often toxic in an aquatic environment, may be beneficial to plants when placed on land. The initial problem with using dredged sediments as soil is that they are dispersed, have no soil structure, and may set up like concrete upon drying. This problem is generally overcome after weathering, i.e., wetting and drying, freezing and thawing, and exposure to microorganisms and plants. As the weathering progresses, the dredged material develops structure that enhances air, water, and root penetration. Tillage, or other means of mechanical disturbance, will accelerate the process. We have conducted a series of demonstrations and experiments that indicate that this scenario is generally true for the Peoria Lakes sediments.

Investigations to date show that fine-grained backwater sediments are similar in character to native topsoil (Darmody and Marlin 2002, Darmody et al, 2004 in press). The germination and growth of a variety of plants in sediment and central Illinois topsoil was essentially equivalent. The conclusion is that sediments can serve as well as natural, high quality topsoil as a plant growth medium in the greenhouse. Metal uptake by plants was elevated in some instances, but doe not appear to be a serious problem.

Peoria Lake sediment placed in a pit and on fields developed typical soil structure after weathering. A field at East Peoria was monitored after it was covered with sediment in 2000. When sampled in late November of 2001, the site supported a continuous stand of grass and other weedy vegetation. The sediments showed evidence of the development of soil structure. Moist consistence was firm in the sediments and very firm in the underlying fill. There was good root penetration in the sediment, and the internal soil surfaces were covered with common fine roots, which generally did not penetrate the soil's structural units themselves. Therefore, in about 15 months, the sediments developed much more favorable soil properties as they weathered. The site was revisited in December of 2003. Vegetation was still growing on the sediment. Soil structure was evident throughout the sediment, and live roots were found on the soil ped faces down to the contact with the underlying materials. Small insects and other soil-dwelling fauna were also found on the soil's structural units surfaces.

In another demonstration, fine-grained sediment from the same Peoria Lake location was placed in a gravel pit within a day after excavation in May of 2000. The wet sediment was over 8 meters deep in some locations. The site was visited in October 2002. By then there was a thick stand of vegetation on the sediments, including cottonwood trees and willow trees about 8 to 10 feet tall. This vegetation was all volunteer. A soil profile was exposed to determine the physical characteristics of the sediments. Good soil structure had developed to a depth of about 4.5 feet. Below this depth, there was little evidence of soil structure.

ii. Amendment to Sandy Agricultural Soil. Crop production on sandy soil amended with Illinois River sediment is under study by University of Illinois soil scientist Dr. Robert Darmody with funding from the state. The study plots are near Kilbourne in Mason County. Varying amounts of sediment were applied to standard plots as a top dressing or were incorporated by tilling. Otherwise, the plots were treated the same, including minimal use of irrigation. Corn and soybeans were grown on the plots. Current plans are to extend the study through the 2004 season and measure the uptake of heavy metals by the plants.

Preliminary results indicate that sediment moderates fluctuations in soil temperature and significantly improves moisture-holding capacity in sandy soil. Seed germination and plant growth were also greater on sediment plots. During the 2003 season corn yields were greater on all sediment plots. Plots with 6 to 12 inches of sediment produced over 3.5 times the yield of untreated sandy soil plots. Soybean yields were not as dramatic, although the 6-inch treatments produced statistically higher yields than the controls or other sediment plots. The 6-inch incorporated plots produced 1.6 times the yield of the controls.

Sandy soils are found in several counties bordering the Peoria and La Grange Pools. Given the nearness of some fields to the river and backwaters, it may be feasible to pump sediment directly to fields or transport it short distances by other means. This study will help determine whether sediment will improve soil conditions enough to warrant placement onto sandy fields. Placing a 6-inch layer on a 100-acre field would require about 80,600 cubic yards of sediment.

iii. Sediments Used for Greenhouse Applications. A proposed dredging project to improve wildlife habitat and recreation in the Peoria Lakes reach of the Illinois River will generate a large quantity of dredged sediment. The objective of this study was to investigate a possible beneficial use of the sediment as topsoil. Sediment was mixed with various amounts of biosolids, municipal compost, and horse manure. Barley and snapbeans were grown in the mixtures in the greenhouse. Plants grew well in all treatments, except snapbeans were stunted by salts in unleached biosolid mixtures. The highest overall yield for barley was obtained in the treatment composed of 50 percent sediment and 50 percent biosolid. For snapbeans, the highest yield was the treatment composed of 70 percent sediment and 30 percent biosolid. Heavy metals in plant tissues are within ranges considered normal, except for molybdenum (Mo) in snapbeans which is at a level of concern if the plants were used exclusively as animal fodder. Addition of biosolids to sediments decreased Mo plant availability. Based on these results, this sediment has no inherent chemical or physical properties that would preclude use as topsoil substitute.

In terms of standard agronomic parameters such as plant growth, results confirm previous work that established that sediments from the Peoria Lakes reach of the Illinois River make excellent topsoil material. Both legume and grass plants grew well in all sediment mixtures and improved the plant growth potential of unleached biosolids. Addition of biosolids to sediment mitigates some of the problem with growing plants directly in sediments or biosolids. Pure sediments may have poor physical characteristics, at least initially under some field conditions. Pure biosolids have excessive salts that inhibit plant growth, particularly legumes, as evidenced by the death of some snapbean plants on 100 percent biosolids. The sediments may experience improved tilth and higher plant nutrient content under field conditions when mixed with biosolids. The biosolids release less of their load of potentially toxic heavy metals and the injurious salt content is diluted by sediment addition. Mo uptake from sediments is decreased by biosolid addition.

An optimum sediment-to-biosolid ratio would be a range of 80:20 to 70:30 on a volume basis. This mixing ratio was also shown to reduce uptake of metals by crops, perhaps due to dilution as well as to modifications of soil properties, such as pH.

H. Conclusion and Recommendations. A number of technologies and innovative approaches show great promise in reducing costs and improving the current approach to remove and place sediment for restoration of Illinois River backwaters. Limited investigation of some of these techniques and the sediment's suitability for beneficial use have highlighted potential benefits. It is recommended that additional detailed evaluation and demonstrations of some of these concepts be implemented. These activities may be studied alone or conducted in conjunction with restoration projects. Some suggested lines of inquiry are presented below.

Lessons learned from past island projects constructed as part of the UMRS-EMP, along with information from other island projects (primarily in coastal areas) will be adapted to the unique conditions found in Illinois River backwaters. A demonstration of various ways to build islands with sediments would be useful. This could include the use of geotextile tubes and fabric, as well as sand and riprap where feasible. The evaluation should include different fabrics to determine whether sediment passes through over time, their overall durability, and their usefulness in combination with riprap. The use of geotextile tubes and other means of forming narrow windbreaks to reduce wave action and resuspension of sediments should also be investigated. The impact of frequent water level and presence of ice fluctuations on the structures requires particular attention.

Another investigation would be to test various options to place sediment on existing or potential islands in lifts to reach greater overall height. The areas would then be monitored to determine the durability of the material and the growth of various types of vegetation including mast-producing trees.

Various options exist for placing layers of sediment on farmland as a soil amendment. Investigations could include using small scrapers called soil movers that can be pulled by farm tractors to incorporate or shape sediments, directly dredging from backwaters to nearby fields with hydraulic or high solids equipment, or placement by trucks.

Further testing of transport options should be investigated. Displacement pumps are clearly capable of handling sediment typically found in the Illinois River. An analysis of the sizing and operation of pumps in relation to distance of the line is in order. This would include options where a pump located on a shallow draft platform pumps material through a pipe as well as to a placing boom. In addition, it would be valuable to evaluate the general design and operational feasibility of a shallow draft conveyor to move sediment from backwaters to islands, to the shore or to barges. If loaded onto barges, it would be important to demonstrate and determine the feasibility of quickly unloading barges of sediment with a slurry pump with minimal water added.

The best restoration option may involve a contractor removing incremental amounts of sediment from several locations in a river reach at different times during the first year and repeating the process over several years until the desired depths are met. This would allow the material at the placement sites to consolidate or be removed for use in more manageable quantities. It would likely require less land and construction at the placement site. This approach is similar in principle to some maintenance dredging contracts that cover river reaches.

In regard to beneficial use, the chemical and agronomic character of deposited sediment and the underlying original bottom in backwaters should be determined in order to identify restoration sites where beneficial use is a viable option. The initial work should require a few samples for chemical contamination and a larger number for characterization of suitability for use as soil or fill. A market analysis for sediment by itself or mixed with other material as a bagged or bulk soil would be useful.

The material on the deltas is sandy and is likely to be useful as fill or in some cases commercial sand. Cores of this material should be taken and evaluated. There is a need for such material at construction and brownfield redevelopment sites near the river and in the Chicago area. The feasibility of moving these deposits by barge, rail and truck needs to be investigated. In addition, sediment could be used as the basis for flowable fill, to be used in utility, road repair, and other construction applications.

Additional testing and use of innovative technologies and beneficial use options are recommended. This is justified based on the fact that restoration of depth diversity within the Illinois River Basin is a major goal that will require dredging and placement. In addition, a wide range of potential technologies and uses exist that merit further exploration.

ILLINOIS RIVER BASIN RESTORATION
COMPREHENSIVE PLAN
WITH INTEGRATED ENVIRONMENTAL ASSESSMENT

APPENDIX E

COST ENGINEERING

ILLINOIS RIVER BASIN RESTORATION
COMPREHENSIVE PLAN
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APPENDIX E

COST ENGINEERING

I. GENERAL

Table E-1 summarizes the project costs for the recommended alternative (Alternative 6) studied for the Illinois River Basin Restoration. This estimate is broken down into five main goals:

Goal 1 Sediment Delivery
Goal 2 Backwaters and Side Channel
Goal 3 Floodplain and Riparian
Goal 4 Connectivity
Goal 5 Water Levels

Each goal is divided into categories of construction and restoration procedures or measures. Under these measures are specific cost items with their associated estimated costs. The level of detail for this preliminary estimate is consistent with the level of design. Costs including appropriate contingencies are presented in accordance with ER 1110-2-1302, Civil Works Cost Engineering. This estimate was prepared without using any site-specific plans but instead was based on conceptual feasibility level cost estimates, and historical construction costs of projects similar in nature. Sources for estimated construction costs included projects from the U.S. Army Corps of Engineers districts within the Mississippi Valley Division, the U.S. Department of Agriculture - Natural Resources Conservation Service in Illinois, and multiple state and local agencies within the State of Illinois.

The number of individual measures or construction practices represents a reasonable distribution of measures to achieve program goals. Actual numbers of individual measures are likely to vary. Specific design features and associated costs will be defined in separate feasibility reports. The operation and maintenance costs were based primarily on professional judgment of recognized experts in their field. Costs for planning, engineering and design comprise 30 percent of construction costs, while contract supervision and administration costs comprise 9 percent of construction costs.

Table E-1 is a summary of construction costs through the 7-year implementation (Tier I).

Table E-1. Program First Costs Through Implementation of Tier I
(October 2003 Price Levels)

Lands and Damages	$ 18,000,000
Fish and Wildlife Facilities	$ 71,950,000
Planning, Engineering, and Design	$ 27,680,000
Construction Management	$ 4,680,000
Technologies and Innovative Approaches	$ 6,140,000
System Management	$ 2,750,000
Total Program Costs	**$131,200,000**

The recommendation for the 7-year authorization, or Tier I, includes extending the current authorization through 2011 and increasing the total funding authorization to $131.2 million. This funding level would provide approximately $122.3 million for restoration projects; $6.1 million for developing technologies and innovative approaches (includes $2.625 million for system monitoring, $3.5 million for site-specific monitoring, $0 for a computerized inventory and analysis system, and $0 million for special studies); and $2.75 million for system management. Restoration efforts would be cost shared 65 percent Federal, or $85.3 million, and 35 percent non-Federal, or $45.9 million. The cost to operate and maintain project features constructed through Tier I are estimated to be $125,000 annually. Tables E-4 and E-5 illustrate funding for Tier I. Table E-6 illustrates the estimated schedule for implementation of Tier I.

The recommendation for the 11-year authorization, or Tier II, includes extending the current authorization through 2015 and increasing the total funding authorization to $345.6 million. This funding level would provide approximately $309.1 million for restoration projects, $30.8 million for developing technologies and innovative approaches (includes $18.6 million for system monitoring, $9.0 million for site-specific monitoring, $1.2 million for a computerized inventory and analysis system, and $2 million for special studies), and $5.75 million for system management. Restoration efforts would be cost shared 65 percent Federal, $224.6 million, and 35 percent non-Federal, $121.0 million. The cost to operate and maintain project features constructed through Tier II are estimated to be $201,000 annually. Tables E-4 and E-5 illustrate funding for Tier II.

Efforts associated with management include direct costs for Corps of Engineers project management as well as Illinois DNR staff time as in-kind services. These costs are estimated at roughly $750,000 per year once the program is established.

The technologies and innovative approaches component includes a number of items called for in Section 519. The proposed system- and goal-level monitoring would be phased in over approximately 7 years to about $4 million per year. The level of site-specific project monitoring would be based on roughly 3 percent of project construction costs. Due to the costs associated with establishing the technologies and innovative approaches component, it is estimated that roughly 5 percent of the initial construction authorization amount would be utilized for these efforts. The costs for technologies and innovative approaches is estimated to be 9% in Tier II as the monitoring plan is refined, more construction is complete, and the computerized inventory and analysis system and special studies components are initiated. It is estimated that a computerized inventory and analysis system and special studies would be phased in to a level of approximately $300,000 and $500,000 per year respectively.

The largest component of the recommended $345.6 million authorization would focus on critical ecosystem restoration projects. The total amount directed toward restoration projects is estimated to be $309.1 million. This amount includes costs associated with first cost of construction, real estate, and operation and maintenance. Of the $309.1 million, $241.5 million would be directed toward the first cost of construction, which includes contract administration, land credits, supervision and administration, and operation and maintenance manual and $59 million toward the feasibility study and plans and specifications. Based on the large study area, complexity of the ecosystem restoration, and the opportunities for increased cost effectiveness, adaptive management of up to 3 percent of the construction implementation costs were also included. The total cost to operate and maintain projects that would be constructed through implementation of Tier II (2015) is $694,000.

The 50-year implementation cost is shown in table E-2. The restoration cost includes $6,600 million in restoration projects as shown in Table E-3 as well as an estimated $200 million in adaptive management.

Table E-2. Summary of Program Costs for 50-year Implementation
(in millions of dollars)

Restoration Projects	$6,798
Technologies & Innovative Approaches	$ 585
System Management	$ 55
Total Implementation Cost	**$7,438**

II. PRICE LEVEL

This estimate was prepared to October 2003 price levels. These costs are considered to be fair and reasonable to a well-equipped and capable contractor and include overhead and profit.

III. CONTINGENCY DISCUSSION

After review of project descriptions and discussions with engineering and construction personnel involved in the project, cost contingencies were developed which reflect the uncertainty associated with each cost item. These contingencies are based on qualified cost engineering judgment of the available design data, type of work involved, and uncertainties associated with the work and schedule. The overall contingency for the cost estimate is about 35 percent. The basis for the selection of the contingency factor is primarily due to the conceptual design of a project feature, unknown quantities, and unknown site conditions. Many of the project features can be constructed using conventional methods.

IV. RECOMMENDED PLAN

A descriptive explanation of the work features and basic assumptions for the recommended alternative are included in Section IV.A. of the main report. Detailed MCACES estimates will be prepared for site-specific projects during the preparation of site-specific designs.

A description of plan components for the recommended authorization is included in Section IV.D. of the main report.

Table E-3. Summary of Construction Costs for 50-Year Implementation

Restoration Measures	Unit of Measure	USACE Const./Unit Cost	Contingency	Amount with Contingency in 2003 Dollars	Quantity	Total Construction Cost	Planning, Engineering and Design (30%)	Supervision and Administration (9%)	Real Estate Cost per Unit	Total Real Estate	Total Cost	Annual O&M Cost in 2003 Dollars	Total O&M
Goal 1 Sediment Delivery													
1.1 Grade Control													
1.1.1 Riffle Structure													
Major Tributary	Each	$110,000	35%	$148,500	10	$1,485,000	$445,500	$133,650	$4,238	$42,380	$2,106,530	$149	$1,485
Minor Tributary	Each	$22,000	35%	$29,700	424	$12,592,800	$3,777,840	$1,133,352	$4,295	$1,821,080	$19,325,072	$30	$12,593
1.1.2 Grade Control Structure													
Major Tributary	Each	$1,120,000	35%	$1,512,000	3	$4,536,000	$1,360,800	$408,240	$4,238	$12,714	$6,317,754	$500	$1,500
Minor Tributary	Each	$200,000	35%	$270,000	46	$12,420,000	$3,726,000	$1,117,800	$4,295	$197,570	$17,461,370	$200	$9,200
1.2 Bank Stabilization													
1.2.1 Vegetation													
Mainstem	100 ft	$11,000	35%	$14,850	0	$0	$0	$0	$784	$0	$0	$208	$0
Major Tributary	100 ft	$9,025	35%	$12,184	4754	$57,921,548	$17,376,464	$5,212,939	$734	$3,489,436	$84,000,387	$171	$810,902
Minor Tributary	100 ft	$7,100	35%	$9,585	8457	$81,060,345	$24,318,104	$7,295,431	$684	$5,784,588	$118,458,468	$134	$1,134,845
1.2.2 Stone Armor													
Mainstem	100 ft	$20,550	35%	$27,743	0	$0	$0	$0	$784	$0	$0	$25	$0
Major Tributary	100 ft	$16,900	35%	$22,815	593	$13,529,295	$4,058,789	$1,217,637	$734	$435,262	$19,240,982	$21	$12,176
Minor Tributary	100 ft	$13,200	35%	$17,820	871	$15,521,220	$4,656,366	$1,396,910	$684	$595,764	$22,170,260	$16	$13,969
1.2.3 In-stream weirs/barbs/groins/spur													
Mainstem	Ea. (1/100 ft)	$32,780	35%	$44,253	0	$0	$0	$0	$584	$0	$0	$80	$0
Major Tributary	Ea. (1/100 ft)	$9,350	35%	$12,623	2957	$37,324,733	$11,197,420	$3,359,226	$559	$1,652,963	$53,534,341	$23	$67,185
Minor Tributary	Ea. (1/100 ft)	$4,950	35%	$6,683	4346	$29,042,145	$8,712,644	$2,613,793	$534	$2,320,764	$42,689,346	$12	$52,276
1.2.4 Longitudinal Stone Toe													
Mainstem	100 ft	$10,275	35%	$13,871	0	$0	$0	$0	$584	$0	$0	$12	$0
Major Tributary	100 ft	$8,450	35%	$11,408	2631	$30,013,133	$9,003,940	$2,701,182	$559	$1,470,729	$43,188,983	$10	$27,012
Minor Tributary	100 ft	$6,600	35%	$8,910	4707	$41,939,370	$12,581,811	$3,774,543	$534	$2,513,538	$60,809,262	$8	$37,745
1.3. Wetland/Retention Structure													
1.3.1 Small Basin (<1 acre)	Each	$28,000	35%	$37,800	5150	$194,670,000	$58,401,000	$17,520,300	$6,645	$34,221,750	$304,813,050	$200	$1,030,000
1.3.2 Medium (1-5 acres)	Each	$90,000	35%	$121,500	1082	$131,463,000	$39,438,900	$11,831,670	$26,130	$28,272,660	$211,006,230	$500	$541,000
1.3.3 Large (150 acres)	Each	$3,300,000	35%	$4,455,000	5	$22,275,000	$6,682,500	$2,004,750	$423,638	$2,118,190	$33,080,440	$15,000	$75,000
Sum by Goal						**$685,793,588**	**$205,738,076**	**$61,721,423**		**$84,949,388**	**$1,038,202,475**		**$3,826,887**

Table E-3. Summary of Construction Costs for 50-Year Implementation

Restoration Measures	Unit of Measure	USACE Const./ Unit Cost	Contingency	Amount with Contingency in 2003 Dollars	Quantity	Total Construction Cost	Planning, Engineering and Design (30%)	Supervision and Administration (9%)	Real Estate Cost per Unit	Total Real Estate	Total Cost	Annual O&M Cost in 2003 Dollars	Total O&M
Goal 2 Backwaters and Side Channel													
2.1 Backwater Restoration													
2.1.1 8-Foot Depths	Backwater	$1,263,889	35%	$1,706,250								$0	
2.1.2 8 to 6 Foot Depths	Backwater	$171,111	35%	$231,000								$0	
2.1.3 6 to 3 Foot Depths	Backwater	$140,000	35%	$189,000								$0	
2.1.4 3 to 0 Foot Depths	Backwater	$23,333	35%	$31,500								$0	
2.1.5 4-Foot Deep Holes	Backwater	$3,265,046	35%	$4,407,813								$0	
2.1.6 8-Foot Deep Holes	Backwater	$2,527,778	35%	$3,412,500								$0	
2.1.7 12-Foot Deep Holes	Backwater	$2,381,944	35%	$3,215,625								$0	
Total Backwater Cost				$13,193,688	60	$791,621,250	$237,486,375	$71,245,913	$1,213,187	$72,791,228	$1,173,144,765	$0	$0
2.2 Island Protection													
2.2.1 Off-Bank Revetment	Island Protection	$361,387	35%	$487,872								$878	
2.2.2 Bankline Revetment	Island Protection	$129,067	35%	$174,240								$157	
2.2.3 Timber Piles	Island Protection	$119,680	35%	$161,568								$485	
Total Island Protection				$823,680.00	15	$12,355,200	$3,706,560	$1,111,968	$9,497	$142,454	$17,316,182	$1,520	$22,795
2.3 Side Channel Restoration													
2.3.1 Stub Dikes	Side Channel	$67,375	35%	$90,956								$164	
2.3.2 Dredging 6 ft	Side Channel	$102,667	35%	$138,600								$0	
2.3.3 Dredging 3 ft to 6 ft	Side Channel	$16,427	35%	$22,176								$0	
2.3.4 Dredging 0 to 3 ft	Side Channel	$2,738	35%	$3,696								$0	
Total Side Channel Restoration				$255,428.10	35	$8,939,984	$2,681,995	$804,599	$33,361	$1,167,622	$13,594,199	$164	$5,730
Sum by Goal						**$812,916,434**	**$243,874,930**	**$73,162,479**		**$74,101,304**	**$1,204,055,146**		**$28,526**

Table E-3. Summary of Construction Costs for 50-Year Implementation

Restoration Measures	Unit of Measure	USACE Const./ Unit Cost	Contingency	Amount with Contingency in 2003 Dollars	Quantity	Total Construction Cost	Planning, Engineering and Design (30%)	Supervision and Administration (9%)	Real Estate Cost per Unit	Total Real Estate	Total Cost	Annual O&M Cost in 2003 Dollars	Total O&M
Goal 3 Floodplain and Riparian													
3.1 Floodplain and Riparian													
3.1.1 Timber Stand Improvement (1)	Acre	$2,500	35%	$3,375	19600	$66,150,000	$19,845,000	$5,953,500	$3,502	$68,632,600	$160,581,100	$2	$39,200
3.1.2 Mast Tree Planting (1)	Acre	$1,400	35%	$1,890	19600	$37,044,000	$11,113,200	$3,333,960	$3,502	$68,632,600	$120,123,760	$65	$1,274,000
3.1.3 Prairie Plantings (1)	Acre	$1,000	35%	$1,350	31500	$42,525,000	$12,757,500	$3,827,250	$3,603	$113,481,000	$172,590,750	$5	$157,500
3.1.4 Moist Soil Management Units (1)	Acre	$6,000	35%	$8,100	39650	$321,165,000	$96,349,500	$28,904,850	$3,837	$152,126,900	$598,546,250	$20	$793,000
3.1.5 Wetland Plantings (1)	Acre	$2,650	35%	$3,578	39650	$141,847,875	$42,554,363	$12,766,309	$3,837	$152,126,900	$349,295,446	$7	$277,550
3.1.6 Gated Levee	Each	$2,000,000	35%	$2,700,000	8	$21,600,000	$6,480,000	$1,944,000	$4,382	$35,056	$30,059,056	$20	$160
3.1.7 Repair Environmental Levees	Each	$283,300	35%	$382,455	8	$3,059,640	$917,892	$275,368	$4,382	$35,056	$4,287,956	$0	$0
3.2 In-stream Aquatic Restoration													
3.2.1 Riffle Structure													
Major Tributary	Each	$110,000	35%	$148,500	1400	$207,900,000	$62,370,000	$18,711,000	$4,238	$5,933,200	$294,914,200	$149	$207,900
Minor Tributary	Each	$22,000	35%	$29,700	6795	$201,811,500	$60,543,450	$18,163,035	$4,295	$29,184,525	$309,702,510	$30	$201,812
3.2.2 Channelization Remeander in Floodplains													
Minor Tributary	100 ft	$45,000	35%	$60,750	6600	$400,950,000	$120,285,000	$36,085,500	$11,963	$78,955,800	$636,276,300	$365	$2,405,700
Sum by Goal						**$1,444,053,015**	**$433,215,905**	**$129,964,771**		**$669,143,637**	**$2,676,377,328**		**$5,356,822**
Goal 4 Connectivity													
4.1 Dam Removal													
Major Tributary	Each	$300,000	35%	$405,000	1	$405,000	$121,500	$36,450	$3,000	$3,000	$565,950	$0	$0
Minor Tributary	Each	$300,000	35%	$405,000	1	$405,000	$121,500	$36,450	$2,700	$2,700	$565,650	$0	$0
4.2 Fish By-Pass Channel													
Major Tributary	Each	$894,830	35%	$1,208,021	7	$8,456,144	$2,536,843	$761,053	$26,429	$185,003	$11,939,042	$2,416	$16,912
Minor Tributary	Each	$343,970	35%	$464,360	1	$464,360	$139,308	$41,792	$13,600	$13,600	$659,060	$929	$929
4.3 Fish Ramp Structure													
Major Tributary	Each	$1,688,132	35%	$2,278,979	11	$25,068,764	$7,520,629	$2,256,189	$8,427	$92,700	$34,938,283	$11,395	$125,344
Minor Tributary	Each	$107,658	35%	$145,339	18	$2,616,100	$784,830	$235,449	$3,789	$68,200	$3,704,579	$727	$13,081
4.4 Denil Structure													
Minor Tributary	Each	$788,906	35%	$1,065,024	2	$2,130,047	$639,014	$191,704	$3,600	$7,200	$2,967,966	$213	$426
Sum by Goal						**$39,545,415**	**$11,863,624**	**$3,559,087**		**$372,403**	**$55,340,530**		**$156,691**

Table E-3. Summary of Construction Costs for 50-Year Implementation

Restoration Measures	Unit of Measure	USACE Const./ Unit Cost	Contingency	Amount with Contingency in 2003 Dollars	Quantity	Total Construction Cost	Planning, Engineering and Design (30%)	Supervision and Administration (9%)	Real Estate Cost per Unit	Total Real Estate	Total Cost	Annual O&M Cost in 2003 Dollars	Total O&M
Goal 5 Water Levels													
5.1 Dam Management													
5.1.1 Remote control dam	Lump Sum	$3,000,000	35%	$4,050,000	1	$4,050,000	$1,215,000	$364,500	$0	$0	$5,629,500	$0	$0
5.1.2 Revise Regulation Manuals (2)	Each	$80,000	35%	$108,000	7	$756,000	$0	$0	$0	$0	$756,000	$0	$0
5.1.3 Install and Maintain Gages (2)	Each	$15,000	35%	$20,250	10	$202,500	$0	$0	$0	$0	$202,500	$12,500	$125,000
5.1.4 Install New Tainter Gates	Each	$13,900,000	35%	$18,765,000	2	$37,530,000	$11,259,000	$3,377,700	$0	$0	$52,166,700	$15,000	$30,000
5.2 Storage													
5.2.1 Storage	Ac-ft	$2,133	35%	$2,880	160000	$460,800,000	$138,240,000	$41,472,000	$2,300	$368,000,000	$1,008,512,000	$5	$800,000
5.3 Infiltration													
5.3.1 Upland Structures and Filter Strips	Ac	$5,556	35%	$7,500	38400	$288,000,000	$86,400,000	$25,920,000	$3,400	$130,560,000	$530,880,000	$7	$259,200
5.4 Pool Drawdown													
5.4.1 Peoria Pool (2)	Lump Sum	$7,800,000	35%	$10,530,000	1	$10,530,000	$3,159,000	$947,700	$0	$0	$14,636,700	$0	$0
5.4.2 LaGrange Pool (2)	Lump Sum	$12,200,000	35%	$16,470,000	1	$16,470,000	$4,941,000	$1,482,300	$0	$0	$22,893,300	$0	$0
Sum by Goal						**$818,338,500**	**$245,214,000**	**$73,564,200**		**$498,560,000**	**$1,635,676,700**		**$1,214,200**
Grand Totals						**$3,800,646,951**	**$1,139,906,535**	**$341,971,961**		**$1,327,126,732**	**$6,609,652,178**		**$10,583,126**

(1) Unit costs shown are half those normally used for USACE construction projects of this type. Each of these measures assumed that construction or implementation would occur on half of the acreage shown and benefits would spread to the portion through volunteer establishment.

(2) No Planning, Engineering, and Design or Supervision and Administration costs are included because these activities involve mainly planning or would be negligible.

(3) Columns containing missing or zero ($0) for total cost or total O&M were not used to formulate cost except for Goal 2, where sub-measures comprising a restoration measure are listed.

Table E-4. Summary of Annual Component Costs for 7- and 11-Year Authorization

Illinois River Basin Restoration Comprehensive Plan													
Annual Component Costs (in 000's of Dollars)													
							TIER 1				TIER 2	TOTAL	
Component	**Year 1**	**Year 2**	**Year 3**	**Year 4**	**Year 5**	**Year 6**	**Year 7**	**Year 8**	**Year 9**	**Year 10**	**Year 11**	**Years 1-11**	**% of Total**
Technologies and Innovative Approaches	**$0**	**$75**	**$692**	**$859**	**$1,298**	**$1,700**	**$1,519**	**$6,153**	**$5,965**	**$6,168**	**$6,354**	**$30,784**	**8.9**
System Monitoring	$0	$0	$350	$425	$500	$600	$750	$4,000	$4,000	$4,000	$4,000	$18,625	5.4
Site-Specific Monitoring	$0	$75	$342	$434	$798	$1,100	$769	$1,353	$1,165	$1,368	$1,554	$8,959	2.6
Computerized Inventory and Analysis System	$0	$0	$0	$0	$0	$0	$0	$300	$300	$300	$300	$1,200	0.3
Special Studies	$0	$0	$0	$0	$0	$0	$0	$500	$500	$500	$500	$2,000	0.6
System Management	**$0**	**$100**	**$100**	**$600**	**$600**	**$600**	**$750**	**$750**	**$750**	**$750**	**$750**	**$5,750**	**1.7**
Critical Restoration Projects	**$711**	**$3,715**	**$11,407**	**$14,884**	**$27,410**	**$37,763**	**$26,414**	**$46,460**	**$40,010**	**$46,966**	**$53,369**	**$309,109**	**89.4**
Adaptive Management	$0	$0	$0	$434	$798	$1,100	$769	$1,353	$1,165	$1,368	$1,554	$8,542	2.5
Sub Watershed (Minor Tributary)	$73	$990	$2,608	$4,034	$16,070	$27,741	$8,026	$18,865	$18,269	$28,748	$46,525	$171,948	49.7
Major Tributary	$433	$433	$747	$784	$4,112	$2,362	$3,224	$3,945	$559	$2,207	$4,377	$23,183	6.7
Floodplain Restoration (Main Stem)	$16	$22	$1,751	$3,444	$1,743	$118	$118	$235	$735	$3,408	$6	$11,595	3.4
Pool Drawdown (LaGrange Pool)	$0	$0	$0	$0	$435	$435	$946	$8,570	$9,347	$779	$0	$20,511	5.9
Backwater Restoration (Dredging)	$189	$2,080	$6,047	$5,644	$3,835	$2,346	$9,671	$9,881	$9,674	$9,898	$415	$59,680	17.3
Side Channel Restoration/ Island Protection	$0	$191	$254	$545	$418	$3,660	$3,660	$3,611	$261	$557	$493	$13,650	3.9
TOTAL	**$711**	**$3,890**	**$12,199**	**$16,343**	**$29,309**	**$40,063**	**$28,683**	**$53,363**	**$46,725**	**$53,884**	**$60,474**	**$345,643**	**100**
Federal Share of Total	$462	$2,529	$7,930	$10,623	$19,051	$26,041	$18,644	$34,686	$30,371	$35,024	$39,308	**$224,668**	**65**
Operations and Maintenance	$0	$0	$0	$0	$1	$27	**$65**	$125	$126	$149	**$201**	**$694**	

Table E-5. Summary of Cumulative Component Costs for 7 and 11-Year Authorization

Illinois River Basin Restoration Comprehensive Plan													
Cumulative Component Costs (in 000's of Dollars)													
							TIER 1					TIER 2	
Component	**Year 1**	**Year 2**	**Year 3**	**Year 4**	**Year 5**	**Year 6**	**Year 7**		**Year 8**	**Year 9**	**Year 10**	**Year 11**	
Technologies and Innovative Approaches	**$0**	**$75**	**$767**	**$1,626**	**$2,924**	**$4,624**	**$6,143**	**4.7%**	**$12,297**	**$18,262**	**$24,430**	**$30,784**	**8.9%**
System Monitoring	$0	$0	$350	$775	$1,275	$1,875	$2,625	2.0%	$6,625	$10,625	$14,625	$18,625	5.4%
Site-Specific Monitoring	$0	$75	$417	$851	$1,649	$2,749	$3,518	2.7%	$4,872	$6,037	$7,405	$8,959	2.6%
Computerized Inventory and Analysis System	$0	$0	$0	$0	$0	$0	$0	0.0%	$300	$600	$900	$1,200	0.3%
Special Studies	$0	$0	$0	$0	$0	$0	$0	0.0%	$500	$1,000	$1,500	$2,000	0.6%
System Management	**$0**	**$100**	**$200**	**$800**	**$1,400**	**$2,000**	**$2,750**	**2.1%**	**$3,500**	**$4,250**	**$5,000**	**$5,750**	**1.7%**
Critical Restoration Projects	**$711**	**$4,426**	**$15,833**	**$30,717**	**$58,128**	**$95,891**	**$122,305**	**93.2%**	**$168,765**	**$208,774**	**$255,740**	**$309,109**	**89.4%**
Sub Watershed (Minor Tributary)	$73	$1,062	$3,670	$7,704	$23,774	$51,515	$59,540	45.4%	$78,406	$96,675	$125,423	$171,948	49.7%
Major Tributary	$433	$867	$1,614	$2,398	$6,509	$8,872	$12,096	9.2%	$16,040	$16,599	$18,806	$23,183	6.7%
Floodplain Restoration (Main Stem)	$16	$37	$1,788	$5,232	$6,975	$7,093	$7,211	5.5%	$7,446	$8,180	$11,589	$11,595	3.4%
Pool Drawdown (LaGrange Pool)	$0	$0	$0	$0	$435	$870	$1,816	1.4%	$10,386	$19,732	$20,511	$20,511	5.9%
Backwater Restoration (Dredging)	$189	$2,269	$8,316	$13,960	$17,795	$20,141	$29,812	22.7%	$39,693	$49,367	$59,266	$59,680	17.3%
Side Channel Restoration/ Island Protection	$0	$191	$445	$990	$1,408	$5,068	$8,728	6.7%	$12,339	$12,600	$13,157	$13,650	3.9%
Adaptive Management	$0	$0	$0	$434	$1,232	$2,332	$3,101	2.4%	$4,454	$5,620	$6,988	$8,542	2.5%
TOTAL	**$711**	**$4,601**	**$16,801**	**$33,143**	**$62,452**	**$102,515**	**$131,198**	**100.0%**	**$184,561**	**$231,286**	**$285,170**	**$345,643**	**100.0%**
Federal Share of Total	$462	$2,991	$10,920	$21,543	$40,594	$66,634	**$85,279**		$119,965	$150,336	$185,360	**$224,668**	
Operations and Maintenance	$0	$0	$0	$0	$1	$28	**$93**		$218	$344	$493	**$694**	

Table E-6. 11-Year Implementation Plan

Ecosystem Plan Components	No. of Projects	Cost	Resources: PM	ED	RE	OD	CD	CT	Cont	Land	Year 1 (Q1–Q4)	Year 2 (Q1–Q4)	Year 3 (Q1–Q4)	Year 4 (Q1–Q4)	Year 5 (Q1–Q4)	Year 6 (Q1–Q4)	Year 7 (Q1–Q4)	Year 8 (Q1–Q4)	Year 9 (Q1–Q4)	Year 10 (Q1–Q4)	Year 11 (Q1–Q4)	Years 1-11 (Q1–Q4)
Technologies and Innovative Approaches		**$30,842**									**$0**	**$75**	**$692**	**$859**	**$1,298**	**$1,700**	**$1,519**	**$6,153**	**$5,965**	**$6,168**	**$6,354**	**$30,784**
System Monitoring		$18,625	$466	$466					$17,694		$0	$0	$350	$425	$500	$600	$750	$4,000	$4,000	$4,000	$4,000	$18,625
Site Specific Monitoring		$9,017	$448	$448					$8,063		$0	$75	$342	$434	$798	$1,100	$769	$1,353	$1,165	$1,368	$1,554	$8,959
Computerized Inventory and Analysis System		$1,200	$30						$1,170		$0	$0	$0	$0	$0	$0	$0	$300	$300	$300	$300	$1,200
Special Studies		$2,000	$200	$200					$1,600		$0	$0	$0	$0	$0	$0	$0	$500	$500	$500	$500	$2,000
System Management		**$5,750**	**$4,888**	**$805**	**$58**						**$0**	**$100**	**$100**	**$600**	**$600**	**$600**	**$750**	**$750**	**$750**	**$750**	**$750**	**$5,750**
Adaptive Management		**$8,542**	**$427**	**$854**			**$854**		**$6,407**		**$0**	**$0**	**$0**	**$434**	**$798**	**$1,100**	**$769**	**$1,353**	**$1,165**	**$1,368**	**$1,554**	**$8,542**
Sub Watershed (Minor Tributary)		**$260,693**									**$73**	**$990**	**$2,608**	**$4,034**	**$16,070**	**$27,741**	**$8,026**	**$18,865**	**$18,269**	**$28,748**	**$46,525**	**$171,948**
Waubonsie		**$2,248**									Waubonsie											
2. Compile Plans and Specification for Project		$170	$36	$112	$12	$5	$5				P&S											
3. Complete LERRDS		$7			$7								LERRDS									
4. Contract Project Construction		$6						$6					Contract									
5. Construct Project / Land Credit		$2,060	$7	$66			$85		$942	$960				Construct								
6. Create Operations and Maintenance Manual		$5		$5											O&M Manual							
7. Conduct Annual O&M		$5		$5												Annual O&M	Annual O&M	Annual O&M	Annual O&M	Annual O&M	Annual O&M	
Iroquois River (Sugar Creek)		**$6,009**											Iroquois River									
1. Complete Feasibility Study		$250	$88	$125	$23	$9	$6						Feasibility									
2. Compile Plans and Specification for Project		$250	$53	$165	$18	$8	$8						P&S									
3. Complete LERRDS		$18			$18									LERRDS								
4. Contract Project Construction		$6						$6						Contract								
5. Construct Project / Land Credit		$5,473	$18	$140			$315		$3,500	$1,500					Construct							
6. Create Operations and Maintenance Manual		$12		$12												O&M Manual						
7. Conduct Annual O&M		$12		$12													Annual O&M	Annual O&M	Annual O&M	Annual O&M	Annual O&M	
Blackberry Creek		**$6,309**										Blackberry Creek										
1. Complete Feasibility Study		$550	$193	$275	$50	$19	$14					Feasibility										
2. Compile Plans and Specification for Project		$250	$53	$165	$18	$8	$8						P&S									
3. Complete LERRDS		$18			$18									LERRDS								
4. Contract Project Construction		$6						$6							Contract							
5. Construct Project / Land Credit		$5,473	$18	$140			$315		$3,500	$1,500					Construct							
6. Create Operations and Maintenance Manual		$12		$12													O&M Manual					
7. Conduct Annual O&M		$12		$12														Annual O&M	Annual O&M	Annual O&M	Annual O&M	
McKee Creek		**$6,309**											McKee Creek									
1. Complete Feasibility Study		$550	$193	$275	$50	$19	$14						Feasibility									
2. Compile Plans and Specification for Project		$250	$53	$165	$18	$8	$8							P&S								
3. Complete LERRDS		$18			$18										LERRDS							
4. Contract Project Construction		$6						$6							Contract							
5. Construct Project / Land Credit		$5,473	$18	$140			$315		$3,500	$1,500						Construct						
6. Create Operations and Maintenance Manual		$12		$12													O&M Manual					
7. Conduct Annual O&M		$12		$12														Annual O&M	Annual O&M	Annual O&M	Annual O&M	
Senachwine Creek		**$7,500**										Senachwine Creek										
1. Complete Feasibility Study		$550	$193	$275	$50	$19	$14					Feasibility										
2. Compile Plans and Specification for Project		$250	$53	$165	$18	$8	$8						P&S									
3. Complete LERRDS		$18			$18									LERRDS								
4. Contract Project Construction		$6						$6						Contract								
5. Construct Project / Land Credit		$6,664	$18	$140			$315		$4,691	$1,500					Construct							
6. Create Operations and Maintenance Manual		$12		$12												O&M Manual						
7. Conduct Annual O&M		$12		$12													Annual O&M	Annual O&M	Annual O&M	Annual O&M	Annual O&M	
Tenmile Creek		**$7,500**										Tenmile Creek										
1. Complete Feasibility Study		$550	$193	$275	$50	$19	$14					Feasibility										
2. Compile Plans and Specification for Project		$250	$53	$165	$18	$8	$8							P&S								
3. Complete LERRDS		$18			$18									LERRDS								
4. Contract Project Construction		$6						$6							Contract							
5. Construct Project / Land Credit		$6,664	$18	$140			$315		$4,691	$1,500					Construct							
6. Create Operations and Maintenance Manual		$12		$12													O&M Manual					
7. Conduct Annual O&M		$12		$12														Annual O&M	Annual O&M	Annual O&M	Annual O&M	
Crow Creek West		**$7,500**										Crow Creek West										
1. Complete Feasibility Study		$550	$193	$275	$50	$19	$14					Feasibility										
2. Compile Plans and Specification for Project		$250	$53	$165	$18	$8	$8							P&S								
3. Complete LERRDS		$18			$18									LERRDS								
4. Contract Project Construction		$6						$6							Contract							
5. Construct Project / Land Credit		$6,664	$18	$140			$315		$4,691	$1,500					Construct							
6. Create Operations and Maintenance Manual		$12		$12													O&M Manual					
7. Conduct Annual O&M		$12		$12														Annual O&M	Annual O&M	Annual O&M	Annual O&M	
Yellow River		**$7,500**										Yellow River										
1. Complete Feasibility Study		$550	$193	$275	$50	$19	$14					Feasibility										
2. Compile Plans and Specification for Project		$250	$53	$165	$18	$8	$8							P&S								
3. Complete LERRDS		$18			$18									LERRDS								
4. Contract Project Construction		$6						$6							Contract							
5. Construct Project / Land Credit		$6,664	$18	$140			$315		$4,691	$1,500					Construct							
6. Create Operations and Maintenance Manual		$12		$12													O&M Manual					
7. Conduct Annual O&M		$12		$12														Annual O&M	Annual O&M	Annual O&M	Annual O&M	
Implementation Phase I	**1**	**$25,813**												Implementation Phase I								
1. Complete Feasibility Study		$2,109	$738	$1,054	$190	$74	$53							Recon Feasibility		Approval						
2. Compile Plans and Specification for Project		$1,406	$295	$928	$98	$42	$42									P&S						
3. Complete LERRDS		$71			$71												LERRDS					
4. Contract Project Construction		$6						$6									Contract					
5. Construct Project / Land Credit		$22,171	$71	$571			$1,285		$14,281	$5,963								Construct				
6. Create Operations and Maintenance Manual		$50		$50																O&M Manual		
7. Conduct Annual O&M		$50		$50																	Annual O&M	
Implementation Phase II	**2**	**$25,813**														Implementation Phase II						
1. Complete Feasibility Study		$2,109	$738	$1,054	$190	$74	$53									Recon Feasibility		Approval				
2. Compile Plans and Specification for Project		$1,406	$295	$928	$98	$42	$42											P&S				
3. Complete LERRDS		$71			$71														LERRDS			
4. Contract Project Construction		$6						$6											Contract			
5. Construct Project / Land Credit		$22,171	$71	$571			$1,285		$14,281	$5,963										Construct		
6. Create Operations and Maintenance Manual		$50		$50																		
7. Conduct Annual O&M		$50		$50																		
Implementation Phase III	**2**	**$25,813**															Implementation Phase III					
1. Complete Feasibility Study		$2,109	$738	$1,054	$190	$74	$53										Recon Feasibility		Approval			
2. Compile Plans and Specification for Project		$1,406	$295	$928	$98	$42	$42												P&S			
3. Complete LERRDS		$71			$71															LERRDS		
4. Contract Project Construction		$6						$6												Contract		
5. Construct Project / Land Credit		$22,171	$71	$571			$1,285		$14,281	$5,963											Construct	
6. Create Operations and Maintenance Manual		$50		$50																		
7. Conduct Annual O&M		$50		$50																		
Implementation Phase IV	**4**	**$25,813**																Implementation Phase IV				
1. Complete Feasibility Study		$2,109	$738	$1,054	$190	$74	$53											Recon Feasibility		Approval		
2. Compile Plans and Specification for Project		$1,406	$295	$928	$98	$42	$42													P&S		
3. Complete LERRDS		$71			$71																LERRDS	
4. Contract Project Construction		$6						$6													Contract	
5. Construct Project / Land Credit		$22,171	$71	$571			$1,285		$14,281	$5,963												
6. Create Operations and Maintenance Manual		$50		$50																		
7. Conduct Annual O&M		$50		$50																		

Table E-6. 11-Year Implementation Plan

Ecosystem Plan Components	No. of Projects	Cost	Resources PM	ED	RE	OD	CD	CT	Cont	Land	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10	Year 11	Years 1-11
Major Tributary		**$22,765**									$433	$433	$747	$784	$4,112	$2,362	$3,224	$3,945	$559	$2,207	$4,377	$23,183
Kankakee State Line		**$649**																				
2. Compile Plans and Specification for Project		$250	$53	$165	$18	$8	$8															
3. Complete LERRDS		$2			$2																	
4. Contract Project Construction		$6						$6														
5. Construct Project / Land Credit		$391	$2	$12			$27		$300	$50												
6. Create Operations and Maintenance Manual		$1		$1																		
7. Conduct Annual O&M		$1		$1																		
Kankakee River		**$6,458**																				
1. Complete Feasibility Study		$650	$228	$325	$59	$23	$16															
2. Compile Plans and Specification for Project		$200	$42	$132	$14	$6	$6															
3. Complete LERRDS		$21			$21																	
4. Contract Project Construction		$6						$6														
5. Construct Project / Land Credit		$5,567	$21	$168			$378		$4,200	$800												
6. Create Operations and Maintenance Manual		$14		$14																		
7. Conduct Annual O&M		$14		$14																		
Fox River/ Hoffman Dam	**1**	**$7,829**																				
1. Complete Feasibility Study		$730	$255	$365	$66	$26	$18															
2. Compile Plans and Specification for Project		$487	$102	$321	$34	$15	$15															
3. Complete LERRDS		$25			$25																	
4. Contract Project Construction		$6						$6														
5. Construct Project / Land Credit		$6,565	$25	$198			$446		$4,953	$943												
6. Create Operations and Maintenance Manual		$16		$16																		
7. Conduct Annual O&M		$16		$16																		
Implementation Phase II	**1**	**$7,829**																				
1. Complete Feasibility Study		$730	$255	$365	$66	$26	$18															
2. Compile Plans and Specification for Project		$487	$102	$321	$34	$15	$15															
3. Complete LERRDS		$25			$25																	
4. Contract Project Construction		$6						$6														
5. Construct Project / Land Credit		$6,565	$25	$198			$446		$4,953	$943												
6. Create Operations and Maintenance Manual		$16		$16																		
7. Conduct Annual O&M		$16		$16																		
Floodplain Restoration (Main Stem)		**$11,595**									$16	$22	$1,751	$3,444	$1,743	$118	$118	$235	$735	$3,408	$6	$11,595
Pekin North		**$6,975**																				
2. Compile Plans and Specification for Project		$20	$4	$14	$1		$1															
3. Complete LERRDS		$23			$23																	
4. Contract Project Construction		$23						$23														
5. Construct Project / Land Credit		$6,888	$23	$76			$254		$4,800	$1,735												
6. Create Operations and Maintenance Manual		$21		$21																		
7. Conduct Annual O&M		$21		$21																		
Implementation Phase I	**1**	**$4,620**																				
1. Complete Feasibility Study		$295	$100	$168	$21		$6															
2. Compile Plans and Specification for Project		$196	$35	$141	$14		$6															
3. Complete LERRDS		$10			$10																	
4. Contract Project Construction		$23						$23														
5. Construct Project / Land Credit		$4,086	$10	$58			$180		$2,004	$1,834												
6. Create Operations and Maintenance Manual		$9		$9																		
7. Conduct Annual O&M		$9		$9																		
Pool Drawdown (LaGrange Pool)		**$20,511**									$0	$0	$0	$0	$435	$435	$946	$8,570	$9,347	$779	$0	$20,511
Implementation Phase I	**1**	**$20,511**																				
1. Complete Feasibility Study		$1,087	$337	$674	$65		$11															
2. Compile Plans and Specification for Project		$725	$130	$544	$36		$14															
3. Contract Project Construction		$6						$6														
4. Construct Project / Land Credit		$18,693	$82	$659			$1,482		$16,470													
5. Revise Regulation Manual		$0																				
6. Conduct Annual O&M		$0																				
Backwater Restoration (Dredging)		**$93,525**									$189	$2,080	$6,047	$5,644	$3,835	$2,346	$9,671	$9,881	$9,674	$9,898	$415	$59,680
Peoria- Upper Island		**$7,618**																				
3. Complete LERRDS		$32			$32																	
4. Contract Project Construction		$6						$6														
5. Construct Project / Land Credit		$7,550	$32	$253			$630		$6,135	$500												
6. Create Operations and Maintenance Manual		$0		$30																		
7. Conduct Annual O&M		$0																				
Pekin South		**$7,699**																				
2. Compile Plans and Specification for Project		$320	$74	$200	$25	$11	$11															
3. Complete LERRDS		$32			$32																	
4. Contract Project Construction		$6						$6														
5. Construct Project / Land Credit		$7,341	$32	$225			$320		$5,600	$1,164												
6. Create Operations and Maintenance Manual		$0																				
7. Conduct Annual O&M		$0																				
Implementation Phase I	**1**	**$19,552**																				
1. Complete Feasibility Study		$1,975	$691	$988	$178	$69	$49															
2. Compile Plans and Specification for Project		$1,317	$277	$869	$92	$40	$40															
3. Complete LERRDS		$66			$66																	
4. Contract Project Construction		$6						$6														
5. Construct Project / Land Credit		$16,188	$66	$528			$1,187		$13,194	$1,213												
6. Create Operations and Maintenance Manual		$0																				
7. Conduct Annual O&M		$0																				
Implementation Phase II	**1**	**$19,552**																				
1. Complete Feasibility Study		$1,975	$691	$988	$178	$69	$49															
2. Compile Plans and Specification for Project		$1,317	$277	$869	$92	$40	$40															
3. Complete LERRDS		$66			$66																	
4. Contract Project Construction		$6						$6														
5. Construct Project / Land Credit		$16,188	$66	$528			$1,187		$13,194	$1,213												
6. Create Operations and Maintenance Manual		$0																				
7. Conduct Annual O&M		$0																				
Implementation Phase III	**2**	**$19,552**																				
1. Complete Feasibility Study		$1,975	$691	$988	$178	$69	$49															
2. Compile Plans and Specification for Project		$1,317	$277	$869	$92	$40	$40															
3. Complete LERRDS		$66			$66																	
4. Contract Project Construction		$6						$6														
5. Construct Project / Land Credit		$16,188	$66	$528			$1,187		$13,194	$1,213												
6. Create Operations and Maintenance Manual		$0																				
7. Conduct Annual O&M		$0																				

Table E-6. 11-Year Implementation Plan

Ecosystem Plan Components	No. of Projects	Cost	Resources								Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10	Year 11	Years 1-11
			PM	ED	RE	OD	CD	CT	Cont	Land	Q1 Q2 Q3 Q4	Q1 Q2 Q3 Q4	Q1 Q2 Q3 Q4	Q1 Q2 Q3 Q4	Q1 Q2 Q3 Q4	Q1 Q2 Q3 Q4	Q1 Q2 Q3 Q4	Q1 Q2 Q3 Q4	Q1 Q2 Q3 Q4	Q1 Q2 Q3 Q4	Q1 Q2 Q3 Q4	Q1 Q2 Q3 Q4
Side Channel Restoration / Island Protection		**$22,273**									**$0**	**$191**	**$254**	**$545**	**$418**	**$3,660**	**$3,660**	**$3,611**	**$261**	**$557**	**$493**	**$13,650**
Alton Pool	**2**	**$4,500**										Alton Pool										
1. Complete Feasibility Study		$159	$56	$79	$11	$11	$2					Recon Feasibility		Approval								
2. Compile Plans and Specification for Project		$106	$22	$68	$7	$7	$1							P&S								
3. Complete LERRDS		$5			$5										LERRDS							
4. Contract Project Construction		$6						$6							Contract							
5. Construct Project / Land Credit		$4,223	$5	$43			$97		$4,034	$43						Construct						
6. Create Operations and Maintenance Manual		$2		$2															O&M Manual			
7. Conduct Annual O&M		$2		$2																Annual O&M	Annual O&M	
Starved Rock Pool	**2**	**$1,545**										Starved Rock Pool										
1. Complete Feasibility Study		$159	$56	$79	$11	$11	$2					Recon Feasibility		Approval								
2. Compile Plans and Specification for Project		$106	$22	$68	$7	$7	$1							P&S								
3. Complete LERRDS		$5			$5										LERRDS							
4. Contract Project Construction		$6						$6							Contract							
5. Construct Project / Land Credit		$1,268	$5	$43			$97		$1,079	$43						Construct						
6. Create Operations and Maintenance Manual		$2		$2															O&M Manual			
7. Conduct Annual O&M		$2		$2																Annual O&M	Annual O&M	
LaGrange Pool	**4**	**$2,545**																LaGrange Pool				
1. Complete Feasibility Study		$159	$56	$79	$11	$11	$2											Recon Feasibility		Approval		
2. Compile Plans and Specification for Project		$106	$22	$68	$7	$7	$1													P&S		
3. Complete LERRDS		$5			$5															LERRDS		
4. Contract Project Construction		$6						$6													Contract	
5. Construct Project / Land Credit		$2,268	$5	$43			$97		$2,079	$43											Construct	
6. Create Operations and Maintenance Manual		$2		$2																		
7. Conduct Annual O&M		$2		$2																		
											Year 1	**Year 2**	**Year 3**	**Year 4**	**Year 5**	**Year 6**	**Year 7**	**Year 8**	**Year 9**	**Year 10**	**Year 11**	**Years 1-11**
PROJECT COST		**$431,362**	$17,703	$42,596	$5,719	$1,854	$24,064	$240	$265,395	$73,792	$711	$3,715	$11,407	$14,451	$26,612	$36,663	$25,645	$45,107	$38,844	$45,598	$51,815	**$300,567**
TOTAL COST		**$476,496**	$24,161	$45,369	$5,776	$1,854	$24,919	$240	$300,329	$73,792	$711	$3,890	$12,199	$16,343	$29,309	$40,063	$28,683	$53,363	$46,725	$53,884	$60,474	**$345,643**
CUMULATIVE COST											$711	$4,601	$16,801	$33,143	$62,452	$102,515	$131,198	$184,561	$231,286	$285,170	$345,643	**$345,643**
FEASIBILITY COST		**$35,195**	$12,271	$17,738	$3,110	$1,228	$848	$0	$0	$0	$433	$1,541	$3,674	$2,483	$2,755	$3,549	$4,397	$8,091	$6,101	$2,604	$0	**$35,628**
P&S COST		**$23,371**	$4,723	$14,988	$1,561	$683	$658	$0	$0	$0	$243	$243	$711	$1,794	$1,433	$1,462	$2,364	$2,195	$3,320	$7,027	$2,590	**$23,383**
LERRDS COST		**$1,218**	$0	$0	$1,218	$0	$0	$0	$0	$0	$35	$38	$22	$86	$92	$72	$91	$57	$164	$177	$402	**$1,236**
CONTRACT COST		**$18,945**	$82	$659	$0	$0	$1,482	$252	$16,470	$0	$0	$6	$35	$24	$54	$6	$16	$8	$34	$17	$50	**$250**
CONSTRUCTION / LAND CREDIT COST		**$385,577**	$1,154	$9,199	$0	$0	$20,746	$0	$245,221	$73,883	$0	$1,888	$6,965	$10,032	$22,252	$31,536	$18,718	$34,750	$29,207	$35,289	$49,183	**$239,818**
O&M MANUAL COST		**$238**	$0	$238	$0	$0	$0	$0	$0	$0	$0	$0	$0	$31	$26	$38	$60	$7	$17	$53	$6	**$238**
ANNUAL O&M COST		$694	$0	$694	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$1	$27	$65	$125	$126	$149	$201	$694

ILLINOIS RIVER BASIN RESTORATION
COMPREHENSIVE PLAN
WITH INTEGRATED ENVIRONMENTAL ASSESSMENT

APPENDIX F

REAL ESTATE PLAN

ILLINOIS RIVER BASIN RESTORATION
COMPREHENSIVE PLAN
WITH INTEGRATED ENVIRONMENTAL ASSESSMENT

APPENDIX F

REAL ESTATE PLAN

I. PURPOSE OF THE REPORT

This Real Estate Plan is being submitted as the technical Real Estate document of the Illinois River Basin Restoration and Illinois River Ecosystem Restoration Feasibility and Comprehensive Plan with Integrated Environmental Assessment. The preparation is in accordance with Engineering Regulation (ER) 405-1-12 and follows the general outline for feasibility reports, even though this report is not seeking individual project implementation authority.

Actual site locations under this report have not been determined. There are a few cases where site-specific reports have been developed under this legislation but are yet to be approved.

This Real Estate Plan is to be considered tentative in nature and for planning purposes only. Several assumptions were made for report purposes in regard to lines on ground and ownership determination. Both property acquisition lines and the estimates of cost are subject to change, even after this report is approved.

Baseline Cost Estimates for Real Estate have been completed in a generalized sense for all of the sites. These baseline estimates—as well as some site-specific investigations—will be used to develop a concept level estimate for all of the proposed sites. Because this report is seeking a programmatic approval of future projects, additional planning reports will be submitted for approval prior to implementation of any specific project.

Government-owned or privately-owned lands were not mapped out or drawn at any of the proposed project locations. The Real Estate Division of the Rock Island District Corps of Engineers was asked to provide this information based on latest known communications. It is assumed that future projects that arise due to approval of the Illinois River Basin Restoration Comprehensive Plan will allow for the Real Estate Division to adequately provide detailed and accurate project information.

II. DESCRIPTION OF LANDS, EASEMENTS, RIGHTS-OF-WAY, RELOCATIONS, AND DREDGED OR EXCAVATED MATERIAL DISPOSAL AREAS (LERRD) REQUIRED FOR CONSTRUCTION, OPERATION AND MAINTENANCE OF THE PROJECT

A. Project Locations and Description. Section 519 of the Water Resources Development Act (WRDA) 2000 defines the Illinois River Basin as the Illinois River in Illinois, its backwaters, its side channels and all tributaries, including their watersheds, draining into the river. The Illinois Basin comprises 55 counties within the states of Illinois, Indiana and Wisconsin (figure 1).

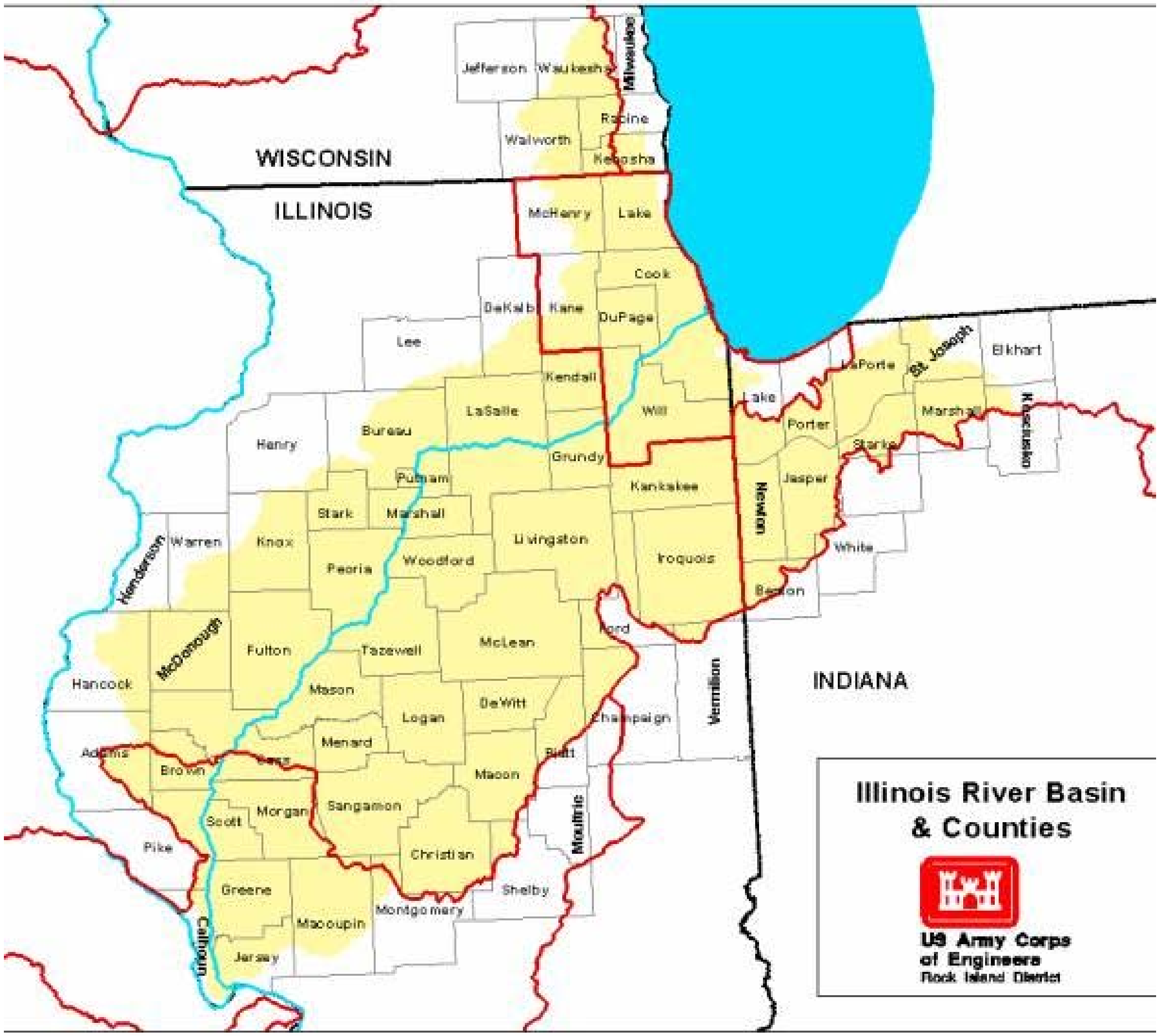

Figure F-1. Map of the Illinois Basin (shaded in yellow)

Alternative 6 is the preferred alternative for this study and provides for the following measures:

Ecological Integrity - Restoration would provide a measurable increase in the level of habitat and ecological integrity at the system level.

Sediment Delivery - reduce sediment delivery from Peoria Lakes tributaries by 40 percent, other tributaries upstream of Peoria Lakes by 11 percent, and tributaries downstream of Peoria Lakes by 20 percent. System benefits include reduced delivery of 20 percent to Peoria Lakes and 20 percent system wide.

Backwaters and Side Channel - restore 12,000 acres in 60 of the approximate 100 backwaters on the system; dredge an average of 200 acres per backwater, the optimal level of 40 percent of the approximate 500-acre average of backwater area. This would create optimal backwater and over-wintering habitat spaced approximately every 5 miles along the system. Restoration of 35 side channels and protection of 15 islands.

Floodplain, Riparian, and Aquatic - restore 75,000 acres of mainstream floodplain (approximately 14.9 percent of total mainstream floodplain area), including approximately 31,700 acre of wetlands, 25,300 acres of forest and 18,000 acres of prairie; tributary restoration of 75,000 acres (approximately 8.8 percent of total tributary floodplain area) including approximately 47,600 acres of wetlands, 13,900 acres of forest and 13,500 acres of prairie; and aquatic restoration including 500 miles of tributary stream (16.6 percent of the approximately 3,000 miles of channelized streams) with a mix of improved in-stream aquatic habitat structure and channel meandering.

Connectivity - restore fish passage at all mainstem dams on the Fox River (12 dams), all dams on the West Branch of the DuPage River (5 dams), all mainstem dams and one tributary (Salt Creek) of the Des Plaines River (17 dams), Wilmington and Kankakee Dams on the Kankakee River, Bernadotte Dam on the Spoon River, and the Aux Sable Dam.

Water Level - create 107,000 acres of storage area at an average depth of 1.5 feet and 38,400 acres of infiltration. Increase water level management at navigation dams using electronic controls and increased flow gauging. Results include an 11 percent reduction in the 5-year peak flows in tributaries, an overall average 20 percent increase in tributary base flows, and up to 66 percent reduction in the occurrence of half-foot or greater fluctuations during the growing season in the mainstream Illinois River. This alternative also would see benefits accrue from drawdowns in LaGrange or Peoria Pools.

Water Quality - anticipate improvements in water quality due to reduced sedimentation, phosphorus and nitrogen delivery. These improvements would result from sediment delivery reduction measures and water level management measures.

If fully implemented over the next 50 years, Alternative 6 would:

- provide a measurable increase in system ecological integrity;
- reduce systematic sediment delivery by 20 percent;
- restore 12,000 acres of backwaters;
- restore 35 side channels;
- protect 15 islands;
- restore 75,000 acres of mainstream floodplain;

- restore 75,000 acres of tributary floodplain;
- restore 1,000 stream miles of aquatic habitat;
- provide fish passage along the Fox, DuPage, Des Plaines, Kankakee, Spoon, and Aux Sable Rivers;
- reduce the 5-year peak flows in tributaries by 11 percent;
- increase tributary base flows by 20 percent;
- produce a 66 percent reduction in water level fluctuations along the mainstream during the growing season; and
- provide system level improvements in water quality.

The recommendation includes extending the current authorization through 2015.

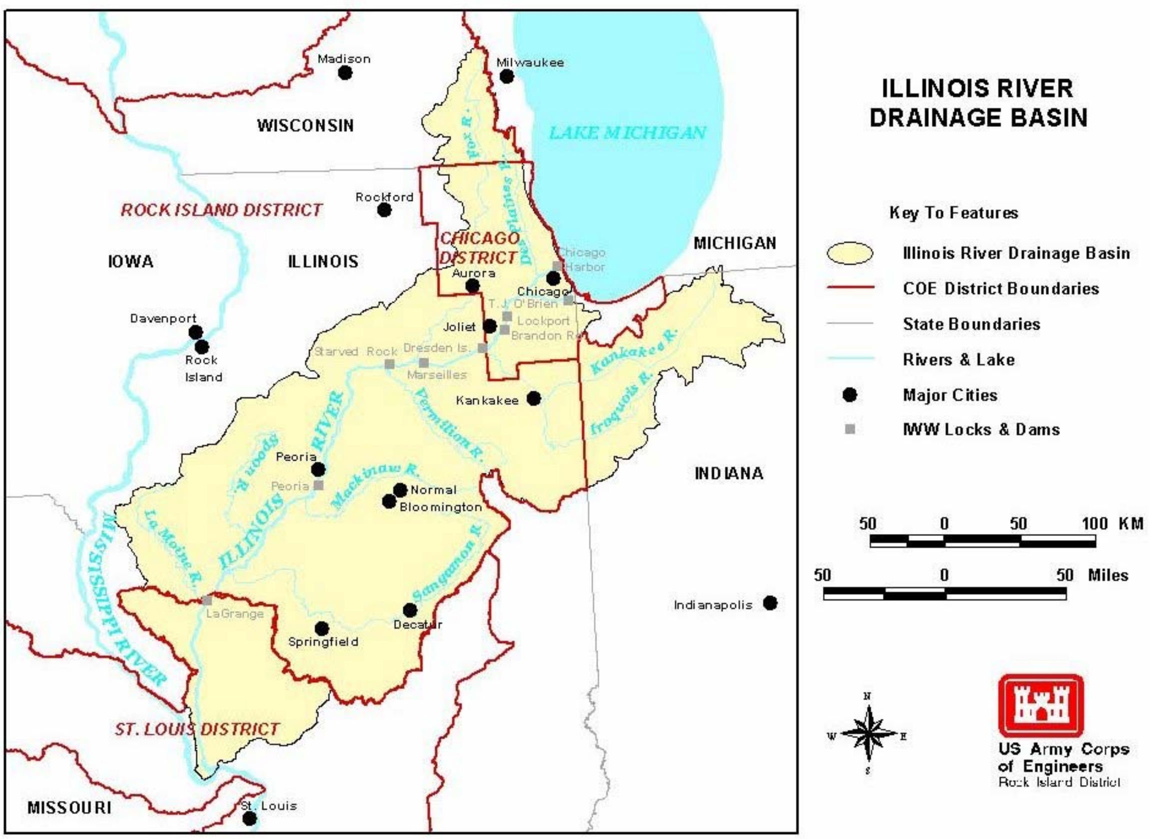

Figure F-2. Map of Illinois River Drainage Basin

1. Location. Site-specific locations are not available for the purpose of this report.

2. Project Description and Rationale. For the purposes of this report, an estimate of $3,000 per acre was assumed for agricultural and recreation lands anticipated for the project. This amount includes contingencies but does not include land acquisition expenses. Land values in residential and urban areas could be considerably higher. As an example, the Waubonsie project land was valued between $6,000 and $8,000 per acre. It is uncertain at this time where other projects will be located.

3. Baseline Cost Estimate. A baseline cost estimate has not been prepared for this report due to the lack of actual locations and the number of landowners involved. Figures were given to the Engineering Division of the Rock Island Corps of Engineers to aid in development of their construction figures, i.e. $3,000 per acre. Gross Appraisals will be performed as individual project areas are developed, actual land boundaries are determined, and the number of landowners are known. Four reports— Pekin Lake – Northern Unit; Pekin Lake – Southern Unit; Waubonsie Creek; and Peoria – Upper Island—that have been established under this authority contain gross appraisal information and Baseline Cost Estimates.

4. Summary of Estates and Acres Required. This section will be addressed in future Real Estate Plans for each individual project, as applicable.

5. Map of Possible Areas of Impact Due to Construction. There are no maps that represent the possible areas of impact due to construction. There are currently no references to landowner boundaries. There is also no reference as to the location of proposed project areas. Future real estate reports will include the applicable Section, Township, and Range details.

B. Location

A determination of actual boundaries of federally-owned lands and privately-owned lands has not been made. Information in this Real Estate Plan Appendix is based entirely on assumption and is to be utilized for initial planning purposed only.

As each project is proposed for implementation the issue of the proper estate to be acquired will be revisited. There is a recommendation within this document that estates less than Fee be authorized for this project where they represent the appropriate estate. The possible estates to be utilized for each individual site component are listed in paragraph D, Summary of Estates Required.

Since the lands could not accurately be located or addressed there were several assumptions made in the establishment of estimated costs. Any additional costs would be determined on a case-by-case basis.

C. Consolidated Summary of Type and Number of Properties Affected by the Proposed Project

This Real Estate Plan is based on assumptions and limitations. There have been no property data searches made or detailed mapping performed. Each individual proposed project area will contain specific information that reflects the estimated number and type of properties affected.

D. Summary of Estates Required

1. Standard Estates. The following standard estates from ER 405-1-12 may be utilized for the project. Additional estates required for access may be necessary and will be reviewed during each individual plan preparation.

Fee Title Estate

The fee simple title to (the land described in Schedule A)(Tract Nos. ____, ____ and ____), subject, however, to existing easement for public roads and highways, public utilities, railroads and pipelines.

Temporary Work Area Easement

A temporary easement and right-of-way in, on, over and across (the land described in Schedule A)(Tracts Nos. ______, ______ and ______), for a period not to exceed ___________________, beginning with date possession of the land is granted to the United States, for use by the United States, its representatives, agents, and contractors as a (borrow area) (work area), including the right to (borrow and/or deposit fill, spoil and waste material thereon) (move, store and remove equipment and supplies, and erect and remove temporary structures on the land), and to perform any other work necessary and incident to the construction of the _______________________ Project, together with the right to trim, cut, fell and remove therefrom all trees, underbrush, obstructions, and any other vegetation, structures, or obstacles within the limits of the right-of-way; reserving, however, to the landowners, their heirs and assigns, all such rights and privileges as may be used without interfering with or abridging the rights and easement hereby acquired; subject, however, to existing easements for public roads and highways, public utilities, railroads and pipelines.

Channel Improvement Easement

A perpetual and assignable right and easement to construct, operate, and maintain channel improvement works on, over and across (the land described in Schedule A) (Tracts Nos. ____, ____ and ____) for the purposes as authorized by the Act of Congress approved __________________, including the right to clear, cut, fell, remove and dispose of any and all timber, trees, underbrush, buildings, improvements and/or other obstructions therefrom; to excavate, dredge, cut away, and remove any or all of said land and to place thereon dredge or spoil material; and for such other purposes as may be required in connection with said work of improvement; reserving, however, to the owners, their heirs and assigns, all such rights and privileges as may be used without interfering with or abridging the rights and easement hereby acquired; subject, however, to existing easements for public roads and highways, public utilities, railroads and pipelines.

Flowage Easement (Permanent Flooding)

The perpetual right, power, privilege and easement permanently to overflow, flood and submerge (the land described in Schedule A) (Tracts Nos. ___, ___, and ___) (and to maintain mosquito control) in connection with the operation and maintenance of the ____ project as authorized by the Act of Congress approved ____________________________, and the continuing right to clear and remove any brush, debris and natural obstructions which, in the opinion of the representative of the United States in charge of the project, may be detrimental to the project, together with all right, title and interest in and to the timber, structures and improvements situate on the land (excepting ___________________ (here identify those structures not designed for human habitation which the District Engineer determines may remain on the land)); provided that no structures for human habitation shall be constructed or maintained on the land, that no other structures shall be constructed or maintained on the land except as may be approved in writing by the representative of the United States in charge of the project, and that no excavation shall be conducted and no landfill placed on the land without such approval as to the location and method of excavation and/or placement of landfill; 1/ the above estate is taken subject to existing easements for public roads and highways, public utilities, railroads and pipelines; reserving, however, to the landowners, their heirs and assigns, all such rights and privileges as may be used and enjoyed without interfering with the use of the project for the purposes authorized by Congress or abridging the rights and easement hereby acquired; provided further that any use of the land shall be subject to Federal and States laws with respect to pollution.

1/ If sand and gravel or other quarriable material is in the easement area and the excavation thereof will not interfere with the operation of the project, the following clause will be added: "excepting that excavation for the purpose of quarrying (sand) (gravel) (etc.) shall be permitted, subject only to such approval as to the placement of overburden, if any, in connection with such excavation;"

Road Easement

A perpetual and assignable easement and right-of-way in, on over and across (the land described in Schedule A) (Tracts Nos. , and) for the location, construction, operation, maintenance, alteration and replacement of (a) road(s) and appurtenances thereto; together with the right to trim, cut, fell and remove therefrom all trees, underbrush, obstructions and other vegetation, structures, or obstacles within the limits of the right-of-way; (reserving, however, to the owners, their heirs and assigns, the right to cross over or under the right-of-way as access to their adjoining land at the locations indicated in Schedule B); 2/ subject, however, to existing easements for public roads and highways, public utilities, railroads and pipelines.

2/The parenthetical clause may be deleted, where necessary; however, the use of this reservation may substantially reduce the liability of the Government through reduction of severance damages and consideration of special benefits; therefore, its deletion should be fully justified.

Flowage Easement (Occasional Flooding)

The perpetual right, power, privilege and easement occasionally to overflow, flood and submerge (the land described in Schedule A) (Tracts Nos.____, ____ and ____). (and to maintain mosquito control) in connection with the operation and maintenance of the __________ project as authorized by-the Act of Congress approved _____________, together with all right, title and interest in and to the structure; and improvements now situate on the land, except fencing (and also excepting _____________________ (here identify those structures not designed for human habitation which the District Engineer determines may remain on the land) 3/ ; provided that no structures for human habitation shall be constructed or maintained on the land, that no other structures shall be constructed or maintained on the land except as may be approved in writing by the representative of the United States in charge of the project, and that no excavation shall be conducted and no landfill placed on the land without such approval as to the location and method of excavation and/or placement of landfill;

3/ the above estate is taken subject to existing easements for public roads and highways, public utilities, railroads and pipelines; reserving, however, to the landowners, their heirs and assigns, all such rights and privileges as may be used and enjoyed without interfering with the use of the project for the purposes authorized by Congress or abridging the rights and easement hereby acquired; provided further that any use of the land shall be subject to Federal and State laws with respect to pollution. If sand and gravel or other quarriable material is in the easement area and the excavation thereof will not interfere with the operation of the project, the following clause will be added: “excepting that excavation for the purpose of quarrying (sand) (gravel) (etc.) shall be permitted, subject only to such approval as to the placement of overburden, if any, in connection with such excavation;”

Railroad Easement

A perpetual and assignable easement and right-of-way in, on, over and across (the land described in Schedule A) (Tracts Nos. , and) for the location, construction, operation, maintenance, alteration and replacement of a railroad and appurtenances thereto; together with the right to trim, cut, fell and remove therefrom all trees, underbrush, obstructions, and other vegetation, structures, or obstacles within the limits of the right-of-way; (reserving, however, to the landowners, their heirs and assigns, the right to cross over or under the right-of-way as access to their adjoining land at the locations indicated in Schedule B;) 4/ subject, however, to existing easements for public roads and highways, public utilities, railroads and pipelines.

4/ The use of this reservation clause may substantially reduce the liability of the Government through reduction of severance damages.

2. Justification for Easement Estates in Lieu of Fee. Acquisition of easement estates in lieu of Fee estates is proposed for future projects based upon the extent of the interest required for the construction, operation, and maintenance of each respective project. A Channel Improvement Easement is adequate for the project needs in that all restoration work will be performed within the stream or directly adjacent to the stream.
A Temporary Work Area Easement would be required to provide staging areas for equipment and supplies, and to be used as material disposal placement sites. In addition**,** acquisition of easements versus Fee Simple Title to proposed lands is preferred by the primary project sponsor, the Illinois Department of Natural Resources (Illinois DNR), and by the public and private landowners whose lands may be needed for future projects. There are landowners who do not wish to convey Fee Simple Title

to the project sponsor. However, they are receptive to granting the necessary easement estate to the sponsor so that project features may be incorporated on their lands.

The use of an easement estate versus a fee estate would require case by case evaluation. District Counsel may also be tasked to prepare a legal opinion applying the facts of the specific project with regard to the navigation servitude. The Headquarters USACE must approve the use of a non-standard estate. Fee would be the required estate in areas where project features include recreation.

III. LANDS REQUIRED OWNED BY THE SPONSOR

Not all of the sponsors for this project have been identified. The Illinois DNR has shown interest in the Illinois region of the study area. Other sponsors and lands in Wisconsin and Indiana will be determined as the need arises. These lands will be identified in future planning documents as required.

IV. NON-STANDARD ESTATE DISCUSSION

There are currently no non-standard estates being proposed within this report.

V. FEDERAL PROJECT WITHIN THE LERRD REQUIRED FOR THE PROJECT

Previous Federal projects lay within the boundaries of some of the anticipated proposed project features. These lands will be identified in future planning documents as required.

VI. FEDERALLY-OWNED LAND WITHIN THE PROJECT AREA

Along the Mississippi River, the United States has acquired all the real estate interests needed for the construction, operation and maintenance of the navigation channel project; the situation along the Illinois Waterway (IWW), however, is different. Portions of the IWW were improved or were in the process of being improved by non-Federal entities prior to the United States assuming complete control of the Illinois Waterway Navigation Project with respect to improvement for the purpose of navigation; therefore, the United States did not acquire a real estate interest in all of the lands that are affected by the construction, operation and maintenance of the IWW Navigation Project. As a result, the existing real estate interests and rights the United States has with respect to the real estate required for the construction, operation and maintenance of the Illinois Waterway Navigation Project is a complex mixture and varies with each location along the waterway. Following is a summary explanation of the existing real estate interests and rights which the United States has along the IWW.

> By Public Law 520, 71st Congress, dated 3 July 1930, Congress authorized the United States to undertake the project for improvement of navigation on the Illinois Waterway, in accordance with the report of the Chief of Engineers as submitted in Senate Document Numbered 126, 71st Congress 2nd Session. In the report of the Chief of Engineers, it is explained that the Constitution of the State of Illinois prohibits the State from conveying title to any of the real estate and associated improvements that the State had acquired and developed for the improvement of the waterway. The Secretary of War asked the Attorney General of the United States to confirm whether or not,

> upon the Illinois Waterway Project being authorized by Congress, the United States would have complete control of the waterway including the structures, even though the State of Illinois could not formally convey title to the United States. The Attorney General concluded that, with respect to the parts of the waterway that are navigable streams improved by the State, the United States may, under appropriate acts of Congress, take complete control over the improvement and regulation of navigation without any amendment to the Constitution of Illinois or permission from the State. The Governor of the State of Illinois, in a brief to the Secretary of War dated 19 March 1930, states the opinion of the Governor, "that, upon adoption of the Illinois Waterway by the Federal Government, and upon an appropriation being made for its completion, the Federal government will acquire as full and complete jurisdiction and control of said waterway and its appurtenances, as if, by appropriate authority, conveyance of title had been made by the State of Illinois." Therefore, while the State of Illinois did not convey title of the real property interest and associated improvements acquired and developed by the State of Illinois for the waterway, it was the understanding and intent of both the United States and the State of Illinois that the United States would have complete control of the waterway upon the project being authorized by Congress, as if title had been conveyed. This provides only a brief summary of what is contained in the Chief of Engineers report. For a complete understanding of the circumstances, refer to the full text of the communications in Senate Document Numbered 126, 71st Congress 2nd Session.

In other portions of the IWW including part of the Des Plains River, the Lockport Lock, the Chicago Sanitary and Ship Canal, the Chicago River and the Calumet-Sag Channel, the Metropolitan Water Reclamation District of Greater Chicago (MWRD) acquired real estate interests and developed improvements prior to the United States being authorized to develop those portions of the waterway for navigation.

The Department of the Army entered into a Memorandum of Agreement with MWRD which provides for the Department of the Army to operate and maintain certain improvements that were developed by MWRD on portions of the waterway in the Chicago River, the Chicago Sanitary and Ship Canal and part of the Des Plains River including, but not limited to, the Chicago River Lock and Lockport Lock, and to perform certain additional activities in connection with maintenance of portions of the waterway. The agreement also states that the MWRD and the Department of the Army hereby convey to each other, at no cost, all rights of entry and/or easements necessary for each to carry out its responsibilities under this agreement.

The Calumet-Sag Channel project was authorized with the provision that a local interest shall furnish all lands and easements necessary to prosecute the work. MWRD signed Assurance Agreements for the Calumet-Sag Channel Project agreeing to furnish free of cost to the United States all lands, easements, rights-of-way, relocations, and dredged or excavated material disposal areas (LERRD) necessary for the new work and for subsequent maintenance when and as required. The MWRD subsequently has conveyed easements, fee title and rights-of-entry to the United States over areas required by the United States for the project.

Subsequent to the United States assuming control and operation of the various portions of the IWW, the United States proceeded to acquire certain additional real estate interests, in the name of the United States, that were required for the construction, operation and maintenance of the IWW Project.

Therefore, the real estate interests and rights which the United States has for the Illinois Waterway Project vary greatly, depending on the specific portion of the project. Table 1 provides a basic summary of the entities believed to hold real estate interests required for the various parts of the Illinois Waterway Project at both the Locks and Dams and in the Pools.

Table F-1 identifies entities believed to hold existing real estate interests—that is, Lock and Dam and Pool area sites—required for the IWW in the various project portions.
The Corps of Engineers maintains records only of those real estate interests that are held by the United States for the Illinois Waterway Project. It would be ideal to have complete documentation of all of the real estate interests needed for the project stating who holds the interests. However, to identify all of the real estate interests held by the other entities that are required for the project would require a significant effort and expenditure of funds to research and compile the records. Therefore, it is most practical to identify who may currently have real estate interests for the project on a case-by-case basis as the need arises.

With respect to the real estate interests that were previously acquired by the State of Illinois for the Illinois Waterway Project where the state has not actually conveyed title to the United States, if any new work is to be done on that property, it would at least require a title search to verify that the State of Illinois still owns the property. If the State of Illinois owns the property to be affected by new work, it may also be prudent to verify with the State of Illinois that they agree the property is part of that which the United States assumed control of for the purpose of improving navigation.

The United States also has the right to construct, operate and maintain the navigation project in areas located below the ordinary high water line without the requirement to obtain any real estate interest in those areas. Questions have been raised in discussions relative to the Navigation Study and associated Environmental Restoration projects as to whether or not navigation servitude applies in the case of environmental restoration work. If navigation servitude does not apply, it will require that appropriate real estate interests be obtained for such work where it is located below the ordinary high water line, the same as for areas located above the ordinary high water line. This can be a critical factor in determining the total cost and feasibility of such projects. To determine the real estate interests required for environmental restoration projects will first require a definite determination as to whether or not navigation servitude applies. If such projects located below the ordinary high water line are to be proposed and pursued, a request should be made early on for a legal determination as to the applicability of navigation servitude in such cases in order that the full extent of any real estate interests required for the project can be determined.

It is unknown at this time as to what federally-owned lands exist within the Indiana and Wisconsin portions of the basin. This will be addressed in future planning reports for each individual project.

Table F-1. Illinois Waterway Ownership Facts

Project Portion	Lock and Dam Site Ownership	Pool Area Ownership
LaGrange Lock & Dam	United States	There is no indication in the records of any real estate interests acquired for the LaGrange Pool.
Peoria Lock & Dam	United States	State of Illinois and United States
Starved Rock Lock & Dam	State of Illinois	State of Illinois and United States
Marseilles Lock, Canal and Dam	State of Illinois and United States	State of Illinois and United States
Dresden Island Lock & Dam	State of Illinois	State of Illinois and United States
Brandon Road Lock & Dam	State of Illinois	The United States has some real estate interests. This pool is primarily contained by walls. If there is any additional real estate interest held for the pool, it would likely be the State of Illinois and/or the MWRD.
Lockport Lock, and Chicago Sanitary & Ship Canal	MWRD	MWRD
Calumet Sag Channel	No Lock	United States and MWRD
T. J. O'Brien Lock	United States	None known
Chicago River, Chicago Harbor and Lock	Located in Chicago District; real estate information unavailable in Rock Island District.	Located in the Chicago District; real estate information unavailable in the Rock Island District.

VII. NAVIGATIONAL SERVITUDE

All of the projects with real estate located below the Ordinary High Water line within the Navigational Servitude will be evaluated. An Attorney's Opinion of Compensability addressing the use of the servitude for these types of projects will be prepared on a case-by-case basis.

VIII. POSSIBILITY OF INDUCED FLOODING DUE TO PROJECT

It is unknown at this time if induced flooding will be caused within the project areas. However, site-specific project evaluations will determine potential effects and seek to avoid induced flooding.

IX. RELOCATION ASSISTANCE BENEFITS

All of the projects that evolve from the Illinois River Basin Restoration Comprehensive Plan will be evaluated as to the provisions and requirements necessary for relocation assistance benefits. This will be performed during each project plan as necessary.

The Relocation Assistance Program mandated by Public Law 91-646 would be utilized in the event that any person would be displaced from their home, business, or farm. Relocation benefit costs are separate and in addition to the acquisition payments of real property. Relocation benefits would be reviewed during the study phase for each respective project that may be implemented. Project lands would be typically located within the river itself or on flood prone land that is unimproved. It is anticipated that implemented projects that would affect improved lands would not involve a significant number of displacements.

X. MINERAL ACTIVITY/TIMBER HARVESTING IN PROJECT AREA

Mineral, oil, and gas rights will not be acquired except in areas outside the Navigational Servitude where development would interfere with project purposes. Mineral rights not within the servitude will either be acquired where necessary (for project purposes) or will be reserved and subordinated to the Federal government's right to regulate their development in a manner that will not interfere with the primary purposes of the project, including public access. Each proposed project would be evaluated to determine where minerals should be acquired, reserved and subordinated, or in some cases left entirely outstanding. The multiplicity of ownerships in mineral interests, the variety of minerals, and the different methods of mineral exploration, recovery, and production make it impracticable to define in advance specific guidelines concerning the reservation of mineral interests and their subordination to primary project purposes in any given project. The implementation of real estate planning documents will fully discuss and consider the need for or extent of acquisition and/or reservation of mineral interests.

XI. SPONSORS' LEGAL AND PROFESSIONAL CAPABILITY TO ACQUIRE LERRD

As individual projects are submitted for approval, an assessment of sponsor capabilities would be made. Proposed sponsors would be reviewed for their legal and professional capability to acquire the required LERRD.

The Illinois DNR will be the sponsor for the following identifiable projects within the basin area that is lying within the Rock Island District Corps of Engineers boundary: Pekin Lake – Northern Unit; Pekin Lake – Southern Unit; Waubonsie Creek; and Peoria – Upper Island. Separate reports and Real Estate Plans have been developed for these projects.

The Illinois DNR has the knowledge and capability to adequately take care of their Real Estate responsibilities. However, due to limited staffing, the Illinois DNR may require assistance to support them in their acquisition activities. The acquisition activities for each individual project will be assessed on a case-by-case basis to determine the need for assistance.

The sponsors for lands lying within the basin area of Indiana and Wisconsin have yet to be determined.

XII. ZONING ORDNANCES PROPOSED

It is uncertain if zoning ordnances will be proposed for this project. This will be further investigated as each individual project is planned and developed.

XIII. SCHEDULE OF LAND ACQUISITION MILESTONES

The implementation of study documents will take place as each project is proposed. The time and cost to prepare Real Estate Plans, Real Estate Design Memorandums and Real Estate maps, as applicable, will vary depending on the size and nature of each proposed project.

Upon approval of the implemented study document, real estate acquisition schedules would be variable and be based on the number of tracts involved, sponsor capabilities, and input by the individual project sponsors. As required, each respective Real Estate Plan or Real Estate Design Memorandum would provide a schedule of land acquisition milestones.

XIV. FACILITY OR UTILITY RELOCATIONS

Each project submitted for implementation approval will undergo an evaluation of facility or utility relocation. If applicable, a Preliminary Attorney's Opinion of Compensability will be prepared in accordance with ER 405-1-12 and included in the Real Estate Plan or Real Estate Design Memorandum, as applicable.

The issue of relocation of towns is unknown and unlikely at this time due to the uncertainty of the environmental feature.

XV. IMPACTS OF SUSPECTED OR KNOWN CONTAMINANTS

Environmental site assessments would take place prior to the implementation of each respective project and any environmental conditions or contamination issues would be addressed at that time. Minor impacts associated with site acquisition usage, dredging, and dredged material placement may occur during the construction of proposed projects; however, no significant adverse impacts are expected. The use of best management practices and proper construction techniques would minimize adverse water quality impacts. No separable lands have been identified as being needed for mitigation purposes.

XVI. LANDOWNERS' SUPPORT OR OPPOSITION TO THE PROJECT

Since no detailed site specific project boundaries have been identified, it is unknown at this time whether landowners support or oppose the projects. The State of Illinois would seek to work with willing landowners. This intent may not apply to other sponsors or areas of Wisconsin and Indiana where the sponsors have not yet been identified. The sponsors would however retain the ability to utilize Eminent Domain proceedings per the Project Cooperation Agreement (PCA).

XVII. RISKS OF ACQUIRING LANDS BEFORE EXECUTION OF THE PCA OR AUTHORIZED DOCUMENTS

Prior to execution of the PCA, in accordance with ER 405-1-12, Chapter 12, the Sponsors will be advised in writing of the risks associated with acquiring land. There are provisions in the Section 519 language of WRDA 2000 that state:

> (A) VALUE OF LANDS.—If the Secretary determines that lands or interests in land acquired by a non-Federal interest, regardless of the date of acquisition, are integral to a project or activity carried out under this section, the Secretary may credit the value of the lands or interests in land toward the non-Federal share of the cost of the project or activity. Such value shall be determined by the Secretary.

There may be lands that apply to this provision. If such lands arise, the appropriate documentation will be provided to the Secretary for determination.

XVIII. OTHER REAL ESTATE ISSUES RELEVANT TO THE PROJECT

The non-Federal sponsors shall provide a percentage of the cost of construction of any project carried out, including provision of all the LERRD required to accommodate construction, operation, and maintenance of the project. If the value of LERRD exceeds the percentage of total project costs, the sponsors may be reimbursed for that portion in excess of the percentage, or the Government may assume financial responsibility for payment of the portion that exceeds that percentage.

A Real Estate Plan will be prepared in accordance with ER 405-1-12 for all lands that are to be acquired by the sponsors for each proposed project.

The Government and each respective sponsor will enter into a Project Cooperation Agreement (PCA) prior to initiation of land acquisition by the sponsor. Generally, the sponsor is responsible for 100 percent of all operation and maintenance costs of the project.

There is currently no standard model PCA available for this project. A PCA has been approved for the Peoria – Upper Island Project. Over time, as additional projects are completed, a model PCA will be pursued.

In the event that the LERRD required by a proposed project is encumbered with a conservation easement estate, the critical “bundle of sticks” of ownership may not be available to convey to the USACE, such as the right to construct, overflow and inundate the land, etc. Most conservation programs entail partnerships with others, to include federal agencies, state agencies, or non-governmental offices. The management by many different agencies contributes to the complexity of conservation type programs. The value of proposed project lands encumbered with a pre-existing conservation easement may be affected. Therefore, the allowance of a LERRD credit for encumbered project lands would require additional research, as necessary.

ILLINOIS RIVER BASIN RESTORATION
COMPREHENSIVE PLAN
WITH INTEGRATED ENVIRONMENTAL ASSESSMENT

APPENDIX G

U.S. FISH AND WILDLIFE SERVICE
COORDINATION ACT REPORT

FISH AND WILDLIFE COORDINATION ACT REPORT

for the

ILLINOIS RIVER ECOSYSTEM RESTORATION STUDY

Submitted to:
U.S. Army Corps of Engineers
Rock Island District
Clock Tower Building
Rodman Avenue, P.O. Box 2004
Rock Island, Illinois 61201-2004

Prepared by:
Kraig McPeek
U.S. Fish and Wildlife Service
Rock Island Ecological Services Field Office
4469 48th Avenue Court
Rock Island, Illinois 61201

U.S. FISH AND WILDLIFE SERVICE
GREAT LAKES – BIG RIVERS REGION
FORT SNELLING, MINNESOTA

May 2004

Table of Contents

LIST OF TABLE AND FIGURES

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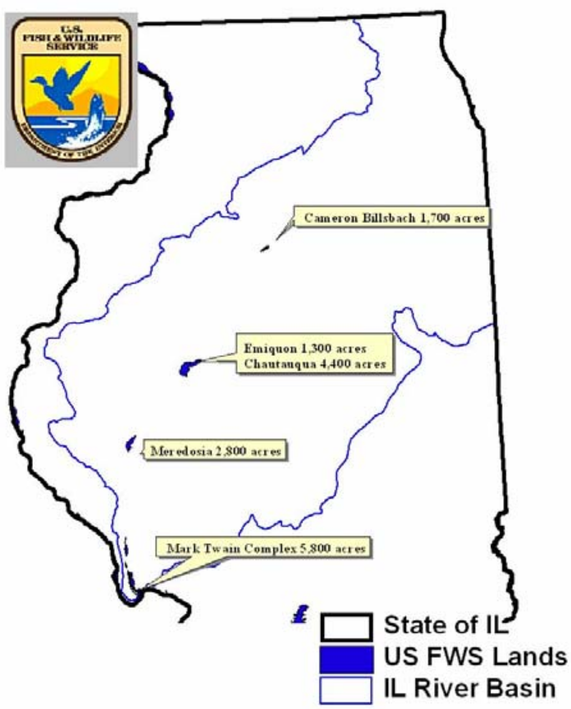
Chapter 1 – Introduction, Background and Purpose

Introduction

The U.S. Fish and Wildlife Service (Service) became a major partner in the Illinois River (IR) community in 1936, when Congress authorized the acquisition of 4,488 acres of IR floodplain to establish the Chautauqua National Fish and Wildlife Refuge (Figure 1.1). The purpose of the refuge was national in scope and aimed at preserving the wetlands, waters, and floodplains so critical to the continued existence of fish and wildlife. Since that time, our work on the IR system has expanded to include over 16,000 acres of lands and water in the National Wildlife Refuge system along the IR and its floodplain. Including state-managed lands, about 10 percent of the IR floodplain is managed for fish and wildlife purposes.

Figure 1.1, US Fish and Wildlife Service, National Refuge Lands within the Illinois River Basin



In addition to direct land management authority, the Service is authorized under the Fish and Wildlife Coordination Act (16 U.S.C. 661 et seq.) to provide reports, such as this one, on federally funded projects. The purpose of the report is to present information on the likely effects of the proposed project on fish and wildlife resources. The Fish and Wildlife Coordination Act presents an opportunity for the Fish and Wildlife Service to offer recommendations and comments which will help to improve proposed project alternatives and features for fish and wildlife habitat.

Further, we provide technical assistance under the National Environmental Policy Act (NEPA) of 1969. The NEPA requires that an environmental impact statement be prepared when a Federal action is proposed which may result in significant impacts to the environment. It further requires an analysis of cumulative effects, defined in 40 CFR §1508.7 as:

> "the impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time."

As an ecological restoration initiative, we believe that the net result from all related projects would be beneficial to the natural resources of the IR basin.

The Service also provides technical expertise on the protection and enhancement of federally threatened and endangered species by consulting with Federal agencies on effects to those species. Consultation under the Endangered Species Act is outlined in Chapter 7 of this report.

Background

The Illinois River Ecosystem Restoration Study is being carried out under the Corps of Engineers' General Investigations Program. The study was initiated pursuant to the provision of funds in the Energy and Water Development Appropriations Act, 1998. The study was authorized by Section 216 of the 1970 Flood Control Act. Congress has provided specific authority to address Illinois River Basin Restoration in Section 519 of the Water Resources Development Act (WRDA) of 2000. This authority calls for the completion of a comprehensive plan and critical restoration projects. Efforts were initiated following the provision of funds in the Energy and Water Development Appropriations Act of 2002.

This Fish and Wildlife Coordination Act Report addresses the final response to the Comprehensive Plan portion of the Illinois River Restoration authority provided in Section 519 of the WRDA of 2000.

Purpose

The purpose of this report is to present information and our opinions, recommendations, and comments on impacts of the proposed IL 519 authority, Illinois River Restoration Project, and the preferred alternative. This authority seeks to improve the Illinois River Ecosystem by concentrating on seven key ecosystem related goals and implementing a selected alternative to address system-wide problems. We offer direct comments on each of these goals as well as the alternative formulation and agency coordination throughout this report and, in particular, in the final chapter (9) of the report titled conclusions and recommendations.

We also provide an analysis and recommendations on the ongoing river management projects such as the restructured 9-foot Channel Navigation Study, Environmental Management Plan (EMP), and Long Term Resource Management Program (LTRMP) and how those programs will interact, either independently or in cooperation with, the IL 519 authority. It is vital for the successful restoration of the system that these programs be complimentary and cohesive. As we strive to repair the ecological damage of the past century, it is important that river resource managers address other on-going authorities/initiatives and identify ways to compliment one another.

Chapter 2 - Proposed Project Description and Formulation Process

The Rock Island District Corps of Engineers (Corps), in partnership with the Illinois Department of Natural Resources (IDNR), has investigated an array of alternatives to initiate ecosystem restoration of the IR basin. Both small and large-scale management features, related to the ongoing management of the basin and potential future management of the basin, have been investigated and discussed with representatives from the majority of interested stakeholders throughout the State of Illinois. These investigations included: (1) Identifying a series of critical restoration projects and locations, (2) Identifying basin-wide programs that currently act to alleviate specific concerns related to sediment, and (3) Identify natural resource needs in terms of biologically significant areas, water level management, side channel habitat restoration, and backwater restoration. In addition to system wide investigations, the project includes LTRMP to be established and implemented by the IDNR in conjunction with the Illinois Natural History Survey and the Illinois State Water Surveys as a portion of the non-Federal cost share to the project.

Description of Project Area

The IR begins near Channahon, Illinois, at the confluence of the Des Plaines and Kankakee Rivers and flows over 270 miles to Grafton, Illinois, where it joins the Upper Mississippi River (UMR). The Illinois Waterway includes all of the IR and continues approximately 60 additional miles upstream along portions of several rivers and man-made channels to Lake Michigan. Except where indicated, this document references the IR portion of the basin and its associated tributaries including their watersheds draining into the IR. The basin is approximately 30,000 square miles and contributes to roughly 40 percent of the entire State of Illinois in land area. The IR basin consists of eight major tributaries including the Des Plaines, Kankakee, Fox, Vermilion, Mackinaw, Spoon, Sangamon, and La Moine Rivers and their watersheds.

Project Objectives

The feasibility study identifies several planning objectives which include the following: (1) Assess overall restoration needs and develop a consensus-based desired future condition of the Illinois River Watershed, (2) Address restoration of ecosystem function, structure, and dynamic processes to the nationally recognized IR system. Help restore a naturalistic, functioning, and self-regulating system and protect critical resources from further degradation, (3) Develop Critical Restoration Projects in the context of broader system/ecosystem or watershed level. Consider the interrelationships of plant and animal communities and their habitats in a larger ecosystem context (health, productivity, and biological diversity), (4) Incorporate an adaptive management approach to restoration efforts considering the interconnectedness of water and land, dynamic nature of the economy and environment, and need for flexibility in the formulation and evaluation process, (5) Develop watershed or sub-watershed management plans identifying the combination of recommended actions to be undertaken by various potential stakeholders, (6) Collaborate in partnership with other governmental agencies, organizations, and the private sector, (7) Produce benefits consistent with the North American Waterfowl Management Plan, U.S. Shorebird Conservation Plan, Partners in Flight Bird Conservation Plan, Clean Water Action Plan, Mississippi River/Gulf of Mexico Watershed Nutrient Task Force, and

Brownfield's Cleanup and Redevelopment, (8) Provide ancillary recreational benefits, (9) Minimize the conversion of farmland, and (10) Meet requirements established in Section 519 of the WRDA 2000.

As an overarching objective and identified as (6) in the above section, the planning process was intended to coordinate a multi-agency multi-program restoration initiative to develop system-wide management actions which, when implemented as system alternatives, would restore, improve, and/or protect the natural resources of the IR basin and return it to a 'self-sustaining' ecosystem.

In an effort to organize system needs, a series of six goals were established to address the basin's ecological needs (Chapter 3). These goals, in conjunction with the above objectives, were combined to create seven system alternatives (Chapter 4) to be evaluated for ecological benefits.

Listed here are a few of the small and large scale measures which have been identified as system needs and are incorporated into each of the seven alternatives for the system either through a specified goal or through management actions of alternatives.

Small-Scale Measures (wetland and stream corridor improvements)

- Stabilize unstable streams in rural and urban areas, particularly streams where the rate or magnitude of erosion yields abrupt or progressive changes in location, gradient, or pattern of natural or human-induced changes (ex., work with a variety of U.S. Department of Agriculture (USDA) and Soil and Water Conservation District (SWCD) programs).

- Reduce the effects of excessive sedimentation in the river and its associated water bodies.

- Restore riparian and floodplain biological functions.

- Restore connections between system ecological elements.

Large-Scale Measures

- Water level management (of the IR mainstem).

- Backwater restoration (12,000 acres in recommended plan).

- Side channel habitat restoration (35 project locations in recommended plan).

As early as 1945, it was known that the levees along the IR needed to be rectified to reduce flood heights and/or improve habitats for waterfowl, fish, and other floodplain dependant species. The Illinois Department of Conservation (now IDNR) urged that the levee and drainage districts be considered for storage of flood waters. In addition, they argued that these levees could serve as high quality habitat for floodplain dependant species (IL DOC 1950).

The statements by the Department of Conservation in 1950 remain concerns today. As outlined by the feasibility report, extensive water level management opportunities still exist within and along current levee and drainage districts. These opportunities, however, will require extensive coordination between interested agencies and landowners. It is important that river managers, interested drainage districts, and stakeholders participate in this process. The IL 519 Study teams will need to work with floodplain organizations to understand and alleviate some the concerns which exist.

The IL 519 program should seek future partnerships with drainage districts. These partnerships may allow for the utilization of specified areas as recreational hunting areas while assisting with water level management, one of the most serious problems impacting the IR.

Chapter 3 – Ecosystem Restoration Goals

Goals

In an effort to efficiently plan and organize the IR Ecosystem Restoration alternatives, a program objective and six goals were formed and subcommittees tasked with organization within each of these goal categories. Although each goal category can be linked to others, they also stand alone and require specific attention when assessing the system as a whole. Ultimately combinations of goals comprise system-wide alternatives (Table 4.1). The objective of the program and the six goals and associated problem statements are:

Objective: Restore and maintain ecological integrity, including habitats, communities, and populations of native species and the processes that sustain them.

Problem: The combined effects of habitat loss to urban and agricultural development, human exploitation, habitat degradation and fragmentation, water quality degradation, and competition from aggressive invasive species have significantly reduced the abundance and distribution of many native plant and animal species in the Illinois River Basin. In addition, human alterations of Illinois River Basin landscapes have altered the timing, magnitude, duration, and frequency of habitat forming and seasonal disturbance regimes. These systemic changes, no longer simple cause and effect relationships, are now severely limiting both the habitat and species populations and use of the Illinois River Basin.

Goal 1: Reduce sediment delivery to the Illinois River from upland areas and tributary channels with the aim of eliminating excessive sediment load.

Problem: Increased sediment loads from the basin have severely degraded environmental conditions along the mainstem Illinois River by increasing turbidity and filling backwater areas, side channels, and channel border areas. Improved practices have reduced the amount of sediment generated from many agricultural areas, but large quantities of sediment are still delivered to the river due to eroding channels and tributary areas, including urban and rural construction sites. The most critical problems are the loss of depth and habitat quality in off-channel areas connected to the mainstem river. Similar problems can be seen at other areas within the basin where excessive sediment has degraded tributary habitats.

Goal 2: Restore aquatic habitat diversity of side channels and backwaters, including Peoria Lakes, to provide adequate volume and depth for sustaining native fish and wildlife communities.

Problem: The dramatic loss in productive backwaters, side channels, and channel border areas is due to excessive sedimentation. In particular, the Illinois River has lost much of its critical spawning, nursery, and over-wintering areas for fish, habitat for diving ducks and aquatic species, and backwater aquatic plant communities. A related problem is the need for timely action. If restoration is not undertaken soon, additional significant aquatic areas will be lost due to conversion to terrestrial habitats.

Goal 3: Improve floodplain, riparian, and aquatic habitats and functions.

Problem: Land use and hydrologic change has reduced the quantity, quality, and function of aquatic, floodplain and riparian habitats. Flood storage, flood conveyance, habitat availability, and nutrient exchange are some of the critical aspects of the floodplain environment that have been adversely impacted.

Goal 4: Restore and maintain longitudinal connectivity on the Illinois River and its tributaries, where appropriate, to restore or maintain healthy populations of native species.

Problem: There is a lack on lateral and longitudinal hydrologic connectivity on the Illinois River and its tributaries. Aquatic organisms do not have sufficient access to diverse habitat such as backwater and tributary habitat that are necessary at different life stages. Lack of longitudinal connectivity slows repopulation of stream reaches following extreme events such as pollution or flooding and reduces genetic diversity of aquatic organisms.

Goal 5: Restore Illinois River and tributary hydrologic regimes to reduce the incidence of water level conditions that degrade aquatic and riparian habitat.

Problem: Historical basin changes and river management have altered the water level regime along the mainstem Illinois River, stressing the natural plant and animal communities along the river and its floodplain. The most critical changes include an increased incidence of water level fluctuation, especially during summer and fall low water periods, and the lack of drawdown in areas upstream of the navigation dams.

Goal 6: Improve water and sediment quality in the Illinois River and its watershed.

Problem: The state's surface water resources are impaired due to a combination of point and non-point sources of pollution. Through effective regulatory efforts, point sources of impairments have continued to decline. Non-point sources of water quality impairment, such as sediments and nitrates, continue to degrade the surface waters of the state.

The Corps and IDNR have done an excellent job identifying system restoration goals that are not only critical to the restoration of the IR ecosystem, but are also tangible and can produce achievable ecological outputs. However, significant coordination is still needed to establish the required agreements to make the IL 519 successful and the restoration of the IR possible. In particular, goals 1, 3, and 6 are being actively pursued in various efforts by a number of different entities throughout the basin. These similar interests may provide significant cumulative benefits through coordination and support by this study.

Chapter 4 – Project Alternatives

Project Alternatives

Using the recommendations of each restoration goal subcommittee, eight basic system alternatives were designed. These eight alternatives cover a wide level of effort and range from 'no action under the 519 authority', 'regional improvement', 'maintaining the current system' to 'reasonable upper bound to system improvements'. Table 4.1 represents each alternative, the level of effort, and some expected benefits of each of the goals. After each alternative had been outlined, the IL 519 team evaluated each alternative and selected a preferred alternative. The preferred alternative reflected opinions of several regional and state experts in the fields of waterfowl ecology, sediment retention, fishery ecology, aquatic vegetation, and other IR system issues. In addition to reflecting these experts' opinions, the preferred alternative sought to establish a future condition of the IR which was consistent with management plans and restoration efforts of the basin.

Alternative Plans Considered in the IL 519 Study, See Table 4.1: The eight alternatives were established and evaluated in this feasibility report starting with 'No Action' and incrementally increasing in scope to the eighth alternative. Table 4.1 outlines the goal by goal benefits which are expected to be seen from each of the evaluated alternatives. These alternatives were formulated and evaluated through a series of multi-agency coordination meetings and represent predicted desired/future conditions as outlined by the participating agencies and individuals.

Table 4.1, System-wide Alternatives w/ benefits by goal category

Alternative Name	1	2	3	4	5	6
	Sediment Delivery	Backwaters & Side Channels	Floodplain, Riparian, & Aquatic	Connectivity	Water Level Management	Water Quality
No Action	Some Increase Delivery	Decline 1-2%/yr	No Change	Potential Improvement	More Fluctuations	Minor Improvement
Alt 1	0% Upper Tribs 20% Peoria Tribs 0% Lower Tribs	3,600 BW acres 10 Side Channel 10 Island Protect	5,000 acres MS 5,000 acres Trib 25 stream miles		1.5% Peak Reduce 30k acre-ft	Minor Regional Improvements
Alt 2	0% Upper Tribs 40% Peoria Tribs 0.5% Lower Tribs	6,100 BW acres 20 Side Channel 15 Island Protect	5,000 acres MS 10,000 acres Trib 50 stream miles		2.5% Peak Reduce 45k acre-ft	Regional Improvements
Alt 3	11% Upper Tribs 40% Peoria Tribs 4% Lower Tribs	8,600 BW acres 30 Side Channel 15 Island Protect	20,000 acres MS 20,000 acres Trib 100 stream miles	Fox, DuPage, DesPlaines	2.5% Peak Reduce 45k acre-ft, Auto Gates	Some System Improvements
Alt 4	11% Upper Tribs 40% Peoria Tribs 4% Lower Tribs	6,100 BW acres 20 Side Channel 15 Island Protect	5,000 acres MS 20,000 acres Trib 100 stream miles	Fox, DuPage, Des Plaines, Kankakee, Spoon, Aux Sable	7.5% Peak Reduce 160k acre-ft, Auto Gates	Some System Improvements
Alt 5	11% Upper Tribs 40% Peoria Tribs 4% Lower Tribs	8,600 BW acres 30 Side Channel 15 Island Protect	40,000 acres MS 40,000 acres Trib 250 stream miles	Fox, DuPage, Des Plaines, Kankakee, Spoon, Aux Sable	7.5% Peak Reduce 160k acre-ft, Auto Gates	Some System Improvements
Alt 6	11% Upper Tribs 40% Peoria Tribs 20% Lower Tribs	12,000 BW acres 35 Side Channel 15 Island Protect	75,000 acres MS 75,000 acres Trib 500 stream miles	Fox, DuPage, Des Plaines, Kankakee, Spoon, Aux Sable	7.5% Peak Reduce 160k acre-ft, Auto Gates, Drawdown	Some System Improvements
Alt 7	11% Upper Tribs 40% Peoria Tribs 20% Lower Tribs	18,000 BW acres 40 Side Channel 15 Island Protect	150,000 acres MS 150,000 acres Trib 1000 stream miles	Fox, DuPage, Des Plaines, Kankakee, Spoon, Aux Sable, 3 Mainstem Dams	7.5% Peak Reduce 160k acre-ft, Auto Gates, Drawdown, Replace Wickets	Some System Improvements
	Preferred alternative plan is Alt. 6					

Recommended Plan, Alternate 6

Ecological Integrity: Restoration under this goal would provide a measurable increase in the level of habitat and ecological integrity at the system level through implementation of all goal recommendations. It is a basic assumption of the study team and participating agencies (including the Service) that this initiative would produce system-wide biological and ecological benefits. Alternate 7 would produce more resource benefits but the cost has been determined to be too high.

These recommendations, when combined into Alternate 6, will provide a level of management that is unparalleled within the basin at this time. However, we emphasize the need and importance of coordination between Federal, state, and private restoration efforts within the basin. These efforts, though common in goal, can become less efficient if appropriate coordination and funding opportunities are not established. In addition, we feel that immediate and localized benefits could be seen at sites that are in existing Federal, state, and private conservation agency ownership. Targeting these pre-existing sites could greatly reduce planning and real estate costs while maximizing benefits to the system.

Sediment Delivery: Alternate 6 calls for the reduction in sediment delivery from the Peoria tributaries by 40 percent, other tributaries upstream of Peoria Lakes by 11 percent, and tributaries downstream of Peoria Lakes by 20 percent. System benefits include reduced delivery of sediment by 20 percent to Peoria Lakes and 20 percent system-wide.

Excessive sedimentation is well known to be a significant source of ecological loss within the IR basin. However, sedimentation is part of a natural process by which stream channels meander through their floodplains via erosion and deposition. It is only when a particular stream is prevented from meandering that erosion and sedimentation begin to adversely affect the stream. In reference to this alternative's goal of reducing 40 percent of the Peoria tributaries sediment delivery, excessive sediment control could also produce negative ecological impacts at the localized stream level as well as at a cumulatively larger scale. Localized investigations may be warranted to determine if retention of significant sediment loads will alter critical habitat forming processes and adaptive management measures may be required to alter project features to ensure system stability.

In regard to the use of grade control structures, the feasibility report (page 4-3) states that, "Pool and riffle units provide a diverse range of hydraulic and biological niches that are critical to sustaining thriving river habitats". The use of this technique for sediment control is relatively new and few biological investigations have been completed. These structures do provide pool habitat as well as some degree of riffle habitat. However, the larger stone used for construction may not provide the critical habitats which are found in natural riffles. We recommend that (at a project specific level) the Corps adhere to any newly published scientific literature relevant to the specifications of pool-riffle complexes.

Backwater and Side Channels: Under Alternate 6, restoration is proposed for 12,000 acres in 60 of the approximate 100 backwaters on the IR system. The alternative calls for dredging an average of 200 acres per backwater, at an optimal level of 40 percent of the approximate average 500-acre backwater area. This would create optimal backwater and over-wintering habitat spaced approximately every five miles along the system. The alternative also calls for the restoration of 35 of the remaining 56 side channels in the IR and protection of 15 islands.

Because these very issues are also being studied and recommendations being made under the Corps' Navigation Study, if this authority moves forward, a much greater level of coordination needs to be initiated to insure that overlap and competition does not become an issue. The environmental restoration objectives of the Navigation Study may prove to be of vital importance to this effort and vice versa (see Chapter 8, Agency Coordination).

Floodplain, Riparian, and Aquatic Restoration: Restoration under Alternate 6 is proposed for 75,000 acres of mainstem floodplain (approximately 14.9 percent of total mainstem floodplain area) including approximately 31,700 acres of wetlands, 25,300 acres of forest, and 18,000 acres of prairie. Tributary restoration is proposed for 75,000 acres (approximately 8.8 percent of total tributary floodplain area) including approximately 47,600 acres of wetlands, 13,900 acres of forest, and 13,500 acres of prairie. Aquatic restoration is proposed for 500 miles of tributary streams (16.6 percent of the approximately 3,000 miles of channelized streams) with a mix of improved instream aquatic habitat structure and channel remeandering.

We agree that these types of habitat restoration are needed within the basin. Mainstem floodplain habitats have been lost at an alarming rate during the last century and have created the degraded system that we have today. It seems appropriate that a strong initiative of this goal should be to establish contacts and relationships with private floodplain landowners. These relationships will be vital in the establishment of restoration efforts. Funding to private entities should also be considered in order to create privately owned habitat projects within the floodplain.

As it relates to tributary floodplains and tributary streams, we encourage the project management branch of the Corps to work with their regulatory branch and coordinate information flow between one another. The regulatory branch of the Corps is the primary agency responsible for the issuance of Section 404 water quality permits and, as a result, has contacts with a significant number of tributary landowners who wish to channelize streams and/or alter wetlands that exist on their lands. With the cooperation of the regulatory branch, initial contacts could be made to minimize future stream impacts as well as identify past channelization projects using their R.A.M.S. database. This database is tied directly to a geographic information system and can be used to spatially assess potential project sites for restoration or preservation.

Connectivity: This alternative calls to restore fish passage at all mainstem dams on the Fox River, all dams on the West Branch of the DuPage River, all mainstem dams and one tributary (Salt Creek) of the Des Plaines River, Wilmington and Kankakee Dams on the Kankakee River, Bernadote Dam on the Spoon River, and the Aux Sable Dam.

Water Level Management: This alternative aims to create 107,000 acres of storage area at an average depth of 1.5 feet and 38,400 acres of groundwater infiltration, increase water level management at navigation dams using electronic controls and increased flow gauging. Results are predicted to include an 11 percent reduction in the five-year peak flows in tributaries, an overall average 20 percent increase in tributary base flows, and up to 66 percent reduction in the occurrence of half-foot or greater fluctuation during the growing season in the mainstem IR. This alternative also would see benefits accrue from drawdowns in the LaGrange or Peoria Pools.

Though sedimentation has been identified as a serious problem within the IR basin, uncontrolled fluctuations in the water levels of the IR also create a very significant problem for the ecology of the IR. These fluctuations create unstable substrates and produce undesirable water regimes in many of the backwaters. These problems combine to create a system that has lost and is unable to re-grow a significant percentage of its aquatic vegetation. Though cumulative benefits will be seen throughout the life of this project (as uplands and tributary watersheds are restored), priority should be give to measures which return some natural regime to the hydrology of the IR. Drawdowns within the LaGrange and Peoria Pools may prove to be extremely effective if annual base flows present the opportunity to sustain a pool-wide drawdown. Drawdown attempts are annually initiated on Pool 13 of the Mississippi River and similar drawdowns have been complete on Pools 8 and 25 on the Mississippi River. These projects on the Mississippi may present 'lessons learned' which could be utilized for the IR drawdown attempts.

Water Quality: This alternative is anticipated to improvement water quality due to reduced sediment, phosphorus, and nitrogen delivery. These improvements would result from sediment delivery reduction measures and water level management measures.

As an overall ecosystem restoration project, we anticipate that the IR will slowly regain some of its lost capacity to process excessive nutrient loads. In addition to the direct benefits in water quality due to the reduction of sediment loads, phosphorus and nitrogen, a healthy system will improve the overall water quality.

Chapter 5 - Existing Natural Resources in the Illinois River Basin

This chapter attempts to provide a general summary of habitat and land use characteristics, a list of public lands, and a general description of the current status and importance of natural resources within the IR basin. A more comprehensive overview of fish and wildlife resources, their habitats, and the physical and biological processes that affect them can be found in "Ecological impacts of navigation system development, operation, and maintenance" (Theiling 2000) and the April 2000 Draft Coordination Act Report from the Service to the Corps regarding the Navigation Study on the Upper Mississippi River System.

The Illinois River floodplain ecosystem is in a severely degraded condition. The most serious threats to the river during the last 100 years have been related to poor water and sediment quality, excessive sedimentation, exotic species, and isolation of the river main stem from its floodplain. In spite of the fact that water quality has improved greatly in recent decades, the river is currently unable to support the diverse assemblages of fish, wildlife, macroinvertebrate, and plant species that were present prior to 1900. Although protected and restored areas, particularly in the lower pools, provide important habitat for a variety of fish and wildlife species, additional conservation measures, rehabilitation projects, and long-term monitoring are needed to improve the condition of this once highly productive ecosystem.

Many sources of information were used to compile this chapter. The primary sources of information were the "Ecological impacts of navigation system development, operation, and maintenance" (Theiling 2000), and the *Ecological Status and Trends of the Upper Mississippi River System 1998* (Status and Trends Report) prepared by the Upper Midwest Environmental Sciences Center (UMESC) in Onalaska, Wisconsin (USGS 1999). The Status and Trends Report describes UMR and IR natural resources trends primarily based on monitoring data collected by the LTRMP in Pools 4, 8, 13, 26, and the Open River on the UMR and the LaGrange Pool on the IR. The natural resources inventory (described below) was also used as a source of fish and wildlife resource information.

Natural Resources Inventory

As a partner in river resource management, the Service initiated compilation of a Geographic Information System (GIS) database of natural resources for the UMR and IR in 1998. The primary objectives of the project were to: (1) Illustrate the spatial distribution of existing important habitats for fish and wildlife resources throughout the UMR and IR floodplain ecosystems, (2) Identify existing and potential navigation-related impacts to those resources, and (3) Identify potential mitigation opportunities.

The UMESC produced base maps for the project which contained land cover/land use classifications, river miles, wing dams, boat access points, refuge boundaries, levees, and topographic quadrangles. The base maps were used as a foundation to identify and digitize the following additional categories of information: bald eagle roosting and feeding areas, bald eagle nests, heron and egret nesting colonies, waterfowl use areas, migratory and resident bird habitats, mussel and fingernail clam resources, commercial fisheries, sport fisheries, fish over-wintering areas, fish spawning areas, other important fish habitats, reptile and amphibian use areas, mammal use areas, unique habitats, areas with potential for enhancement or restoration, navigation impact areas, and areas which have already been restored.

The Service completed the draft database which contained information gathered from existing literature and from over 60 river biologists and managers who participated in a series of 8 workshops held from June 1998 to February 1999. Workshop participants included representatives from the following Federal and state agencies: U.S. Fish and Wildlife Service, U.S. Geological Survey, U.S. Army Corps of Engineers, Minnesota Department of Natural Resources, Wisconsin Department of Natural Resources, Iowa Department of Natural Resources, Illinois Department of Natural Resources, and Missouri Department of Conservation.

Draft maps and tables were created and printed by UMESC and sent to over 100 professional biologists, managers, and university professors from the agencies mentioned above as well as the Nature Conservancy, National Audubon Society, Western Illinois University, and Midwest Raptor Research Fund for the technical review process. UMESC finalized the database consistent with the information and comments received during the review period, and hard copy atlases displaying all records with customized icons were printed (USFWS 2000b; USFWS 2000c). Table 5.1 and Figure 5.2 demonstrate the types of spatial and narrative information contained in the database and atlases. Table 5.1 represents all entries within the IR Natural Resource Inventory and contains 1277 records which are summarized by category and IR pool. Figure 5.2 is a spatial representation of the IR near the Tazewell and Mason County line.

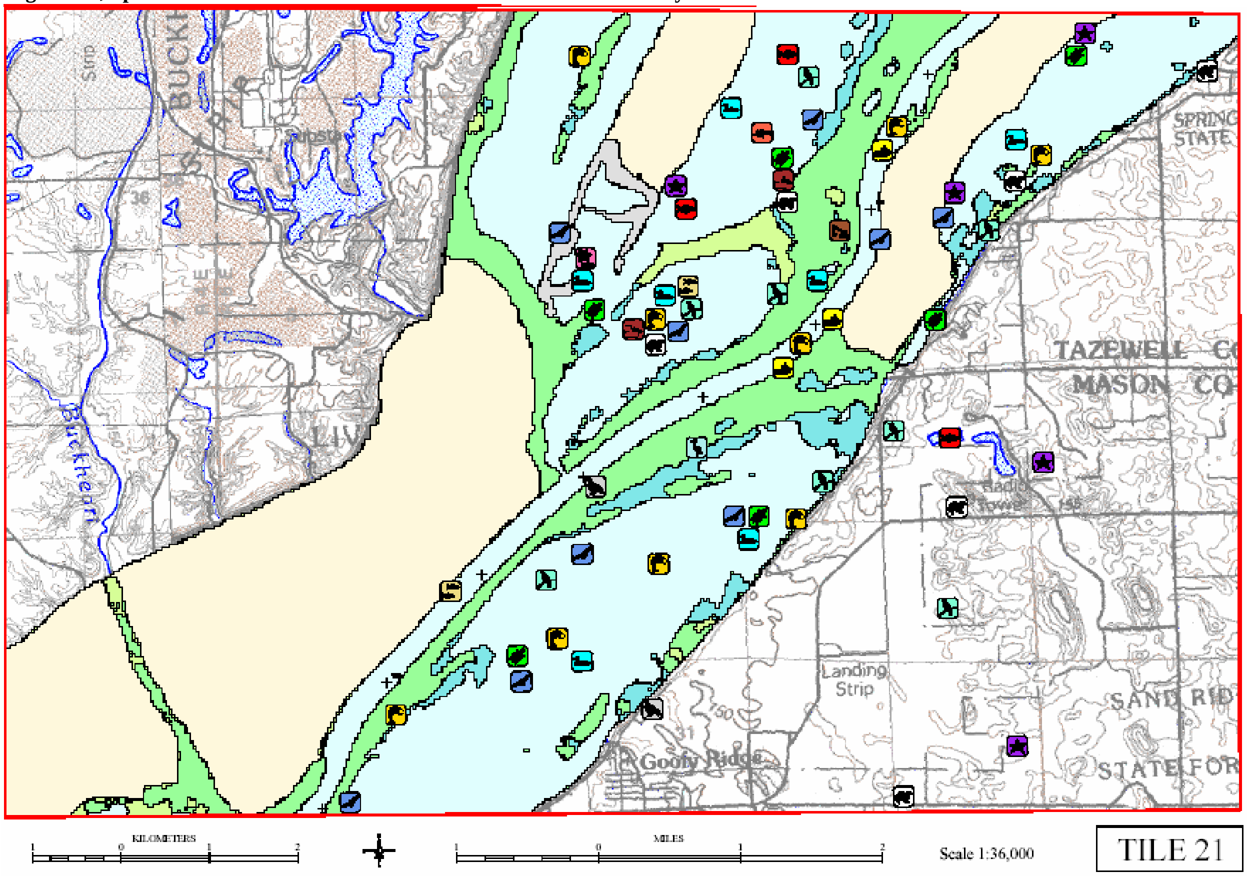
Although we caution against using this information for purposes other than making gross comparisons between areas or for making very generalized conclusions, this dataset presents a unique compilation of existing natural resources along the IR mainstem. Though not developed for this specific purpose, the inventory can act as a significant resource at the regional, systemic, and executive team levels of the IL 519 Study process. In addition, this tool (developed by a multidisciplinary team including the Corps and IDNR) could be utilized and improved/expanded for tracking additional restoration efforts which are funded or authorized under the IL 519 authority.

In addition to housing natural resource data, the inventory also contains a general reference for recreational use areas up and down the river. As an identified objective, the feasibility report states that ancillary recreational benefits would be seen through implementation of the IL 519 authority. The resource inventory could also assist with this objective.

Table 5.1, Number of records in the IR resources inventory data set by category and pool.

Resource Category	Pool								
	Alton	LaGrange	Peoria	Starved Rock	Marseilles	Dresden Island	Brandon Road	Lockport	**Total**
Migratory and resident birds	31	58	32	2	6	5	0	0	**134**
Waterfowl use areas	27	59	39	3	9	6	0	1	**144**
Heron and egret nesting colonies	3	4	2	0	0	0	0	0	**9**
Bald eagle nests	5	6	0	0	0	0	0	0	**11**
Bald eagle roosting and feeding areas	18	51	21	0	2	0	0	0	**92**
Fish over-wintering areas	9	12	4	1	2	0	0	0	**28**
Fish spawning areas	12	18	26	7	4	2	0	0	**69**
Sport fisheries	22	71	83	7	9	12	1	1	**206**
Commercial Fisheries	2	29	0	0	0	0	0	0	**31**
Other important fishery resources	6	7	6	3	2	0	0	0	**24**
Mussel and fingernail clam resources	18	15	7	2	2	0	0	0	**44**
Mammal use areas	9	23	12	2	4	0	0	1	**51**
Reptile and amphibian use areas	54	29	1	0	1	0	0	0	**85**
Unique areas	20	40	28	7	15	5	0	9	**124**
Areas with potential for enhancement	34	10	3	0	1	1	0	0	**49**
HREPs and other restored areas	9	9	2	0	0	0	0	0	**20**
Navigation impact areas	4	41	36	6	11	4	3	1	**106**
Total	**283**	**482**	**302**	**40**	**68**	**35**	**4**	**13**	**1227**

Figure 5.2, Spatial distribution of the IR near the Tazewell/Mason County Line



Floodplain Lands Managed for Fish and Wildlife Resources

Land management authorities vary in the IR corridor. Unlike the UMR, the Corps owns only a small amount of land in the IR floodplain, except in Alton Pool. Public lands along the lower IR are primarily owned and managed by the IDNR or the Service. Along the upper IR, public lands are managed by the IDNR or county forest preserve districts.

<u>National Wildlife Refuges:</u> Congress has placed over 16,000 acres of land and water in the IR floodplain into the National Wildlife Refuge System (Table 5.3). The commercial navigation channel passes along or through most of these tracts. Refuge lands along the IR are managed primarily for the benefit of fish and wildlife, but also contribute greatly to recreation, flood storage, and water supply functions of the system. These lands provide significant habitat for many animal and plant species which utilize floodplain habitats. Such habitat has been largely eliminated or is being developed or modified in many non-refuge areas.

Table 5.3, Summary of National Wildlife Refuge lands along the Illinois River

Illinois River National Wildlife and Fish Refuges	**Acres**	**Location**
Cameron-Billsback Unit	1,709	Peoria Pool
Chautauqua NWR	4,488	LaGrange Pool
Emiquon NWR	1,303	LaGrange Pool
Meredosia NWR	2,883	Alton Pool
Mark Twain National Widlfie Refuge Complex		
Two Rivers NWR	5,840	Alton Pool
Total IR acres in the National Wildlife Refuge System	**16,223**	

Two Rivers National Wildlife Refuge of the Mark Twain National Wildlife Refuge Complex includes over 5,800 acres along the lower portion of the IR, near its confluence with the UMR. The refuge has additional lands along the UMR. Key goals of the refuge are to conserve and enhance the quality and diversity of fish and wildlife and their habitats and to restore floodplain function in the river corridor. It is recommended that where appropriate, the IL 519 goals be coordinated with existing or draft refuge Comprehensive Conservation Plans (CCPs). These CCPs may present existing plans to increase fish and wildlife habitat and offer a roadmap to success in these areas without the need for extensive additional planning efforts.

State Managed Lands**:** The IDNR manages over 50,000 acres for migratory waterfowl and hunting at 23 sites along the IR, including 6 state parks and several boat access sites. In the Alton Pool, approximately 8,800 acres of Corps-owned lands are managed by IDNR. In general, management objectives of these lands are to provide refuge for fish and wildlife and to provide access and enhance opportunities for outdoor recreation including camping, hiking, boating, hunting, fishing, trapping, and wildlife observation.

Private Management: There is a considerable amount of fish and wildlife habitat controlled by private interests in the IR floodplain. Private duck hunting clubs manage approximately 60,000 acres of the floodplain (Havera 1995). The Illinois Chapter of The Nature Conservancy is restoring natural floodplain communities on former agriculture levee districts as part of an overall IR conservation plan. Among their goals is reestablishing the ecological processes that once supported the abundant and diverse biological communities along the river. Restoration has begun at their Spunky Bottoms Project, which consists of 1157 acres in Brown County. Plans include reestablishing wetland habitats and working with the Corps of Engineers on a Section 1135 project that will include a water control structure to provide a managed connection with the river. Planning is also underway for the Conservancy's Emiquon Project in Fulton County, where their recently acquired 7604-acre property will have over 6000 acres of restored open water, marsh, wet prairie, and bottomland hardwood habitats in the floodplain. The Wetlands Initiative is in the process of acquiring a 2500-acre drainage and levee district along the IR near Hennepin, and similar restoration efforts are anticipated.

General Habitat and Land Cover Characteristics

The IR floodplain has two distinct geomorphic reaches which cover a total of approximately 613,000 acres (Theiling 2000). The upper IR is a geologically young section of the river, extending upstream from the town of Hennepin, and the lower IR follows an ancient reach of the

Mississippi River, from Hennepin to Grafton, Illinois. Land cover types based on LTRMP 1989 data are summarized in Table 5.4.

The upper IR reach includes the Starved Rock and Marseilles navigation pools and is characterized by a steep gradient, narrow floodplain, and a lack of non-channel aquatic habitat. This reach accounts for only 10 percent of the total IR floodplain area.

Table 5.4, Percentage of land cover types in the Illinois River floodplain by upper and lower reaches (source: LTRMP 1989 data).

Land Cover Type	Upper Illinois River	Lower Illinois River
Aquatic Vegetation	1%	2%
Grasses/Forbs	12%	4%
Urban/Developed	20%	3%
Sand	<1%	<1%
Open Water	23%	16%
Agriculture	24%	61%
Floodplain Forest	21%	14%

The lower IR reach includes the Peoria, LaGrange, and Alton navigation pools and has a very broad floodplain, extensive backwaters, and a low gradient that drops less than one foot per mile. This reach accounts for 90 percent of the total area of the IR floodplain (Theiling 2000). Extensive sedimentation problems in this reach continue to threaten the productivity of backwater and main channel border areas. Floodplain development has isolated a majority of the floodplain from the main channel and many backwaters are now behind levees. For example, in the LaGrange and Alton Pools approximately 55 percent of the floodplain is isolated from the main channel.

Table 5.5, Historical overview of conditions on the Illinois River, 1900 to present.

Time Period	Description
pre-1900	Historically, the Illinois River was ecologically diverse and served as a nationally significant commercial fishery, sport fishery, and waterfowl hunting area.
1900	The Chicago Sanitary and Ship Canal was constructed, and water from Lake Michigan and sewage from Chicago were diverted into the Illinois River.
1910	The river's benthic organisms were destroyed due to the increased pollution and low dissolved oxygen levels.
1920	Aquatic plant beds had virtually disappeared from the river.
late 1920's - early 1930's	Sewage treatment plants were constructed in Chicago, resulting in improved water quality and dissolved oxygen levels in the river. Aquatic plant beds and macroinvertebrates returned.
1930's	The lock and dam system was constructed to support commercial navigation.
1955-1960	The river changed rapidly during this time frame, and a critical ecological threshold was broken. Macroinvertebrates and aquatic plant beds disappeared from the river, followed by a subsequent rapid decline in fish and wildlife populations. Accelerated de
1970's	The Clean Water Act of 1972 facilitated reductions in toxic waste and organic pollutant loads in the river, resulting in improved water quality. However, excessive sediment inputs as well as sediment resuspension continued to result in the loss and degra
1990's	The exotic zebra mussel (native to eastern Europe) entered into the Illinois River from Lake Michigan and spread rapidly throughout the river. Most native mussel beds in the river were infested by 1993.
2001	The Illinois River still has not recovered to an ecologically sustainable condition. In spite of the water quality improvements afforded by waste water treatment facilities, sedimentation, non-point source pollution, and poor water clarity remain serious

Overall habitat conditions on the IR have been severely degraded during the last 100 years. A historical summary of events and conditions on the river are provided in Table 5.5.

Water Quality: A number of factors including domestic sewage, industrial wastes, and agricultural land use practices have adversely affected water quality in the IR during the past 100 years. In the past 30 years, improvements in water quality have taken place with implementation of the Clean Water Act. However, runoff from urban areas and agricultural fields in the watershed continue to transport sediment, fertilizers, and pesticides into the waters of the IR. Waves generated by wind and commercial tows re-suspend fine sediments, resulting in ongoing poor water clarity. Sedimentation is perhaps the most serious problem threatening the river's resources today.

Fishery Resources: The distribution and relative abundance of fish are more completely known than most other faunal groups in the IR. A total of 150 species representing 27 families have been recorded from the waters of the IR and upper waterway, of which 66 are considered common to abundant (Havera et al. 1980). Considerable variation in numbers of species is found from upstream to downstream, with greater species diversity in the lower pools where more backwater lake habitats are available (Havera et al. 1980).

Fishery resources have been adversely impacted by a number of perturbations during the last 100 years, including industrial and municipal pollution, agricultural and urban runoff, extensive levees, loss of aquatic habitat due to sediment deposition, poor water clarity, and exotic species. Although fishery populations have fluctuated greatly during the last century and species composition has changed remarkably, the fishery has shown a strong recovery in recent years.

Recreational Fishing: The IR sport fishery has improved greatly since measures to reduce toxic waste and organic pollutant loads were enacted by public agencies in the 1970s. Estimated angling expenditures per day are $49.1 million for over two million sport fishing activity days. The IR averages over two million sport fishing days annually, or about 5 percent of the total fishing in Illinois. Game species commonly occurring in the IR include largemouth bass, white bass, smallmouth bass, sauger, channel catfish, drum, crappie, bullhead, bluegill, and miscellaneous sunfish such as the green and pumpkinseed.

Use of the sport fishery on the IR directly corresponds to the health and desirability of the fish population. A definite increase in sport fishing pressure has been noted in recent years. New recreation areas make boating access for fishing easier in the Tri-County area (Peoria) than in many areas along the river. The resurgence of the game fish population is being well utilized and fishing should remain good as long as water conditions remain favorable.

Commercial Fishing: Historically, the IR was a nationally significant commercial fishery. At the turn of the century, a 200-mile reach between Hennepin and Grafton produced 10 percent of the total U.S. catch of freshwater fish, more than any other river without a commercial anadromous fishery. During this time, about 180 pounds per acre were harvested. The commercial fishery declined during the 1950s and 'bottomed-out' in 1979, with a harvest of only 305,018 pounds.

However, the fishery has shown remarkable improvement since 1979. Data provided by the

IDNR indicates that the average annual harvest from the IR during the five-year period 1996-2000 was 923,094 pounds. In the year 2000, the total harvest was 796,360 pounds, with 48 percent coming from LaGrange Pool, 32 percent from Alton Pool, and 20 percent from Peoria Pool. In terms of biomass, the 2000 catch was comprised of 52 percent buffalo, 27 percent catfish, 11 percent common carp, 4 percent Asian carp, and 2 percent drum.

Mussel Resources: In 1900, approximately 40 mussel species occurred in the IR. However, mussel populations were decimated by a variety of perturbations encountered during the next several decades (Table 5.6). Since passage of the Clean Water Act in 1972, mussels have shown some signs of recovery. For example, the resource had recovered sufficiently to allow the harvest of 181 tons of mussels from the river in 1988 (Fritz 1989). Surveys conducted by the Illinois Natural History Survey from 1993 to1995 indicated that a number of species had begun to recolonize in several pools (e.g., 11 species in Marseilles Pool, 8 species in Starved Rock Pool, 15 species in Peoria and LaGrange Pools, and 17 species in Alton Pool) (USGS 1999).

Table 5.6, Numbers of freshwater mussels species by pool and year (Illinois Natural History Survey)

Navigation Pool	1870-1900	1906-1909	1966-1969	1993-1995
Marseilles	38	0	0	11
Starved Rock	36	0	0	8
Peoria	41	35	16	15
La Grange	43	35	18	15
Alton	41	36	20	17

However, further recovery of mussel resources remains threatened by the exotic zebra mussel, which was first documented in the IR in 1991. Zebra mussels entered into the IR via Lake Michigan and spread rapidly throughout the river. Most native mussel beds in the river were infested by 1993 (USGS 1999). One site near the confluence with the UMR had zebra mussel densities as high as 100,000 per square meter in 1993 (USGS 1999). As with mussels on the UMR, the future status of IR mussel fauna is very uncertain.

Birds: Historically, IR floodplain habitats have supported a wide variety of bird populations including waterfowl, colonial waterbirds, songbirds, wading birds, shorebirds, raptors, and woodpeckers. Prior to the 1950s, the IR floodplain was one of the most important waterfowl staging areas in the country (USGS 1999). Since then, however, human modifications to this floodplain ecosystem have resulted in habitat degradation and an associated decrease in bird use of the IR corridor. Dabbling duck populations on the IR have decreased steadily since the late 1940s as waterfowl migration routes have shifted from the IR to Pools 19-26 of the UMR (USGS 1999).

In spite of the overall degradation in habitat within the IR floodplain, protected and restored areas in the lower pools continue to provide important areas where waterfowl and other migratory birds can stop, rest, feed, and nest. The Alton, LaGrange and Peoria Pools support greater species diversity and higher numbers of migratory and resident birds than upstream pools (USFWS 2000b). The lower pools of the IR may provide benefits to as many as 264 bird species (USFWS 2001a).

The American Bird Conservancy has designated the Illinois River National Wildlife and Fish Refuges as an *Important Bird Area in the United States*, reflecting the importance of these areas to bird populations. In addition to supporting waterfowl, refuge lands are also known to support bald eagles and other raptors, colonial waterbirds, songbirds, wading birds, shorebirds, and woodpeckers (USFWS 2001a). Continued efforts to protect and restore habitats within the IR floodplain will be of benefit to many migratory bird populations over the long-term.

Mammals: A total of 28 species of mammals have been officially recorded in the Illinois River National Wildlife and Fish Refuges, including foxes, coyotes, raccoons, whitetail deer, badgers, beaver, muskrat, woodchucks, rabbits, squirrels, opossum, mink, and otter (USFWS 2001a). The federally endangered Indiana bat is also known to utilize forested habitats along the river and has been recorded within the IR floodplain in LaSalle, Pike, and Jersey Counties (Walters 2001). It is anticipated that future protection and restoration of floodplain areas would induce benefits to a wide variety of mammal species.

Reptiles and Amphibians: Wetlands and backwater lakes within the IR floodplain provide important habitat for a variety of reptiles and amphibians, including frogs, toads, salamanders, turtles, and snakes. As expected, the resources inventory (USFWS 2000b) shows that the Alton, LaGrange, and Peoria Pools in the lower IR are of particular importance for these animals. Further, the Illinois chorus frog, a state-listed species, has been recorded at several locations within the IR floodplain (USFWS 2000b). Protection and restoration of IR floodplain habitats should be considered an important component in the conservation of Illinois' reptiles and amphibians. Additionally, data gaps should be filled to better establish population status and trends.

Macroinvertebrates: Ammonia toxicity has been identified as a causal agent in the widespread disappearance of benthic macroinvertebrates on the IR during the mid-1950s (USGS 1999). Because these organisms play such an important role in the aquatic food web, declines in macroinvertebrate populations in the past have been linked to subsequent declines in fish and bird populations on the IR. Sparks (1984) identified the decline in benthic macroinvertebrates as an important causal factor in the decline of the IR commercial fishery since 1950. The shift in migratory bird use away from the IR in the 1950s is also likely directly related to the status of the macroinvertebrate community.

Today, macroinvertebrate communities continue to remain poor in the upper reaches of the IR, and fingernail clams and mayflies now only occur in low densities in the lower river reaches (USGS 1999). In contrast to the UMR, fingernail clam densities are higher in channel areas than in non-channel areas in the IR; this is probably attributable to the fine grained sediments in channel areas, lack of channel border habitats, and water and sediment quality problems in the backwaters of the IR (USGS 1999).

If habitat conditions in IR backwaters can be restored to support a more diverse, healthy macroinvertebrate community, then fish and waterfowl populations will also clearly benefit. Management strategies aimed at achieving this goal should be incorporated and prioritized in the IL 519 project authority and among all restoration efforts in the IR floodplain and watershed.

Floodplain Forests: Floodplain forest habitat covered 14.3 percent (or 78,467 acres) of the IR valley landscape in 1989 (USGS 1999). Although existing floodplain forest acreages have been greatly reduced in comparison to pre-settlement times, these habitats are still an important component of IR floodplain ecosystem. They provide important habitat for fish and wildlife during flood conditions, reduce soil erosion, and improve water quality. Floodplain forests are particularly important to migratory bird populations. Management actions, much like those at Pekin Lake, are needed to restore and enhance the quality of floodplain forests in the IR floodplain.

Aquatic Vegetation: Aquatic plant beds were well-established in IR backwaters prior to the 1900s. Organic pollution nearly eliminated these beds by 1922, but they returned in the late 1930s in response to waste water treatment (USGS 1999). In the mid-1950s, a critical threshold with respect to sediment problems was reached, and aquatic vegetation died out on the IR. This die-off was followed by backwater substrates becoming easily disturbed, an increase in turbidity, a shift in the fish community toward more tolerant species, and a shift in waterfowl migrations away from the IR. Aquatic plant beds have not recovered since the 1950s, and their distribution is primarily restricted to backwater areas isolated from the river (USGS 1999).

Aquatic plant beds perform a number of important ecological functions including: generation of dissolved oxygen, stabilization of substrates, filtration of suspended sediments, uptake of nutrients, supplying tubers as an important food source, providing habitat for invertebrate communities, and providing shelter for young and spawning fish (USGS 1999). Therefore, restoration of aquatic plant beds should be incorporated as an important objective for ongoing and future restoration projects in the IR floodplain.

Chapter 6 – Probable Future Conditions (with and without project)

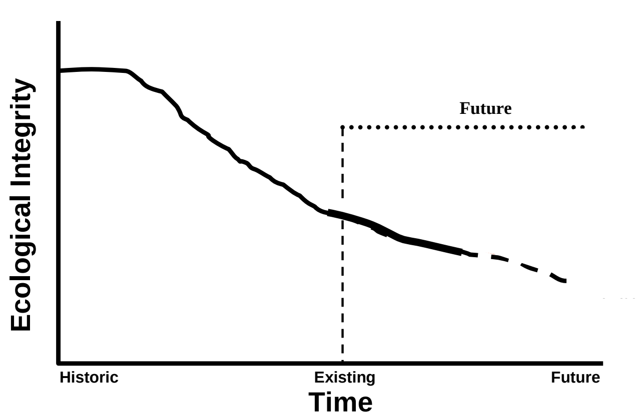
Over the past century, fish and wildlife habitats on the IR have been severely degraded by navigation activities, floodplain development, poor water quality (point and non-point source pollution), tributary watershed degradation, and exotic species introduction. Improved water quality in the last 30 years has resulted in significant beneficial effects on aquatic organisms, but overall the ecosystem is still declining. Although some biologists believe that the rate of degradation has subsided, many habitats and IR species populations are expected to degrade further in coming decades. The cumulative effects of navigation project operation and maintenance actions, impacts from floodplain development, continued sedimentation, continual degradation in tributary watersheds, un-natural hydrologic regimes, and the additional spread of exotic species will continue to degrade species diversity and habitat quality and quantity unless management actions are taken to reverse this trend.

As they are currently funded or structured, we agree with the Corps that the currently authorized restoration and management activities are not adequate to reverse the system-wide decline in fish and wildlife habitat that is occurring.

Future Without Project Condition

Based on assumptions, which are outlined by the Corps' Feasibility Study and have been documented by other environmental reports on the IR system regarding current conditions of the ecosystem and anticipated changes, it appears likely that the future without project conditions of the IR will continue to degrade from the present condition without management intervention. Figure 6.1 depicts future projected conditions of the IR as predicted by regional experts. These predicted conditions were established through expert panel discussions and extensive research efforts within the state and IR basin. This predicted degradation is well documented (see Status and Trends Report and the Upper Mississippi River and Illinois Waterway Cumulative Effects Study).

Figure 6.1, Predicted Future condition of IR w/out Project



**** Not to Scale – Illustrative Purposes only***

In addition to this feasibility study, another recent investigation makes predictions on the future of fish and wildlife resources on the IR and is used in this chapter to help describe probable future conditions without the project. This study is the *Upper Mississippi River and Illinois Waterway Cumulative Effects Study* (Cumulative Effects Study), also prepared by the Rock Island District Corps for the System Navigation Study (USACE 2000a; USACE 2000b). The Cumulative Effects Study analyzed historic photographs to quantify trends in aquatic habitat since river impoundment in the 1930s. Geomorphologists extrapolated the observed trends over the next 50 years. Biologists then interpreted what effect these aquatic habitat changes would have on fish and wildlife. The Cumulative Effects Study has some significant limitations. It does not address terrestrial habitat changes which are critical to ecosystem health, and depth was not included as an aquatic parameter which seriously impaired the evaluation of changes in habitat quality.

For the purposes of this study, the future without project analysis was defined as follows. The without project condition is what the river basin and its uses are anticipated to be like over the 50-year planning period without any restoration implemented as part of the study. Of general concern to the Service is the lack of the future without project analysis to address the likelihood of environmental restoration occurring within the IR basin as part of the Navigation Study being completed by the Corps. If, however, the Corps is making an assumption that that the future only includes continued operation and maintenance of the 9-foot Channel Project and no significant changes related to environmental restoration, then that assumption should be described within the feasibility report.

The Rock Island District has the responsibility for completing both the IL 519 Study and the Navigation Study and should produce an analysis of future condition based on the co-inhabitance of the two authorities.

Corps of Engineers Cumulative Effects Study

The Corps' Cumulative Effects Study predicts changes in UMR and IR aquatic habitat likely to result from multiple influences (e.g., floodplain development, changes in water quality, and sediment input from the watershed), not just navigation traffic-related effects. Trends in floodplain terrestrial habitat were not analyzed since the Corps' focus was on aquatic habitats potentially affected by navigation traffic. Despite some serious limitations, the study still provides a useful forecast of future trends in fish and wildlife aquatic habitats.

General conclusions drawn by the geomorphic analysis of the IR include the following:

1. The flow along the IR is affected by numerous man-made and natural influences including structures to operate and maintain the 9-foot navigation channel. These include levees, wing dams, bridges, channel erosion and sedimentation, dredging, locks and dams, dams and reservoirs on tributaries, watershed land use, consumptive water use, and potentially climate change.

2. River stages within the IR navigation pools are significantly influenced by the operation of the 9-foot Channel Project locks and dams.

3. The 9-foot Channel Project and levees have influenced river stages within the IR. The construction of levees along the IR has isolated large portions of the floodplain from the river and reduced available flood storage capacity.

Regarding predictions for aquatic habitat changes, the Cumulative Effects Report estimates the following:

With respect to the IR and upper waterway, the report states that significant portions of existing backwater areas would be converted to marsh or wetland by the year 2050, referring to the work of other investigators. The report concludes that "...little overall change has occurred along the main channel from the confluence with the UMR upstream to the Brandon Road Lock and Dam." These statements are very consistent with the finding of the IL 519 Study and underline the significance of the sedimentation issues in the IR basin.

Predictions made by the Cumulative Effects Study for the IR are summarized in the following table (Table 6.2).

Table 6.2, Summary of aquatic habitat changes on the Illinois Rivers (summarized from the Corps' Cumulative Effects Study (USACE 2000a; USACE 2000b)).

	Habitat Trends	Animal/Plant Trends
Illinois River	Significant loss of backwater lakes anticipated due to sedimentation. No change in main channel habitat.	Main channel species will remain stable, but backwater guilds will likely decline.

The following aquatic guilds were assessed in the Cumulative Effects Study based solely on general planning information. No depth data was available and no field testing was conducted. Thus, the assessment is limited to assumptions based on increasing or decreasing aquatic surface area. The IL 519 Study Feasibility Report also addresses these issues and concluded with similar findings. The following sections include a summary of the IL 519 Study, a summary of the Cumulative Effects Study, and our analysis for each aquatic guild.

Aquatic Vegetation: The IL 519 Study concluded that on the mainstem IR, submersed aquatic plants died off in the mid-1920s. In the late 1930s, these plants made a brief recovery in response to early wastewater treatment efforts. By the 1950s, aquatic plants reached a critical threshold, in relation to sediment and wave-related problems, from which they have not recovered. Currently, submersed aquatic plants are found only in isolated areas of the mainstem. This loss of vegetation has lead to easily disturbed backwater substrates, increased turbidity, poorer habitat conditions, and fish communities increasingly dominated by species tolerant of low dissolved oxygen and poor habitat. Waterfowl, particularly diving ducks, have shifted their migrations away from the IR. Limiting factors to submersed aquatic plant recovery include sediment quality, excessive sedimentation and turbidity, rough fish activity, and unstable water levels.

The Cumulative Effects Study concludes that many areas will only sustain their productivity with the assistance of habitat improvement projects such as the EMP, water level management, and island stabilization. These improvements are needed to maintain no net loss due, in part, to the ongoing 9-foot Channel Project with increasing traffic. Without such improvements we can anticipate that continued sedimentation and attendant turbidity will lead to further degradation of aquatic plant diversity and productivity.

Waterfowl and Wetlands: The IL 519 Study concluded that there were declines in diving ducks (essentially gone since the 1950s) and dabbling ducks (80 percent decline in mallard populations) in the basin, documented and summarized by the Illinois Natural History Survey. These losses can be linked to a loss of food sources (aquatic plants and macroinvertebrates) in the 1950s and ongoing habitat degradation and loss. On the mainstem, habitat conditions are typically favorable only in areas isolated from the river. The loss of aquatic plants and the benthic community were identified as limiting factors on waterfowl populations.

The Cumulative Effects Study concluded that diving ducks such as canvasback and scaup feed on aquatic vegetation and invertebrates during their fall migration. Impounded areas above certain Locks and Dams and backwater areas are especially important. Future use of the UMR (specifically the IR valley) by diving ducks will depend on the availability of these food resources. Any factors affecting aquatic vegetation and invertebrates in the impounded areas will likely cause a similar response to the numbers of diving ducks using the areas. With up to 50 percent of the canvasbacks in North America using the Mississippi River basin, protection and enhancement of these resources is critical.

Fish: The IL 519 Study concluded that fish populations and diversity are thought to be stable in the lower pools and still improving in the upper pools, though at lower levels than those estimated prior to European settlement. The long-term outlook may be for populations and native species diversity to decline gradually (increasing invasive species, suitable habitat declining, and loss of mainstem benthic community).

The Cumulative Effects Study concluded that in recent decades, as water quality has improved, so have fish populations. Some species of fish which prefer high velocity main channel and side channel habitats are very healthy such as walleye, channel catfish, drum, and shovelnose sturgeon. Despite impediments such as navigation dams which block fish movement, these fish populations will likely remain stable or increase in the future. The pallid sturgeon, however, may be on the verge of extinction due to habitat loss in the unimpounded reach of the Mississippi River and lower reach of the IR. Other fishes that prefer backwaters and low velocity waters such as buffalo, bluegill, largemouth bass, and crappie are likely to decrease in number as suitable backwater habitats are lost to sedimentation, unless management actions reverse this trend. Suitable overwintering areas may become scarce, affecting entire fish communities within pools that cannot navigate to suitably deep areas to overwinter.

Freshwater Mussels: The IL 519 Study concluded that mussels had historically declined in response to over-harvesting and poor water quality, as well as ongoing problems with excessive sedimentation. After initial efforts to improve water quality, mussel populations also improved. This improvement was most evident in the upper river, where water quality impacts were most severe. Commercial mussel harvests have resumed in the lower mainstem pools. However, the general trend is still declining (numbers and species), attributed to excessive siltation, loss of habitat, chemical pollution (including herbicide and insecticide runoff), and competition from exotic species (zebra mussels).

The Cumulative Effects Study concluded that unionid mussels are one of the most important invertebrate groups on the river. Generally, mussels prefer coarse and firm stable substrates where several species may aggregate in groups known as “mussel beds.” Since the early 1900s, sedimentation has caused a significant loss of suitable mussel habitat throughout the IR. Construction of channel regulatory structures, such as wing dikes, has also eliminated significant areas of habitat in the main channel border and side channels. Some loss of habitat is likely to continue from these activities.

Potentially, the most significant threat to the future of IR mussels is the threat posed by the exotic zebra mussel. Limited sampling of mussel beds in early 2000 indicated that large numbers of native mussels were being killed by zebra mussel infestation. However, early sampling in 2003 and 2004 indicates that zebra mussel infestations may be declining and native unionids beds are stabilizing (Don Helms, aquatic ecologist, pers. com. 2004). This trend is likely to fluctuate as is typical of exotic species population dynamics, which create peak and bust-type cycles. River biologists are thus expecting the zebra mussel population to rebound and see lasting effects from this invasion. Although much has been learned, there is much more to learn about the impacts of this exotic mussel. It is assumed that native unionids will continue to decline over the next 50 years.

<u>Macroinvertebrates</u>: The IL 519 Study concluded that long-term widespread declines in benthic macroinvertebrates are linked to domestic and industrial pollution, metal contaminated sediments and ammonia, as well as increasingly silty substrates. These declines have had adverse effects on river fishes and birds. Because of their wide distribution and potential to exhibit dramatic community changes when exposed to water and sediment pollution, they are ideal indicators of environmental quality.

The Cumulative Effects Study predicts that burrowing invertebrates could decline in the future as sedimentation continues. This group of animals includes mussels, fingernail clams, mayflies and other insects, and worms. Continued sedimentation and turbidity, aggravated by navigation and tributary watershed degradation, will further degrade aquatic habitats used by macroinvertebrates.

<u>Floodplain Forests</u>: The IL 519 Study concluded that floodplain forests have been severely impacted by habitat loss, altered hydrology, fire suppression, and increasing fragmentation. Invasive species are becoming more common, primarily in the understory. In addition, higher water tables associated with the navigation pools have reduced, and in some areas, eliminated mast tree regeneration. More flood and water tolerant species, such as silver maple, have become the dominant species and species diversity is decreasing. Timber harvesting of maples is becoming increasingly common, leading to further losses in forested areas and increasing forest fragmentation. Without restoration efforts in both reestablishing forests and restoring species diversity, forests and forest-dependent species will continue to decline.

The Cumulative Effects Study concluded that agricultural and urban development have caused a significant loss of floodplain forest along the IR. IR floodplain forests are heavily influenced by water stage. The water level alterations of the early 1900s and navigation locks and dams of the 1930s severely altered the floodplain forests of the system. Most notably these changes led to more flood tolerant trees and the loss of a significant portion of the mast producing tree species. In addition to these early twentieth century changes, the flood of 1993 caused significant mortality in many of the remaining forest stands along the IR, particularly in the lower reaches. Elevated water levels from river impoundment continue to stress forests and hamper regeneration. Acreage of willow and cottonwood communities is predicted to decline further in the impounded reaches, but remain at the same level in the unimpounded reach. In the areas heavily impacted by sedimentation, patches of willow and cottonwood seedlings have since colonized openings created by the flood of 1993.

Amphibians and Reptiles: The Cumulative Effects Study concluded that turtles, frogs, snakes, toads, and salamanders comprise some of the least studied fauna on the floodplain. Most of these animals favor backwater shallow wetland habitats. Their diversity is promoted by isolation from predators. For this reason, they are likely to decline in diversity as isolated wetlands in the floodplain decline, and also in numbers where backwater habitats are also declining from sedimentation.

Migratory Birds: The Cumulative Effects Study concluded that bottomland forest habitats support significant numbers of migratory birds such as songbirds, bald eagles, herons, egrets, and ospreys. Shorebirds use shallow wetlands and mud flats. Red-shouldered hawks, which are a state endangered species in Illinois, are dependant upon larger contiguous forest tracts which are now found primarily along the river. Declines in songbird use and diversity may be inevitable if forest habitat continues to decline.

Ecological Integrity: Based on all the factors above, the general ecosystem integrity, or health, of the Illinois River Basin is still declining in spite of the dramatic water quality improvements made as a result of the Clean Water Act. Pressure on the remaining habitats will continue to increase as the population increases. Finally, changes to the ecosystem over time have been dramatic. Current trends may be difficult to reverse and will require significant commitments of resources and time.

USGS Status and Trends Report

In addition to the Cumulative Effects Study and this feasibility report, the USGS Status and Trends Report (USGS 1999) evaluated the present status and makes predictions for three reaches of the UMR and the lower reach of the IR with respect to six criteria. These six criteria are as follows.

Table 6.3, Summary of Status and Trends Criteria for the IR

CRITERIA	Illinois River Lower Reach
Viable Native Populations & their Habitats	Degraded & stable
Ability to Recover From Disturbances	Degraded & stable
Ecosystem Sustainability	Degraded & declining
Capacity to Function as part of a Healthy Basin	Degraded & stable
Annual Floodplain Connectivity	Degraded & stable
Ecological Value of Natural Disturbances	Degraded & stable

1. The ecosystem supports habitats and viable native animal and plant populations similar to those present prior to any disturbance.

2. The ecosystem is able to return to its pre-existing condition after a disturbance, whether natural or human-induced.

3. The ecosystem is able to sustain itself.

4. The river can function as part of a healthy basin.

5. The annual flood pulse “connects” the main channel to its floodplain.

6. Infrequent natural events such as floods and droughts are able to maintain ecological structure and processes within the reach.

Each river reach was graded for the six criteria as being degraded, heavily impacted, moderately impacted, or unchanged/recovered. Future trends for these criteria were then forecast for each river reach. Trends for each criteria can be stable, improving, or declining. A summary of the report's evaluation for the IR is presented in Table 6.3.

The USGS report predicts that habitats in the IR will continue to degrade overall from sedimentation and erosion because the river's natural processes are unable to function. Habitat projects to reestablish terrestrial and aquatic structural diversity are needed to offset deteriorating habitats. Point source pollution, high sediment loads from the watershed, agricultural run-off, and introduction of exotic species will continue to pose threats.

The combination of floodplain isolation, sedimentation, altered water regimes, and poor sediment quality make any short-term reversal of IR degraded habitats unlikely. Each of these factors is so degraded that improvement of any one alone may not result in much overall benefit.

The USGS report concluded that in order to maintain the current ecological conditions of the IR system and to restore degraded functions, a significant increase in restoration activities is needed.

Future With Project Conditions

The Corps has hosted a series of meetings between the IDNR, the Service, The Nature Conservancy, and other interested parties over the past two years to discuss and outline expected future conditions of the IR. During these meetings, future desired environmental conditions and measurable targets were discussed and established for the key categories of fisheries, waterfowl and wetlands, mussels, macroinvertebrates, aquatic vegetation, forests, and ecological integrity (please see Section III, page 3-47 of the feasibility report for specific targets by category). Representatives of each agency also discussed and identified the system alternative which was most likely to address the serious ecological problems facing the IR and that would obtain the future desired conditions. Alternatives 6 and 7 were chosen as most likely to create the desired future conditions and ultimately Alternative 6 was chosen as the preferred alternative. Figure 6.4 presents the probable future conditions of the IR under each of the system goals evaluated.

Restoration Alternatives

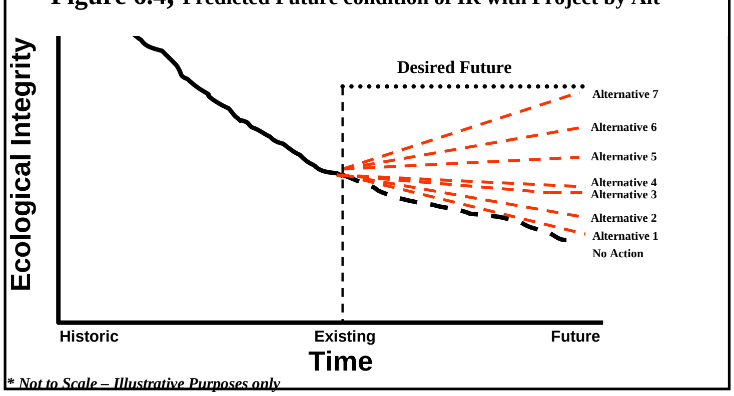


Figure 6.4, Predicted Future condition of IR with Project by Alt

When undertaking a restoration initiative of this scale, it is important that key priorities be established to alleviate future competition of limited funds and resources. For that reason, the IL 519 Study group has discussed the importance of criteria prioritization and has established the following list of priorities:

1. Habitat restoration and/or protection projects should be closely coordinated and combined with projects developed under other goals and authorities, in order to maximize systemic ecological integrity and effectiveness of restoration efforts and dollars.

2. The assessment process should focus on quality of the habitat and the presence of threats for the area under consideration. Those areas threatened most immediately should be targeted for protection.

3. Connectivity to the IR and major tributaries and between protected areas should be key focus area.

4. Preference should be given for improving and protecting existing moderately degraded habitat areas near rare and unique communities.

5. Give special consideration to rare areas.

6. Alter hydrologic regime most relevant disturbance regime to encourage species regeneration.

7. Terrestrial patch size recommendations (amount shown or greater):

   a. Bottomland hardwood forest = 500-1000 acres; 3000 acres needed for some interior avian species.

   b. Grasslands = 100-500 acres.

   c. Nonforested wetland = 100 acres, spaced 30-40 miles apart.

   d. Riparian zone = 100 feet each side; 200-300 feet wide total.

8. Aquatic habitat recommendations:

   a. Mainstem backwaters/side channels ≥ 6 feet deep, spaced 3-5 miles apart.

   b. Instream riffles – Depending on the size of the stream, the number of structures required ranges from 4 per mile for large tributaries to 22 for minor tributaries.

Though we understand that future issues may alter these priorities, it should be stressed that this list was established through agency discussion and was agreed upon at several group meetings. This list should be used to guide planning efforts at the regional team, system team, and executive team levels.

Chapter 7 – Endangered Species Consultation

The Endangered Species Act (ESA) directs all Federal agencies to work to conserve endangered and threatened species and to use their authorities to further the purposes of the Act. Section 7 of the Act, called "Interagency Cooperation," is the mechanism by which Federal agencies ensure the actions they take, including those they fund or authorize, do not jeopardize the existence of any listed species.

Consultation under the ESA for the Illinois River 519 Study was initiated by a letter from Mr. Kenneth A. Barr, Rock Island District Corps of Engineers, dated August 2003. The letter requested a list of federally threatened and endangered species occurring within the project area, which was considered the entire Illinois River Basin within the boundaries of the State of Illinois. This information is provided in Table 7.1.

Table 7.1, Federally Listed Threatened or Endangered Species within the IR basin

	Status	Common Name (Scientific Name)	Habitat
Birds	Threatened	Bald eagle (*Haliaeetus leucocephalus*)	wintering and breeding
Mammals	Endangered	Indiana bat (*Myotis sodalis*)	caves, mines (hibernacula); small stream corridors with well developed riparian woods; upland forests (foraging)
		Gray bat (*Myotis grisescens*)	caves and mines; rivers & reservoirs adjacent to forests
Plants	Endangered	Leafy prairie clover (*Dalea foliosa*)	prairie remnants on thin soil over limestone
		Pitcher's thistle (*Cirsium pitcheri*)	only on shorelines or sand dunes of the Great Lakes. *believed to be extirpated from Illinois
	Threatened	Decurrent false aster (*Boltonia decurrens*)	disturbed alluvial soils
		Eastern prairie fringed orchid (*Platanthaera leucophaea*)	mesic to wet prairies
		Lakeside daisy (*Hymenopsis herbacea*)	dry rocky prairies
		Mead's milkweed (*Asclepias meadii*)	virgin prairies
		Prairie bush clover (*Lespedeza leptostachya*)	dry to mesic prairies with gravelly soil
Invertebrates	Endangered	Hines emerald dragonfly (*Somatochlora hineana*)	spring-fed wetlands, wet meadows and marshes
		Karner blue butterfly (*Lycaeides melissa samuelis*)	pine barrens and oak savannas on sandy soils and containing wild lupines (*Lupinus perennis*), the only known food plant of the larvae.
Mussels	Endangered	Clubshell mussel (*Pleurobema clava*)	riverine habitats.
Reptiles	Candidate	Eastern massasauga rattlesnake (*Sistrurus c. catenatus*)	shrub wetlands

The Illinois River Basin is host to 13 federally threatened or endangered species, one candidate species, and numerous state threatened or endangered species. We offer the following description of how projects proposed and planned under the IL 519 authority would comply with the Endangered Species Act of 1973, as amended.

To comply with ESA at the program level (i.e. this feasibility report), a programmatic consultation must be completed. The programmatic consultation may be completed before or after project authorization. However, it must be completed before construction begins or any irretrievable commitment of resources is made.

It is the Federal action agency's responsibility to fulfill Section 7 consultation. It has been our recommendation to the Corps that consultation be initiated and completed in advance of authorization of the IL 519 program. However, the Corps has chosen to fulfill their responsibility under the ESA after the program receives congressional authorization. At that time, the Corps will complete a programmatic Biological Assessment (BA) and consult with us to identify and avoid, to the extent feasible, impacts to all federally threatened or endangered species within the IR basin.

A major purpose of this study is to benefit fish and wildlife of the IR Basin. No specific projects will be approved or constructed prior to the completion of the forthcoming programmatic BA, and consultation with the Service under Section 7 of the ESA has been completed. If additional consultation under Section 7 of the ESA is required for site specific projects which have impacts or actions not covered under the programmatic documentation, then independent consultation will be initiated and completed at that time. All future activities under this potential authority will be coordinated through the appropriate USFWS office.

Chapter 8 – Program/Agency Coordination

Coordination between the Service and the Corps

Service staff have been actively involved in the IL 519 Study process and with the project team by attending meetings and providing comments on draft documents. In addition to present coordination efforts, increased coordination will be needed during implementation, at a site specific level. National Wildlife Refuges, Partners for Fish and Wildlife (PFW), and other Service interests can help to achieve many of the goals outlined by this feasibility report. It is our interest to be an active team member at the Regional Team level, as well as at a system-wide management level.

Partners for Fish and Wildlife: The PFW program through the Service has restored thousands of acres of natural habitats within the State of Illinois. Although not all within the IR basin, Table 8.1 outlines the Service's conservation efforts within the State of Illinois through this program and the associated acreages restored. This program operates out of the Rock Island Field Office and our National Wildlife Refuge offices. It is a very effective and efficient way of restoring habitats. It should be considered for partnership in future goal attainment calculations. During fiscal year (FY) 2003 alone, the PFW program restored approximately 2,015 acres of habitat within the state. In addition, the PFW is an active partner with USDA programs. Together they work with interested landowners on land conservation through either USDA or PFW programs. Service biologists within the PFW program frequently work with the county NRCS district conservationist, state biologists, and many other conservation authorities throughout the state. Through the combination of the effectiveness of the program and the strong relationships among natural resource managers, the program has become very successful.

Table 8.1, PFW restoration in IL (IL PFW Coordinator Wayne Fischer, pers. Comm.)	
Wetland basins	1987-2003, PFW has restored 376 wetland basins consisting of 7,581 acres
Upland restoration	1991-2003, PFW has restored 46 upland areas consisting of 1,603 acres
During FW 2003	PFW has restored 20 basins totaling 2,015 acres.

Coordination Needs

General agency coordination has been conducted between the IDNR, USACE, USFWS, and many other interested parties regarding the IL 519 Project. However, intensive collaboration and program integration between the IDNR/USACE and the NRCS, SWCD, friends groups, ecosystem partnerships, conservation clubs, TNC, Wetland Initiative, private stakeholders, etc. is needed for the successful development of specific projects. Many of these established entities are vital to the achievement of the system goals as outlined by the IDNR and Corps. It may be appropriate for the Corps to investigate avenues of providing funding to these groups to implement small scale projects that can achieve cumulative success at the watershed scale. It would also appear counterproductive for the Corps to spend project dollars preparing plans and specifications for project features that may or may not already be planned by other agencies (i.e. stream bank stabilization features, etc.).

As stated in the 'Significance of the Illinois River Basin' section of the executive summary report, "local communities, counties, and non-governmental organizations have developed approximately 40 management plans calling for restoration of all or a portion of the Illinois River Basin". Yet nowhere within the feasibility report does it outline how those management plans would be utilized under this authority or even complimented by this authority. It also isn't clear how, if implemented under separate funding, these management plans would be incorporated into the desired future conditions of the goal categories, most notably Goal #1 (sediment load reduction) and Goal #6 (improve water and sediment quality). Significant benefits are seen annually through projects implemented by SWCD, local NRCS, IL EPA, the Service, and other conservation agencies. These benefits should be acknowledged in future desired conditions.

Upper Mississippi Environmental Management Program: The most significant approved system-wide effort to enhance and restore UMR and IR fish and wildlife resources is the habitat rehabilitation enhancement projects (HREP) being constructed by the EMP. The EMP was first authorized by the Water Resources Development Act of 1986 (PL 99-662) and permanently authorized in that Act in 1999. The objectives of most HREPs are to restore fish and wildlife habitats degraded by sedimentation. As of 1997, approximately 28,000 acres (or about 1 percent) of the UMR-IR system have been enhanced through this program. In the future over 100,000 acres (or approximately 3.6 percent) of UMR-IR floodplain habitat may be enhanced.

EMP habitat restoration projects have helped reverse habitat decline within their immediate areas. The projects have been typically designed to achieve a select number of objectives such as migratory bird habitat, improved aquatic vegetation, fish overwintering, or bottomland hardwoods. However, in practice, each project has provided multiple fish and wildlife benefits.

For many EMP habitat projects, there is significant maintenance cost for structural upkeep. In the future, short-term mini-projects with little or no maintenance may prove to be more cost effective.

The Service is a strong proponent of the EMP. However, as it is currently funded or structured, we do not believe that the EMP alone can reverse the system-wide decline in fish and wildlife habitat that is now occurring. Future EMP habitat projects must be able to address the systemic driving variables as well as the localized symptoms of habitat decline. It has become apparent that the EMP, IL 519, navigation-related mitigation, and other similar projects need to be integrated into an overall ecosystem management program. The IL 519 Feasibility Report does not adequately describe these relationships. Much effort during the plan formulation was directed to identifying resource problems, opportunities, and ecosystem goal identification. However, more attention is needed toward agency collaboration and program integration needed to successfully restore the IR ecosystem.

USDA Programs: Several USDA programs provide funding to agricultural producers in support of environmental objectives, generally administered through the local NRCS field offices. The Environmental Quality Incentives Program (EQIP) provides technical, financial, and educational assistance to farmers and private landowners who are faced with serious threats to soil, water, and related natural resources. Working with approximately 2,400 landowners within the Illinois River Basin, the EQIP program has expended approximately $2.9 million for financial and educational assistance to treat natural resources concerns on approximately 250,000 acres. The

Wildlife Habitat Incentive Program (WHIP) has provided approximately $250,000 of assistance to develop and improve wildlife habitat on private lands within the Illinois River Basin.

The Wetland Reserve Program (WRP) increases wildlife habitat and improves water quality by providing additional wetland habitat, slowing overland flow, and providing natural pollution control. To date, approximately $3.4 million has been spent in the Illinois River Basin to restore 2,300 acres of habitat on 13 properties. Also, the Conservation Reserve Program (CRP) enrollments beyond the Conservation Reserve Enhancement Program (CREP) enrollments provide additional in-place conservation practices facilitating resource management in the Illinois River Basin. Finally, the Forestry Incentives Program provides an avenue of assistance to private landowners for planting trees, improving timber stands, as well as other non-industrial private forest land practices.

In April 1997, the USDA officially launched the National Conservation Buffer Initiative and pledged to help landowners install 2 million miles of conservation buffers by the year 2002. The initiative is led by the NRCS (in cooperation with the Agricultural Research Service, Farm Service Agency, Forest Service, and Cooperative State Research, Education, and Extension Service), state conservation agencies, conservation district, and numerous other public and private partners. The National Conservation Buffer Initiative encourages farmers and ranchers to understand the economic and environmental benefits of buffer strips and use these practices through the various programs of the conservation tool kit. Programs used for this effort include the continuous CRP sign-up, as well as the EQIP, WHIP, WRP, Stewardship Incentives Program, and Emergency Watershed Protection Program.

USDA programs have been very successful in the relative short time frame in which they have been in existence. Specific lessons learned through this program should prove to be invaluable to the IL 519 Study team as they work to establish similar achievements as has the USDA within the IR basin. Again, we encourage the Corps to investigate opportunities to assist in the funding of specific USDA type programs which perhaps already have landowner contacts and have identified prime project sites to meet or address one of the seven environmental restoration goals.

Coordination Within the Rock Island District Corps

Section 404 Regulatory Branch: As the primary regulator of Section 404 permits, the regulatory branch of the Rock Island District plays an extremely important role in this restoration initiative. It appears that many beneficial projects could be targeted by contacts made through the regulatory branch. Interested and willing landowners could be directed to contact key members of regional teams for assistance in stream restoration (as opposed to channelization), wetland protection (as opposed to draining), and many other important habitat protection measures.

Relationship of the IL 519 Study to the Navigation Study**:** The feasibility report written for the IL 519 Study states on page eight, third bullet under Assumptions and Exceptions that: "The Comprehensive Plan (IL 519 Study) will develop recommendations consistent with the Upper Mississippi River-Illinois Waterway System Navigation Feasibility Study and the Upper Mississippi River Comprehensive Plan projects, but will not duplicate efforts and investigations regarding transportation and flood protection needs". However, significant duplication is noted between the restoration measures and intensities of those measures within the two programs' preferred alternatives. The Service strongly recommends that these two initiatives be more closely coordinated with one another and potentially integrated as part of one another.

Table 8.2, Comparative restoration of IL 519 and the navigation study.

Restoration measures by alternative through Navigation Study (Reach 4: Illinois Waterway)						
Ecosystem Measure	Alternative A	Alternative B	Alternative C	Alternative D	Alternative E	Virtual Reference
Island Building	0	3	4	4	4	4
Fish Passage	0	0	0	0	5	5
Floodplain Restoration	0	0	0	4	14	15
WLM - Pool Scale	0	0	0	0	0	0
WLM- Backwater	0	0	0	1	1	1
Backwater Restoration (Dredgi	0	340	680	920	1,040	1,120
Side Channel Restoartion	0	20	30	34	36	39
Wing Dam/Dike Alteration	0	3	3	3	3	3
Island Protection	0	15	15	15	15	15
Shoreline Protection	0	59	59	59	59	59
Topographic Diversity	0	0	0	0	0	0
Dam Point Control	0	0	0	0	0	0
Floodplain Restoration-Im.Op.	0	2	2	2	2	2
Total	0	119	147	168	191	199
Percent of Total	0	60%	74%	84%	96%	99%

* BW dredging was assumed at a 20 acre footprint

* information provided at NAV Study Public Meeting October 2003

Restoration measures by alternatives of the IL 519 Authority							
Ecosystem Measure	Alternative 1	Alternative 2	Alternative 3	Alternative 4	Alternative 5	Alternative 6	Alternative 7
Island Building	0	0	0	0	0	0	0
Fish Passage	0	0	0	3*	6*	6*	9*
Floodplain Restoration (Main Stem)	5,000	5,000	20,000	5,000	40,000	75,000	150,000
WLM - % Peak Reduced	1.50%	2.50%	2.50%	7.50%	7.50%	7.50%	15.00%
Backwater Restoration (Dredgin	3,600	6,100	8,600	6,100	8,600	12,000	18,000
Side Channel Restoartion	10	20	30	20	30	35	40
Island Protection	10	15	15	15	15	15	15
Shoreline Protection	0	0	0	0	0	0	0
Total acres restored	8,600	11,100	28,600	11,100	48,600	87,000	168,000
% of Total that is BW dredging	42%	55%	30%	55%	18%	14%	11%

* represents fish passage at Fox, DuPage, DesPlaines, Kankakee, Spoon, Aux Sable, then 3 main stem dams in that progressive order

Particular discrepancies exist between many of the main stem systematic issues and restoration efforts. These discrepancies subsequently produce much overlap between the two authorities. This overlap, though understandable, would be inefficient and unproductive as these two important authorities move forward to construction. Much of this potential duplication could be avoided if new institutional arrangements would be established. A new institutional framework should be considered that provides a central forum for integrating the IL 519, EMP, Navigation Study, and others (e.g. 1135, 206, and Comprehensive Plan). The Navigation Study has recommended a management triad consisting of a (1) River Council, (2) Science Team, and (3) Regional Management Team. The River Council could be the policy forum for integrating the IL 519 authority with other projects. Table 8.2 presents an ecosystem measure comparison of the two authorities and their respective preferred alternatives (preferred alternatives are shaded).

Much like the Mississippi River, the Illinois River has paid a significant environmental toll for the seven lock and dam structures and other navigation related structures. Environmental alternatives which mitigate navigation impacts may be implemented on the Illinois River, if the Navigation Study is approved. As is currently outlined in the IL 519 Feasibility Report, all projects to be funded under this authority would require a 35 percent cost share from the non-Federal partner (IDNR) and 65 percent Federal cost. However, as outlined in the Navigation Study, some restoration efforts to offset navigation impacts would be implemented at 100 percent Federal cost. This will create a level of competition between the two authorities and especially in restoration categories such as Backwater Restoration (see Table 8.2).

Each of these initiatives appears to have been formulated completely independent of one another and this is reflected in an apparent duplication of effort. For example, each identifies the need to restore backwater topographic diversity and defines the importance of water level management changes for the IR. The IL 519 Study has determined that a total of 12,000 backwater acres would need to be dredged in order to restore the system in the preferred alternative (Table 8.2, Alternative 6), whereas the Navigation Study recommended that only 920 backwater acres would need to be dredged (Table 8.1, Alternative D). The Corps' Navigation Study predicts that dredging those 920 acres would benefit up to 27,600 acres (at a 1:30 ratio). Applying this rationale to the IL 519 Study would greatly exceed the 12,000 acres proposed by the IL 519 by thousands of acres. The same types of disconnects can be seen when looking at the water level management feature of the two alternatives.

Pending authorization by Congress, these two programs and related projects such as the EMP and UMR Comprehensive Plan should be more closely integrated and, at least, should become complementary of one another.

Chapter 9 - Recommendations and Conclusions

Conclusions

1. The IR ecosystem has been so severely degraded by human activities during the last 100 years that its ecological integrity and ability to recover from disturbance has been greatly diminished. Sedimentation problems continue to pose serious threats to backwater areas in the lower pools which currently provide habitat for a number of fish and wildlife species. A collaborative and adaptive management strategy involving implementation of conservation measures, rehabilitation projects, and long-term monitoring is needed to improve the condition of this ecosystem. Management decisions and actions at both the watershed and more localized scales will ultimately determine the future fate of this once highly productive river resource.

2. In cooperation with the IDNR, we believe that the Corps has done a good job of identifying system wide environmental needs and establishing an implementation process to address many of these issues. However, significant coordination is still needed to establish the appropriate level of government, non-government, and private cooperation to successfully restore the Illinois River Basin.

3. Because of sedimentation and human-induced alterations to the floodplain ecosystem, aquatic and terrestrial habitats throughout the IR will continue to decline at spatially variable and largely unquantified rates. Prioritization schemes should be implemented at the project fact sheet level to insure that limited dollars be applied most efficiently.

4. The main channel of the IR will remain stable, but backwaters will continue to decline from sedimentation. In coordination with the Navigation Study and EMP restoration efforts, critical backwater areas within each pool should be identified and restored as expeditiously as possible.

5. Main channel fish populations are expected to remain healthy, but fish species requiring backwater habitats for any life requirements will likely decline. An anticipated rapid response to backwater restoration efforts will likely be seen among fish guilds requiring backwater habitat.

6. During the fall, state natural resource agencies, the Service's National Wildlife Refuges, and many privately owned duck clubs artificially manipulate water levels in several management areas along the IR. These moist soil units enhance growth of aquatic vegetation and supplement natural sources of food. Unmanaged backwater areas that currently provide dabbling duck food resources are likely to decline in future years as backwaters diminish. There may be opportunities to work with private landowners and establish partnerships to enhance the management of these areas and potentially the integrity of the IR.

7. The quality of bottomland hardwood forest habitat will decline. Associated species which depend upon mast and mature/over mature stands will decline due to lack of regeneration.

8. As they are currently funded or structured, we do not believe that the current ecosystem restoration efforts within the basin can reverse the system-wide decline in fish and wildlife habitat without a more intense coordination between and among agencies. Future IL 519, EMP, Navigation Study, etc. habitat projects must be able to address the systemic driving variables as well as the localized symptoms of habitat decline.

Recommendations

1. All management actions (both Federal and state) such as those implemented under EMP, IL 519, Navigation Study, USDA, USFWS, and other restoration efforts along the mainstem of the IR and the mainstem floodplain need to be coordinated with one another to ensure efficient and successful management of the IR basin. This coordination may be best met through specific institutional arrangements and the formation of a management triad consisting of (1) River Council, (2) Science Team, and (3) Regional Management Team.

2. Several similar recommendations have become apparent during the coordination of this project and in light of strides made by the UMR Navigation Study to implement environmental restoration as a key component of that study's alternative matrix. It is strongly recommended that the IL 519 and the Navigation Study be more closely coordinated with one another and potentially integrated as part of one another. Much like the Mississippi River, the Illinois River has paid a significant environmental price for structures that allow and improve navigation. Environmental alternatives which mitigate navigation impacts on the Illinois River need to be coordinated with projects funded through the IL 519 authorization.

3. We recommend that a regular line of coordination be established between the Corps and the Service for endangered species consultation for the IR basin. Regional teams should coordinate with the appropriate field office of the Service (Chicago, Rock Island, or Marion, Illinois) and establish how project fact sheets would be coordinated with the Service. It is also recommended that the regional teams outreach to the appropriate field office and identify Service employees to act as a participant to the regional team. These types of relationships are important in establishing a smooth flow of information and to avoid unnecessary delays in project formulation.

4. As the primary regulator of Section 404 permits, the regulatory branch of the Rock Island District plays an important role in the success of this restoration initiative. It appears that many beneficial projects could be targeted through contacts made by the regulatory branch through Section 404 permit applications. Interested and willing landowners could be directed to contact key members of regional teams for assistance in projects such as stream restoration (as opposed to channelization) or wetland protection (as opposed to draining). Wetland, stream, and forest mitigation as outlined in the Corps' recent 'draft mitigation guidelines' could be emphasized for the most important areas within each tributary watershed of the Illinois River Basin.

5. We encourage the Corps to investigate opportunities to assist in the funding of specific USDA type programs where landowner contacts have been made and prime project sites identified to address one or more of the seven environmental restoration goals. In addition to government-led efforts, there may also be opportunities to work with various non-government organizations to accomplish many of the basin goals as well. These types of partnerships could reduce planning efforts and present more efficient 'on the ground' projects.

6. Alternative features, predominantly with regard to sediment reduction techniques, which are untested for their ecological integrity function (i.e. riffle structures, bendway weirs, etc.) should be implemented through a cautious and scientific approach to identify ecological reactions. Opportunities should be sought to collaborate with state and/or private universities to study the biological interactions of these features.

7. Adaptive management techniques should be established that would allow the Corps and IDNR to redirect focus of the IL 519 authority if future conditions of the IR turn out to be less desirable than predicted, especially in regard to sediment delivery assumptions into the Illinois River Basin.

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ILLINOIS RIVER BASIN RESTORATION
COMPREHENSIVE PLAN
WITH INTEGRATED ENVIRONMENTAL ASSESSMENT

APPENDIX H

MONITORING PLAN

TABLE OF CONTENTS

List of Tables

List of Figures

EXECUTIVE SUMMARY

Rivers and streams are a valuable and integral part of every major ecotone and alteration of these systems has a long and varied history throughout the world. Many of these changes are a direct result of various management practices designed to meet human needs including flood control, power generation, navigation, irrigation, and recreation. Dominant management practices used to meet these needs have typically involved altering flow and habitat availability through impoundment, channelization, leveeing, and water diversion. All of these practices have far ranging temporal and spatial impacts on the physical and biological processes that define a given ecosystem. However, new initiatives to repair aspects of ecosystem structure and function are beginning to emerge. The Illinois River Ecosystem Restoration (IRER) project is one such initiative that is focusing on restoring not only mainstem areas of the Illinois River, but also much of the contributing watershed.

The IRER is a multi-disciplinary, collaborative initiative between several federal agencies (U.S. Army Corps of Engineers, U.S. Environmental Protections Agency, U.S. Fish and Wildlife Service, U.S. Geological Survey, Natural Resources Conservation Service), the state of Illinois (Department of Natural Resources, Environmental Protection Agency, Department of Agriculture), local and/or regional government agencies, and several non-government organization (e.g., The Nature Conservancy). The overall goals of the IRER are to: 1) maintain and restore biodiversity 2) reduce sediment delivery from tributaries, 3) restore backwater and side channel habitats, 4) restore floodplain and riparian habitats, 5) reconnect the river to its floodplain, 6) naturalize hydrology, and 7) improve sediment and water quality with the intent to improve the structure and function of the Illinois River Basin. To achieve these goals, most of the restoration practices implemented through IRER will focus on projects that establish physical reductions in sediment loads; restore or protect side channel, backwater, and floodplain habitats; and naturalize water level fluctuations throughout the basin. One very important aspect of this restoration effort is documenting the physical and biological responses throughout the process to provide information into an iterative feedback loop. These responses can primarily be measured through long term monitoring at several spatial scales. Our objectives were to develop a conceptual and structural framework for watershed assessment and long term monitoring as part of the IRER program.

This report contains two chapters. The first chapter deals specifically with developing a long-term monitoring framework. This monitoring protocol highlights an inter-disciplinary effort attempting to monitor all major characteristics of the river (e.g., water quality, geomorphology, biota). The bulk of this chapter focuses on identifying appropriate biotic and abiotic response variables that can be used to identify ecosystem change as a result of restoration practices. Within the Illinois River Basin, there are many potential measures that may be useful in assessing goal-specific accomplishments. The response measures identified throughout the proposed plan should provide information that is ecologically meaningful, relevant to the spatial and temporal scales being measured, responsive to implemented restoration practices, provide benchmarks of progress in accomplishing the stated goals, and be easily understood.

The proposed monitoring framework is defined at three distinct, hierarchical spatial scales to facilitate ecosystem response to the restoration goals and will also provide information that 1) characterizes the current status of the ecosystem (status), 2) tracks changes in the ecosystem through time at multiple spatial scales (trends), and 3) rigorously evaluates project specific management practices (evaluation). Within each spatial scale, the typical sampling design, sampling approach, and likely variables (or metrics) that should be measured are discussed. Response variables will be discussed at two levels: 1) those that are critical and must be measured and 2) those additional variables that are desirable and would provide a significant amount of information, but may not be as immediately critical as those listed above. We recognize that several ongoing data collection efforts and programs (e.g., Environmental Management Program's Long Term Resource Monitoring Program, Illinois River long term fish population study, USGS and ISWS hydrology monitoring, water quality monitoring, etc.) within the basin will likely be beneficial and complimentary to the proposed monitoring program presented here. Therefore, the intent of the proposed monitoring framework is to complement the already existing programs to create a more comprehensive monitoring effort.

Because river restoration is a newly emerging field, there are likely considerable knowledge gaps that may need to be investigated to provide a better understanding of ecosystem responses to restoration practices. In this situation, short term (i.e., 3-5 year) studies may be appropriate to identify the underlying processes that will aid in understanding the ecosystem. Accordingly, we have provided a summary of potential focused research topics.

In the second chapter of this report, we present a general summary of watershed assessment approaches. Watershed assessments are a crucial first step in identifying environmental degradation and also in identifying the action needed to fix problems. However, we present only the basic paradigms to appropriate watershed assessments because information beyond biotic and abiotic conditions (e.g., public opinion, economics, etc.) should be included and are beyond the scope of this document.

Chapter I
LONG TERM MONITORING

INTRODUCTION

River Restoration Background

Rivers and streams are a valuable and integral part of every major ecotone and alteration of these systems has a long and varied history throughout the world. Many of these changes are a direct result of various management practices designed to meet human needs including flood control, power generation, navigation, irrigation, and recreation. Dominant management practices used to meet these needs have typically involved altering flow and habitat availability through impoundment, channelization, leveeing, and water diversion. All of these practices have far ranging temporal and spatial impacts on the physical and biological processes that define a given ecosystem. For example, about 14% of the world's total annual runoff is held in reservoirs that has ultimately resulted in changes to both the biotic and abiotic characteristics of these systems because the aquatic environment has been converted to a lentic system (Downes et al. 2002). Biotic changes can range from local changes in community composition and/or structure to broader extirpations of species or entire communities and changes in fundamental processes (e.g., nutrient cycling; bioenergetics, etc.). Abiotic shifts are similarly affected with relatively localized issues like point-source pollution to systemic issues like sedimentation and shifts in geomorphology of the stream bed and its floodplain.

The effects of these modifications are beginning to be ameliorated in some systems. The science of restoring riverine systems is relatively young, but attempts to repair damaged systems due to human impacts are emerging in several places around the world. Common techniques used to address major problems within a river system include improving water quality, removing dams, reconnecting channels with their floodplains, flow remediation, and increasing stream meander. Many ongoing river restoration projects are spatially limited by focusing on restoring small rivers and streams or fairly localized reaches of larger rivers (e.g., Cook et al. 1992; Biggs et al. 1998; Cals et al. 1998; Lake 2001; Erskine 2001). However, there are now a handful of restoration projects materializing that are taking a more holistic approach to large river restoration including much, if not all, of the entire basin. For example, the Kissimmee River restoration effort has been the impetus of restoration activities since the early 1970's where the focus has been aimed at restoring the river basin's flow regime, water quality, and habitat diversity (Toth et al. 1997). Other major river systems that have existing or emerging restoration programs include the Murray-Darling Basin (Australia), the Rhine River Basin (Europe) and the Volga River (Russia). While the spatial and temporal scales and the specific objectives that exist among these projects may vary slightly, the overriding goal of these efforts remains the same - to restore the ecosystem.

Ecosystem restoration is defined as an applied approach to re-establish the structure and function of an ecosystem (Cairns 1988; Downes et al. 2002). Conceptually, structure pertains to biotic and abiotic diversity; whereas, function typically refers to the processes that drive the ecosystem (e.g., productivity, sedimentation, nutrient transport, nutrient loading). Therefore, the primary goal of any restoration effort should be to redirect the structure and function trajectory of a degraded ecosystem to something that more closely approximates historic conditions (i.e., pre-impoundment, pre-channelization, pre-European settlement, etc.). It is crucial that both structure and function be considered and incorporated into restoration planning processes to ensure a holistic approach to restoration activities. This means that the restoration process should be a thorough, relatively long term and comprehensive commitment that also incorporates an iterative process to capitalize on new information as it becomes available (Williams et al. 1997).

There are a myriad of established restoration techniques and/or programs that can be readily implemented in the riparian areas and smaller watersheds of the Illinois River (Table 1). Likewise, a smaller list of generally accepted management practices are available for restoration in larger tributaries and river systems (e.g., dredging and water control structures). The challenge will be to assess their efficacy and impacts at both local and smaller spatial scales along the river basin. Therefore, a key element to this process is establishing an ability to identify or detect changes to the ecosystem in response to restoration practices used to accomplish the restoration goals. Consequently, it is critical to establish, *a priori*, a scientifically rigorous and explicit monitoring design to ensure that the most efficient use of time and money are implemented with the greatest information return.

The thrust of evaluating restoration successes or failures involves an ability to extricate the complex interactions between natural variability, human activity, and responses to restoration efforts in a given system (Bryce and Hughes 2003). These issues are magnified in large river systems, like the Illinois River, because they typically traverse a longitudinal gradient that can encompass many landscapes. Further complications arise in larger rivers because they are relatively unique and provide little opportunity for replicated study at the broadest spatial scales. Similarly, responses can also occur at varying time scales that are dependent upon processes driving the system and the extent of the restoration effort. This creates several unique challenges to restoring large rivers, especially in the assessment and monitoring stages (Pegg and McClelland in press). Issues like appropriate scales of measure (e.g., mainstem, local, other), logistical limitations, and financial constraints all pose significant obstructions to appropriately evaluate ecosystem responses. Recent advances in technology, like remote sensing, have helped overcome some of these obstructions providing an opportunity to develop a sound restoration monitoring program. However, novel approaches will be required to adequately assess ecosystem changes through time and at multiple spatial scales.

Illinois River Ecosystem Restoration (IRER)

This Illinois River Ecosystem Restoration effort is a multi-disciplinary, collaborative initiative between several federal agencies (U.S. Army Corps of Engineers, U.S. Environmental Protections Agency, U.S. Fish and Wildlife Service, U.S. Geological Survey, Natural Resources Conservation Service) the state of Illinois (Department of Natural Resources, Environmental Protection Agency, Department of Agriculture), local and/or regional government agencies, and several non-government organizations (e.g., The Nature Conservancy) with the intent to improve structure and function of the Illinois River Basin (Figure 1). The over-riding philosophy behind this restoration effort centers on the fact that there are several specific factors, or stressors, currently degrading the structure and function (or integrity) of the Illinois River Ecosystem. Those factors have been identified as excessive sedimentation rates, loss of floodplain and side channel connectivity and highly variable water levels that ultimately translate into environmental extremes and/or loss of habitat for biotic organisms. Specifically, the goals of the IRER are to:

- Restore and maintain ecological integrity, including habitats, communities, and populations of native species, and the processes that sustain them,
- Reduce sediment delivery to the Illinois River from upland areas and tributary channels with the aim of eliminating excessive sediment load,
- Restore aquatic habitat diversity of side channels and backwaters, including Peoria Lakes, to provide adequate volume and depth for sustaining native fish and wildlife communities,
- Improve floodplain, riparian, and aquatic habitats and functions,
- Restore and maintain longitudinal connectivity on the Illinois River and its tributaries, where appropriate, to restore or maintain healthy populations of native Species,
- Restore Illinois River and tributary hydrologic regimes to reduce the incidence of water level conditions that degrade aquatic and riparian habitat, and
- Improve water and sediment quality in the Illinois River and its watershed.

Under these objectives, most of the restoration practices implemented through the IRER will focus on projects that establish physical reductions in sediment loads; restoring or protecting side channel, backwater, and floodplain habitats; and naturalizing water level fluctuations throughout the basin.

As the number of site-specific projects increases, we ultimately expect cumulative ecosystem improvements that should be detected at not only the localized project sites, but also at broader spatial scales including major tributaries and the mainstem Illinois River (see Comprehensive Plan for more detail). Therefore, it is critical that ecosystem responses to the restoration practices be appropriately assessed to ensure the restoration goals are effectively measured at all spatial scales. Accordingly, our objective was to develop a framework for long term monitoring and watershed assessment that would provide valuable insight into the restoration efforts, through an iterative process, as part of the IRER program. Because river restoration is a newly emerging field, there are likely considerable knowledge gaps that may need to be investigated to provide a better understanding of ecosystem responses to restoration practices. In this situation, short term (i.e., 3-5 year) studies may be appropriate to identify the underlying processes that will aid in understanding the ecosystem. Accordingly, we have also provided a summary of potential focused research topics.

Conceptually, as ecosystem limiting factors are sufficiently addressed throughout the Illinois River Basin, ecosystem structure and function will improve. The issue at hand is determining how to measure both the amelioration of the limiting factors (stressors) and improvements to the ecosystem in a scientifically rigorous, yet cost effective approach. There are three main approaches to gathering information relevant to this type of assessment: 1) use existing or newly developed indicators of ecosystem health, 2) develop conceptual and/or quantitative models that predict ecosystem change, and 3) collect data over long time periods to determine the overriding processes. Each approach has associated positive and negative biases and uncertainties that should be considered. Arguably, these three approaches can and should be linked and coordinated to ensure data needs for each are met. Simply stated, proper planning and implementation to capitalize on all three approaches will provide the best evaluation of the status of the IRER program in terms of meeting the established restoration goals.

Indicators of Ecosystem Health

Summary indices have been used in the past to provide a general view of ecosystem condition. Their popularity stems from the fact that a relatively small amount of information need be collected to hopefully show overall condition because collecting information on every aspect of an ecosystem is not feasible from both a logistics and cost stand point. Many of the indices typically use an aggregation of several measured variables, or metrics, used to mark overall system health. This approach began initially by using specific chemical indicators of point source contamination for assessment and monitoring of aquatic systems (Karr 1991). However, there has been a growing body of evidence over the past two decades that shows one or a select few biotic and abiotic variables can provide much more meaningful ecological indicators that can aid in evaluating the full range of ecosystem condition and responses to restoration or disturbances in aquatic and terrestrial ecosystems (Karr 1991; Pajak 2000; Yoder and DeShon 2003). For example, monitoring programs like the U.S. Environmental Protection Agencies' (EPA) Environmental Monitoring and Assessment Program (EMAP) now include a variety of biotic indicators in addition to physical measures to estimate the condition of aquatic ecosystems (Hughes et al. 2000). These indicators take into account the physical condition of the environment, but also focus on various levels of the ecological hierarchy, including indicators of individual organism health or condition, population level metrics, and complex, multimetric indices that aggregate measures from multiple assemblages of organisms and their environment that reflect overall ecosystem health.

Good indicators, including complex and multimetric indicators, are useful for assessing and tracking shifts in resource condition because they offer easy comparability across regions. However, even though multimetric indicators such as Index of Biotic Integrity (IBI) have proven to be responsive to ecosystem change (Gammon and Simon 2000; Karr and Chu 2000; Bryce and Hughes 2003), the complexity of both the indicators themselves and their interaction with various stressors can present challenges to accurately and effectively communicating information to decision makers and the public (Schiller et al. 2001). Much of the controversy stems from the ambiguity and inherent variability associated with some of the measures used in the aggregation of measurements into an index. The exact process of the aggregation can be controversial and mathematically complex, and is usually conducted by specialized research scientists (Barber 1994; Schiller et al. 2001).

While such indicators provide valuable information, there are several uncertainties associated with solely using this approach. First, the spatial extent of this system is considerably larger than the ecosystems in which many of the biotic indicators were developed. This means that the transferability of IBIs and similar indices among catchments and at varying scales of inference (e.g., spatial scales) without careful consideration and evaluation may be limited (Angermeier and Karr 1986) and should be a strong emphasis for additional focused research. Another uncertainty with using indicators is that a reference condition is typically needed to establish responses. Most of the Illinois River Basin has been subjected to anthropogenic impacts (Sparks 1995). Locating pristine reference sites will therefore be unlikely and will have to rely on using historical data, conceptual and quantitative models, and the best professional judgement of the resource managers to establish restoration targets that reflect a reference type condition or restoration goal. Because this is not entirely an objective process, a considerable amount of variability can be introduced into an index at this stage. Given these uncertainties, indicators still remain a preferred method of assessing ecosystem responses because the philosophy is conceptually simple and they are also easy to relay to decision makers. An added benefit to using a suite of indicators is that the information used to calculate each metric can be easily used within an adaptive management plan. Much of the information collected can be readily used in newly developed metrics as knowledge of the system increases. Inherently the main focus of the monitoring framework should be to collect data that are appropriate to an iterative process whereby the indicators are evaluated for their effectiveness to measure ecosystem responses to the restoration goals. Therefore, the infrastructure of using indicators should include an ability to identify, evaluate, and implement existing and new indicators through focused research and evaluation. Conceptually, the linkages between the components of this process are shown in Figure 2.

Within the Illinois River Basin, there are many potential measures that may be useful in assessing goal-specific accomplishments in subject areas like geomorphology, hydrology, and biology (Tables 2-5). The list of variables in Tables 2 -5 is by no means comprehensive and provides only general categories from which information may be gathered throughout the basin. Much of the long term monitoring framework discussed below is aimed at identifying important information that can be gathered from these general categories. In many cases, the information can be broken into sub-categories or other measures of change like population metrics (e.g., Karr 1991) that may summarize information about the entire ecosystem. However, it is important to note that within these categories, useful variables calculated from this list should provide information that is ecologically meaningful, relevant to the spatial and temporal scales being measured, responsive to implemented restoration practices, provide benchmarks of progress in accomplishing the stated goals, and easily understood.

Conceptual and Quantitative Models

The second approach to assessing restoration activities is the use of both conceptual and quantitative models. This approach is important because it can provide valuable information into the iterative restoration process. Conceptual models can be useful tools in presenting a clear idea of how the ecosystem generally works and also may provide information about how resource managers perceive the effects of various changes.

Quantitative models capitalize on existing and new data as they are collected and are an integral part of the restoration equation. These models are useful to provide a more mechanistic understanding of how the ecosystem has responded to change (Bahr et al. 2003). The largest asset to modeling is that it goes well beyond simple data collection and can provide a more holistic view of the ecosystem. DeAngelis et al. (2003) further highlighted three main reasons for using models within a monitoring framework. First, models may be needed to evaluate restoration targets for indicators or measures that can be directly measured. Second, models formalize hypothesized causal relations that link restoration efforts to ecological outcomes. Finally, models provide a means of forecasting to evaluate outcomes of various restoration practices. Examples that may prove useful to the IRER program include models that evaluate sedimentation rates, changes in hydrology, and changes in biotic trophic interactions (bioenergetics). The drawback is that in some instances proper models are not well developed or information is often limited in either spatial or temporal extent thereby limiting the inferences and applicability of such models. Fortunately, the information put into the models will continually improve through additional data provided by the long term data collection efforts. This aspect highlights the fact that there should be an adequate balance between modeling and data collection so that both approaches can be simultaneously advanced.

Long Term Data Collection

Ultimately, the empirical data that are used for the indicator and modeling approaches will be collected through coordinated data collection efforts that will maintain a long term data string. While long term data collection is the foundation for both the indicator and modeling approaches, it also provides unique characteristics in that it can provide information about the underlying processes of ecosystem structure and function - both present and future. Additional information that is gained over time will also be invaluable to the indicator and modeling aspects of the monitoring program by making them substantially more robust.

Long term data collections can also provide a great deal of information about the statistical abilities of the monitoring framework to detect change. For example, Lubinski et al. 2001 evaluated the ability of the Long Term Resource Monitoring Program (LTRMP) on the Upper Mississippi River Basin to detect change at several spatial scales for several biotic and abiotic components. Lubinski et al. (2001) used existing data from the LTRMP to conduct a power analysis of several factors and found that the LTRMP sampling design, while having widely variable results, was relatively adequate to detect changes in water quality, aquatic vegetation, and fish data, but needed additional sampling for macroinvertebrates. Existing Illinois River data will provide some insight on how effective the data collection may or may not be, but similar types of evaluations should also be conducted on the IRER monitoring data set at appropriate intervals to document the efficacy of the program and also to identify areas that need improvement.

As the cumulative number of restoration projects increase throughout the basin, ecosystem responses are expected at many spatial and temporal scales. However, there are likely lags in any detectable changes in the ecosystem because it will take some time for the ecosystem to "stabilize" after construction or to reach some additive level where the ecosystem shows change. For example, as water quality improves at a restoration site, noticeable responses in biotic communities may take one or several years to allow the communities to respond to the new conditions through completion of life cycles and immigration. In this context, there is evidence suggesting the fish communities along the Illinois River improved at a lag of about 10 years in response to improved water quality (Pegg and McClelland in press). Unfortunately, very little published information is available to provide guidelines for identifying appropriate temporal and spatial inferences. The crux of this issue therefore is determining what constitutes the appropriate temporal and spatial scales for measuring change among each variable measured. The paucity of information in this realm then mandates that long term data be collected to not only provide insight into response times for the IRER program, but will also provide guidance for other restoration projects within the region and nation.

Report Structure

This report contains two chapters. The first chapter deals specifically with developing a long term monitoring framework. This monitoring protocol highlights an inter-disciplinary effort attempting to monitor all major characteristics of the river (e.g., water quality, geomorphology, biota). The bulk of this chapter focuses on identifying appropriate biotic and abiotic response variables that can be used to identify ecosystem change as a result of restoration practices.

This monitoring framework is defined at three distinct, hierarchical spatial scales to facilitate ecosystem response to the restoration goals and will also provide information that 1) characterizes the current status of the ecosystem (status), 2) tracks changes in the ecosystem through time at multiple spatial scales (trends), and 3) rigorously evaluates project specific management practices (evaluation). The broadest scale is the mainstem scale and will likely represent the cumulative or system-level improvements. Second, the sub-basin scale will be monitored to measure responses within a somewhat smaller spatial context than the mainstem effort. Because each discipline will be required to deal with this spatial scale in slightly different fashions to measure ecosystem responses, monitoring efforts highlighted at this level will be discussed in detail within each discipline. However, the spatial scales will generally be sampled at the Hydrologic Unit Code (HUC) 8 or HUC 12 levels (Figure 3). Finally, project-specific monitoring will be conducted to evaluate the implemented restoration practices. Project-specific monitoring should also provide a more rapid assessment (in relative terms) of biotic and abiotic improvements. This framework is designed to show ecosystem responses at all spatial scales to provide an easy assessment of the restoration targets identified in the IRER goals and objectives.

Within each spatial scale, the typical sampling design, sampling approach, and likely variables (or metrics) that should be measured will be discussed . Response variables will be discusses at two levels: 1) those that are critical and must be measured and 2) those additional variables that are desirable and would provide a significant amount of information, but may not be as immediately critical as those listed above. The cost estimates provided (Table 6) should be cost-indexed for future inflation. The data collected from this effort will be electronically stored and available via computer using technology already in place (e.g., Illinois River Decision Support System).

In the second chapter, we present a general summary of watershed assessment approaches. Watershed assessments are a crucial first step in identifying environmental degradation and also in identifying the action needed to fix problems. However, we present only the basic paradigms to appropriate watershed assessments because information beyond biotic and abiotic conditions (e.g., public opinion, economics, etc.) should be included and are beyond the scope of this document.

Coordination with Ongoing Sampling Efforts

There are several ongoing data collection efforts and programs (e.g., long term fish population study, hydrology monitoring, water quality monitoring, Long Term Resource Monitoring Program, etc.) within the basin that will likely be beneficial and complimentary to the proposed monitoring program presented here. These data are beneficial because they provide the only existing information about the current condition of the ecosystem. Although existing information is valuable, the existing programs are by no means comprehensive and leave many critical information gaps throughout the basin. However, a concerted effort to dovetail existing work with the proposed monitoring framework discussed here can provide much more valuable information than any one data collection effort could ever achieve on its own. In other words, the sum of all these programs can equal more than a simple summation of the respective parts. The composite set of information can then lead to more accurate data for detecting ecosystem improvements and will ultimately lead to more informed ecosystem management decisions. Therefore, the intent of the following monitoring framework is to complement the already existing programs to create a more comprehensive monitoring effort. Built into the framework is the assumption that existing data collection efforts are required to meet other objectives, in addition to the restoration monitoring. Therefore, they shall continue as such without direct financial support from the IRER. Coordinating additional monitoring with existing programs will provide gains in knowledge of ecosystem responses rather than compete. With this in mind, several important monitoring efforts are specifically discussed in the monitoring framework section as they may be integrated into the IRER monitoring program. Many other data sets exist that can also contribute significantly to the monitoring and assessment of the Illinois River Basin but may not provide as clear a link or be as readily assimilated into this framework. Therefore, a more comprehensive summary of these data sets may prove most useful in the watershed assessment phase and are summarized there.

Our intent is to recommend a wholly integrated monitoring framework across disciplines and spatial scales. However, in presenting the monitoring framework, we feel it important to specifically identify the types of data that each discipline/spatial scale requires to make appropriate restoration goal oriented assessments. This is merely a presentation issue within this report and in no way implies redundant data collection efforts are necessary. Rather, we envision data collection of variables common among disciplines (e.g., land cover, physical habitat measures, etc.) to be collected by the discipline that has the best expertise to collect the data. These data will then be provided among disciplines to create a fully integrated database.

Study Design – Statistical Approaches

Designing a framework that provides the ability to test hypotheses in a rigorous, statistical fashion is crucial to the success of not only the monitoring plan, but also the restoration activities being evaluated. Further, the value of such a program without this characteristic is severely reduced. There are several options that can be used to perform these analyses including trend analysis, regional references, Before-After Control-Impact (BACI) design, and iterative modeling as new information is gathered (as discussed in the project-specific sediment monitoring section). Each approach is useful, but exhibits desirable characteristics within certain disciplines that facilitate restoration evaluations. Therefore, we recommend a monitoring design that provides an opportunity to quantitatively measure ecosystem change in the following ways.

Trend Analysis

Many larger ecosystems pose unique problems that prevent experimental assessment using traditional approaches. The main problem is that in most cases, un-impacted systems of similar size, structure, and function are not available, thereby making either paired or replicated analyses impossible. In this instance, monitoring aspects of the system over long periods can provide the most robust approach in measuring system changes. The value of this approach is that the power in detecting overall changes increases with time because temporal variability can eventually be accounted for with a long enough time series of data. Therefore, we recommend a consistent and recurring monitoring effort at the broader spatial scales presented here.

Regional References for Sub-Basin Comparison

Regional reference sites are least disturbed areas within the same region as the treated sub-basin. Abiotic and biotic indicators of stream quality at the regional reference sites are used as benchmarks to assess changes in treated sub-basins once restoration practices are implemented. There are two basic approaches to establishing the regional reference condition (Wiley et al. 2002). The simplest is to use sites that have not been impacted or have a relatively low level of anthropogenic impacts for comparison among the impacted sites. Alternatively, when clearly identifiable reference sites are not available, Simon (2002) recommends regional normalization for the variables or metrics being measured. Regional reference condition normalization is an approach that uses statistical modeling techniques to estimate reference conditions. The mechanics behind this normalization are relatively detailed, but conceptually simple. The basic premise is that standardized comparisons are made against sites that have the least amount of impact in the region or target measures that are then used to gauge ecosystem responses to restoration or other management practices. A limitation to this approach is that the normalization will be required for each sub-basin or other spatial scales to which this technique might be applied to ensure applicability. However, given the paucity of un-impacted sites within the sub-basins of the Illinois River, this method can be very useful.

BACI Design

It is widely recognized that implementation of restoration/remediation practices in watersheds is our best hope of minimizing the impacts of nonpoint source pollution on surface waters. Accomplishing this in a cost-effective manner requires a much greater understanding of the large-scale effects of restoration practices on both physical and biotic attributes of aquatic systems. Such understanding is best obtained through carefully designed and controlled long-term experiments carried out at several spatial scales. The overall objective of this long-term monitoring framework is to develop and implement a scientifically sound monitoring program that will effectively detect physical and biologically meaningful changes in stream integrity in response to watershed management practices. Our study design was developed based on the experiences of other watershed remediation programs in the United States (Spooner and Line 1993; Wolf 1995; Wang et al. 1996) as well as our own experiences in the Pilot Watershed Program (Dodd et al. 2003).

A sound experimental design is essential to document a strong relationship between implementation of restoration practices and changes in overall stream quality as well as specific indicators of stream quality (i.e., macroinvertebrate and fish communities). The basic design advocated by Spooner and Line (1993) and Wang et al. (1996) involves the use of paired watersheds, in which only one of the two watersheds receives restoration practices. The paired watersheds should be as similar as possible in characteristics such as climate, geology, drainage area, aquatic thermal regimes, land use, and stream gradient. The experimental design used to assess the impacts of unreplicated perturbations is referred to as the Before-After-Control-Impact-Pairs (BACIP) design (Stewart-Oaten et al. 1986; Stewart-Oaten et al. 1992). In this design, paired samples are taken simultaneously (as nearly as possible) at the Impact site (i.e., where a restoration practice has been applied) and a nearby "Control" site. Replication is achieved by collecting such paired samples on a number of dates both Before and After the treatment has been applied in the Impact site. Each observed difference (e.g., in smallmouth bass density, sediment load) between the Impact and Control sites in the Before period is considered to be an estimate of the mean difference that would have existed in the After period had the restoration practice not been implemented. A time series of observed differences between the Impacted and Control sites is developed, and a change in the mean difference between the Before and After periods indicate that the system at the Impacted site has undergone a change relative to the Control site. Assumptions of the statistical model for this design are discussed in detail by Stewart-Oaten et al. (1992). The design can be augmented to allow increased ability to detect treatment effects by incorporating more than one Control site (Underwood 1991; Underwood 1994).

The ability of the BACIP design to detect effects of a treatment depends strongly on the number of sampling dates Before and After the treatment is initiated, the effect size of the treatment (defined as the difference between the average Before and After differences between the Impacted and Control sites), and the variability in the differences between the Impacted and Control sites in each period (Osenberg et al. 1994). Obtaining an adequate number of Before samples is crucial, because additional Before samples cannot be obtained after the treatment is initiated. Osenberg et al. (1994) showed that parameters that are measured (e.g., water chemistry, invertebrate/fish communities) can vary markedly in their ability to detect significant treatment effects. In addition to using larger scale data such as water quality or fish community characteristics at the watershed scale, Osenberg et al. (1994) suggests that parameters based on properties of individual organisms (e.g., growth rate) may be useful in detecting treatment effects, especially when the number of sampling dates is relatively small.

There are several spatial scales at which the BACIP design can be applied in watershed studies. For example, if we are interested in the local effect of a restoration practice (e.g., installation of a 1 km vegetated buffer strip), a Control site could be selected immediately upstream of the buffer strip, and measurements for the Impact site could be made within the treated segment. Assessment of sub-watershed and watershed-wide effects of restoration practices requires the use of a paired watershed to serve as the Control as well as incorporation of several sites throughout the Impacted and Control watersheds. In general, our approach will be to use the BACIP design to assess local, sub-watershed, and watershed-wide effects of restoration practices on the hydrology, geomorphology, and biological communities.

Long Term Monitoring Design

Bisbal (2001) identified five universal themes that are common among most monitoring programs. Those features include characteristics that:

1. All programs should measure attributes of environmental conditions and biotic inventory at relevant temporal spatial scales,
2. Research should be conducted to improve ecosystem understanding in both disturbed and undisturbed ecosystems,
3. Provide integration, coordination, and collaboration of efforts across organizations and geographic scales,
4. Ensure management decisions are based on the best and current information available, and
5. Predict future conditions and suggest hypotheses for future evaluation.

In this context, the long term monitoring framework we present here is designed to highlight the most critical data that need collection (i.e., minimum funding level) and additional information that would facilitate tracking or testing for ecosystem structure and function (i.e., ideal funding level) as they meet the goals and objectives of the IRER.

Responses can be measured at many temporal and spatial scales. The best means to track change is to ensure that the monitoring is conducted at the same scale as that applied to the restoration efforts. Therefore, we suggest a monitoring framework that encompasses three spatial scales to ensure responses are detected both in a timely and systemic manner. The first level of monitoring will deal specifically with responses in the mainstem Illinois River and its floodplain. This monitoring will likely give the best indication of changes in the overall system. The second level of monitoring will move away from the mainstem and focus on sub-basins or tributaries to the Illinois River. This scale of monitoring will likely provide information on the regional responses of the ecosystem to restoration or other factors that can facilitate change. Finally, we will monitor and rigorously evaluate restoration practices at the project specific level. This scale will provide the best ability to test the effectiveness of practices implemented on the project site using standard statistical designs (e.g., BACI).

Monitoring Plan

MAINSTEM

GEOMORPHIC MONITORING PLAN

Changes in the geomorphology of the uplands and river systems are complexly linked to the seven ecosystem restoration goals identified for the Illinois River basin. Basin geomorphology, including stream channel morphology and processes, landscape (uplands beyond the 100 yr floodplain) morphology and processes, and underlying geology, has direct implications for five of these goals:

- Reduce sediment delivery to the Illinois River from upland areas and tributary channels with the aim of eliminating excessive sediment load.
- Restore aquatic habitat diversity of side channels and backwaters, including Peoria Lakes, to provide adequate volume and depth for sustaining native fish and wildlife communities.
- Improve floodplain, riparian, and aquatic habitats and functions.
- Naturalize Illinois River and tributary hydrologic regimes to reduce the incidence of water level conditions that degrade aquatic and riparian habitat.
- Improve water and sediment quality in the Illinois River and its watershed.

In the Geomorphology Monitoring Plan (GMP) developed here, tools are suggested for measuring progress towards these goals. Geomorphology as a field encompasses a wide range of aspects of the physical and chemical environment. This plan focuses on providing an historical and spatial geomorphic context for the hydrology, sediment and habitat monitoring activities described in this document. At small scales, the GMP is mainly concerned with evaluating factors that affect sediment yield from the upland landscape, whereas at large scales the GMP is mainly concerned with the geomorphic response of stream channels to specific restoration projects. Sediment quality, water quality, and wetlands issues are also addressed.

Monitoring Goals and Objectives

The goals of the GMP vary with scale. Because monitoring is most successful when addressed towards particular research questions, monitoring at the project scale will seek to identify specific large scale responses of stream channels to particular restoration practices. At the mainstem and sub-basin scales, it is difficult to pose specific process-response questions, and to link large-scale projects to systemic changes (Rae 1995; Reid 1995; Lisle 1999; Watershed Professionals Network 1999). Therefore the goal of the GMP at small scales is to periodically assess indicators for trends in system "health" and to gauge progress of the IRER in reaching its goals. The goals of the GMP will be met by achieving the following objectives:

Provide baseline characterization of watershed geology and morphology.

Essential in the assessment phase is a comprehensive picture of the three-dimensional geology, materials properties, and configuration of the watershed. Assessment will cull from wide variety of existing and some new data to establish the current condition of the watershed and infer future response to change. This description of the physical setting is integral to all other monitoring and assessment activities.

Characterize anthropogenic and intrinsic changes in the watershed that affect water and sediment runoff (stream power and sediment yield).

Features such as precipitation, Impervious Factor, and BMP area have potentially strong influence on water and sediment runoff that are put into ISWS sediment budget model. Measurements could eventually become inputs to an upland sediment yield computer model that would be linked to the ISWS sediment budget for assessment of landscape sensitivity and prediction of sediment yield changes with changes in the watershed.

Determine intrinsic dynamical behavior of stream channels within each target watershed.

Rates of change of stream channels that are part of "natural" meandering behavior can be used to evaluate channel response to restoration measures. The objective is accomplished through analysis of historical air-photo data, and periodic surveys of channel pattern and morphology, and analysis of floodplain geology.

Evaluate impact of site-specific restoration projects, BMP implementation in floodplain and uplands, land use changes, and climatic variability.

Pre-project assessment and post-project monitoring of stream geomorphology is essential for evaluating success of each project. In addition, project effects must be compared to the long term effects of agricultural BMPs and other land use practices. These effects are not often reported, although they are expected to be marked and widespread. Changes in channel cross-section, bed and bank material, channel slope, and channel pattern are critical data for many ecosystem monitoring and assessment activities. Periodic surveys at ISWS streamflow monitoring sites and additional locations determined during baseline watershed assessments will provide the basic data.

Determine long term changes in sediment and water quality along the Illinois River and major tributaries.

In the Comprehensive Plan, it is assumed that objectives for meeting sediment and water quality goals will be achieved through progress in meeting the other goals. This assumption will be tested by periodic (~ 10 yr) review of reports from federal (USGS, USEPA) and state (IEPA) agencies, and a new IDNR sampling program to provide temporal and spatial control.

Provide measurements of change in channel and watershed geomorphology.

Continued observation of channel and floodplain adjustments to projects and watershed changes are critical to monitoring work of collaborating disciplines. A set of indicators appropriate for measuring progress towards restoration goals can be established from a broad suite presented here.

Review of Conceptual Models of Fluvial Geomorphology

Generally, models of stream dynamics and watershed processes can be divided into three groups, theoretical, empirical, and conceptual. Predictive capability of each of these model types varies. Theoretical models are based on mathematical and physical principles and can predict phenomenon very accurately under ideal conditions. Theoretical models serve as the basis for empirical and conceptual models. Empirical models are developed by collecting and analyzing data. Much of our understanding of fluvial systems has been acquired through the use of empirical models. Empirical models estimate the relationships between variables (e.g. drainage area and discharge) and therefore can characterize a geomorphologic process in a specific stream for the duration that data was collected. After empirical relationships have been established, scientists may attempt to extrapolate these relationships and make predictions. Conceptual models are developed from relationships derived from empirical and theoretical models, and help mangers and scientists to simplify difficult concepts by breaking them down into general categories. While conceptual models may aid our understanding of stream systems and facilitate communication among peers, the use of conceptual models for prediction of geomorphologic process for designing restoration projects is unwarranted. A model that is both applicable and useful to the Illinois River Basin should first characterize the geomorphologic relationships to determine rates and directions of change of processes in Illinois streams. Through characterizing geomorphologic processes, locations of sediment sources and sinks may be determined. Four of the dominant models in current fluvial geomorphologic thought are described below.

A Classification of Natural Rivers (Rosgen 1994)

Model description – The Rosgen method is a conceptual model, but is more accurately described as a classification scheme. The Rosgen-method "integrates", or rather indexes, variables through stratifying data from a wide range of physiographic and climatic settings into "stream types".

The expressed objectives of the Rosgen method are:

1. "Predict a river's behavior from its appearance."
2. "Develop specific hydraulic and sediment relations for a given morphological channel type and state."
3. "Provide a mechanism to extrapolate site-specific data collected on a given stream reach to those of a similar character."
4. "Provide a consistent and reproducible frame of reference of communication for those working with river systems in a variety of different professional disciplines."

Data needs – Table 7 lists information required for each level of stream inventory and the objectives of each level.

Model Assessment – The Rosgen method has received wide recognition and is potentially applicable to Illinois streams. However, the data on which the Rosgen method is based was largely collected from the western North America and New Zeeland. Therefore geologic, climatologic, and ecologic factors distinctive of the Midwest may not be well accounted for. More important, the reliability of the model for predicting of channel change is tenuous at best and has yet to be verified (Miller and Ritter 1996; Ashmore 1999). It may instead be limited to conceptualization of stream dynamics and communication frame of reference for resource managers (Juracek and Fitzpatrick 2003).

Miller and Ritter (1996) and Ashmore (1999) questioned several of the assumptions in the method presented in Rosgen (1994) as well as some of the variables (or metrics) used. Ashmore (1999) argued “that grain size and slope are the primary variables for channel design and that stream type is irrelevant.” He pointed out that empirically derived relationships do not require the classification of streams and that Rosgen classification ignores the accepted understanding of fluvial processes. Miller and Ritter (1996) gave a pointed discussion as to why the Rosgen classification cannot be used to formulate management outlined by Rosgen (1994). Perhaps the most problematic is that Rosgen classification does not consider climatic or hydrologic regime. As Rosgen (1994, p. 187) stated “Stream types can imply much more than what is initially described in it's alphanumeric title.”

The Rosgen method is based on data from natural rivers. By contrast, most channels and their watersheds in the Illinois River Basin are modified. Drainage (tiling, ditching, channelization) and pumping have greatly changed the hydrography and hydrology over the past two centuries (Thompson 2002, Prince 1997). In many cases it is likely that streams and their watersheds are still responding to settlement era modifications, not to mention more recent disturbance. Because restoration efforts will be focused on the disturbed and not natural systems, geomorphologic models based on disturbed system are likely more applicable and more useful for designing and monitoring restoration projects.

Channel Evolution Model for Incised Channels (Schumm et al. 1984)

Model description – Schumm et al. (1984) present a model for channel evolution based on data from several creeks in northern Mississippi. This model uses space for time substitution to represent change through time (e.g. evolution). The first step in developing the model is classifying stream reaches based on the dominant processes at work in each reach. Identifying locations of nickpoints by field inspection was central to classifying reach types. For example, uppermost reaches (upstream of the primary nickpoint in Oaklimiter Creek) were considered Types I, II, and III and were characterized as degradational with little sediment in the bed of the channel and erosion and sediment transport as the dominant processes. Lowest reaches were classified as Types IV and V and were characterized by sediment accumulation, meandering planform and stable alternate bars. In the Schumm et al. (1984) model for channel evolution it was determined that width to depth ratios discriminated between reaches that were in disequilibrium (unstable) and quasi-equilibrium (stable).

Data needs – Data for this channel evolution model were generated from Soil Conservation Service surveys. Morphometric data were either generated from cross-sectional and longitudinal surveys (i.e., width, depth, width-to-depth ratio, slope) or measured directly in the field (depth of sediment in the channel). Stage of channel evolution is determined based on these morphometric variables (Table 8).

Model Assessment – The model was developed for watersheds ranging from 50 to 400 mi^2. Schumm et al. (1984) stated that the predictive power of their channel evolution model is limited by the range of conditions on which it was based and size. Therefore this particular channel evolution model would only be applicable to Illinois streams if they are found to be in the same range of conditions including but not limited to size. Data similar to those collected for northern Mississippi streams would have to be collected to verify that Illinois streams fall within the appropriate range. The conceptual channel evolution model would not be directly useful for monitoring purposes, however procedures used to develop the channel evolution model could be used to measure change over time.

Channel Evolution Model for Disturbed Channels (Simon 1989; Simon 1994)

Model Description – Simon (1989, 1994) presents an empirical model of bed elevation adjustment in response to channel modification. The data collected on West Tennessee streams that were cleared of vegetation and modified by channelization. Simon observed that degradation occurred for 10-15 years upstream of an area of maximum disturbance (AMD) and aggradation occurred downstream of the AMD. Sites that were initially degrading after disturbance experienced a secondary phase of aggradation in response to excessive incision. From the results of this model, conceptual models of bank-slope development and modified channel evolution were produced. The key to applying these models is knowing when and where a channel disturbance or modification has occurred.

Data needs – To model bed level adjustment, aggradation/degradation rates were calculated using periodic bed level elevations at USGS and Corps gauging stations. Bed level adjustment can only be estimated for streams that have multiple gauging stations and where regular measurements of bed level are collected at several points along the stream. Elevation and discharge data needs to be collected over a sufficient duration as to encompass the channel disturbances (development or restoration). The conceptual models were based on observations of bank slope, bank material, ages of vegetation, bed-level adjustment among other factors.

Model Assessment – This model was developed from data collected in streams with watersheds ranging from 10 to 2445 mi^2. The techniques used in the model could be applied in Illinois streams of similar size where data is collected at multiple gauging stations (water, sediment, and bed level) or where data at a gauging station is supplemented by regular measurement of bed level at several locations along a stream of interest. If the density of bed elevation data points in space and time are sufficient this model could be applied to streams prior to restoration to characterize response to disturbance and therefore more efficiently apply restoration measures. Nevertheless, pervasive stream behavior as specified in the model has not been demonstrated for the Illinois River basin. The potential for using the bed elevation adjustment model for long term monitoring of restoration is high if monitoring networks are in place prior to restoration.

Relative Bed Stability index (Olsen et al. 1997)

Model Description – This assessment method works under the assumption that an increase in peak flows over time leads to increased channel instability. The authors propose a quantitative method called the relative bed stability index (RBS) to assess channel stability on the stream reach level. They generate RBS values for critical shear stress and critical unit discharge empirically for stream reaches in western Montana.

Data needs – This technique requires slope, discharge, and grain size data (D-50, D-84). After RBS's are calculated for several stream reaches, their percentage distributions give indications of how many unstable stream reaches exist. Field measurements include channel cross section, water surface slope, streambed particle size distribution, and field identification of bankfull stage.

Model Assessment – This method could be applied at the reach scale (project level) to assess channel stability. The RBS index could provide estimates of relative stability at the reach scale if baseline data were collected prior to project construction. The data used to develop this assessment technique were exclusive of many features inherent to natural streams (reaches with bends, pools, bars) and thus cannot account for horizontal instability (channel migration). This technique may be useful in assessing situations where excessive channel incision is occurring but may not be diagnostic for determining restoration measures.

<u>Summary</u>

Four geomorphologic models are assessed in this report. This is a very small sample of the potential pool of geomorphologic models, but it is representative of the range techniques available for geomorphologic monitoring of streams in the Illinois River Basin. Conceptual models are presented by Schumm et al. (1984), Rosgen (1994), and Simon (1989). While Rosgen's model may be useful as a communication tool, the Schumm et al. (1984) and the Simon (1989) models aid in communicating the nature of site-specific phenomenon by linking process to response (c.f., Juracek and Fitzpatrick 2003). The procedures used by Schumm et al. and Simon in developing their respective models could prove useful in monitoring change through time in stream channels in Illinois, and thus could also be used evaluate the success of restoration practices on a watershed, subwatershed or project scale. Olsen et al.'s (1997) method to assess relative bed stability is reach-specific and could be useful at project sites. Nevertheless, other more comprehensive procedures should be investigated.

Review of Existing Monitoring Study Designs

There is no comprehensive geomorphic monitoring presently done in Illinois, although there are a few monitoring programs that could be drawn upon. The existing stream monitoring network is a critical component and its features and shortcomings are described elsewhere in this document. Upland erosion estimates by county Soil and Water Conservation Districts have been ongoing since 1994, but the data are not statistically valid at any scale (Illinois Department of Agriculture 2002) and have to be carefully examined for usefulness in determining sediment yield or indicating landscape change. As annotated in Appendix A, datasets such as landcover, aerial photography, and Conservation Reserve Enhancement Program (CREP) records are potentially rich with geomorphic information, but considerable work must be done to extract and that information and to develop suitable analytical metrics. Water and sediment quality data are currently monitored at both the Federal and State levels, but methods vary significantly so that robust conclusions cannot be easily drawn.

We have reviewed geomorphic monitoring programs and research efforts directed at evaluating monitoring tools. The scales and scopes of these programs, which come from across several continents, vary considerably (Table 9). The best plans consider not only processes and products in stream systems, but link these to evolution of the surrounding landscape (e.g., Collins and Knox 2003; Harvey 2001; Simon 1989). Further, they are targeted with clear goals with defined endpoints (Rae 1995; Reid 1995; Lisle 1999; Trush 1995). The plans are tuned to regional or local requirements.

General guidance for developing a set of indicators for geomorphic change at small scales is provided by Osterkamp and Schumm (1996), Welch (2003), and USNPS (2000b). Osterkamp and Schumm (1996) suggested that monitoring the combination of flow and sediment yield would be likely to show long term, basin wide environmental change. Sediment yield could be assessed by monitoring slope soil profiles, using coring to determine sediment storage in floodplains, and other techniques. Welch (2003) developed a ranked set of indicators for monitoring in Canadian parks. The ranking considered relevance of the indicator to monitoring goals and environmental setting, degree of connection of an indicator with other indicators, and practicality of measurement. Although the exact list is not necessarily appropriate to Illinois, the conceptual model could be useful.

Many of the monitoring programs reviewed rely solely on observations of in-channel processes. In fact, geomorphic components are often restricted to flow gaging, sometimes including suspended sediment monitoring. By contrast, others (Rae 1995; Spittler 1995; Owens and Walling 2002; Rhoads and Miller 1999; Lisle 1999) found that ignoring beyond-channel or "watershed" processes severely limited the value of the monitoring, especially the ability to discriminate cause-effect relationships. Harvey (2001) is an excellent example of developing critical linkages between watershed and channel processes.

By way of summary, Table 2 lists 12 geoindicators after Berger and Iams (1996) that could be used to monitor geomorphic change in the Illinois River basin. Geoindicators are "measures of geological processes and phenomena occurring at or near the Earth's surface and subject to changes that are significant in understanding environmental change over periods of 100 years or less" (Berger 1996). Thus they have been selected because measurement methods with statistical discriminating ability have been demonstrated. Although the specific measures are not new, the geoindicators program has made a significant contribution by casting an extensive list of geological processes and products into a monitoring framework. The geoindicators framework has been used by the U.S. and Canadian national parks in resource management planning (USNPS 2000a; USNPS 2000b; McCarthy 2001).

Table 2 is comprehensive in the sense that some indicators overlap with other disciplines, while other indicators may have only local significance. Indicators selected from this list and exact methods used to measure them must address particular research questions at specific scales. At this stage of planning it is not easy to determine what will be the most useful indicators, although several are suggested below. Karst activity, for example, is relevant to only small portions of the basin and thus may not be immediately important. Several of the water and sediment quality parameters are already monitored to some degree by agencies such as USGS and IEPA, although we recommend additional sampling and small scale analysis here. Similarly, flow and suspended sediment protocols are being developed by ISWS.

Proposed Monitoring Plan

The Hydrologic and Sediment Monitoring Plan described elsewhere in this document is targeted at changes in sediment transport and delivery by streams. The Geomorphic Monitoring Plan complements that effort by focusing on changes in watershed or upland conditions affecting sediment yield (sediment derived from the watershed; the difference between yield and delivery is storage) as well as stream morphology. These analyses both feed on data acquired in other monitoring programs (e.g., flow and suspended sediment load) as well as feed back information on the physical setting for analyses within those programs.

Small scale monitoring, which is addressed at ecosystem restoration in the Illinois River mainstem and sub-basins, would most likely comprise periodic and general assessments of watershed condition. That is, investigation would be limited mainly to trend analysis, at least until ecosystem management covers a significant portion of an individual sub-basin. Monitoring at these scales should focus on factors that affect sediment yield, including climate, landcover, and soil erodibility (Table 2). Changes in these parameters indicate potential changes in sediment yield, which in turn can be compared to changes in stream carrying capacity of suspended and bedload sediment, and to sediment delivery as measured at stream gauging stations as determined in the Sediment and Hydrology Monitoring Plan. Predictions of sediment storage or removal from alluvial valleys can then be made. Wetlands are expected to be important features of restoration in the Illinois River Basin, but their use as a either a tool or a target of monitoring is complex. Wetlands in this context are discussed generally below. Improvements in water and sediment quality are expected to occur as secondary benefits of restoration projects. To determine progress towards these goals, a geochemical monitoring plan is suggested.

Critical Response Measures:

Stream Power and Sediment Yield – One objective in basin-wide geomorphic monitoring should to determine trends in parameters that affect stream power and sediment yield from the uplands. Stream power, a function of flow, channel slope, and channel morphology is an estimate of a stream's ability to erode and transport sediment, and thus is fundamental to stream channel dynamics (Rhoads 1995). A significant portion of the sediment currently transported by tributary streams is thought to be remobilized from pulses of sediment delivered from uplands and stored in floodplains during agricultural clearance of the watershed (Bhowmik and Demissie 2001). Sediment yielded from the uplands either is fed directly to streams or replenishes the supply of stored sediment. Thus monitoring watershed factors that influence the combination of stream power and sediment yield provides critical context to flow and sediment load monitoring proposed elsewhere in this document. Further, the combination of slope, landcover/landuse, soil erodibility, and hydrology can feed a robust model for upland sediment yield. Changes in the landscape that affect stream power and are likely to be sensible over 5-100 years include climate, landcover, and landuse (including land practices and channel modifications). Slope and soil erodibility are unlikely to change at small scales of analysis over this span of time. A basinwide analysis of these data should be conducted every 10 years.

People are perhaps the dominant geomorphic agent worldwide (Hooke 2000). Their activities are captured in landcover and landuse maps, although the potential effects are complex. The dominant activities in the IRB are urban and suburban development, agriculture, and transportation. Also important but smaller in areal extent is resource extraction (water, earth materials, etc.). Landuses are patchy across the landscape, each type may affect rates, volumes, or flow patterns of water and sediment runoff differently for specific types of precipitation events (Riggs and Ames 2000). Thus the scale of influence of any specific landuse or collection of landuses may be restricted (Niehoff et al. 2002).

Impervious factor (also 'imperviousness', 'impervious cover'), extracted from landcover maps or other data sources, has been used as an indicator of landuse in several of the monitoring plans we reviewed. It is the sum of societal hard surfaces that prevent infiltration of precipitation, and thus affect overland runoff, typically by increasing the onset and peakedness of flood discharges on hydrographs. The increased overland runoff may also affect sediment yields. Although landuse affects on ecosystems are complex and thus detailed analysis requires complex models, impervious factor is a good initial indicator of the effects of the built environment on system hydrology (Randhir 2003). Although commonly applied in urban regions (e.g., Zielinsky 2002), it has also been used in monitoring programs in non-urban settings (e.g., Water Resources Section 2002). Impervious factor is typically conceptualized as the proportion of a watershed that has been built upon; the effective impervious area (EIA) only includes built areas that are directly connected to the watershed drainage system. Effective impervious area thus includes street surfaces and adjacent sidewalks, driveways connected to streets, rooftops directly connected to a curb or stormwater system, and parking lots (Randhir 2003). Further, there are several ways of estimating impervious factor, and results may differ significantly (Endreny et al. 2003). It is important to note that mitigation areas are not typically included in determinations of impervious factor. A refined EIA metric could include credits for mitigation if a suitable data source could be found.

Climate changes that could occur over a period of decades and affect basin hydrology include storm intensity, storm frequency, temperature, and seasonality. Climate monitoring and research has a long history at the ISWS. These data need to be reviewed for implications of long-term trends on stream power.

Data Needs -- Landcover data are a rich dataset that attracts much attention because it is relatively easy to obtain and provides statewide coverage at moderate resolution. Further, the Illinois Department of Agriculture is expected to update the landcover dataset at 1 to 3 yr intervals (IDNR et al. 2003), providing the potential for a consistent and current dataset for long term monitoring. The existing dataset is adequate for regional (1:100,000 and smaller) studies. Research must be done, however, to assure that the landcover data provide sufficient accuracy in impervious factor estimates at sub-basin and project sub-basin scales, as well. Endreny et al. (2003) demonstrated that the source scale of impervious factor estimates has a strong affect on modeled watershed hydrography when scaling a calibrated BASINS model from a catchment (0.2 mi^2) to a sub-basin (400 mi^2). We recommend a pilot research effort to determine impervious factor from DOQQs using digital methods analogous to Endreny et al. (2003; see also ESRI 2003). This may increase the scalar usefulness of impervious factor as an indicator by an order of magnitude.

Regional climate data are obtained by the ISWS and reported from eight stations within the Illinois River basin subannually. These data should be sufficient to allow identification of long-term regional climatic trends that affect flow. If larger scale analyses are needed, however, it must be determined whether or not estimations of precipitation within a target watershed are sufficiently accurate from these data.

Slope can be determined from DEMs that exist at resolutions varying from 10m to 30m at 1:24,000. Higher resolution LIDAR data has also been captured for the DesPlaines valley. Although spatial coverage over the Illinois River basin is good, the accuracy of slope estimated from variably-scaled data must be assessed. Further, portions of this dataset are out of date and the dataset is mainly static unless new initiatives are begun. A static dataset could be a problem for project or catchment investigations because large scale slope changes can be significant over 50 years. For example, significant differences in slope from decades-old maps have been observed during ongoing mapping at ISGS. Nevertheless, regional slope evolution operates at much longer time scales, so current slope data may be sufficient for regional studies. A focused research project is suggested to address these issues.

Soil erodibility data obtained from USDA soil surveys are presently available basinwide as small scale (1:250,000) STATSGO data. Within a few years, all counties are expected to have large scale (1:15,000) SSURGO data that would be suitable for several scales of analysis.

Estimated cost: $75,000 for each decadal analysis assuming use of existing data.

Desirable Response Measures:

Agricultural and Planning BMPs-- Agriculture plays a dominant role in shaping the landscape of Illinois through cropping practices and drainage. Agricultural practices are influenced through several state and federal programs, but since participation is voluntary and the programs have independent and potentially conflicting goals, combined effects are not well documented. Presumably the general result is one of reduced soil loss (sediment yield) from uplands and increased direct runoff from drainage. Although the affects are complex, it would be useful to gauge progress in land management by comprehensively mapping areal coverage of BMPs. Possible indicators are percent area of watershed in BMP and percent area of contiguous BMP. Sub-basin wide data would have to be compiled from USDA-Farm Service Agency and Soil and Water Conservation District records. The format of records varies from paper to GIS-ready, depending upon the county. Agricultural BMP mapping provide an interesting comparison to impervious factor because their areal extents have a presumed inverse relationship.

BMP data could be extended to include runoff mitigation sites in developed areas. These would help refine impervious factor analysis. There is no known database of mitigation sites, although some may be maintained by county planners or approximations may be developed from developing areas where zoning requires runoff mitigation planning. Data mining and feasibility studies for database creations would be an essential preliminary step.

Estimated cost: $35,000 - $75,000 per survey.

Wetland Function – Wetlands play multiple roles in the management plan: as goals of the plan, as management tools, and as geoindicators. The existence of wetlands alone contributes to the goal of achieving biodiversity and habitat. In addition, wetlands are a management practice; increasing wetland acreage will increase the functions of wetlands and achieve other goals. For example, water quality improvements can be made by increasing wetland area, which will increase floodwater storage and remove more suspended sediment. Finally, wetlands and their functions are geoindicators that can be used to determine the state of watershed health, need for management, and success of management strategies.

Wetlands perform a number of known functions, including providing habitat for flora and fauna;

providing hydrologic functions such as flood control, stabilizing channels and banks, and sustaining low flows; providing water-quality improvements such as denitrification, removing sediments and adsorbed metals, and others. However, the quantity of each wetland function likely depends on the type of wetland and its setting.

Scope of current wetland research and monitoring

The vast majority of current wetland research and monitoring in the Illinois River Watershed is done on a project-specific basis. Different governmental agencies, non-governmental organizations (NGOs), and private companies and individuals are performing or funding wetland restoration and creation, and they require widely varying levels of monitoring. Significant wetland restoration and creation projects are either funded or regulated by federal and state agencies under various governmental programs, including the U.S. Army Corps of Engineers (Section 404), Illinois Environmental Protection Agency (319 Program), the Natural Resources Conservation Service (WRP, CREP), and others. Unfortunately, the data are not being collected in a systematic or uniform manner due to the differing guiding regulations. No known systematic wetland research or inventory is underway throughout the Illinois River watershed other than the National Wetlands Inventory from the 1980s, which is now out of date.

Establishing Goals and Monitoring

If wetlands are to be studied as a measure of the Illinois River watershed, it is first necessary to determine what wetland parameters need to be monitored. This can only be done in the context of the goals of the Illinois River management plan, because each function of a wetland will impact the goals of the management plan differently.

Unfortunately, the location of Illinois wetlands, the magnitude of their functions, and their impact on the management goals is not fully known and is not being determined by the project-specific monitoring that is currently underway in the watershed. Therefore, it is necessary to establish a research program that identifies and quantifies the functions of the various types of wetlands throughout the watershed and determines how each function helps fulfill the goals of the management plan. With that information, the steps that should be taken to maximize the benefits of wetlands toward fulfilling the goals of the management plan can be determined.

In the interim, it may be possible to use indicators or data collected at reference sites as a partial substitute for basin-wide data. Indicators may include such as total wetland acreage, duration and frequency of flooding, sedimentation rate, water quality, and others. Some goals, such as increased habitat and flood storage, are directly related to total wetland area, although the magnitude of the function provided by each type of wetland will differ widely. Other goals may not be described well by indicators, and it may be preferable to use studies of reference sites to infer the health, function, and status of Illinois wetlands before and after the management goals are being implemented. The few wetland studies in Illinois that identify or quantify wetlands functions may act as a guide to the indicators that can be used.

Estimated cost: None can be specified at this time.

Sediment and Water Quality - Goal 7 of the Comprehensive Plan calls for improvements in sediment and water quality. Progress towards this goal is expected to be the passive result of restoration projects not directed at sediment and water quality, however. Nonetheless, monitoring must be conducted in order to determine whether or not there is progress towards these goals.

Various federal and state agencies have monitoring plans for water quality and sediment quality (e.g., LTRMP 1999; IEPA 2002). They employ a wide range of biological, chemical and physical indicators to develop indices of the "quality" of the waters in Illinois. Results from these investigations are difficult to integrate, however. The level of spatial coverage and frequency of sampling vary from agency to agency. More importantly, results from different monitoring activities are not be readily comparable due to differences in sampling and analytical protocols. Stream sediments are often collected with various surface grab samplers with no further treatment (Rhoads and Cahill 1999). Other protocols specify variously subsampling sediment by wet or dry sieving at various size fractions ranging from 63 micron to 2 mm (Adolphson et al. 2002; LTRMP 1999; IEPA 2002).

To resolve these issues and to gauge systemic responses of sediment and water quality to restoration activities, a program should be established at IDNR to collect water and sediment quality data in key watersheds of the Illinois River. The program would obtain water and bulk sediment samples to be analyzed for a suite of nutrients, inorganic contaminants, and organic contaminants following methods of Rhoads and Cahill (1999). Monumented sites on high to small order streams would be reoccupied cyclically complete a basin-wide assessment every ten years. Robust statistical techniques have been developed for evaluating temporal and spatial trends in geochemical data, although they may require tuning to the specific needs of this project (Singh 1993; Singh and Nocerino 1995; Singh et al. 1994). A manual for standard methods of collection and analysis would be developed to ensure long-term data reliability. Elements of both a critical and desired program are outlined below. These programs are in addition to those suggested in the Aquatics plan, because the Aquatics protocols are specifically directed to habitat and fish-toxicity issues.

The decadal analysis of the dataset would include a survey of results from other geochemical monitoring programs.

Phase I (Critical and Desirable Programs)

1) Identify the lead agency and PI for project. 2) Prioritize stream sampling locations. 3) Develop sampling, analytical and data storage procedures. 4) Hire a fulltime field/database technician (s).

Estimated cost: $35,000 to $70,000.

Phase II (Critical Program)

Stream water and sediment samples will be collected annually from major tributaries to the Illinois River and 10% of the watersheds or surface area. Annual sampling will be cycled so that all watersheds are sampled at least once sampled in ten years. Five key sites will be sampled annually. Approximately 250 water and 125 surface sediment samples should be obtained. Water samples will be analyzed for nutrients, inorganics and standard water quality parameters ($14,000). All sediment samples will be analyzed for nutrient and inorganic contaminants, and a subset of 50 will be analyzed for organic contaminants ($28,000).

Estimated cost: $95,000/year, including supplies, overhead, and 1 FTE.

Phase II (Desirable Program)

Stream water and sediment samples will be collected from major tributaries to the Illinois River and 20% of the watersheds or surface area. Annual sampling will be cycled so that all watersheds are sampled at least once sampled in five years. Ten key sites will be sampled annually. Approximately 500 water and 250 surface sediment samples should be obtained. Water samples will be analyzed for nutrients, inorganics and standard water quality parameters ($28,000). All sediment samples will be analyzed for nutrient and inorganic contaminants, and a subset of 100 will be analyzed for organic contaminants ($56,000).

Estimated cost: $185,000/year, including supplies, overhead, and 2 FTEs.

ECOLOGICAL MONITORING PLAN - AQUATIC

The mainstem Illinois River is comprised of six impounded reaches of varying lengths and habitat characteristics. The upper river is generally characterized as a narrow valley, with a more swift current due to a higher gradient. The lower river has a lower gradient and is characterized as an alluvial floodplain (Starrett 1971). These physical differences translate into distinct differences in geomorphology as well as habitat structure and complexity and may, in part, contribute to divergences in biotic and abiotic variables between the upper and lower river (Baker et al. 1991; Lamouroux et al. 1999). For example, recent studies of fish populations in the Illinois River have suggested two distinct fish communities that are consistent with geomorphic differences (Pegg and McClelland in press). The first community is generally comprised of the lower three pools; whereas, the second community is made of fishes found in the upper three pools. This and other similar information provides useful insight into how monitoring data should be collected along the mainstem Illinois River. Further, any data collected at this level should provide information at resolutions covering impounded, upper/lower division, and entire river to assess ecosystem responses in the context of the restoration goals is recommended. Therefore, a sampling design that ensures complete coverage of all pertinent hierarchical scales.

Sampling for aquatic biota will be structured in a stratified random block design with dominant habitat types being the lowest sample unit. This is a common experimental design and one that is currently used through the Environmental Management Plan's (EMP) Long Term Resource Monitoring Program (LTRMP) of the Upper Mississippi River Basin. While the variables that should be measured along the Illinois River may differ slightly from that of the LTRMP, the proposed sampling framework will philosophically follow the LTRMP's design in most respects (e.g., Gutrueter et al. 1995). The premise of this design is that the sample sizes are structured such that they are weighted by the size of a given study reach and the available habitats found within that reach.

Measurable changes in biotic communities to restoration practices will likely occur through both relatively simple, direct responses as well as through more complex secondary or higher order interactions. The organisms that can provide information on these responses are varied and complex in themselves ranging from microscopic fungi to larger fish and water birds (Table 3). All of these taxa can provide valuable information, but some are better suited for monitoring due to sampling logistics and public/scientific perceptions of value. Therefore, it is critical to enure that any taxa measured will provide meaningful information towards detecting systemic transformations. The following provides a general overview of the critical and desirable response measures (with their associated justifications) for monitoring on the mainstem Illinois River.

An important aspect to note is that the sample sizes recommended for each measure do not indicate exclusive sampling efforts for each measure. In most cases, data needed for each measure will be collected simultaneously at each site to improve cost efficiency.

Biotic indicators used to assess ecosystem health and responses to restoration are not well developed for larger rivers like the Illinois River, but there are a few regionally developed indices that may provide some broad initial guidance on community responses until an Illinois River specific index can be developed (e.g., Wisconsin River and Ohio River indices) through focused research. Developing ecological indicators for large rivers presents several challenges relative to non-wadeable streams. Reference sites are absent, since nearly all large rivers in temperate latitudes have been significantly altered (Benke 1990; Dynesius and Nilsson 1994). Natural variation in life-history, adaptations to environmental conditions across a biological hierarchy, and within indicator metrics (e.g., richness, growth, proportion of large river species) is much greater within the geologic, climatic, latitudinal, and longitudinal landscape of rivers than for wadeable streams where many of the existing indices were developed. For example, tolerance to turbidity in native riverine fishes is an important variable used in many indices. However, the actual measured metric can have highly different meaning in the context of where the fish evolved. Much of the mainstem Missouri River has historically been very turbid and the fish are therefore well adapted to high turbidity, whereas natives fishes in the upper Mississippi and Illinois rivers are less well evolved to cope with high turbidity conditions. The interpretation of a high score in the turbidity tolerance metric could then have very different meaning depending on which system is being assessed. However, the need to communicate environmental information to decision makers in an understandable fashion is essential if ecological assessments are to affect public policy and benefit the resource. The challenge for developing ecological indicators in any focused research will be to disentangle the complex interactions between natural environmental variation and effects of human activity on the landscape (Bryce and Hughes 2003), and effectively communicate this information to the public (Schiller et al. 2001). However, we expect that some elements of this mainstem data set will likely show ecosystem responses in terms of the restoration goals. Many of these elements will likely be included in any indicator developed for the Illinois River and will therefore still provide valuable and meaningful information on their own. These measures may include items like shifts in community composition, improved abundances of native species, and many of the same metrics calculated in the sub-basin and project specific evaluation scales (Table 4) as structure and function are systemically improved. The thrust of the proposed monitoring effort therefore is focused on judicious data collection that will provide insight into individual biotic responses and also feed information into a myriad of potential comprehensive biotic metrics that can be used to measure ecosystem responses to the IRER goals.

Critical Response Measures:

Fish - Fish have been used widely in the past to document changes to various ecosystems (e.g., Karr 1991). This group of organisms are valuable because they are found throughout the mainstem Illinois River and provide a cumulative reflection of many trophic levels to environmental changes including many of the expected changes that will occur through the IRER efforts. Additionally, a large amount of information can be gathered on this group with a relatively small amount of effort including species distributions, changes in species richness, changes in community structure and function, population dynamics data, growth rates, and many other categories that have all been used to classify the 'health' of fish communities (e.g., Karr 1991). These responses can also be measured at multiple scales (i.e., mainstem, sub-basin, local) and through time that increases our ability to integrate our findings across multiple spatio-temporal scales. Finally, this group is an ideal selection for monitoring because the general public has at least a basic understanding of what changes in fish communities mean to an ecosystem.

The fish data collected through this monitoring effort will supplement three major on-going monitoring efforts in the basin 1) Long term fish population monitoring (F-101-R), 2) annual sampling by the IDNR through F-67-R, and 3) the LTRMP. All three data sets provide valuable information on the existing and historic conditions of the Illinois River in some capacity. However, each is limited in either spatial and/or temporal coverage of the mainstem. For example, the LTRMP samples fish populations throughout the La Grange Reach using a multiple gear approach, but provides no information on the remainder of the river. The other two projects are similarly hindered in that they sample at sites located throughout the mainstem river, but are conducted in only certain habitats and over a very limited time frame each year (late summer/early fall) and use only electrofishing gears that is biased toward sampling only shoreline habitats. Therefore, the proposed monitoring framework presented here should attempt to fill in the spatial and temporal data gaps to provide the best information possible on the fish community responses to the restoration goals. Ongoing research is attempting to evaluate the compatibility of these three data sets for future analyses but the results are not expected for some time. However, the LTRMP efforts use a multiple gear approach to characterize the fish community within a broad range of habitats (i.e., mainstem, side channel, backwater) compared to the other two projects. This aspect of the LTRMP is highly desirable and makes it a favorable approach the proposed framework should build upon to provide easy comparability.

Fish sampling protocols on the mainstem will typically follow the LTRMP with respect to gear selection, site selection, and data gathering (Gutrueter et al. 1995). Information from other reaches collected for IRER monitoring will therefore easily dovetail into existing data and monitoring efforts that should strengthen the overall capabilities of this monitoring program. However, a significant variation to the LTRMP sample design is that we recommend collecting seasonal fish data as weather conditions allow to provide data on seasonal habitat use and distributional patterns. Specifically, winter sampling will not breach the compatibility of the LTRMP and IRER data sets. Rather this adds an additional temporal dimension that is lacking in the LTRMP effort.

Linking existing with new data collection efforts can be relatively easily accomplished by simply expanding the level of effort used in the LTRMP to include the remaining reaches of the Illinois River that are not currently being sampled. The main assumption here is that the power to detect changes in the fish community will be similar to Lubinski's et al. (2001) findings for the Upper Mississippi River Basin. For example, annual LTRMP fish sampling in the La Grange reach typically collects about 450 samples per year from the dominant habitats available during the summer and fall. If this level of effort is scaled up to the entire length of the mainstem, then a proportionate number of samples that should be collected from the rest of the river would total about 1,100 over the same time frame. An additional river-wide effort of about 520 samples collected during the winter months should also be incorporated into the monitoring framework to ensure over-winter habitat use issues can be addressed. This level of effort is assuming all dominant habitats (main channel, side channel, connected backwater, unconnected backwater) sampled in the La Grange Reach are available in the same proportion throughout the river. Because the upper half of the river does not have an extensive floodplain like that of the lower river, it is reasonable to expect the actual number of sample sites to be scaled down appropriately as habitat availability is quantified throughout the basin. Therefore, the suggested sample sizes here should represent the maximum number of samples to be collected.

Aquatic Vegetation - Aquatic vegetation is an important component of riverine ecosystems because it provides nutrient remediation characteristics, stabilization of sediments and also provides habitat and food for many aquatic organisms. Therefore, aquatic vegetation is highly sought after and establishing or maintaining stands of aquatic vegetation have been the crux of many habitat remediation efforts along the river. Vegetation may also provide local and regional response information to restoration practices. In the lower half of the Illinois River, vegetation responses could be a very effective measure of the status of naturalized water levels (Goal 6) because it is currently thought that rapid and extreme water level fluctuations that presently occur are limiting factors for vegetation in the main channel border, side channel, and connected backwater habitat areas. Furthermore, because all dominant habitats will be sampled, aquatic vegetation data can be used to compare management strategies (i.e., connected vs. unconnected backwaters).

Submersed and emergent aquatic vegetation will be monitored using standard LTRMP sampling techniques (e.g., rake, quadrat, transects; Yin et al. 2000) at the same location fish sampling occurs. Where feasible and/or available, remote sensing technologies will also be used to measure stands of vegetation at all spatial scales. Remote sensing may considerably reduce field costs for this data collection effort in the future. Unfortunately, the costs are currently inhibitive and will require the vegetation monitoring to establish and maintain a large field component at present.

Macroinvertebrates - One of the more important taxa that can quickly identify localized changes in mainstem habitats are macroinvertebrates (excluding freshwater mussels). These taxa are important not only because of their rapid response to environmental change, but they also play a significant role in food web dynamics by breaking down organic matter into useable nutrients for themselves and other lower trophic organisms and also by providing a food source for higher trophic organisms like fish, birds, reptiles, and amphibians.

A limitation to using macroinvertebrates is their lack of mobility. Therefore, presence or absence of a species or group of species will likely provide localized to regional information on responses to the IRER efforts. However, their importance to the ecosystem warrants continual assessment at all spatial scales possible. Sampling methodology will should generally the ponar grab sample method used by LTRMP. This effort samples macroinvertebrates in all the dominant riverine habitats, but is limited in both temporal sampling and the level of analyses. The LTRMP effort currently only samples macroinvertebrates during one season (spring) at about 120 random sites (stratified by available habitat) within the La Grange Reach. These efforts should be expanded to include the entire basin and at least seasonal (4 times/year) sampling, if not a more frequent level of effort. Therefore, the level of additional work would be considerable (about 1,550 samples annually), but will likely provide more immediate response indicators than fish or aquatic vegetation that have longer life-cycles. Within this context, the macroinvertebrates should also be identified to the lowest taxonomic level possible rather than grouped into a few large categories as is the current standard protocol for the LTRMP (Thiel and Sauer 1999). Taking this approach will not preclude these data from integration with the LTRMP data, but will provide considerably more information on communities and their responses to the restoration goals beyond the very general information that is currently provided.

Water Quality - Water quality, while not a direct measure of biotic responses, can be extremely useful in measuring biotic associations and reactions to newly created environmental conditions. We propose to measure physical attributes of water quality like turbidity, conductivity, and flow rates as well as variables that can give information on nutrient availability like total nitrogen, total phosphorus, chlorophyll-a, etc. Data will also be collected to assess general habitat characteristics (e.g., substrate type, amount of structure, etc) of sample sites where biotic data collection occurs.

Standardized water quality sampling has been well established by the EPA, USGS, and other organizations. Many of those aspects have been included in the LTRMP protocols and we therefore recommend following the LTRMP water quality sampling protocols (www.umesc.usgs.gov/ltrmp.html). However, the location for sample selection and timing though should be slightly modified and will be at two levels. Ideally, a full suite of water quality and physical habitat data should be collected where any biotic sampling occurs. These data will be used to identify causal relations between physical and chemical improvements in the system. However, completing a full suite of water quality parameters for each site is not feasible. Therefore, physical water quality and habitat information (temperature, conductivity, dissolved oxygen, etc.) will be measured at each site, but other water quality information (nutrients, anions, cations) will only be collected at about 10 percent of the biotic sample sites from each habitat and reach combination.

Secondly, water quality monitoring should be at regular intervals (e.g., bi-weekly) throughout the year at a select few sites within each reach. The exact total number of sites should generally total less than 10 per impounded reach. Key sites would typically include headwater and tailwater, main channel, major side channel, tributary confluences of major tributaries, and other important sites as determined by the U.S. Army Corps of Engineers and State of Illinois.

The water quality monitoring effort described above does not include monitoring efforts that measure toxic chemicals (e.g., PCBs, atrazene, etc.) and heavy metals (e.g., mercury). These parameters are being adequately measured by existing water quality monitoring efforts through the USGS (National Water Quality Assessment program), USEPA, and the Illinois Environmental Protection Agency. Therefore, there is no need to expand the sampling effort in this area of water quality monitoring. An added benefit to using these data is that in many instances these contaminants are also measured in fish tissue providing another link between biotic and abiotic responses to ecosystem improvements.

Zooplankton - One potentially valuable indicator of system productivity that is not currently measured through any existing monitoring program is zooplankton. These organisms are at the lower end of the food-web and may be valuable indicators of system productivity. In this context, zooplankton may show the most rapid systemic response to IRER restoration goals due to their position in the trophic level. Very little information is available on zooplankton communities throughout the river other than a few short-term studies that have largely focused on ancillary issues to monitoring such communities (Kofoid 1899; Emge et al.1974; Goodrich 1999). Therefore, it will be important to collect zooplankton community structure and abundance data throughout the river. Sample collection is relatively simple and should follow methods highlighted in Lemke et al. (2003) or similar sampling protocols at sites where other biotic information are being collected.

One drawback to this approach is that identification can be time consuming and require a relatively high level of training in the laboratory. However, their ecological significance makes them a desirable taxa to monitor. A simple means to determine the scale of information needed will be to evaluate zooplankton community and structure data through focused research at the beginning of the monitoring effort. This evaluation will primarily use saturation curves to refine the exact number of samples required to make sound assessments of this diverse group of organisms without losing significant information.

Estimated cost: $525,000 for the first year and $475,000 for subsequent years.

***Desirable Response Measures*:**

Mussels - Freshwater mussels are likely one of the more sensitive groups of organisms to environmental change in lotic systems. They are certainly one of the most threatened groups of organisms in North America and as a result warrant attention (Cummings 1991). Multiple gear approaches have been used in the past to characterize mussel communities suggesting a multi-gear approach as most the effective sampling approach to gather information. Typically these gears include using divers, braille rails, and dredges. Using these collection techniques can also be somewhat cost inhibitive. This is especially the case if divers are required as this type of diving necessitates better than entry level expertise and experience. The typical life-cycle of these organisms is such that measurable responses to ecosystem improvement may take may years. However, freshwater mussels are extremely sensitive to negative changes in environmental conditions. This makes mussels a valuable data source because they may be good measures to an unexpected biotic response from management practices or restoration efforts. There are some limited data collection efforts in the Illinois River that are conducted by the IDNR during commercial harvest periods. However, these data are usually limited to a specific area that is marked for harvest each year and not comprehensive. Data collection for this taxa would likely be somewhat different than that identified for the other biotic components. Community measures would largely focus on sampling known mussel beds to monitor shifts in communities at representative locations throughout the river.

Estimated cost: Additional $75,000 per year.

ECOLOGICAL MONITORING PLAN - TERRESTRIAL

In its pristine condition the Illinois River watershed was a very diverse system. Communities associated with the riparian zone alone included upland forest, mesic prairie, wet meadow, shallow marsh, deep marsh, shrub wetland, floodplain forest, deep water, channel, shallow water, and hill prairie (U.S. Fish and Wildlife Service). Diverse plant communities along the river supported incredible wildlife abundance and diversity with may species highly adapted to specific habitat conditions. The river and its wetlands were once considered one of the most productive fishing and waterfowl hunting areas in the United States (Bell 1981).

Many wildlife species still spend part of the year along the Illinois River and the streams in its watershed, from year round residents to species found there only during migration, and entirely terrestrial species to those found on land for brief but critical stages of their life. Wildlife use the Illinois River, its tributaries, and the lands found along them as a continuum and the boundaries of legally defined floodplains, riparian zones, and wetlands mean little to animals. In addition, the aquatic-terrestrial interface is dynamic, at one time changing gradually on a seasonal cycle, now it changes rapidly and on a much shorter cycle. Rapid changes in water depth and position of the interface force major changes in wildlife distribution and use of habitat. Many wildlife species found in the watershed have declined significantly. For some species, such as waterfowl, declines are well documented, but relatively little is known of the current and former status of many others.

Monitoring of wildlife abundance and quantification of their habitats is very intensive. Even species that use similar habitats require different sampling methodologies. Therefore, indicators have drawn interest for monitoring of environmental conditions and methods have been tested using birds and amphibians. Wildlife are particularly attractive as potential indicators because they integrate the cumulative effects of environmental stresses. Across species groups there may be redundancy in their responses. However, due to differences in the ecology of different species and species groups, and because some species are subject to stressors outside the Illinois River system none can be used as a single indicator for all the others. Many species have become so rare that they warrant monitoring their status alone.

Maintenance and restoration of community and species level biodiversity is an over arching goal of the Illinois River restoration program. Biodiversity within the Illinois River basin is an important component of biodiversity within the state of Illinois. Many wildlife species by themselves integrate factors at multiple spatial scales and specific relationships are difficult to quantify, but wildlife components taken together provide an excellent biodiversity and system integrity indicator for the Illinois River watershed as a whole.

Wildlife monitoring is intended to build on current monitoring programs. However, because most programs are not designed to assess conditions strictly along the Illinois River and its tributaries, do not collect data at enough points for a statistically useful sample at the sub-basin or watershed scale, or are not designed to evaluate responses from restoration efforts, they do not adequately provide for the needs of this program. The objectives of the wildlife/terrestrial monitoring component are to use wildlife and terrestrial vegetation measures to quantify habitat conditions and indicate watershed protection, to suggest protocols that can be used to assess wildlife and vegetation response to restoration, and provide measures that are scientifically sound and interpretable by the general public. Wildlife and vegetation monitoring should compliment other aspects of the overall monitoring program. Development of this monitoring protocol is ongoing and must remain adaptive after monitoring begins.

Some data will only be collected along the mainstem, some only in sub-watersheds, and some will be collected in both areas. Monitoring of critical response measures includes 10 programs with 14 components (Table 5). Some components rely entirely on analysis of data collected under existing programs or require adding additional sampling points to existing programs. Other components use existing programs as a framework to build a program designed specifically for the Illinois River watershed.

Sampling Considerations & Data Analysis

Caution should be exercised in evaluating the results of restoration practices. Many projects, for example riparian forest establishment, will take time to develop and anticipated species response could take many years. Intensive monitoring of birds, plants, and amphibians should detect subtle changes and document restoration trajectory.

Data at specific monitoring points, project areas, within sub-basins and mainstem, and for the entire watershed should be evaluated over time. Data should be summarized and reported at each spatial level to indicate status and success of restoration activities for each scale. Statistical comparisons between sampling units should be avoided but qualitative comparisons can be made.

Sauer et al. (2003) provides an excellent treatment of considerations and analyses for estimating population change for different types of monitoring data. For monitoring components surveyed annually, an assessment should be made after 5 years, incorporating observed variation, to determine if sample sizes are suitable for detection of response and whether strong relationships exist between variables.

Critical Response Measures:

B. Wetland habitat communities in floodplain - Landscape assessment using remote sensing is a powerful tool for quantifying small scale patterns and major habitat deficiencies. However, wildlife utilize habitat at much larger scales and remote sensing is inadequate for accurately distinguishing different community types. Aerial/photographic survey of floodplain habitat or spatial assessment with intensive ground-truthing provides a more accurate and detailed assessment of the amount of each wetland community type within the floodplain. This is particularly important because a change in wetland community by degradation may remain undetected using only remote sensing and many wildlife species, while sensitive to landscapes, make use of habitat at smaller scales. In addition, several important wetland community types (i.e., submergent, floating leaved, emergent, and moist soil) have become rare along the Illinois River as a result of major hydrologic fluctuations.

The USGS Upper Midwest Environmental Sciences Center provides a community level coverage along the Illinois River mainstem for the Long Term Resource Monitoring Program (LTRMP) once every 5-10 years. A sub-community level classification is produced for the entire mainstem using a combination of aerial photography and expert interpretation. The LTRMP community level data should be used to monitor changes in community composition over time for the entire mainstem, river segments, and for project areas. Community level assessment of sub-basin riparian areas is not recommended because of lower overall diversity of communities in sub-basins and cost to complete classifications for all riparian area throughout the watershed.

Community level assessment relates to Illinois River restoration goals similar to landscape level assessment but at a higher spatial resolution. Vegetative communities along the Illinois River mainstem have been affected primarily by altered hydrology and sedimentation. Vegetative response in some mainstem wetlands has been rapid when hydrologic conditions have been temporarily restored during drawdowns or drought (USGS 2003). Therefore successful hydrologic restoration is the key, and combined with measurable reduction in sediment could result in rapid increases in target plant communities.

Estimated cost: $1,000.

D. *Waterfowl* - Historically the Illinois River was a nationally significant waterfowl area with wetlands along the river providing important feeding and resting habitat for waterfowl during migration (Bell 1981, Havera 1999). The Illinois River still provides important waterfowl habitat, however, years of surveys have documented dramatic declines in waterfowl along the river. While many waterfowl species have declined in numbers resulting from loss of habitat in their nesting areas, the decline in use of the Illinois River can also be attributed to habitat loss and degradation and a resulting shift in migratory stopover patterns. For example, diving ducks were once found in large numbers along the Illinois River but shifted their use to the Mississippi River and other areas following the loss of their preferred food sources (Havera 1999). Differences in habitat preference among waterfowl species make their numbers a potential indicator for many habitat types.

The proposed waterfowl monitoring program will supplement existing fall and winter surveys conducted by the Illinois Natural History Survey (INHS) and the Illinois Department of Natural Resources (IDNR) by reinstituting spring migration surveys. The spring surveys will be used to determine waterfowl response to spring habitat conditions. Spring surveys should be conducted weekly from mid-February through April. Selection of monitoring sites for both spring and fall/winter surveys should be based on the experience and expertise of INHS & IDNR biologists. However, monitoring sites should not be limited to areas that already support high numbers of waterfowl resulting from higher quality habitat. Monitoring of potential or historically important waterfowl habitat areas may be a means to track restoration progress. In addition, the list of potential monitoring sites should be updated periodically to include new areas that develop following restoration efforts.

Waterfowl species that still make use of the basin are expected to respond quickly to changes in habitat conditions. Some annual change in waterfowl numbers reflects habitat quality on nesting grounds. Differences in migration use-days between Illinois River habitat areas probably better reflects relative habitat quality between sites. Species with reduced use of the Illinois River basin may take longer to respond depending on the level of change and the annual variation of habitat conditions for different areas.

Monitoring of waterfowl relates strongly to restoration goal one of restoring and maintaining a diverse waterfowl population and sustainable populations of all species. Waterfowl should also respond to improved aquatic habitat diversity and efforts to improve riparian habitat and function.

Estimated cost: $38,000.

E. Wading birds and cormorants - This group includes relatively common species such as the great blue heron and several rare species listed as endangered or threatened. Optimal habitat for wading birds depends on very specific hydrologic conditions. Ideal conditions allow backwaters to fill from the adjacent river during flood stage allowing fish to enter, followed by a slow draw-down which creates foraging opportunities for these birds as fish are stranded in small pools (Gawlik et al. 2003). These conditions are most critical for medium and small wading birds because they tolerate a narrower range of water depths. Hydrologic conditions along much of the Illinois River prevent adequate fish use of wetland areas or appropriate foraging conditions for most species.

Colonial nesting waterbirds are also sensitive to disturbance and rookeries are typically found some distance from high levels of human activity. Most species prefer mature trees for placement of nests. High mortality of floodplain forest trees has resulted in fewer potential nest sites in some areas.

Monitoring will include an aerial survey conducted annually to document rookery locations, followed by intensive ground monitoring of all known rookeries to document the number of active nests. Monitoring will be confined to rookeries found along the Illinois River mainstem. If monitoring of all mainstem rookeries becomes cost prohibitive, a random sample can be selected for monitoring. However, all nest areas that contain cormorants, rare herons or egrets should be monitored. Data should be used to document and map all rookeries, and summarized by number of active nests by rookery and by species.

Herons, egrets, and cormorants are good indicators of hydrologic conditions, fish populations, and riparian forest structure. A response in rookery distribution and numbers will be most rapid following hydrologic restoration, provided nest trees are present in an area. Anticipated response time is 5-10 years. Species diversity and abundance of colonial nesting waterbirds is expected to increase at the mainstem level over a longer time period following restoration progress, including forest maturation.

Estimated cost: $25,000.

G. Shorebirds - Many species migrate through Illinois in large numbers but few species breed here. Most shorebirds require protected beaches or predator-free islands for nesting, and show high fidelity to nest sites. The altered hydrology and flows on the Illinois River have eliminated stable islands. Suitable foraging habitat is found in shallow water areas and mudflats, but major water level fluctuations results in this habitat being present for short periods.

Shorebirds make use of a range of areas during migrations. Some species use ephemeral wetlands in agricultural fields as stopover habitat during wet springs. Similar to other riparian associated species, route based surveys have limited utility for most shorebirds (de Szalay et al. 2000). Monitoring should be targeted to unique habitats within riparian areas, areas utilized every year, and breeding species. Fall water levels currently provide the most suitable habitat for shorebirds within the Illinois River basin, therefore abundance during spring migration should be emphasized as an indicator.

Some monitoring is being conducted opportunistically within the Illinois River basin (Horath et al. 2002) but the program should be greatly expanded. Sampling should include all or a random sample of known and potential habitat areas along the mainstem and tributaries. The International Shorebird Survey (ISS) protocol (Manomet Center for Conservation Sciences 2004) will be used at selected sites. The ISS spring surveys are conducted April 1 through June 10 and fall surveys July 11 through October 31. Complete surveys are difficult to achieve for large and diverse sites, therefore an estimate must be made of the habitat type and area observed. Sampling can be done from selected vantage points within a habitat area. Summary analysis for habitat areas and for the entire mainstem should include migration use-days for all shorebirds and by species. Potential Illinois River basin breeding species are a target indicator because their use may reflect basin factors over a longer time scale.

Estimated cost: $50,000.

H. Bald eagles and ospreys- Bald eagles and ospreys utilize similar habitat. Both species build their nests in large, usually dead trees near open water and forage primarily on fish. The habitat requirements of both species are similar to herons, although they usually forage in deeper water than wading birds. Eagles may exclude ospreys from breeding territories but osprey nests have been documented in heron rookeries. Both species are recovering from population lows in the 1950's and 60's, and they are both considered rare in Illinois (Havera and Kruse 1988). The number of eagle nests is increasing along the Illinois River but no osprey nests have been documented in recent years. Restored habitat along the Illinois River, including management for mature riparian forests or construction of nest platforms near suitable foraging sites but away from human disturbance may result in further increases in nesting activity by both species. Foraging conditions will benefit from improved water quality and generally lower water conditions in backwater lakes and side-channel areas.

Monitoring will build on existing programs and emphasize numbers of nesting eagles. Breeding activity and success should be monitored by maintaining a database of nests, mapping known nest sites, and soliciting reports of new nests from biologists and the public. All nests or a subset of nests should be checked 3 times during the nesting season to determine the proportion of nests occupied and number of young fledged (IDNR protocol – Glen Kruse, personal communication). In addition, winter habitat conditions for eagles should be assessed using the IDNR mid-winter eagle survey. Similar to many other Illinois River wildlife species, eagles and ospreys respond directly to habitat conditions over relatively small areas but integrate the indirect cumulative effects of hydrology, sedimentation, and pollutants over large spatial scales.

Estimated cost: $2,000.

N. Aquatic reptiles - Aquatic reptiles are a relatively unstudied component of large river systems. In part, this results from difficulty in monitoring them at large scales. Many species are thought to be rare or declining. Moreover, this group provides excellent indicators of both aquatic and terrestrial components of riparian systems because they forage in water, reproduce on land, have unique habitat requirements, and some are extremely sensitive to water quality. Amphibians and fish are an important forage component for many aquatic reptiles. Both snakes and turtles require basking sites during spring and early summer when morning temperatures are cool. Water snakes (genus Nerodia), and probably aquatic turtles, require shallow wetlands with gentle slopes at the land-water interface (Laurent and Kingsbury 2003).

Monitoring should be conducted along the mainstem in 30 randomly selected side channels and backwater areas. Monitoring at each site will include basking transects to record numbers of snakes, turtles, and basking sites, location observed, and basking substrate. Run transects by kayak adjacent to the shore line. Because some aquatic turtles are sensitive to water quality, turtle trapping should also be done at each site to determine aquatic turtle community composition and species richness. Monitoring should be conducted from April through early June when basking behavior is most common and before vegetation becomes too dense (Laurent and Kingsbury 2003).

Estimated cost: $27,000.

Other measures - Several proposed wildlife/terrestrial habitat response measures are sampled by HUC 8 units, including both mainstem and tributary HUCs (Table 10). The response measures that include both mainstem and tributary HUCs include: landscape habitat composition, site-specific habitat/vegetation, bottomland/riparian forest and grassland birds, marsh birds, amphibians, and terrestrial mammals. The sampling protocol for these measures are explained the Sub-basin - Ecological/Terrestrial Section. Estimated cost for the mainstem component of these measures follows.

Estimated cost: Landscape habitat composition and metrics (A) - $3,000; CTAP based intensive monitoring of site-specific habitat/vegetation ©), bottomland/riparian forest and grassland birds (K & L), marsh birds (F), and amphibians (M) - $252,000; Terrestrial mammals (I) - $6,000.

Desirable Response Measures:

O. Avian reproduction - Abundance of breeding birds does not necessarily indicate functional habitat quality. Reproductive success may be low even where adult abundance is high (i.e., sink habitat). High quality habitat patches may suffer from landscape or patch fragmentation effects due to high rates of nest predation and parasitism. Therefore, avian reproductive success integrates many factors and provides a good indication of functional habitat quality at the patch and landscape levels.

To evaluate nest success, five sites per habitat (i.e., forest, grassland, wetland) in each sub-basin should be monitored from roughly April to July. Similar to bird monitoring, each sub-basin will be monitored once every 5 years. Nests should be monitored once every 3 days during the active nest cycle and analyzed using the Mayfield method (Mayfield 1975). Nest success should be analyzed by species, reproductive guild, and community, and can be summarized within watershed units.

Avian reproductive success integrates large spatial scales but is expected to respond slowly to restoration efforts. Wetland or grassland breeding avian species will respond more quickly than forest breeding species because herbaceous communities develop more quickly following restoration than forests. A detectable response in reproductive success will probably only be seen following significant increases in habitat patch size and a long period of time for habitat development. Detectable changes in forest bird reproductive success may not be observed for at least 30 years.

Estimated cost: $41,000.

P. Amphibian reproduction - Amphibian embryos are extremely sensitive to environmental conditions. Successful reproduction by amphibians depends on hydrology, water chemistry, and specific habitat requirements (U.S. EPA 2002b). Amphibians require fishless wetlands for successful reproduction and different species prefer different microhabitats for egg deposition. Counts of egg masses provide an indication of breeding effort and the proportion of viable egg masses indicates wetland health (U.S. EPA 2002b). Amphibian adults and embryos are sensitive to many of the same factors with embryos more sensitive than adults. Amphibian egg masses can be used to detect non-vocal species, including salamanders, not detected using call-based surveys.

To monitor amphibian reproduction, a random sub-sample of 15 of the selected amphibian monitoring sites in each sub-basin should be selected. Potential sample sites can be from any of the three habitat types (i.e., forest, grassland, wetland) where calling amphibians were detected. Data collected should include egg mass counts by species and proportion of viable eggs per egg mass. Two visits should be made to each site to detect all breeding species at a site.

Similar to frog and toad call counts, amphibian reproductive effort is expected to respond quickly to improving habitat conditions, particularly hydrology and water quality. Diversity of breeding amphibians provides an additional indicator of habitat complexity. Viability of amphibian eggs generally provides and indication of environmental conditions, potentially at a scale beyond the Illinois River basin.

Estimated cost: $6,000.

HYDROLOGIC AND SEDIMENT MONITORING PLAN

The Integrated Management Plan for the Illinois River watershed had identified sedimentation and un-natural water level fluctuations as the two major causes for ecological degradation in the Illinois River. After extensive discussions and investigations, the Illinois River Basin Restoration project team has identified seven ecosystem restoration goals for the basin. Even though all of the seven goals are related to the hydrology and sediment transport and deposition characteristics of the rivers and streams in the basin, five of the goals address sediment and hydrology directly. These goals are:

- Reduce sediment delivery to the Illinois River from upland areas and tributary channels with the aim of eliminating excessive sediment load.
- Restore aquatic habitat diversity of side channels and backwaters, including Peoria Lakes, to provide adequate volume and depth for sustaining native fish and wildlife communities.
- Improve floodplain, riparian, and aquatic habitats and functions.
- Naturalize Illinois River and tributary hydrologic regimes to reduce the incidence of water level conditions that degrade aquatic and riparian habitat.
- Improve water and sediment quality in the Illinois River and its watershed.

To achieve these goals, a much better understanding of the hydrology and sediment transport and deposition characteristics of the Illinois River and its tributary streams is needed. An effective hydrologic and sediment monitoring network will be vital to a successful restoration program for the Illinois River. This proposed monitoring network will not only provide data that can be used to measure progress towards meeting the goals of the program but will provide the information that is needed now to effectively and efficiently begin implementation of the Illinois River Basin Restoration Project. The hydrologic and sediment monitoring plan presented here is developed to address these needs.

Monitoring Goals & Objectives

It is proposed that a long-term network of streamflow and suspended sediment monitoring sites be established within the Illinois River Basin (IRB), building upon the existing stream and sediment monitoring stations operated by the United States Geological Survey (USGS) the United States Army Corps. of Engineers (USACOE), and the Illinois State Water Survey (ISWS). This monitoring network would have three goals: 1) assess the current hydrologic regimes and suspended sediment transport rates occurring within the IRB; 2) monitor and quantify any changes in hydrologic regimes and suspended sediment transport rates that occur in the future; and 3) evaluate the impacts of restoration projects on stream hydrology, sediment transport and sedimentation. The proposed network will accomplish these goals by providing crucial data needed to help meet the following objectives:

Establish a more detailed and improved sediment budget for the Illinois River: As sedimentation is a major problem in the Illinois River, an accurate and frequently updated sediment budget describing sediment transport rates in the Illinois River and its 11 major tributaries is of primary importance for future river management decisions. The present sediment budget for the Illinois River Basin is our best estimate based on limited available data. The proposed monitoring plan will enable us to develop a much improved sediment budget for the Illinois River basin. With an improved sediment budget resource managers will be better able to establish current or baseline conditions, target restoration efforts, determine basin wide trends over time in sediment loads and delivery and improve our understanding of the codependency of factors influencing the ecological status of the Illinois River and its tributaries.

Identify drainage areas with the highest sediment yields: A detailed sediment budget describing the sediment transport rates of different tributaries, physiographic regions, and stream sizes will determine which types of streams/watersheds have the highest sediment yields within the IRB. In turn this data will provide for an efficient allocation of restoration efforts by allowing managers to prioritize efforts within those areas where the greatest return can be expected.

Evaluate the impact of site specific projects, watershed BMPs, changes in land-use, and climate variability: Monitoring the hydrology and sediment transport rates occurring before and after specific projects/BMPs have been implemented within a stream and/or watershed will provide much needed information regarding the effectiveness of implemented work. Similarly, monitoring the hydrologic and sediment regimes of a watershed before and after land-use changes occur will provide information on how land use affects hydrologic regimes and suspended sediment transport rates. Long-term hydrologic records within a variety of watersheds are also essential for evaluating and accounting for the effects of climatic variability when determining any long-term hydrologic trends within the IRB.

Provide flow and sediment data on small to medium size streams: Many of the important hydrologic, hydraulic, and sediment processes crucial to determining the Illinois River's overall flow regime, sediment transport rates, and ecological health depend on the processes occurring within the small- and medium-sized streams within the basin. Long-term flow and sediment data collected on small- and medium-sized streams are necessary for evaluating the effects that tributaries have on the ecology of the Illinois River through such mechanisms as sediment deposition and their effects on river stages.

Provide calibration, validation, and boundary condition data for the many numerical models likely to be used in studying and developing Illinois River management plans: Many of today's water resource questions are being answered through the use of numerical models that simulate hydrologic, hydraulic, and sediment transport rates. These models allow resource managers to interpret how proposed restoration projects affect not only the project location but how specific projects may influence other components of the system at different spatial scales. To calibrate, validate, and run these models, long-term flow and sediment data are needed. The proposed network will significantly increase the availability of such information in the IRB.

Quantify basic hydrologic parameters for use at ungaged locations within the IRB: The hydrologic and sediment transport properties of many ungaged watersheds will need to be estimated using hydrologic and sediment data collected from watersheds that have similar characteristics. Implementation of the proposed network will provide the required data for watershed models and regional statistical analysis techniques that can be used to estimate hydrologic and sediment transport rates at ungaged locations within the IRB. This in turn will facilitate the planning, development, and evaluation of future IRB restoration projects and best management practices.

Monitor changes in channel morphology: Channel slope and cross-sectional shape are routinely used to compute many hydraulic and geomorphic relationships. The grain size distributions of a stream's bed material, bank material, and suspended sediment are crucial pieces of information used in computer models, sediment transport equations, effective discharge computations, and habitat assessments. The periodic collection of this data at monitoring sites throughout the IRB will provide basic information to hydraulic engineers, geomorphologists, and biologists on current conditions and how channel conditions are changing within streams over time.

Existing Monitoring Network

Streamflow Records - In Illinois there are currently 97 active continuous discharge gages in the Illinois River Basin (IRB) of which 89 are operated by the USGS and 8 are operated by the ISWS. The names and locations of these active gaging stations are presented in Table 11. Also identified in Table 11 are the 80 discontinued gaging stations in the IRB, the number of years over which data have been collected at each station, and whether these data are a full 12-month record (F) or partial (P) record.

The locations of active and inactive gaging stations in Illinois are given in Figure 4. Figures 5 and 6 show the active and inactive gaging stations on streams that have watershed areas less than 400 and 100 square miles, respectively. A review of these figures shows:

- Fifty-two (54%) of the 97 active stations are in the Chicago metropolitan area, specifically in the Fox, Des Plaines, and Chicago-Calumet watersheds. Most of these are in small urban (or urbanizing) watersheds (<100 square miles).

- In the remaining portion of the IRB, most of the gages are on larger watersheds, with drainage areas greater than 400 square miles. There are 19 stations in watersheds less than 400 square miles, 11 of which are located in the Sangamon River watershed (Figures 5 and 6).

- Outside of the Chicago area, there are 10 active gages on small watersheds (<100 square miles). Three of these watersheds are located either in urban areas or immediately downstream of reservoirs (Figure 7a). Of the remaining seven gages, only one has a continuous discharge record longer than 5 years. The other six gages, operated by the ISWS, have relatively short discharge records and are supported by short-term CREP and Lake Decatur research projects (Demissie et al. 2001; Keefer and Demissie 1996).

Suspended Sediment Records - In Illinois there are 21 active monitoring sites collecting suspended sediment data in the IRB. Figure 4 shows the locations of these sites. The USGS is currently collecting sediment data at six locations in the Illinois River Basin. The USACOE is currently collecting suspended sediment data at two locations within the IRB, while the ISWS is currently collecting suspended sediment data at the remaining 13 locations. Between 1972 and 2003 suspended sediment data have been collected at a total of 58 monitoring sites in the IRB. The names and locations of both active and inactive suspended sediment monitoring sites along with details regarding the amount of sediment data available at each of these gaging stations is described in Table 12. The drainage areas being monitored by the 21 active sites are shown in Figure 7b. The locations of these sites are given in Figure 8. Figures 9 and 10 show the locations of sub-basins where suspended sediment monitoring sites monitor basins with drainage areas of less than 400 square miles and less than 100 square miles, respectively. From the information in Figures 7-10 one can make the following six observations:

• Three of the 21 active sites are on the Illinois River while 13 sites are on major Illinois River tributaries with watershed areas greater than 400 square miles. Eight of the 13 suspended sediment sites on major tributaries are part of the Illinois State Water Survey's WARM network, which collect instantaneous suspended sediment samples once a week at various sites throughout Illinois (Allgire and Demissie 1995). Most of the WARM sites provide periods of record in excess of 20 years. Two of the monitoring sites on major Illinois River tributaries are monitored by the USACOE. Data has been collected at both sites since 1997. The remaining three sites, recently reactivated by the USGS, are located on the Fox, Des Plaines and Spoon Rivers.

• The 5 sites monitoring drainage areas less than 400 square miles are all within the Spoon and Sangamon River watersheds (Figure 9). Monitoring at these sites is supported by the short-term CREP research project.

• There are only two suspended sediment monitoring sites in the Chicago metropolitan area.

• None of the bluff streams that are within the mainstem Illinois River Sub-basin and drain less than 400 square miles are currently being monitored for sediment.

• If long term-support is not obtained to continue the sediment monitoring at the ISWS's CREP monitoring sites, no sediment monitoring will occur on streams draining less than 400 square miles.

• If funding is not available to maintain the ISWS 5 CREP monitoring sites and four USGS sites that began collecting sediment data this year (2003), the overall sediment monitoring network will be reduced from 21 sites to 12 sites in the next few years (Figure 7b).

The number of active sediment and discharge monitoring locations within the various major Illinois River sub-basins is shown in Table 13. From this table and Figures 8-10 it can be seen:

• That no sediment monitoring is occurring within three of the 11 major sub-basins of the Illinois River. These sub-basins are the Chicago/Calumet, Iroquois, and Macoupin sub-basins.

• Six Illinois River sub-basins have sediment monitoring sites only on the sub-basin's major river. These six sub-basins are the Des Plaines, Fox, Kankakee, La Moine, Mackinaw, and Vermillion sub-basins.

• The sediment loads representative of streams draining less than 100 square miles and flowing into nine of the Illinois River's major tributaries are not currently being monitored (Figure 10).

• None of the many bluff streams with drainage areas smaller than 400 square miles that flow directly into the Illinois River (found in the Illinois River sub-basin) are currently being monitored for discharge or sediment.

Shortcomings of the Existing Network

The current flow and sediment monitoring network in the Illinois River Basin is insufficient for addressing the many scientific and management questions which need to be answered in order to develop a sound river management program for the Illinois River Basin. The following paragraphs identify four major areas in which the current monitoring network fails to meet current monitoring needs.

Insufficient data to establish a detailed sediment budget for the Illinois River. Only about 70 percent of the major tributaries to the Illinois River are being monitored for suspended sediment. Moreover, as most of the monitoring records at these stations are based on weekly instantaneous suspended sediment samples, load values (particularly peak loads) transported during storm events may be poorly estimated (Allgire and Demissie 1995). Consequently, current sediment budgets for the Illinois River must be currently computed using limited and derived data (Demissie et al. 1992). To obtain a more accurate sediment budget for the IRB, suspended sediment sampling frequency needs to be increased at existing suspended sediment monitoring locations and additional suspended sediment sampling needs to be performed near the confluences of all the Illinois River's major tributaries. Without such basic monitoring our ability to understand and manage the numerous sediment problems within the Illinois River is severely hindered.

Insufficient long-term monitoring of small- and medium-sized streams. Outside the Chicago-metropolitan area virtually no long-term monitoring of flow and sediment is being conducted on small- (< 100 square miles) to medium- (< 400 square miles) sized streams. This lack of long-term monitoring on small- to medium-sized streams is problematic for several reasons. First, one cannot effectively monitor the impacts that watershed BMPs have on downstream conditions. Second, the sediment loads of small- and medium-sized streams cannot be easily estimated and incorporated into overall sediment budgets for the IRB (Demissie et al. 1992). Third, the data needed to perform geomorphic studies involving effective discharge, bankfull discharge, and stream restoration design for small streams is not available (Crowder and Knapp 2002). Similarly, a paucity of long-term flow monitoring on smaller streams prevents one from quantifying the effects that climate variability, and changes in land use have on the IRB's smaller streams (Knapp and Markus 2003).

No monitoring of sediment grain size distributions, bed load transport rates, and basic instream channel properties. Currently, streamflow and suspended sediment monitoring sites are not monitoring erosion/deposition rates, changes in cross-sectional shape, and channel slope. Nor are the grain size distributions of the channel's bed material, bank material, and suspended sediment being periodically measured. Such fundamental information is needed to run hydraulic/hydrologic models and to use existing sediment transport equations. Additionally, such information can be used to provide a more detailed assessment of the existing hydraulic, ecological, and geomorphic conditions within the IRB.

No sedimentation monitoring program exists for the backwater lakes along the Illinois River. Current bathymetric and sediment characterization information does not exist for most of the backwater and floodplain lakes of the Illinois River. It is crucial to perform periodic bathymetric surveys for these lakes. Updated bathymetry and sediment characteristic data when combined with historical mapping products such as the Woermann maps will provide information on the processes that are occurring within these backwater lakes as well as insight into how sedimentation differs between lakes with respect to orientation, channel geometry, degree of connectivity to the mainstem, and/or inputs from local tributaries. This information will also be necessary for the development of site-specific plans for restoration efforts. Sediment volumes, existing or planned minimum depths, and areal extents of various habitat types and potential beneficial uses of sediment can all be determined for current conditions or calculated for different management alternatives.

The proposed monitoring plan consists of three components: mainstem monitoring, basin-wide monitoring, and project specific monitoring. The mainstem and basin-wide components focus on providing a network of monitoring sites and periodic bathymetric surveys to address long-term and systemic issues within the IRB. Based on the current monitoring network's shortcomings, it is recommended that the existing monitoring network be significantly enhanced by placing additional sediment and discharge monitoring sites throughout the Illinois River Basin. The proposed increases in sampling frequency and number of sites are intended in part to address two issues in understanding sediment yields and transport in the Illinois River basin: 1) what is the temporal variation in sediment delivery at selected sites, including changes over time resulting from best management practices (BMPs), and 2) what is the spatial variation in sediment across the basin? These data are needed before we can effectively predict which sub-watersheds are the major sources of sediment in streams so that we can more effectively address how and where to target restoration efforts. In both the temporal and spatial context we are currently trying to use a limited amount of sediment data to analyze a highly variable process.

Recent analysis of sediment records in Illinois by the ISWS for use in estimating effective discharges (Crowder and Knapp 2002) highlighted the problems with determining sediment-discharge relationships with limited data. For those stations on large streams where suspended sediments were sampled every one or two weeks, many years of data were needed to define a stable sediment rating, such that it is difficult to identify meaningful temporal trends within these long sampling periods. One major obstacle is that there is considerable variability (scatter) in the sediment load for a given discharge class, and for higher discharge classes there are relatively few samples from which to estimate the mean sediment load. The use of standard power function (log linear) curves to estimate average sediment loads in lieu of adequate data proved to be inaccurate. Whereas increased sampling on larger tributaries for low and medium flow events (for which there is normally plenty of data) may not significantly improve sediment-discharge relationships, increased sampling of higher flow events is needed for establishing and identifying temporal changes in such relationships. For smaller streams, sediment sampling during storms becomes particularly crucial because most high flow events will be totally missed by standard periodic sampling.

From the current sediment network we have been successful in identifying broad-scale sediment budgets and spatial differences in sediment delivery across the Illinois River basin. However, we have data from very few small watersheds, such that it is difficult to determine whether our small watershed data are representative of other ungaged watersheds across the Illinois River basin. Both modeling efforts and data at additional sites will be needed before we can determine the amount of spatial variability, uncertainties, and relatives difference that could be related to management practices.

A final factor that needs to be addressed is the influence of climatic variability on analyzing trends in stream sediment. The amount of flow and sediment in a stream are highly responsive to the variable sequence of climatic events. In analyzing the influence of climate variability on streamflow quantity, ISWS studies have concluded that streamflow variability associated with climate fluctuations may often be sufficient to mask the impacts of other factors (such as changes related to moderate levels of land-use change or BMPs). We need to keep in mind that we are trying to estimate changes in average stream sediment of 10-20% over time, and that interdecadal changes in total flow volume associated with climate variability are commonly in excess of 20 percent. This is why long-term records are needed for identification of trends in hydrology, sediment yield, and related processes.

Within this plan the placement of new monitoring sites focuses on characterizing the physical processes occurring within different types of morphological and physiographic settings along with identifying the influence land use and climate variability may have on hydrologic and sediment transport processes. Within the Till Plains Section of the Central Lowland Province, there are four major physiographic units making up the IRB (outside the Chicago area): the Galesburg Plain, the Springfield Plain, The Bloomington Ridged Plain, and the Kankakee Plain (Leighton 1948). Table 12 also shows the major physiographic region(s) each sub-basin lies within. Additional monitoring sites are being added so that small- and medium- streams are monitored within each of the sub-basins and the four major physiographic regions making up the IRB.

With a large network of streamflow gages already operating in the Fox, Des Plaines, and Chicago/Calumet sub-basins, additional streamflow and sediment monitoring within these sub-basins is not proposed.

The Illinois River sub-basin is identified as being in particular need of additional monitoring. The bluff streams found in this sub-basin are unique and the apparent high sediment delivery rates of the streams may play a crucial role in the Illinois River's sediment transport processes. To date there has been little hydrologic and suspended sediment monitoring conducted on these bluff streams. Consequently several new monitoring sites are proposed for this sub-basin.

Overall, this proposed monitoring plan efficiently allocates monitoring efforts between the mainstem Illinois, major tributaries of the Illinois River and small- and medium-sized streams throughout the IRB. The resulting network of hydrologic and sediment monitoring stations is a holistic monitoring approach that will better reflects the stream processes occurring within the large variety of watersheds found in the IRB.

Critical Response Measures:

Streamflow and Suspended Sediment - Standardized sampling equipment and procedures will be implemented at all sites within the monitoring network. The equipment and sampling regiment used at a particular location will reflect the stream's size, and storm hydrograph duration. Methods at each gaging site will also follow commonly accepted streamflow and sediment sampling procedures as described by Edwards and Glysson (1999), Rantz (1982a), Rantz (1982b), and FISP (1952).

In general, the monitoring network will collect continuous stream gage data, record hourly or sub-hourly discharge estimates, and collect daily suspended sediment samples. When needed, storm sampling will also be provided at each monitoring site.

Morphologic and Sediment Grain Size Data - At each site, channel slope, cross-sectional shape, suspended sediment grain size distribution, and bed and bank-material compositions will be periodically sampled and/or measured for a reach extending about ten times the width of the stream at the gaging site.

Bathymetric/Sedimentation Survey of Backwater Lakes - The backwater and associated floodplain lakes of the Illinois River are known to be vital to the processes that determine the overall ecology of the Illinois River. To better quantify the sediment characteristics and sedimentation processes that are occurring within these lakes, periodic bathymetric surveys and sediment sampling will be performed at locations where sedimentation has been identified as an ecologic or economic concern.

Ecologically important backwater lakes, side channels, and wetland areas will be identified and periodically surveyed using standard bathymetric surveying practices (USCOE 2002), so that sedimentation patterns and rates can be determined for different reaches of the Illinois River. Sedimentation rates will be determined through sediment dating techniques using Pb^{210}analysis of collected core samples. The use of radiometric dating techniques provides data on sedimentation rates for specific periods and how these rates have changed over time as opposed to the average rate of sedimentation that can be inferred from bathymetry alone. Priority will be given to performing bathymetric surveys that describe sedimentation rates over the entire length of the Illinois mainstem. However, if justified, locations on Illinois Tributaries may also be surveyed.

Locations for bathymetric and sediment characteristic surveys will be identified with input from the agencies conducting ecological monitoring and implementing specific projects (e.g., dredging, water retention, and habitat restoration).

Proposed Basin-Wide Hydrologic and Sediment Monitoring Sites

With the present monitoring network our ability to detect basin wide changes in sediment transport and delivery is negligible, other than at those few stations monitoring small watersheds such as the CREP monitoring network. With the proposed basin wide monitoring network our ability to detect system wide trends and changes in sediment loads and delivery rates would significantly improve. Assuming this network will be operated throughout the Illinois River Basin 519 Restoration Project (10+ years) the accuracy of our sediment yield estimates will improve by more than 50 percent when compared to current capabilities. This improved estimate should allow researchers to determine if progress is being made towards the stated objectives of the IRB 519 Project.

A list of monitoring sites that compose the proposed network that would provide data to achieve the objectives listed in the "Goals and Objectives" section is provided below. Following the name/location of each proposed discharge and sediment monitoring site are comments describing which actions need to be implemented at that location. At locations where discharge and sediment are currently being monitored a recommendation is made to "increase sampling frequency." For stations that currently have active streamflow gages, but need sediment monitoring, a recommendation to "monitor sediment" is made. At sites where neither discharge nor sediment is currently being monitored a recommendation is made to "activate" or "reactivate" discharge and sediment monitoring. To "activate" a station implies no prior data has been collected at that site, whereas to "reactivate" a station means previous discharge and/or sediment data was collected at that site. The locations of all of the proposed monitoring sites within the Illinois River Basin are shown in Figure 11.

Mainstem Locations:

<u>Sites on the Illinois River</u>.

A01 Illinois River at Henry (monitor sediment)

A02 Illinois River at Kingston Mines (monitor sediment)

A03 Illinois River at Marseilles (increase sediment sampling frequency)

A04 Illinois River at Valley City (increase sediment sampling frequency)

These monitoring sites were selected for two reasons. First, the locations are distributed along the entire length of the Illinois River. Second, the sites will be collecting sediment samples at existing stream gages. Note, while suspended sediment has been collected at Pekin and is currently being collected at Chillicothe, stream gages do not exist at either of these locations and discharges must be estimated. Hence, it is recommended that future suspended sediment monitoring take place at Henry and Kingston Mines, where stream gages exist.

Proposed monitoring sites on major tributaries to Illinois River, sites on small tributaries not in the mainstem Illinois sub-basin, sites on small- to medium-sized streams in the mainstem Illinois River sub-basin, and sites representing different morphologic and physiographic regions are presented in the Sub-basin - Hydrologic and Sediment Monitoring Plan section.

The mainstem locations explained above along with the three types of gages explained in the Sub-basin - Hydrologic and Sediment Monitoring Plan section, create a network composed of 58 monitoring sites throughout the Illinois River Basin. While it is believed that this network provides a sound and reasonable framework for meeting the goals and objectives set forth in this proposal, it is recognized that funding for such a comprehensive network may not be feasible. Consequently, a smaller monitoring network, consisting of 45 monitoring sites, is described. This network is believed to contain the minimum number of monitoring stations that would be needed to significantly improve the existing hydrologic and sediment monitoring network and begin providing data to meet the goals and objectives of this proposal. Following is a comparison of the networks capabilities and associated costs.

Under this option, the monitoring network would comprise of 45 monitoring sites. Like the comprehensive network, this network would provide a much improved sediment budget for the IRB and significantly increase monitoring on small- to medium-sized streams. However, compared to the Comprehensive Network, the minimum network would spend about 32 percent less effort monitoring the Illinois River's major tributaries and about 20% less effort collecting hydrologic and sediment data pertaining to small- to medium-sized streams. Monitoring on the Illinois mainstem under this and the comprehensive network would be the same. Thus, the resulting network still emphasizes the collection of data on small- to medium-sized streams, but also provides significantly more data on the larger tributaries than is currently being collected.

In summary, the critical network would support:

1) All four proposed sites on the Illinois River (A01-A04)

2) Fifteen of the twenty-two proposed sites on the Illinois River's major tributaries

3) Five of the seven proposed sites on small tributaries not in the Illinois River sub-basin

4) Ten of the eleven proposed sites on small- to medium-sized streams in the mainstem Illinois River sub-basin

5) Eleven of the fourteen proposed sites to represent different morphologic and physiographic regions

Estimated cost: $1,118,000 to implement and operate this hydrologic and sediment monitoring network during the first year and $634,000 per subsequent year. These costs reflect the combined cost of the mainstem and sub-basin hydrologic and sediment monitoring plan.

Desirable Response Measures:

This comprehensive network, containing a total of 58 monitoring sites, will provide a much improved sediment budget for the IRB and begin long-term monitoring of a large variety of small- to medium-sized streams consistent with the goals and objectives of this proposal. This network also promotes continued monitoring at sites where data has already been collected and increasing the period of record is desirable. Finally, this network monitors specific watersheds where substantial watershed development and research activities are likely to occur (e.g. Spoon). Focusing our monitoring efforts within areas where restoration efforts are likely to occur is beneficial for a number of reasons. This proposed gage network provides the opportunity for adequately describing baseline conditions. Also by being situated in the sub-watersheds where projects will be placed these gages are optimally suited to detect change. It is reasonable to assume the effects of restoration efforts will first be seen in the tributaries. When comparing tributary sub-basins to the entire Illinois River Basin, the decreases in contributing watershed area, sediment storage capacities and codependency of causative variables should all lead to earlier detection of the benefits from restoration efforts. By having a gaging network that addresses different spatial scales we will improve our ability to provide data to help support project siting and other ecological monitoring activities in settings where resources and results can be shared.

In summary the Desirable Network would support:

1) Four sites on the mainstem of the Illinois River (A01-A04)
2) Twenty-two sites on the Illinois River's major tributaries (B01-B22)
3) Seven sites on small tributaries not in the Illinois River sub-basin (C01-C07)
4) Eleven sites on small- to medium-sized streams in the mainstem Illinois River sub-basin (D01-D11)
5) Fourteen proposed sites to represent different morphologic and physiographic regions (E01-E14)

Estimated cost: $1,423,000 to implement and operate this hydrologic and sediment monitoring network during the first year and $815,000 per subsequent year. These costs reflect the combined cost of the mainstem and sub-basin hydrologic and sediment monitoring plan.

Monitoring Plan
SUB-BASIN

ECOLOGICAL MONITORING PLAN - AQUATIC

Most studies on the effects of restoration practices have been implemented on small spatial (e.g. reach-scale) and temporal scales (e.g., Magette et al. 1989). Very few studies have documented the effectiveness of restoration practices in wadeable streams at spatial scales larger than the reach or local scale (Wang et al. 1996; Wang et al. 1997; Wang et al. 2002). In the few studies that were completed at larger spatial (e.g., sub-basin) and temporal scales, the emphasis has been on the effects of stream restoration on chemical/physical parameters (e.g., nutrient concentration, sediment yield) (Trimble and Lund 1982; Gale et al. 1993; Walker and Graczyk 1993; Park et al. 1994; Cook et al.1996; Edwards et al. 1996; Meals 1996; Bolda and Meyers 1997). Responses of the biota to sub-basin wide or watershed wide implementation of restoration practices have been considered only in more recent studies and much less frequently than physical parameters (Fitzpatrick et al. 2001; Stewart et al. 2001; Wang et al. 2002). Currently, there is a lack of understanding on how ecological processes operating at large spatial and temporal scales affect stream fish populations (Schlosser 1995; Roni et al. 2002) and invertebrate assemblages (Richards et al. 1996). However, it is clear that processes operating at large scales (e.g., land use in a sub-basin) can strongly affect the integrity of stream fish and invertebrate communities (Roth et al. 1996; Fitzpatrick 2001; Stewart et al. 2001).

Monitoring responses of a stream system to restoration using several spatial scales (reach, sub-basin, and basin) improves the ability to detect meaningful changes in the integrity of the aquatic community and to discover mechanistic explanations for linkages between abiotic and biotic parameters operating at different scales. By monitoring lotic systems at the sub-basin scale, an intermediate spatial scale, we can assess the collective effects of individual restoration practices implemented at the reach scale to make predictions on potential effects of restoration at the basin scale. Although the sub-basin is an intermediary scale between individual projects and the mainstem of the Illinois River, changes in stream quality at this scale can be better understood by determining mechanisms for changes in stream conditions at an even smaller watershed and sub-watershed scale. To better comprehend the collective effects of restoration at the sub-basin scale and link those with effects of individual projects, monitoring at the sub-basin scale in addition to the sub-basin scale is essential. We are defining sub-basins as large tributaries to the Illinois River mainstem (HUC 8 scale) with watersheds (HUC 10 scale) nested in sub-basins and sub-watersheds (HUC 12) nested within watersheds (Figure 3).

The aquatic ecology monitoring framework focuses on documenting changes in both biotic and abiotic factors in sub-basins of the Illinois River as well as determining immediate and local effects of various practices on the overall stream community. Documenting these changes at various scales (sub-basin, watershed, and sub-watershed) will require the use of different sampling protocols and study design/analytical methods. At the watershed and sub-watershed scale, the Before-After-Control-Impact (BACI) study design will be used to assess changes in physical habitat and aquatic biota (see description in Study Design - Statistical Approaches section in the Introduction). This design accounts for temporal variability increasing the likelihood of detecting true changes in lotic systems at smaller scales and allowing improvements in stream quality to be attributed to restoration practices instead of other events such as changes in climate conditions during the study. With increased scale to the sub-basin level, the BACI design is more difficult to implement due to the challenge of finding a suitable reference sub-basin in the Illinois River basin that will have little or no restoration practices implemented. In this case, trend analysis/repeated measures and regional reference sites (Rasmussen et al. 1993; von Ende 1993; see Study Design - Statistical Approaches section in the Introduction) will be used to evaluate the effectiveness of restoration on aquatic communities. Regional reference sites are least disturbed areas within the same region as the treated sub-basin. Abiotic and biotic indicators of stream quality at the regional reference sites are used as benchmarks to assess changes in treated sub-basins once restoration practices are implemented.

To accurately monitor the combined effects of restoration practices on stream quality, critical parameters need to be identified and collected. Below, we identify those parameters which must be collected (i.e., critical metrics) to accurately detect changes in stream integrity as a result of restoration practices. We also discuss parameters that should be incorporated into a monitoring program (i.e., desirable metrics) in order to obtain a more mechanistic understanding on how changes in one parameter (e.g., habitat quality) affects another (e.g., fish abundance).

Critical Response Measures:

It is crucial that water quality parameters (those related to sampling efficiency and condition of biota), habitat, fish assemblages, and invertebrate (including mussels) communities be monitored at least once a year for several years before and after implementation of restoration practices. Within each sub-basin designated for practices, multiple sites must be monitored at the sub-basin scale (i.e. both upper and lower portions of the mainstem of major tributaries to the Illinois River) as well as at the watershed and sub-watershed scale. For the sub-basin sites, regional references will be used to assess improvements in stream integrity. At both the watershed and sub-watershed scale, reference watersheds within the same sub-basin (when possible) will be monitored to determine improvements in lotic communities. To utilize historical water quality, habitat, and biotic data, we will collect data at sites previously sampled during IEPA/IDNR basin surveys where possible and use qualitative and quantitative collection methods similar to protocols used by these agencies (IEPA 1994; IDNR 2001). Length of each sampling site must include at least one riffle-run-pool sequence (i.e., approximately 35 times the mean stream width) (Lyons 1992; IDNR 2001) with non-channelized sites being no less than 150m and channelized sites being no less than 300m in length (Holtrop and Dolan 2003). For non-wadeable sub-basin sites, station length will be sampled for a given time (30 minutes) instead of a given distance as described in IDNR protocols (IDNR 2001).

Habitat - Chemical/physical habitat data must be collected using two levels of sampling: site-scale and transect-scale. Site-scale parameters (Table 14) will be collected at one location in the site (e.g., water temperature, discharge) or are based on maps of the entire site (e.g., drainage area, stream order) and are assumed to be representative of the entire site. For chemical/physical habitat, efforts will be made by each discipline to sample the same sites in order to collect a more complete dataset on water quality and channel morphology data without duplicating efforts. At locations were this is not feasible, water quality data as it pertains to sampling efficiency, biotic health, and productivity of the stream (temperature, dissolved oxygen, conductivity, periphyton concentrations, etc; Table 14) and channel morphology data using point/transect methods (Table 15) should be collected during biotic assessments.

Transect-scale variables are those which are expected to vary considerably within a site (Table 15). These variables, which pertain to stream channel morphology, bottom substrate, cover for fish, macrophyte abundance, condition of stream banks, and riparian land use/vegetation, should be measured on at least ten, equally spaced transects perpendicular to flow. A modified Stream Assessment Protocol for Ontario (Stanfield et al. 1998) will be used to sample these habitat variables. This protocol is similar enough to IEPA habitat protocol (IEPA 1994) to allow for comparisons with IEPA/IDNR basin survey data. However, in the Ontario protocol, in-stream substrate is measured instead of visually estimated and bank/riparian conditions are assessed. This protocol has been rigorously tested and found to provide consistent and reliable results on repeated habitat sampling of stream systems (Stanfield and Jones 1998). In addition to utilizing habitat data from IEPA/IDNR basin surveys to supplement baseline data, landuse data will be used to assess improvements in system integrity due to implementation of restoration practices at the sub-basin scale.

Fish and Macroinvertebrates - Fish and invertebrate assemblages must also be monitored at least once a year at the same time and site locations as habitat data collection. Every effort will be made to select sites with historical data to obtain additional baseline data and to coordinate sampling among each discipline to collect water quality and channel morphology data that will be useful in predicting and explaining biotic integrity. At sites where water depth is too deep to wade safely with electrofishing gear (i.e. sub-basin sites), boat electrofishing gear will be used to collect fish assemblage data and site length will be determined primarily by electrofishing run time (IDNR 2001). To detect changes in fish populations and assemblage structure at watershed and sub-watershed sites, quantitative collection of fish data is necessary using a single pass with an electric seine and block nets to prevent fish escapement (IDNR 2001). Species richness, abundance, percent composition, and the Index of Biotic Integrity (IBI) metrics will be used to assess changes or shifts in integrity of fish assemblage structure as a result of restoration practices at each of the spatial scales.

Invertebrate communities must be assessed through a randomly stratified design whereby habitat types are sampled in proportion to their occurrence within each site. Both quantitative (Dodd et al. 2003) methods to obtain relative abundance and percent composition of each taxa and qualitative (IEPA 1987; IEPA 2002) methods will be used to compare current invertebrate communities with historical data. At the watershed and sub-watershed sites, quantitative samplers (i.e. Hess sampler in riffles and core samplers in pools/runs) and qualitative samplers (kicknets) used for wadeable sites will be employed. At sub-basin sites, where water depth may be too great to wade, ponar grabs should be used to quantitatively assess invertebrate communities in deep pools and runs in addition to Hess and core samplers (quantitative methods) and kicknets (qualitative methods) in the wadeable margins. Invertebrates should be identified to family when possible in order to allow for distinctions in stream quality/integrity among restored and reference sites. Taxa richness, densities, percent composition, biotic indices (Family Biotic Index and Macroinvertebrate Biotic Index), and percent of intolerant taxa (Ephemeroptera, Plecoptera, and Trichoptera, %EPT) will be used to assess responses of invertebrates to restoration practices. Mussels, which are also good indicators of sedimentation in a system, should also be assessed at least once a year using IDNR's semi-qualitative wading technique (IDNR 2002) to obtain additional baseline data and to assess changes in mussel populations after restoration. Although mussels are long-lived and, therefore, may have a longer lag time in terms of changes in taxa richness, relative abundance of mussels should increase within a relatively short time frame.

Very few studies have examined effects of restoration practices on fish and invertebrate communities as well as physical habitat at the watershed or sub-basin scale, and therefore, it is uncertain as to the time frame in which significant improvements will occur at these spatial scales. However, based on power analysis of baseline data in the Pilot Watershed Program, we feel confident that improvements in habitat, fish, and invertebrate indicators of stream integrity will be detected within 5-10 years after restoration (with at least 5 years of baseline data) at the sub-watershed and watershed scale (Dodd et al. 2002). This preliminary power analysis is supported by a Wisconsin study which examined the effects of best management practices on habitat and fish assemblages where changes in stream quality were reported after only 4-5 years of implementation at the sub-watershed scale (Wang et al. 2002). Because the sub-basin scale is much larger than the watershed or sub-watershed scale, we estimate that improvements in stream integrity will take longer than the 5-10 years we propose for the watershed scale.

Estimated cost: $ 100,000 per sub-basin/year (cost will vary depending on number of sub-basins).

Desirable Response Measures:

Supplemental data collection on chemical/physical habitat, fish, and invertebrates is desired in order to provide further understanding of relationships occurring between abiotic and biotic factors and how they interact under implementation of restoration practices at various spatial scales (sub-basin, watershed, and sub-watershed). To improve our ability to detect improvements in system integrity within sub-basins of the Illinois River, additional sites should be monitored throughout treated sub-basins (including at the watershed and sub-watershed scale) before and after restoration.

Water quality - Water quality parameters of stream integrity should be monitored continuously (see numbers 4-6 in Table 14) when possible by using gaging stations.

Habitat - Physical habitat, including periphyton abundance (see number 7 in Table14), should be monitored seasonally (Table 15). Habitat types (riffles, runs, pools, side-channels, back-waters, etc.) should be measured and mapped within each site to indicate changes or shifting of these habitats which are critical for different life stages of organisms. More detailed bank and riparian data should be collected by quantitatively sampling vegetation using quadrats in randomly selected locations to obtain percent composition and dominance of plant taxa as well as overall condition of the bank and riparian corridor.

Fish and macroinvertebrates- Because composition, structure, and life stages present in the biotic communities of lotic systems change with seasons, particularly for invertebrates, we propose to sample fish and invertebrate assemblages seasonally at the same time as physical habitat collection. Seasonal sampling (spring, summer, and fall) will allow a greater understanding on how restoration practices affect biotic communities at different times of year under different habitat conditions (e.g. higher flow, low percent overstory cover, and low temperatures in spring versus low flow, high overstory cover, and higher temperatures in summer).

To assess effects on relative abundance of fish communities more completely, it would be desirable to quantitatively sample fish using a multi-pass method at longer stream reaches, particularly at sites where habitat complexity makes it difficult to get a reliable estimate of taxa richness and relative abundance using electrofishing gear (i.e. stream reaches with lots of woody debris and root snags where fish can hide) (Holtrop and Dolan 2003). A single pass method is critical and will provide a reliable estimate for species richness and percent composition, but a multi-pass method is desirable in that it will give a more reliable estimation of abundance and densities (Simonson and Lyons 1995).

To improve our understanding of which abiotic and biotic factors directly or indirectly affect fish communities, we also propose collecting and analyzing boney-structures to estimate changes in growth rates and overall health of the fish populations due to restoration practices. Changes in habitat suitability, prey availability, and fish health resulting from restoration practices can be evaluated through analysis of growth rates because growth is affected by both endogenous and exogenous conditions (DeVries and Frie 1996). Species composition, abundance, and size structure are used to describe changes in the population dynamics of stream fish communities, but the results of these metrics alone offer little insight into which factors or how these factors regulate communities. For example, these fish metrics do not give an indication of how well the habitat meets the needs of the species and does not provide information about the length of time it took for the individuals in a population to reach their current size. Besides improving our understanding of the mechanisms regulating stream fish communities, growth rates also gives us an idea of the stream conditions before a study commences. Age and growth analysis will add a much needed mechanistic understanding of how fish integrity is affected by restoration practices in Illinois River sub-basins with minimal effort. Boney structures will be collected from fish during fish community sampling and processing/analysis of these structures will take minimal time (approximately 1 – 1 ½ months a year).

By including additional data metrics beyond those described as “critical”, our monitoring framework will increase knowledge of how changes in abiotic and biotic factors interact at different spatial scales and allow agencies and managers to better predict how restoration practices will collectively influence stream systems in future restoration projects.

Estimated cost: An additional $20,000 per sub-basin/year (cost will vary depending on number of sub-basins).

ECOLOGICAL MONITORING PLAN - TERRESTRIAL

For terrestrial monitoring, the Illinois Natural History Survey Critical Trends Assessment Program (CTAP; Milano-Flores 2003) provides a useful framework for monitoring vegetation and terrestrial wildlife. The CTAP program is designed to monitor the condition of forests, grasslands, wetlands, birds, insects, and streams in Illinois. For each habitat type, 150 sites are monitored on a rotating, 5-year cycle. Site selection is based on randomly selected patches within randomly selected townships throughout the state. Because townships do not provide a suitable sampling framework within the Illinois River basin, we recommend a slightly modified CTAP protocol in which the sample unit is a habitat patch stratified by sub-basins (i.e., eight digit USGS Hydrologic Catalog Units).

In the proposed modified CTAP approach, data will be collected at 30 sample points in each of three habitat categories (i.e., forest, grassland, wetland) in each sub-basin. This framework results in 1,710 monitoring sites (19 sub-basins x 90 points per sub-basin). The spatial sampling frame for our modified framework is the Federal Emergency Management Agency 100 year flood-zones (Illinois State Water Survey 1996) or 300m from USGS digital line graph streams, whichever is wider. Iverson et al. (2001) demonstrated the potential of using 300m buffers to evaluate wildlife habitat in riparian zones for small streams with relatively narrow floodplains. Sampling in each sub-basin will occur once every 5 years.

The proposed monitoring design will support tracking conditions and restoration progress at site and sub-basins scales, while allowing integration up to the entire Illinois River basin. Specific sampling considerations are outlined below. Sub-basins can be combined based on geographic location and landscape characteristics to decrease number of monitoring sites and therefore costs.

A. Landscape habitat composition and metrics - Land use throughout the watershed has an effect on the status and function of the river and the species present. Land use composition is easily assessed using remote sensing and geographic information systems (GIS). Regular assessment documents landscape change and indicates increasing or decreasing watershed protection (Wang et al. 1997; Snyder et al. 2003). Spatial configuration of habitat provides a better indication of landscape quality for organisms but relationships are complex and difficult to quantify (Gustafson 1998).

Land cover should be regularly monitored to evaluate changes in landscape composition and pattern over time. Land use statistics should be summarized by HUC unit (sub-basin), for the entire watershed, and within the defined riparian zone where species monitoring will occur. Increasing amounts of forest, wetland, and grassland reduce soil erosion, filter contaminants, and increase wildlife habitat. The amount of cropland and urban areas in a watershed have been shown to negatively affect aquatic systems (Wang et al. 1997; Snyder et al. 2003). Important measures of habitat spatial pattern for riparian wildlife include forest (including bottomland) patch size and connectivity, wetland (non-forested) patch size and nearest neighbor distance, grassland patch size, width of natural cover along streams, and connectivity of all natural cover along channel.

Land cover classification and assessment is a powerful tool that relates directly and indirectly to many Illinois River restoration goals. The information provided by analyzing landscape habitat composition and pattern relates to diversity and sustainability of habitats and communities, and habitat suitability for species. Species or community level modeling can be applied using land cover data to determine habitat deficiencies that may be limiting distribution or abundance. Analysis of classified satellite imagery will allow tracking of restoration success for general land cover categories over broad spatial scales, including habitat connectivity.

The ability to measure change in land cover is limited primarily by classification level and accuracy. The Illinois land cover data (IDNR et al. 2003) has a pixel size of about 30m x 30m and therefore cannot be used to monitor changes at a very small spatial scale. The tradeoff between classification detail and accuracy results in broad habitat classifications. Land cover changes for patches greater than 30m x 30m can be detected throughout the basin and individual pixels compared over time to track changes. Change can be summarized from the pixel level up to the entire Illinois River watershed at important levels of spatial organization and related to restoration objectives. Land cover data and analysis, in conjunction with the IDNR Comprehensive Wildlife Conservation Plan that is currently being developed, could be used to guide restoration efforts that will provide the greatest benefit to wildlife species of interest.

Estimated cost: $3,000.

C. Site-specific habitat/vegetation monitoring - Intensive vegetation sampling compliments landscape and community level assessment. Much of the wildlife habitat along the Illinois River and its tributaries has been lost due to land use change, hydrologic alteration, or sedimentation, and these are changes that can be measured by landscape and community level assessment. Much of the remaining habitat suffers from changes in vegetation structure or species composition. For example, many of the floodplain forests have lost their mast producing species component and suffered high mortality of mature trees resulting from altered hydrology (Nelson and Sparks 1998; Havera 1999). Vegetation sampling at randomly selected sites provides a means for evaluating diversity at the species level, for monitoring rare species, and for detecting invasive species. Monitoring vegetation at specific sites also provides the opportunity to collect detailed information on vegetation structure that relates to wildlife habitat suitability.

Site selection for intensive vegetation monitoring will follow the protocols described at the beginning of the sub-basin section. Vegetation data generally will be collected using a standard transect approach following CTAP protocols (Milano-Flores 2003). Data collected for all three habitat types (i.e., forest, grassland, wetland) includes plot species composition/richness, ground cover by species, stems of woody species <5cm dbh, and stems and dbh of woody species >5cm dbh. Additional details of the CTAP program can be found in the Critical Trends Assessment Program Monitoring Protocols manual (Milano-Flores 2003). Some vegetation types, like forest and scrub-shrub wetlands, are expected to respond slowly to restoration activities, but intensive vegetation monitoring should be able to detect subtle changes and indicate habitat trajectories.

Guidelines for specific habitat types:

Forest monitoring – Forest patches will be selected using Illinois land cover data forest types (IDNR et al. 2003). CTAP requires a 20 acre forest patch size minimum with a radius of 150m of homogenous forest type, and actual sample sites must be surrounded by a 114m forest buffer, but that restriction could be relaxed if necessary for our program to reach the desired sample size. This may be necessary in smaller watersheds, those with a high proportion of urban area, or watershed units dominated by intensive agriculture.

Grassland monitoring – Grassland patches will be selected from rural and urban grassland types from Illinois land cover data (IDNR et al. 2003) and subject to additional criteria determined by site visits. The only patch size constraint is there must be at least $500m^2$ of suitable habitat area that is ≥10m wide. Suitable grasslands must have <50% shrub and <50% canopy cover.

Wetland monitoring – Wetland sites are selected from Illinois Wetlands Inventory data (IWI; Suloway and Hubbell 1994). The CTAP wetland program monitors only emergent palustrine wetlands that can safely be sampled on foot. Our program will also include scrub-shrub palustrine wetland types and can be extended to include areas on islands that can only be reached by boat. Wetlands must be ≥ 2 acres in size with a minimum of $500m^2$ of suitable habitat area that is at least 10m wide. Because wetland alteration has continued at a rapid pace even since the IWI was completed, an additional criteria is that sample sites must have ≥ 50% obligate, facultative wetland, or facultative plants. Wetland vegetation monitoring should compliment LTRMP vegetation monitoring.

Intensive vegetation monitoring relates to Illinois River restoration goals similar to both community and landscape level assessment but at a higher spatial resolution. Intensive vegetation monitoring will provide a source of information lacking for the Illinois River watershed and provide detailed information on vegetation composition and structure over time. For most restoration practices, subtle changes in vegetation should be detected in the first cycle after implementation. Intensive monitoring will also allow tracking of rare, exotic, and invasive species. Monitoring of vegetation at specific sites can be utilized to ground truth landscape and community level data for classification accuracy.

K and L. Bottomland/riparian forest & grassland birds - Passerine birds have been proposed as excellent multi-scale biological indicators because they are usually easily detected, widespread, many exist in relatively high numbers, and they integrate multiple factors across a landscape (U.S. EPA 2002a; O’Connell et al. 1998). Bird species and communities are sensitive to vegetation composition and pattern, landscape pattern, hydrology, water quality, disturbance, predation, and parasitism (U.S. EPA 2002a). The Illinois River basin is an important area for passerine birds and many rare species rely on habitat found in the riparian zones of the river and its tributaries. Bottomland forests along large rivers are particularly important and support a highly diverse and unique bird community (Knutson et al. 1996). Rare species and bottomland forest obligates include brown creeper, red-shouldered hawk, cerulean warbler, prothonotary warbler, and red-eyed vireo. Species may serve as indicators at different spatial scales based on their size and ecology. For example, raptors and waterfowl range more widely and therefore serve as indicators at larger spatial scales than species like rails or sparrows that wander over a relatively small area during the breeding season (U.S. EPA 2002a). Riparian grasslands could provide habitat for many of the rare grassland species still found in Illinois.

Existing programs such as the North American Breeding Bird Survey “BBS” (U.S. Geological Survey 1998) provide much data. However, because BBS is a road-based survey, little sampling is done in riparian areas where road density is typically low. Therefore, riparian associates and obligate species remain undetected or are detected in very low numbers. We propose a monitoring program following CTAP bird monitoring protocol (Milano-Flores 2003) at the same randomly selected sampling locations where intensive vegetation data will be collected. CTAP methodology is comparable to BBS data collection and much of the same data is collected, however CTAP is designed to relate the bird community and species abundance to habitat conditions at the site. Differences between the two bird monitoring programs include CTAP counts lasting 10 minutes compared with 3 minutes for BBS. CTAP ornithologists record direction and distance to each calling individual allowing the use of distance sampling techniques to estimate bird densities, whereas BBS observers only collect data on numbers. After the ten minute call-count is complete, CTAP ornithologists use a tape to broadcast calls of Illinois marsh birds followed by a one minute listening period for responses. BBS protocol does not allow call solicitation. CTAP protocol requires collection of call data for at least two sample points at each site with a minimum distance between points (300m for grassland and wetland, 150m for forest). If the habitat patch is too small for two sample points, a second sample point is located in the closest similar habitat patch of suitable size. Multiple sample points provide an estimate of local variation.

Monitoring will occur at 30 randomly selected sample points per habitat (forest, grassland, and wetland) in each watershed unit. Abundance should only be assessed at the species level for those species that are generally abundant. Presence/absence or analysis by habitat guild (i.e., riparian forest associates) provides a sound basis for analysis of rare species or those normally only present in low numbers. Data collected within a watershed can be summarized by habitat type in the monitoring year.

Restoration practices that will benefit riparian forest and grassland birds include managing for large habitat tracts, increasing tree species diversity in bottomland forests, and managing for mature forests (Knutson et al. 1996).

F. Marsh birds - Marsh birds are a secretive group of birds that live primarily in emergent or floating leaved vegetation. Their habitat requirements tend to be specific with respect to wetland area and/or vegetation structure. Most species are rarely seen or heard and therefore require specialized sampling techniques. Abundance can be difficult to measure because most species naturally exist at low densities. Therefore species presence, particularly during the breeding season indicates good quality marsh habitat. Presence and breeding activity, particularly of rare species, are good indicators of suitable habitat conditions, and the number of sites where they are found is a more appropriate measure than abundance at a site. Presence/absence data can be summarized across watershed units to provide an indication of distribution and habitat quality.

With the widespread loss of wetland habitat in Illinois, few marsh birds breed in the state. The rarest species, such as the black rail, require short emergent vegetation. This type of habitat is the first to be destroyed by flooding and therefore is rare within the Illinois River watershed.

Monitoring will occur in conjunction with passerine bird monitoring at intensive vegetation sampling points. Observers will use taped calls of marsh birds found in Illinois to solicit call responses. Number of calls and number of individuals responding should be recorded. Because all sample points will be within the riparian zone and because mesic grasslands or forests with well developed herbaceous understories could provide habitat for marsh birds, marsh bird monitoring will occur at all vegetation sample points. While abundance data will be collected, initially data will be summarized based on the number of sample points where species are present within a watershed unit. If restoration supports a numeric response, abundance data can be utilized as an index to track restoration progress.

Marsh birds are good indicators of their specific habitat type and therefore indirectly of hydrologic conditions. Species that use tall emergent vegetation, such as American bittern, may respond more rapidly because we anticipate their habitat will respond more quickly to habitat restoration than short emergent communities. Successful restoration should also result in increasing numbers of marsh birds nesting within the Illinois River basin.

M. Amphibians - There has been considerable interest in using amphibians as indicators of wetland condition (Micacchion 2002; US EPA 2002b). Ecological and life history characteristics that make amphibians desirable as bioindicators include they have both aquatic and terrestrial life stages; they are vulnerable to habitat fragmentation, water chemistry, hydrology, pollution, and climate change; they have a complex life history; and they require fishless ponds for successful reproduction. In addition, most frogs and toads are vocal during the breeding season and call indices can be used to infer changes in abundance.

The relative abundance of frogs and toads can be monitored at concentration areas using frog call surveys (U.S. EPA 2002b, U.S. Geological Survey 2001). We recommend collecting frog and toad call count data at intensive vegetation monitoring points. This will allow efficient selection and monitoring of sites and relation of abundance and species richness to habitat conditions. The protocol uses 2 counts conducted during evenings in the spring. Suitable conditions for conducting surveys and data collected generally follow North American Amphibian Monitoring Program protocol (USGS 2001). Since only 2 surveys will be used, survey dates should be at least two weeks apart and should be carefully selected to account for the most species possible. The first count can be conducted when the minimum night-time air temperature reaches 41˚F. The second count can be done once the minimum night-time air temperature reaches 50-55˚F. Counts begin ≥ 30 minutes after sunset and last for five minutes. Multiple sample points should be surveyed at each site according to CTAP bird monitoring protocol for selection and spacing of points (Milano-Flores 2003).

Unless wetlands are a considerable distance from existing amphibian populations, the most common frog and toad species respond very quickly to habitat restoration. Species richness for a particular wetland or within a sub-watershed is expected to respond more slowly depending on distance to source populations, annual hydrologic variation, and probably many other factors. Frog and toad communities using isolated wetlands indicate conditions primarily at the patch level, whereas amphibians in connected riverine wetlands integrate conditions over larger scales. Salamander population parameters should be considered as well.

Estimated cost for site-specific habitat/vegetation ©), Bottomland/riparian forest and grassland birds (K&L), marsh birds (F), and amphibians (M) - $945,000.

J. Bats - Bats have not been well studied relative to other wildlife species groups (Arnett 2003) but they are good indicators of riparian system integrity and disturbances (Fenton 2003).

Relatively little quantitative data are available regarding the current abundance of most species found in Illinois but clearing of riparian forests, stream channelization, rural housing development, and organochlorine insecticides have contributed to long-term population declines for many species (Herkert 1992). Life history traits provide evidence bats are adapted to stable and predictable habitats (Kunz and Pierson 1994). All Illinois bat species are insectivores and many forage in forested riparian areas. Some species rely entirely on caves for wintering, nesting, and summer roosting, while others utilize trees and shrubs for roost sites and maternity colonies. Most bats forage within a few miles of their roost site. These factors, combined with presence of the Federally Endangered Indiana bat within the Illinois River basin makes bats an attractive indicator species of integrity for the riparian zones of small to medium sized, forested streams.

Foliage and tree roosting bats provide the best indication of forest conditions because multiple aspects of their ecology are dependent on riparian habitat conditions. However, this group of bats poses special challenges for monitoring because they live in small colonies that are widely dispersed (O'Shea et al. 2003). The most effective means of monitoring bats is nocturnal trapping. Trapping provides data on species richness and can allow abundance estimation using multiple trapping sessions and mark-recapture models. However, trapping is very intensive and therefore difficult to implement over a large spatial scale. Technological advances have led to acoustic monitoring devices that combined with software analysis and calibration by trapping permits species discrimination and potentially the development of species specific bat population indices. Gannon et al. (2003) provide a discussion of methodology for acoustic monitoring and data analysis.

Bats should be monitored at randomly selected sub-watershed riparian forest sites. Two approaches can be used. Trapping alone provides information on presence/absence, species richness, and forest obligate species. Trapping combined with acoustic monitoring will permit calibration of species calls and the development of indices using acoustic monitoring alone. For both approaches, data should be analyzed to determine the number of sites where bats are present within each sub-watershed and the species found at each. Annual monitoring will show trends over time at the sub-basin level.

Bats are an important biodiversity component within the Illinois River watershed and an indicator of riparian forest integrity for small to medium sized streams. Bats would be expected to respond, but slowly, to riparian forest restoration. A more rapid response (within 10 years) could be anticipated following projects that protect existing habitat, reduce disturbance and insecticide application. Such projects may include retiring of agricultural fields, preventing forest clearing and stream dredging practices, and protection of riparian areas from housing development. Progression of restoration would likely follow bats feeding in areas first, followed by greater roosting and reproduction as older trees and snags become available.

Estimated cost: $119,000.

I. Terrestrial mammals - Because of their large range size and high trophic position, medium to large mammals integrate a range of environmental conditions over large scales. Riparian mammals like muskrat, beaver, mink, and river otter are sensitive to habitat, water quality, and pollutants. Bobcats require large habitat areas that are relatively free from human disturbance. Some mesopredators, like raccoons and opossums, have shown a positive numeric response to human alterations of the landscape and are now ubiquitous. These species are important nest predators of bird and reptile nests and at unnaturally high numbers or in small habitat patches they impair habitat function.

Major challenges to using mammals as indicators are low abundance and detection rate, particularly for positive indicators. The terrestrial mammal monitoring component will utilize existing data surveys and expand on current monitoring programs. Mammal monitoring will rely on summary analysis of data collected from several IDNR surveys and addition of sample sites to the IDNR Furbearer Sign Survey. A combination of methods is recommended to monitor rare and widely distributed species like river otters and bobcats (Melquist and Dronkert 1987; Rolley 1987). IDNR archery deer hunter surveys and trapper surveys provide data that can be used to monitor population trends for most furbearer species, and the IDNR firearm deer hunter survey provides data on bobcat sightings. However, additional funds are needed to increase the number of sample sites for the Furbearer Sign Survey. Another component to be considered is counts of muskrat houses at marsh sites.

Many IDNR surveys are based at the spatial scale of counties. Watershed level analysis should include summaries of all counties entirely or partly within the Illinois River basin. Riparian level analysis should include only those counties partly within the riparian zone of the Illinois River and its tributaries. Expanding the Furbearer Sign Survey will allow trends and distribution of species to be analyzed for smaller watershed units.

Bobcats and riparian/wetland associated mammals are the positive target indicators. The initial response of target species to restoration will likely be functional. Individuals will probably begin using more area following restoration before there is a response in species numbers. Therefore, positive indicators probably will not show significant changes until at least 20 years into the restoration program and then only with significant increases in habitat. Caution should be exercised in interpreting trends and there should be an attempt to differentiate response from restoration to adaptability and range expansion.

Estimated cost: $17,000.

Desirable Response Measures:

O. Avian reproduction - Abundance of breeding birds does not necessarily indicate functional habitat quality. Reproductive success may be low even where adult abundance is high (i.e., sink habitat). High quality habitat patches may suffer from landscape or patch fragmentation effects due to high rates of nest predation and parasitism. Therefore, avian reproductive success integrates many factors and provides a good indication of functional habitat quality at the patch and landscape levels.

To evaluate nest success, five sites per habitat (i.e., forest, grassland, wetland) in each sub-basin should be monitored from roughly April to July. Similar to bird monitoring, each sub-basin will be monitored once every 5 years. Nests should be monitored once every 3 days during the active nest cycle and analyzed using the Mayfield method (Mayfield 1975). Nest success should be analyzed by species, reproductive guild, and community, and can be summarized within watershed units.

Avian reproductive success integrates large spatial scales but is expected to respond slowly to restoration efforts. Wetland or grassland breeding avian species will respond more quickly than forest breeding species because herbaceous communities develop more quickly following restoration than forests. A detectable response in reproductive success will probably only be seen following significant increases in habitat patch size and a long period of time for habitat development. Detectable changes in forest bird reproductive success may not be observed for at least 30 years.

Estimated cost: $122,000.

P. Amphibian reproduction - Amphibian embryos are extremely sensitive to environmental conditions. Successful reproduction by amphibians depends on hydrology, water chemistry, and specific habitat requirements (U.S. EPA 2002a). Amphibians require fishless wetlands for successful reproduction and different species prefer different microhabitats for egg deposition. Counts of egg masses provide an indication of breeding effort and the proportion of viable egg masses indicates wetland health (U.S. EPA 2002a). Amphibian adults and embryos are sensitive to many of the same factors with embryos more sensitive than adults. Amphibian egg masses can be used to detect non-vocal species, including salamanders, not detected using call-based surveys.

To monitor amphibian reproduction, a random sub-sample of 15 of the selected amphibian monitoring sites in each sub-basin should be selected. Potential sample sites can be from any of the three habitat types (i.e., forest, grassland, wetland) where calling amphibians were detected. Data collected should include egg mass counts by species and proportion of viable eggs per egg mass. Two visits should be made to each site to detect all breeding species at a site.

Similar to frog and toad call counts, amphibian reproductive effort is expected to respond quickly to improving habitat conditions, particularly hydrology and water quality. Diversity of breeding amphibians provides an additional indicator of habitat complexity. Viability of amphibian eggs generally provides and indication of environmental conditions, potentially at a scale beyond the Illinois River basin.

Estimated cost: $16,000.

HYDROLOGIC AND SEDIMENT MONITORING

A list of monitoring sites that compose the proposed network that would provide data to achieve the objectives listed in the "Goals and Objectives" section (see Mainstem - Hydrologic and Sediment Monitoring section) is provided below. Following the name/location of each proposed discharge and sediment monitoring site are comments describing which actions need to be implemented at that location. At locations where discharge and sediment are currently being monitored a recommendation is made to "increase sampling frequency." For stations that currently have active streamflow gages, but need sediment monitoring, a recommendation to "monitor sediment" is made. At sites where neither discharge nor sediment is currently being monitored a recommendation is made to "activate" or "reactivate" discharge and sediment monitoring. To "activate" a station implies no prior data has been collected at that site, whereas to "reactivate" a station means previous discharge and/or sediment data was collected at that site. The locations of all of the proposed monitoring sites within the Illinois River Basin are shown in Figure 11.

Tributary Watershed Locations:

Sites on major tributaries

B01 Des Plaines River at Riverside (increase sediment sampling frequency)

B02 Fox River at Dayton (increase sediment sampling frequency)

B03 Iroquois River at Iroquois (monitor sediment)

B04 Iroquois River near Chebanse (monitor sediment)

B05 Kankakee River at Momence (increase sediment sampling frequency)

B06 Kankakee River near Wilmington (increase sediment sampling frequency)

B07 La Moine River at Colmar (increase sediment sampling frequency)

B08 La Moine River at Ripley (increase sediment sampling frequency)

B09 Mackinaw River near Congerville (increase sediment sampling frequency)

B10 Mackinaw River near Green Valley (monitor sediment)

B11 Macoupin Creek near Kane (monitor sediment)

B12 Mazon River near Coal City (increase sediment sampling frequency)

B13 Salt Creek near Greenview (monitor sediment)

B14 Sangamon River at Monticello (increase sediment sampling frequency)

B15 Sangamon River at Riverton (monitor sediment)

B16 Sangamon River near Oakford (increase sediment sampling frequency)

B17 South Fork Sangamon River near Rochester (monitor sediment)

B18 Spoon River at London Mills (increase sediment sampling frequency)

B19 Spoon River at Seville (increase sediment sampling frequency)

B20 Spoon River in Stark County (activate)

B21 Vermilion River at Pontiac (monitor sediment)

B22 Vermilion River near Leonore (increase sediment sampling frequency)

The IRB as reflected in Figures 4-6 and Figures 8-11 can be subdivided into 12 major sub-watersheds (as originally defined by McConkey and Brown, (2000)). In the previous section, the monitoring site A04 (Illinois River at Valley City) monitors the downstream end of the mainstem Illinois River sub-basin. Here monitoring sites B02, B04, B06, B08, B10, B11, B16, B19, and B22 were chosen to monitor the discharge and sediment loads at the downstream ends of nine of the remaining major sub-basins. B12 was selected to monitor the Mazon River, which is the largest stream contained within the mainstem Illinois River sub-basin. Monitoring sites B13, B15, and B17 were selected to monitor the major tributaries of the Sangamon River, which drains a large portion of the area within the IRB. B01 was selected to monitor flow and sediment conditions within the Des Plaines River. B05, B07, B09, B14, and B18 were chosen because substantial flow and sediment data already exists at these locations. B03, B20 and B21 would monitor sediment inputs from Indiana on the Iroquois River, at the upper portions of the Spoon and Vermilion Rivers, respectively.

Sites on small tributaries not in the mainstem Illinois River sub-basin.

C01 Big Ditch near Fisher (reactivate)
C02 Court Creek near Appleton (increase sediment sampling frequency)
C03 Cox Creek near Newmansville (increase sediment sampling frequency)
C04 Friends Creek near Argenta (monitor sediment)
C05 Haw Creek near Maquon (increase sediment sampling frequency)
C06 North Creek near Oak Run (increase sediment sampling frequency)
C07 Panther Creek at Site M (increase sediment sampling frequency)

The above sites are included in the proposed network for three reasons. First, these sites monitor streams draining less than 100 square miles. Second, these sites are currently collecting discharge and/or sediment data (except for C01 which recently became inactive). Sites C02, C03, C06, and C07 are located within CREP or Pilot Watersheds where the effects BMP implementation are being investigated.

Sites on small- to medium-sized streams in the mainstem Illinois River sub-basin.

D01 Apple Creek in Greene County (activate)
D02 Aux Sable Creek in Grundy & Kendall Counties (activate)
D03 Crow Creek (East) near Washburn (reactivate)
D04 Crow Creek (West) near Henry (reactivate)
D05 East Branch Bureau Creek near Bureau (reactivate)
D06 Indian Creek in Morgan & Cass Counties (activate)
D07 Kickapoo Creek at Peoria (reactivate)
D08 McKee Creek at Chambersburg (monitor sediment)
D09 North Fork Mauvaise Terre Creek near Jacksonville (reactivate)
D10 Quiver Creek-Main Ditch in Mason & Tazewell Counties (activate)
D11 Sugar Creek in Schuyler County (activate)

These sites were selected to be incorporated into the monitoring network because they drain areas < 400 square miles and lie within the Illinois River sub-basin. Currently there is little or no information on bluff streams of this size that flow directly into the Illinois River. Previous research on sediment loads within the mainstem of the Illinois and the presence of large delta formations at the confluences of these streams with the river indicate these streams are major contributors of sediment to the river.

Sites to represent different morphologic and physiographic regions.

E01 Coop Branch in Macoupin County (activate)
E02 Drowning Fork at Bushnell (reactivate)
E03 Flat Branch near Taylorville (reactivate)
E04 Horse Creek in Kankakee County (activate)
E05 Indian Creek in LaSalle County (activate)
E06 Indian Creek near Wyoming (monitor sediment)
E07 Kickapoo Creek near Waynesville (monitor sediment)
E08 Mackinaw River near Lexington (activate)
E09 Missouri Creek in Schuyler County (activate)
E10 North Fork Salt Creek near LeRoy (activate)
E11 North Fork Vermilion River near Charlotte (reactivate)
E12 Salt Fork Vermillion River at Forrest in Livingston County (activate)
E13 Spring Creek near Onarga (activate)
E14 Sugar Cr. at Auburn (Lake Springfield) (activate)

These sites are proposed for two reasons. First, they drain areas less than 400 square miles. Second, by including these sites in the network, at least one stream draining less than 400 square miles will be monitored in every major sub-basin (except in the Des Plaines and Chicago/Calumet sub-basins). Thus, the network as a whole will be monitoring the different physiographic areas within the IRB.

Critical Response Measures:

In summary, the critical network would support:

1) All four proposed sites on the Illinois River (A01-A04)

2) Fifteen of the twenty-two proposed sites on the Illinois River's major tributaries

3) Five of the seven proposed sites on small tributaries not in the Illinois River sub-basin

4) Ten of the eleven proposed sites on small- to medium-sized streams in the mainstem Illinois River sub-basin

5) Eleven of the fourteen proposed sites to represent different morphologic and physiographic regions

Estimated cost: $1,118,000 to implement and operate this hydrologic and sediment monitoring network during the first year and $634,000 per subsequent year. These costs reflect the combined cost of the mainstem and sub-basin hydrologic and sediment monitoring plan.

Desirable Response Measures:

In summary the Desirable Network would support:

1) Four sites on the mainstem of the Illinois River (A01-A04)
2) Twenty-two sites on the Illinois River's major tributaries (B01-B22)
3) Seven sites on small tributaries not in the Illinois River sub-basin (C01-C07)
4) Eleven sites on small- to medium-sized streams in the mainstem Illinois River sub-basin (D01-D11)
5) Fourteen proposed sites to represent different morphologic and physiographic regions (E01-E14)

Estimated cost: $1,423,000 to implement and operate this hydrologic and sediment monitoring network during the first year and $815,000 per subsequent year. These costs reflect the combined cost of the mainstem and sub-basin hydrologic and sediment monitoring plan.

GEOMORPHIC MONITORING PLAN

A baseline dataset for project monitoring would be largely developed during preliminary watershed assessment as is discussed elsewhere in this document. The assessments comprise syntheses of existing data and acquisition of data about the contemporary environment across each target watershed. Assessment identifies the existing static condition as well as establishes intrinsic rates of change (e.g., meander migration), and may reveal some long-term system responses to historical change. In addition, the assessment will identify critical data gaps, potential problems for remediation, sampling locations and appropriate techniques, and tune sampling protocols (c.f., Osterkamp and Schumm 1996). The data examined would include at least surficial geology, landscape history over 100 years or more, channel pattern, channel morphology, and climate or flow, though the exact form will be conditioned by data available for the target watershed.

A wide variety of potential projects are envisioned in the Restoration plan, ranging from stream bank stabilization to wetlands creation. The goals of these projects in turn range from protecting target natural areas to improving water quality to preventing channel incision. Indicators for these various projects must be directed at the specific project objectives. Nevertheless, in many instances a standard set of measurements could feed a range of geoindicators.

Table 9 lists monitoring studies that could be used as a basis for developing indicators once specific projects are identified. Wide varieties of qualitative and quantitative methods were used, and were applied over a range of temporal and spatial scales. The objectives of the monitoring programs ranged from generalized trend analysis (e.g., Swanson Hydrology & Geomorphology 2002) to the more desirable evaluation of integrated and linked indicators (e.g., Rhoads and Miller 1999).

Several temporal phases of monitoring may be necessary for each project, depending upon the nature of response of the target feature. Stream channels, for example, often respond to perturbation as a dampening wave. That is, channel conditions may change rapidly and complexly immediately following project implementation, but over time will change more slowly as a new equilibrium condition is reached. Phased monitoring would also allow survey crews to cycle project monitoring: the higher frequency monitoring of new projects could be picked up as less frequent monitoring is phased in on older projects.

Critical Response Measures:

Channel Geomorphology - White et al. (2004) have outlined a detailed method for measuring channel geomorphology (their Phase II, Reconnaissance Characterization). These are recommended as the fundamental measurement protocols for projects directed at affecting channel processes. Surveys should occur along three reaches, one each downstream, within, and upstream of the project reach.

The Phase II measurements are not a set of indicators, however. The development of indicators to gauge channel geomorphic evolution must, again, be specific to project goals and so must wait until specific projects are proposed. Several of the monitoring plans reviewed in Table 8 provide examples. White et al. (2004) have an indicator-oriented Phase I (Rapid Characterization) channel stability scoresheet that could be used to show evolution of a channel throughout an entire watershed by periodic mapping. Such trend analysis might be useful in gauging overall progress towards restoration goals because it would capture effects of channel restoration projects as well as the totality of watershed changes with time. It must be determined, however, whether the indicators are suitable for gauging response of specific projects (c.f., Doyle et al. 2000). Likewise, a project response indicator could be developed from the Relative Bed Stability index of Olsen et al. (1997) if project goals are appropriate.

Three periods of monitoring are suggested for projects directed at channel processes. Monitoring surveys should be conducted annually for several years after project implementation, followed by less frequent surveying (2-3 yr) until project success or failure is demonstrated. A third period of monitoring would be included in decadal sub-basin-wide mapping surveys using the Phase I methods of White et al. (2004).

Estimated cost: $5,000 per project for 10 year monitoring period (total of 6 surveys).

Wetlands - Specific plans must follow project proposals, but a range of standard techniques are currently used by ISGS, IDNR, and other agencies to monitor wetland functions. The basic measurements can be used to develop a variety of project-specific indicators such as sedimentation rate, frequency and duration of flooding, and water quality.

Estimated cost: Not identifiable at present time.

Desirable Response Measures:

Stream Channel Dynamics - The determination of historic rates of change in channel pattern using the air-photo analysis methods of Urban and Rhoads (2000) and Phillips et al. (2002) has been recommended as part of baseline watershed assessment. Stream channel dynamics are expected to be affected by restoration project implementation as well as non-controlled forcings like climate and landuse changes. Understanding the evolution of stream channel dynamics is essential to assessing whether measured sediment loads are "excessive" or not. Channel pattern and rates of change should be reassessed periodically to determine if channel dynamics are evolving across watersheds in the IRB. The analysis would show both project and non-point source responses.

Potential indicators metrics are meander migration rates and avulsion frequency. The air-photo analysis method shows statistically significant channel evolution only over several decades for very low power, low bedload streams, but shows shorter-term changes in other settings (Phillips et al. 2002; Landwehr and Rhoads 2003). The analysis could be applied at various watershed scales. Targeting selected paired subwatersheds (e.g., HUC12) from across the IRB would be an effective combination of scale and resources. Airphotos have been collected every 5-7 years historically by the NAPP. If this pattern continues, an approximately 20 yr period of reassessment is recommended to allow for acquisition of several sequential photos across each target watershed.

Estimated cost: $25,000 per watershed pair.

ECOLOGICAL MONITORING PLAN - AQUATIC

Critical Response Measures:

Use of restoration practices for reducing nonpoint source pollution are well known (Gale et al. 1993). Instream practices for stabilizing stream banks, increasing habitat diversity, etc., have received some study, mostly in coldwater streams (Edwards et al. 1984; NRC 1992; Hunt 1993). Little information is available on how various individual restoration projects affect lotic systems, particularly the biotic community. Therefore, it is important to assess a variety of individual projects at the local scale. In some cases, the effectiveness of specific restoration practices (e.g., riparian buffer strips, Muscutt et al. 1993; Osborne and Kovacic 1993; Hill 1996) has been well documented, but the vast majority of these studies were conducted over relatively short time frames (Edwards et al. 1984; Magette et al. 1989; Habersack and Nachtnebel 1995; Lee et al. 2001). Based on the few studies which have looked at individual practices (riffle structures, channel modification, and wetlands), changes in river morphology/habitat and improvements in fish and invertebrate communities were documented within 3 years of implementation (Carline and Klosiewski 1985; Fuselier and Edds 1995; Habersack and Nachtnebel 1995; Brown et al. 1997). Thus, abiotic and biotic parameters may respond quickly (within 1-5 years) to certain types of restoration practices although other projects (i.e., on-field practices) may take longer to produce a significant improvement in system integrity. How the performance of individual practices change over longer time periods is largely unknown (Muscutt et al. 1993; Osborne and Kovacic 1993). This monitoring framework extends previous investigations of stream restoration practices by evaluation of individual management practices in warmwater systems over a longer time period. By examining effects of individual practices combined with collectively monitoring practices at the sub-basin and basin scale, this monitoring protocol will help determine which practices have the greatest effect on abiotic and biotic indicators and potentially determine the amount needed to obtain the greatest improvement in system integrity.

To examine the effects of individual restoration practices, the Before-After-Impact-Control Pairs design (described in the Introduction - Study Design and Statistical Approaches section) will be used. When possible, reference or “control” sites in nearby watersheds not receiving extensive restoration practices should be used to account for temporal variability. However, sites immediately upstream of the reach being affected by restoration practices should also provide a suitable reference condition before and after implementation. Within a watershed, multiple sites where the same practice will be implemented should be monitored to determine how longitudinal changes along the stream gradient (i.e., discharge, drainage area, etc.) influences the effectiveness of individual practices. It is also important to sample as many years as possible before implementation of the practice to gain a more accurate picture of baseline conditions and to determine the effectiveness of each restoration practice. Since many of the techniques proposed for the Illinois River basin have not been extensively studied (instream structures, bank/channel stabilization, sediment removal, etc.), it is critical to sample many different practices for several years after implementation to evaluate different responses of stream parameters to various practices and establish at what point in time these practices improve stream conditions. To determine immediate and short-term responses in abiotic and biotic conditions, more frequent sampling (i.e., seasonal) directly after implementation of the practice is critical, while long-term effects can be assessed through annual monitoring over several years.

We propose a level of monitoring similar to that described for monitoring sub-basins in order to assess how individual restoration practices effect habitat and biotic communities and how these practices combined effect the entire basin. Both treated and reference sites should be no shorter than 35 times mean stream width such that at least one riffle-run-pool sequence is included in the site (Lyons 1992; IDNR 2001). Physical habitat data must be collected using site-scale and transect-scale levels of sampling (Tables 13 and 14) with site-scale parameters collected at one location in the site (e.g., water temperature, discharge) and transect-scale variables (e.g., width, depth, substrate, etc.) measured along equally spaced transects. These data requirements are not unique to those needed in the geomorphic monitoring section and are therefore not a redundant sampling effort. Depending on the type of practices implemented, more detailed monitoring of in-stream habitat (i.e., mapping of percent habitat types) or bank/riparian vegetation and condition (i.e., quantitative assessment using quadrats to obtain percent composition and dominance of plant taxa) is critical to determine shifts in physical habitat and provide a mechanistic understanding for changes in the biotic community.

Estimated cost: $10,000 - $30,000 per practice (depending on practice type and other biotic monitoring efforts in the sub-basin).

Desirable Response Measures:

To completely understand how restoration practices directly (e.g., creation of habitat by instream structures) and indirectly (e.g., improvements in water quality affecting prey availability) affect the biotic community, it is essential that fish and invertebrates are monitored in both the treated and reference site at the same time as habitat data collection. Quantitative collection of fish and macroinvertebrate data is necessary, and sampling protocols used to assess effects at the sub-basin scale is critical to assess individual practices. However, additional sampling either through more rigorous methods (i.e., multi-pass fish sampling) or increased frequency of sampling (i.e., seasonal sampling of fish and invertebrates) may be necessary depending on the type of practice implemented. As percent of various habitat types shift or types of habitats become more dominate in the reach due to implementation of a restoration technique (i.e., increase in riffles as a result of decreased sedimentation), this framework will allow us to better assess the changes in overall fish and invertebrate communities by sampling more often and by sampling at locations in the watershed where these habitats are newly formed. By including both abiotic and biotic parameters in the monitoring framework, we can better understand how changes in one parameter as a response to restoration practices interacts with and effects other parameters of the system.

Estimated cost: An additional $10,000 per practice (depending on practice type and other biotic monitoring efforts in the sub-basin).

ECOLOGICAL MONITORING PLAN - TERRESTRIAL

Monitoring should begin at least one year prior to project initiation. Monitoring should be done at randomly selected sites within the project area and an equal number of sites in similar "pre-treatment" habitat outside the project area according to the BACI approach (described in the Study Design - Statistical Approaches section in the Introduction). The number of monitoring and control sites for each project should be determined by project size. Specific monitoring components to be used at project sites depend on location and should match components used for the appropriate watershed unit and habitat type. Data collected at project sites should be included in summary analysis for appropriate watershed units.

HYDROLOGIC AND SEDIMENT MONITORING PLAN

The Illinois River Restoration Project proposes a comprehensive array of restoration measures designed to enhance and protect the ecological integrity of the Illinois River. Many of the proposed efforts are new to the Illinois River and never in Illinois has there been an attempt to integrate such diverse projects into a comprehensive plan with the goal of improving the ecological integrity of a system the size and complexity of the Illinois River Basin. For this effort to be successful it will be necessary to determine if specific projects are performing as envisioned, what the cumulative impact projects are having on both biotic and abiotic systems, and if restoration techniques are sustainable over their project lives. Consequently, as restoration projects are implemented, it will be necessary to begin monitoring specific projects in order to assess the impacts, performance, and sustainability of these techniques. In many cases hydrologic, sediment, and bathymetric data will be crucial to interpreting the biological and other forms of data collected by the various agencies participating in the Illinois River Restoration Project.

Specifically, hydrologic and sediment monitoring along with bathymetric surveys will provide managers with data that can be used in a multi-disciplinary setting to define and refine management strategies that enhances synergy between projects, improves efficiencies and unit costs, and allocates resources to those areas where benefits can be maximized. Moreover, such data will be critical in the adaptive management process, which will be a necessary component in the success of the Illinois River Restoration Project.

In addition to providing the information necessary for adaptive management of specific restoration strategies, hydrologic, sediment, and bathymetric data collected through project specific monitoring will expand and complement the data being collected for system monitoring. Thus, as projects are implemented our ability to refine discharge and sediment budgets for sub-watersheds and hence the entire Illinois River basin will be improved. In turn, this will improve our ability to site resources and specific projects in those areas where benefits can be maximized.

To better assess overall sedimentation rates, it is recommended that bathymetric surveys be performed prior to and periodically after the implementation of any dredging projects on the Illinois River mainstem. Likewise, to better assess how specific projects affect hydrologic and sediment regimes, it is also recommended that hydrologic and sediment monitoring be performed for tributary projects that incorporate best management practices designed to reduce sediment loads or control water levels.

Until specific projects have been proposed and sited only a general outline of the goals, needs and methods of project specific monitoring can be provided. However, it is envisioned that project specific monitoring will be conducted more frequently during the initial years of the Illinois River Restoration Project. Once design plans and techniques have been developed and refined for common scenarios the need to assess proven strategies and methodologies will diminish. It is also known that any future mix of project specific hydrologic and sediment monitoring efforts should share certain design elements. These elements include:

- All data must be collected following accepted practices and methodologies. Specifically, the measurement and computation of streamflow will follow guidelines established by Rantz (1982a, 1982b), while methods for measuring/sampling fluvial sediment will follow methods established by Edwards and Glysson (1999). Likewise, bathymetric surveys will be conducted following USACOE protocols (USACOE 2002).
- Data collection design, frequency, and duration are sufficient to meet defined goals for precision and uncertainty.
- Data formatting, identification, processing and archiving will be done so that compatibility with other Illinois River Restoration Project data as well as traditional and historical data sets is maximized.
- Lastly, a defined methodology should be developed that will ensure that all final monitoring data are available to other researchers, managers and the public in a timely manner.

A brief description of the types of monitoring efforts that are likely to be incorporated into the project specific monitoring component of this plan follows:

Discharge and Sediment Transport Monitoring - This monitoring would include traditional discharge and/or sediment monitoring stations, although bed load monitoring may at times be desirable, particularly for bluff streams draining directly to the Illinois River. Typically, two stations will be required to monitor a specific project site. This number may be reduced if projects are sited near existing gages. The types of information and samples collected would include stage/discharge data and suspended sediment samples utilizing both manual and automated pump samplers for concentration and manually collected samples for particle size analysis. In addition, channel cross section data, bed and bank materials and particle size distribution and channel slope would be defined for the stream reach where the gage(s) are located. Those projects requiring this type of monitoring could include bed/bank stabilization projects, sediment detention sites, channel grade control and projects utilizing buffer strips or wetlands to reduce sediment inputs. Also included in this type of monitoring are those projects implemented for water level management. The volumes actually stored for given runoff events and the time over which this volume is released and the subsequent downstream effects of those releases will be important data in the continued development and refining of the hydrologic models necessary to help attain the stated project goals for water level management.

Estimated cost: Assuming 5 active projects requiring hydrologic and sediment monitoring, the estimated annual budget would be $300,000.

Bathymetric and Sediment Characterization Monitoring - Significant amounts of dredging have been proposed as part of the Illinois River Restoration Project. Once sites have been identified and the desired use of dredge materials has been proposed, it will be necessary to sample existing sediments to ascertain their chemical and geotechnical properties to ensure that the dredge material is suitable for the intended use and to provide information relevant to designing the dredge cut. In addition to providing information necessary for project design, data on particle size distribution, unit weight and sedimentation rates provide insight into the sedimentation processes occurring within Illinois River backwaters which will allow for better more efficient design of dredge projects. The bathymetry of initial dredge projects will need to be determined so that “as built” plans can be developed. Through subsequent resurveys of the project site we can determine what locations and which areal extents, bank slopes and footprints can enhance the sustainability of these projects. Coincident with the bathymetric surveying for any project involving on site use of dredge materials would be the traditional land survey of all constructed landforms such as islands and floodplain ridges. Survey and topographic profiling of constructed land features will be necessary to determine which shapes, heights, orientations, construction sequencing and vegetative/protection schemes hasten and increase the use of these land forms by the biota and improve the longevity of these features.

Locations for bathymetric and sediment characteristic surveys will be identified with input from the agencies conducting ecological monitoring and implementing specific projects (e.g., dredging, water retention, and habitat restoration).

Estimated cost: $200,000 per year.

CONCLUSION

The final component to this framework is the incorporation of an appropriate reporting structure so that information is relayed to decision makers and the general public in a timely manner. In order for the information and data generated by this long term monitoring effort to be effectively utilized, it will be necessary to provide some means by which the various resource managers, researchers, and stakeholders involved in the IRER can access this information. This will be accomplished through a WEB-based data inventory and analysis systems containing collected monitoring data, analysis tools, and mapping products. This site will be designed and maintained to help ensure an efficient transfer or information between various user groups.

We anticipate differential responses within the Illinois River basin that may vary in both spatial and temporal aspects across disciplines. Therefore it is difficult to pinpoint a specific reporting frequency that would provide a meaningful synthesis. Clearly, much of the data will be used as soon as available to provide feedback into the restoration process and will be documented as this occurs. However, we feel it reasonable to have a reporting structure that consists of intermediate data compilation (summary) reports on a 5-year cycle with a much more intensive data analysis report analyzing cumulative status, trends, and goal-specific accomplishments on a 10-year cycle.

The monitoring, watershed assessment, and focused research topics discussed in this report are intended to be an integrated and iterative approach that will assist the Illinois River Ecosystem Restoration program. Generally, we expect to measure ecosystem responses to evaluate goal-specific accomplishments across disciplines by monitoring trends at the larger spatial scales or through more comparative analyses at the project-specific scale. Restoration practices will continually be revised as additional information is gained through this framework through the adaptive management process that has been incorporated into the entire program.

FOCUSED RESEARCH

Focused research is a critical element of the monitoring framework because it provides an avenue to gather issue-specific information and refine collection efforts specific to the assessment of restoration goal accomplishments. Therefore, the following focused research summaries highlight several projects that will provide immediate information that can be integrated into the IRER process. There are certainly many other projects that could and will be developed, but these highlight some immediate information needs beyond the scope of the monitoring framework. Each project has a cost and length of project estimate. These estimates are made under the premise that they could be "stand alone" projects. However, if concurrent monitoring or research efforts are occurring in the same general vicinity, cost sharing among the projects will likely reduce the focused research project costs.

Pilot Project for Estimating Bed Load

To determine total sediment yield at a gaging station it is necessary to measure or estimate the bed load in addition to the suspended sediment load Bed load measurements are very rare and limited in Illinois. There are no standard procedures and equipment to sample bed load accurately for different type streams. Graf used a bed load sampler developed by the USGS (Helley and Smith 1971) to measure bed load for nine streams in Illinois and identified many of the difficulties in measuring bed load (Graf 1983). She also recommended using those results with great caution. Nakato (1981) concluded that bed load of tributary streams in the Rock Island District's reach of the Mississippi River ranged from 6 to 26 percent with an average of 11 percent of the total suspended load. Water Survey researchers have generally used the 5 to 25 percent estimate given by Simons and Senturk for large and deep rivers (Simons and Senturk 1977). However, such a practice introduces undesirable uncertainty to sediment budgets. Several factors contribute to the difficulties in determining bed load. Bed load transport is not initiated to a significant degree until some critical shear velocity is reached with maximum bed load transport occurring during high flows. Data collection is complicated by the necessity of collecting samples during extreme flow conditions coupled with the transient nature of the flows being sampled. In addition, bed load transport is highly variable both temporally and spatially even at constant discharges. This variability requires a relatively intense sampling scheme to accurately quantify bed load.

In this plan we do not recommend a particular method, budget for, or plan to perform bed load sampling at proposed streamflow and suspended sediment monitoring sites. Instead, it is recommended that in the near future a separate pilot study be developed and funded to address bed load sampling and bed load transport processes in the IRB. This pilot study could investigate new techniques by comparing the results of an intensive sampling routine using standard techniques to the results gained from using new technologies such as Doppler instruments to determine the velocities of bed load particles coupled with scour chains to ascertain to what extent the bed became entrained. This information could then be applied to sediment budget estimates for other similar streams to refine our calculations of sediment loads. This pilot study would help narrow the 5 to 25 percent estimates we currently use thereby reducing the uncertainty of our estimate of total sediment load. Moreover, bed load transport rates are believed to be important to channel forming processes and are routinely estimated and incorporated into effective discharge computations (e.g. Andrews 1980; Pickup and Warner 1976).Once suitable methods for determining bed load in Illinois streams have been established, funding should be made available to expand the monitoring activities described in this plan to include bed load monitoring at selected sites.

Estimated cost: $300,000 for three year project.

Comparability of Results from Depth-Integrated and Automated Point Sampling for Suspended Sediment.

Traditionally suspended sediment data for larger rivers in Illinois have been collected using depth-integrating samplers following established USGS protocols. As a means of lowering the cost of sediment monitoring associated with the Illinois River Basin Project the use of automated pump samplers, which collect a sample from a single point, has been proposed. While this strategy may offer potential cost reductions at selected sites it is not known how this data would compare to data collected using traditional protocols. Data collected, processed, and analyzed using consistent protocols are comparable in time and space. Conversely data contained using different protocols may not be comparable (Grey et al. 2000).

Determining how data collected using pump samplers compares to data generated from traditional methods will be necessary before these data could be compiled for future assessment or used in conjunction with historical data to determine sediment transport trends in the Illinois River and its tributaries.

The proposed research would provide pump sampling at 3-5 sites where depth-integrated samples are currently being collected in order to assess the comparability of the resulting data sets. Sufficient particle size analyses would be conducted to determine how the differences in sampling protocols may be causing any persistent bias in results. Once the relationship between these sampling methodologies has been determined automated sampling could be employed to reduce costs or expand the number of sites where data is being collected.

Estimated cost: $365,000 for six year project. Data would be collected for five years to help ensure representative yearly precipitation and run-off during data collection.

What is effectiveness of BMPs in the Illinois River Basin?

In addition to reduction of sediment delivery of tributary streams by restoration projects implemented in the IRER plan, progress towards Goal 5 is expected to be helped through the reduction in sediment yield by implementation of BMPs across the IRB. Indeed, one of the selected indicators in the Geomorphology Mainstem/Sub-basin Monitoring Plan is the % area of crop land in BMP. The BMPs implemented are intended to have several and independent effects. These include reduction of soil erosion (e.g., no till), reduction of direct sediment input to streams (e.g., buffer strips, dry dams), mitigation of chemical inputs (e.g., buffer strips), improvement of riparian habitat (e.g., buffer strips). Further, individual BMPs are implemented in a variety of settings and may have different effects in each of those settings. However, the actual affect of each BMP is not often measured after implementation.

There should be research as to whether or not BMPs have the effect they are intended, and thus whether the recommended indicator of % area crop land in BMP is useful to this monitoring plan. Recent studies by Yang et al. (2003) and Khanna et al. (2003) concluded that the CREP program has been ineffective in Illinois. Several major flaws in their analysis have been pointed out, however (M. Demissie, pers. com. 2004). A confounding issue is that Richards and Grabow (2003) found that sediment yield had to be reduced by 7-9 % over 10 years in three Ohio watersheds in order for that reduction to be sensed in monitoring programs. Can that goal be met in Illinois? It is essential to determine what the actual effectiveness of BMP implementation is both to gauge its contribution towards reducing overall sediment delivery. If it is indeed shown to be effective and sensible at desired scales, then it is justified to use % area BMP as an indicator.

This research could be conducted in several ways. On a meso scale, several of the few existing watersheds with continuous discharge and sediment monitoring for several decades could be analyzed for correlation to time-series trends in % area in BMP. This analysis would be supported by air-photo interpretation of stream dynamics over the same period. The most suitable watersheds for study are those within the ISWS' WARM network of gauging stations. Data from the ISWS gauging stations directed at CREP program should be analyzed, but the period of record is relatively short. Because it may be difficult to identify control watersheds within the IRB, resolution of confounding affects may be also difficult. If a set of control-implemented watersheds can be found, the statistical analysis of Richards and Grabow (2003) would be a useful approach to follow.

Estimated cost: $150,000 total cost for two year project.

Monitoring selected individual or a small collection of CREP projects in a BACI sampling program could also demonstrate BMP effectiveness either as an independent study or in complement to trend analysis of historical data. Specific methods employed would depend upon the BMP (-s) selected for study, but would probably include stream gauging, suspended sediment sampling, and topographic mapping to measure gully and rill erosion. An abbreviated 5 yr monitoring program would follow protocols suggested for restoration projects in this document.

Estimated cost: $200,000 total cost for five year project.

A third approach would be to simulate impacts of BMPs on sediment yield using a computer model. M. Demissie (pers. com. 2004) has suggested several ways to improve upon the analysis of Yang et al. (2003), including use of data of appropriate scale (≥1:24,000) and use of an appropriate continuous simulation model.

Estimated costs: $200,000 total cost for four year project.

Pilot Project to Determine Impervious Cover from Digital Ortho Quarter Quads (DOQQs)

Impervious cover, including roads, sidewalks, rooftops and other built features, is a critical feature of the landscape, and is a recommended metric for monitoring landuse effects (Zielinski 2002). The impervious cover class from existing landcover maps, however, is valid only at small (regional, >1:100,000) scale. Because of the small scale, issues such as connectedness of impervious surfaces (e.g. isolated building within grassed area versus building connected to driveway-street-drainage network) or, conversely, the patchiness of non-impervious areas within generally built regions (e.g., yards, parks in urban areas) cannot be distinguished. Accurate impervious cover data are needed at much larger scale for reliable ecosystem monitoring, hydrological modeling, and watershed assessment. Such a dataset could be developed from DOQQs, which are currently the most complete, high resolution, remotely sensed dataset in Illinois.

Endreny et al. (2003) demonstrated the value of extracting impervious cover from color DOQQs with 0.3 m resolution for large scale work on ecosystem restoration activities in New York. Impervious features were recognized by reflectance and geometry. The Lake County (Illinois) Department of Information Technology created a similar dataset by analyzing color imagery and LIDAR data. A pilot project is recommended to create protocols and validate the methods of Endreny et al. (2003) for the grayscale, 1 m DOQQs available for all of the IRB, as well as for the color, sub-meter imagery available in limited regions of the IRB. The project would also estimate costs for basin-wide dataset development. A selection of DOQQs from high, medium, and low density urban, and rural areas from across the Illinois River Basin would be analyzed. Digital results would be compared to results from on-screen digitization of built areas.

Estimated cost: $25,000 for one year project.

Does high sediment load necessarily lead to ecosystem degradation?

A fundamental assumption in development of the ecosystem restoration plan for the Illinois River basin is that excessive sediment loads in tributary streams are degrading riparian ecosystems. Indeed, there is considerable research supporting this assumption, especially in wetlands along the mainstem of the Illinois River. By contrast, portions of McKee Creek in western Illinois are considered some of the highest quality riparian ecosystems in the state, yet recent research has shown that bedload has been actively transported at least through one reach in southeastern Brown County since the 1930's (Phillips et al. 2002), and very active mass wasting and gully development were recently mapped in tributary watersheds in the upper reaches (M. Barnhardt, pers. comm. 2002). How can these two conditions co-exist?

The research project is envisioned as a comprehensive study of channel dynamics since the 1930's in concert with an assessment of biotic change. Stream channel dynamics would be quantified following the methods of Urban (2000) and Phillips et al. (2002). A longer term record of sedimentation would be established through sedimentological analysis of a series short (~1 m) sediment cores obtain from the McKee Creek floodplain in upstream and downstream reaches. The results will show the variability in processes affecting channel pattern along the length of McKee Creek, and whether or not the location, modes, or rates of channel pattern evolution have changed with time. Observed channel evolution will be correlated to reconstructed land use practices and a synthetic discharge history tuned with data from the recently installed flow gauge at McKee Creek.

Characterizing biotic change is a more difficult task because there are few, if any, historical data sets available. It may be possible to construct pre-settlement ecosystems from work of Styles (1980) and others. The existing ecological condition will be obtained from assessment and monitoring activity undertaken for the IRER program. These data will then be interpreted as the cumulative response to changing environmental conditions.

Although McKee Creek will be the target of a watershed assessment over the next few years and is the assumed site of future ecosystem restoration projects, the envisioned research would be targeted to the goal of linking watershed sediment transport history to ecological condition. Considerable feedback is expected between this research and assessment activities and monitoring associated with project implementation under IRER.

Estimated cost: $100,000 for three year study.

Can a useful sediment yield computer model be developed?

Development of an upland sediment yield computer model is highly desirable because it has the potential to predict potential interactions between climate and landcover changes and estimate sediment storage. Sediment yield models appropriate to patches or small subwatersheds (<1 mi2) include the empirical RUSLE (Renard et al. 1997) and the process-based WEPP (USDA 2003). Empirical models have been successfully applied but also regularly misused (Wischmeier 1976). They have received important criticism in Illinois for overestimating sediment yields from gullies and rills with respect to in-channel sources. Nonetheless, Renschler (2003) suggested that these models could be scaled to larger areas.

By contrast, the SWAT model is a process-based model that has shown considerable promise and is part of the BASINS model that ISWS has implemented for its sediment budget. SWAT is a physically-based subwatershed to regional scale model (USDA-ARS 2003). It was developed for modeling long-term sediment yields and thus is appropriate for long-term monitoring applications. A feasibility study is proposed to implement the SWAT model on a small watershed or subwatershed (e.g. Ten Mile Creek, Woodford and Tazewell counties), demonstrate the extent of validation and tuning needed for successful implementation at a relatively large scale, and then estimate the work necessary to scale the model down to larger watersheds up to sub-basin size.

Estimated cost: $150,000 for five year study.

What is the effect of data scale on slope determinations?

Slope data are essential for many applications. They are particularly a concern for hydrological and sediment routing computer models because runoff and stream power are highly sensitive to slope. Slope data are available statewide as 10 m and 30 m DEMs, and as 0.6 m DEMs in the Desplaines watershed and Peoria County. There has also been success at ISGS the Indiana Geological Survey creating 5 m DEMs from USGS Digital Line Graphs (DLG); though that method does not change the vertical resolution from 10 m DEMs, slope determinations may be more or less accurate. Not only do the 10m, 30m, and custom 5 m data vary in resolution, but some of the source DLG data are decades old and thus their accuracy is suspect. There is anecdotal evidence from ongoing geological mapping at the ISGS that DEMs are significantly different from the current landscape because portions of Illinois are geomorphically active.

How do channel and valley slope determinations vary between those data sources and field measurements? A study is necessary to demonstrate the statistical uncertainty in slope determined from each data source and to show the potential value of acquiring new remotely sensed elevation data, possibly at higher resolution. The investigation should target three subwatersheds, one with relatively high relief on the west side of the Illinois River, another of relatively lower relief on the east side, and a third within the DesPlaines watershed to take advantage of LIDAR data there. Slope maps would be constructed from the available DEM and DLG data. These maps would be tested against field data collected using high-resolution GPS along channel slopes, valley slopes, and selected transects of upland sideslopes.

Estimated cost: $50,000 for two year study.

Analyze Data from Existing Sources

Compile and analyze data from existing sources and relate to watershed conditions over time. The Illinois Department of Natural Resources (IDNR), Illinois Natural History Survey (INHS), other agencies and individuals have collected wildlife and habitat data within the Illinois River watershed over time. Many of these existing resources could provide insights into current and historical conditions along the river and its tributaries, and throughout the watershed. Some existing monitoring programs have been incorporated into the recommended monitoring program but previously recorded data and other programs could aid in tracking wildlife species and habitat conditions. Sources could include:

- IDNR Hunter Harvest Surveys
- IDNR and INHS Waterfowl Surveys and Investigations
- IDNR Wildlife Surveys and Investigations
- IDNR and INHS Wildlife Harvest and Human Dimensions Research
- IDNR Fur-bearing and Non-game Mammal Investigations
- IDNR Mid-winter Eagle Survey
- IDNR heron rookery, shorebird migration, and eagle nest surveys
- IDNR frog and toad monitoring
- IDNR wood duck and Canada goose banding studies
- INHS intensive mallard studies
- National Audubon Society Christmas Bird Count
- USGS North American Breeding Bird Surveys
- US FWS Mourning Dove Call-count Survey
- US FWS Woodcock Singing-ground Survey

Estimated cost: $40,000 per year for three year project.

Intensive annual monitoring of marsh birds and vegetation

Habitat for marsh birds and shorebirds has declined significantly within the Illinois River basin with a resulting decline in bird distribution and abundance. Under the proposed monitoring program shorebirds will be monitored annually but marsh birds will only be monitored at selected sites once every 5 years. Similarly, intensive monitoring of wetland habitat for both species will occur only once very 5 years at selected sites. To assess annual variation in marsh birds and habitat conditions, intensive vegetation monitoring should occur annually at selected sites along the mainstem. Sites should be selected to capitalize on past monitoring of specific sites or in critical habitat areas.

Estimated cost: $50,000 per year for ten year project.

Illinois River Index of Biotic Integrity

Multimetric indices that incorporate aquatic organisms, are the most widely used approach for establishing biocriteria and measuring river health (Karr 1981; Barbour et al. 1995; Simon 1999, Jungwirth et al. 2000; Simon 2003). However, the transferability of IBIs among catchments without considerable modifications may be limited (Angermeier and Karr 1986). Furthermore, Suter (1993) listed 10 criticisms of the IBI approach, including ambiguity, eclipsing (low values of one metric can be dampened by high values of another metric), arbitrary variance, unreality, post hoc justification, and unitary response scales. Reactions to these and other criticisms have been vociferous (e.g., Simon and Lyons 1995; Karr and Chu 2000), but suitable alternatives have not been offered. Therefore, we propose to objectively develop and test an Index of Biotic Integrity for the Illinois River that can be used as one tool to monitor ecosystem responses. We will use both existing and new data as they become available to develop the metrics used to calculate such an index.

Estimated cost: Range from $35-50,000 per year for five year study.

Investigate scalability of Indices

Little is known about how sensitive multi-metric indices are to various spatial scales of an ecosystem. Many of the available indices are largely directed to a certain spatial scale and it is unknown how responsive these indices are at other spatial scales. Indices that are useful at several scales will likely provide a more representative characterization of the ecosystem being studied and will also likely provide cost efficiencies in data collection. We propose to evaluate how scalable existing and newly developed indices are when compared at the spatial scales identified in the monitoring framework (mainstem, sub-basin, project-specific).

Estimated cost: Range from $35-50,000 per year for five year study.

Walleye Habitat Use and Movements

Additional data on habitat utilization of important fish species throughout the Illinois watershed would provide valuable information to help guide restoration practices. We propose to conduct movement studies of walleye (an important sportfish species) using radio-telemetry. Efforts would be focused on determining movement and important spawning areas, summer, and overwintering habitats. Tracking would occur in the mainstem of the Illinois River and in an important tributary, such as the Kankakee River. Information collected in this study will increase our understanding of seasonal movement patterns and help guide development of management practices that will have the greatest benefit for fish populations.

Estimated cost: $100,000 per year for three year project.

Over-winter Fish Habitat Use

Habitat availability and use by fish during critical seasonal periods like winter have been a major concern on the Illinois River in recent years due to the loss of well oxygenated, deep water habitats that are not exposed to high water velocities. Many of the restoration efforts along the mainstem Illinois River will focus on providing more of this type of habitat in backwaters and side channels through dredging and other physical modifications. We propose to evaluate fish use before and after project implementation of the first few projects to verify the newly created habitat is being used to its full potential.

Estimated cost: $100,000 per year with a project life that will cover 2-3 years before and 2-3 years after project construction.

Aquatic Organism Population Genetics
Defining management units in terms of characterizing the distributional extent of distinct populations can be a critical factor when making decisions about the basin. One means to quantify exactly what the distribution limits of unique populations are can be determined using common population genetic practices (allozyme and DNA analyses). This can be especially important for mobile species like fish. We propose to evaluate the population structure of selected fish species from the Illinois River in the context of an appropriate distributional range of the species in question. This approach will put the Illinois River populations into a useful geographical context. Ultimately, this information will be useful in providing guidance on inferences of Illinois River fishes. Likely candidate species for study could include, but are not limited to, *Sander* spp. complex, *Morone* spp. complex and other fish known to move relatively large distances. Cost estimates will vary depending on the number of samples needed.

Estimated cost: Range from $50-75,000 per year for each species and/or species complex for a 2-3 year study.

Limiting Factors for Aquatic Vegetation
Establishing and maintaining populations of aquatic vegetation has been a major issue in the mainstem portion of the lower Illinois River for several decades. We propose to study growth rates and establishment potential of select species of aquatic vegetation in the Illinois River using an experimental design that protects plants from biotic, physical and both forms of limitations for establishment. This information will be valuable to the restoration process in that it will provide insight into how to protect areas where aquatic vegetation is desired.

Estimated cost: $75,000 for year one and $50,000 for years two and three.

Establishing Backwater Structure and Function
A critical issue associated with floodplain and backwater connectivity is understanding the relation these habitats have in contributing to the structure and function of the Illinois River ecosystem. Therefore, we propose to study backwater and floodplain lakes to establish a range of variability in determining what aspects of each type of water body (e.g., connected or not connected, restored or not restored, etc.) contributes to the ecosystem. This information will provide meaningful information that can be used to assist in identifying restoration approaches for specific needs.

Estimated cost: $75,000 per year for three to five years.

Development of Habitat Metrics and Indices for Use in the Illinois River Basin

Metrics and indices to assess changes in habitat can be an important component of the Illinois River restoration monitoring program. Before these metrics can be usefully applied, there is a need to assess current quantitative habitat methods which are used to establish indicators of stream quality and to assess metrics for habitat indices that reflect improvements and deterioration in aquatic systems. In wadeable streams, Illinois EPA currently uses a point/transect method for quantitatively assessing physical habitat as well as the Stream Habitat Assessment Procedures (SHAP) index for qualitative assessment. Similarly, the Ohio EPA has developed a Qualitative Habitat Evaluation Index (QHEI) to assess wadeable streams. However, the accuracy of point/transect methods at describing habitat conditions and the applicability of habitat indices at different spatial scales (large rivers to small headwater streams) have not been extensively studied. We propose to address these two important questions through a multi-scale study to determine the accuracy and precision of various quantitative habitat methods and use this data to produce indicators of stream quality for development of an Illinois habitat index. We envision that the developed Illinois habitat index will be a macro-scale approach that measures processes influencing stream habitat (e.g., sinuosity, pool/riffle development) rather than the individual factors that shape these characters (e.g., depth, substrate size) and that a version of the index can be applied to larger rivers as well as wadeable streams. Additionally, the index 1) will allow sufficient resolution to separate high quality and low quality streams, 2) will comprise metrics that vary with stream conditions and biotic conditions (i.e. correlate to fish and invertebrate biotic metrics), 3) will have acceptable reproducibility among different field staff, and 4) can be completed with minimal time, personnel, equipment, and field measurements.

Estimated cost: $100,000 per year for three years.

Effects of Sediment Toxicity on Mussel Populations

The reestablishment of viable mussel populations along the Illinois River and its backwaters depends not only on physical habitat improvements (e.g., dredging) but also on the quality of the remaining bed sediments. Specifically, pore water concentrations of dissolved ammonia and possibly other toxicants including hydrogen sulfide may be high enough at certain times of the year and in certain locations to be toxic to mussels.

Sparks and Ross (1992) attempted to identify the toxic substances that may have been responsible for the rapid decline in several species of aquatic organisms in the upper Illinois River during the mid-1950. Toxicity tests with both the fingernail clam and water flea (*Ceriodaphnia dubia*) using pore waters from various locations between river miles 6 and 248 strongly implicated ammonia as the species primarily responsible for the observed acute toxic effects. The total ammonia concentrations in the pore waters used typically ranged between about 20 and 60 mg/L (as N). However, Sparks and Ross (1992) were unable to precisely characterize ammonia toxicity due to difficulties obtaining the accurate pH measurements required to determine the fraction of the total ammonia that exists in the highly toxic un-ionized form (i.e., NH_3).

Machesky et al. (2004) determined ammonia concentrations in the upper 30 cm of Peoria Lake pore waters (river miles 164 to 179) (Figure 1). These measurements were accompanied by accurate pH measurements determined in the field on separate cores. The primary source of this pore water NH_4-N is typically the solubilization and anoxic metabolism of particulate organic nitrogen (Berner, 1980, DiToro, 2001). Overlying water column values were usually less than the analytical detection limit of 0.07 mg/L as NH_4-N. Mean and median pore water concentrations, however, increased from about 1-2 mg/L NH_4-N at an average sediment depth of 3 cm, to about 10 to 20 mg/L NH_4-N at 27 cm average sediment depth. It is also apparent that average and median NH_4-N concentrations below 15 cm average sediment depth were significantly higher during our October sampling dates than those in April. Consequently, the higher October concentrations could reflect greater microbial activity during this period due to the warmer sediment temperatures.

Methods:
1) Pore water sampling for ammonia, hydrogen sulfide with in situ dialysis samplers and by sectioning sediment cores, followed by centrifugation-filtration to isolate pore water. Important ancillary parameters such as pH, and dissolved- and total organic carbon would also be measured.

2) Detailed, in situ microelectrode measurements of ammonia, pH, D.O., and hydrogen sulfide in the upper 1-2 cm of sediments.

These direct measurements would provide much higher vertical resolution ($\leq$ 100microns) than is attainable with either dialysis or centrifugation-filtration methods ($\leq$ 1 cm vertical resolution). Consequently, ammonia and hydrogen sulfide measurements would be most detailed in the zone most frequently inhabited by mussels.

3) Direct measurements of sediment-overlying water exchange of ammonia and other related constituents with benthic flux chambers.

These measurements would provide important information regarding the sources and sinks of pore water ammonia.

4) Development of diagenetic models for ammonia and hydrogen sulfide, as well as other predictive tools.

Developing these models would aid in forecasting where physical restoration efforts would be most successful.

Estimated cost: $250,000 for three year project. The initial two years will be directed towards sampling, laboratory analysis, and data collection.

Chapter II
WATERSHED ASSESSMENT

INTRODUCTION

Watershed assessments are essential for describing and documenting patterns, processes, and functions within a watershed system (Lessard et al. 1999). Further, watershed assessments will assist in understanding past and present conditions. Although a wide variety of information can and must be used in an integrated watershed assessment, choosing information that corresponds directly to the purpose and needs of the assessment is necessary to assure efficient use of resources and funding.

The information included in a watershed assessment depends on the issues addressed, agencies involved, targeted audience, etc (Lessard et al. 1999). Jensen et al. (2001) proposed three steps for ensuring that appropriate information is included in a watershed assessment. First, major policy questions or resource issues to be addressed in a program need to be clearly identified. The identification of specific resource issues to be addressed (e.g., decreased habitat function due to sedimentation) depends on posing appropriate questions. Through many discussions with state and federal partners, seven goals have been identified for the Illinois River Ecosystem Restoration Program (IRER). They are:

- Restore and maintain ecological integrity, including habitats, communities, and populations of native species, and the processes that sustain them,
- Reduce sediment delivery to the Illinois River from upland areas and tributary channels with the aim of eliminating excessive sediment load,
- Restore aquatic habitat diversity of side channels and backwaters, including Peoria Lakes, to provide adequate volume and depth for sustaining native fish and wildlife communities,
- Improve floodplain, riparian, and aquatic habitats and functions,
- Restore and maintain longitudinal connectivity on the Illinois River and its tributaries, where appropriate, to restore or maintain healthy populations of native Species,
- Restore Illinois River and tributary hydrologic regimes to reduce the incidence of water level conditions that degrade aquatic and riparian habitat, and
- Improve water and sediment quality in the Illinois River and its watershed.

Therefore, watershed assessments must identify resource status as it relates to the goals listed above.

Second, Jensen et al. (2001) propose selecting the appropriate scale of analysis. The appropriate scale depends on the resource, function or process being assessed in a watershed. Certain assessment tools such as the U.S. Environmental Protection Agency's (USEPA) Know Your Watershed or Index of Watershed Indicators are useful at national or regional scales (USEPA 2002). Similar tools applied to Illinois specifically, namely, the Illinois EPA Water-body Tracking System (IEPA 2004), provide more detailed information at the state level. These comparative assessments give insight into the relative condition of watersheds within their respective regions. Comparative assessments at small scales already have been conducted for the Illinois River Basin (IEPA 1998b) and can aid in focusing where best to scale-up to more detailed, comprehensive watershed assessment (watershed characterization). Therefore simultaneous discipline-specific watershed assessments focusing on integration and synthesis of information (hydrologic, geomorphic, and biologic) at site, sub-basin, and the Illinois River Basin scales are necessary.

Third, Jensen et al. (2001) suggest identifying a set of scale-specific, measurable, and mappable features that relate to the issues being addressed. Previous watershed assessment methodologies, such as the Watershed Implementation Plan (IEPA 1998a), require numerous types of information at many scales. However, some of the information required (e.g., air quality) was difficult for local planning groups to gather, and did not relate directly to the issues being addressed (e.g., flooding). Through this project, we intend to identify variables that best relate to the resource issues being addressed through IRER.

While restoration project identification involves many facets (e.g, policy, socio-economic, and scientific justifications), we feel the following may provide a suitable guide for assessing the existing biotic an abiotic conditions. Therefore, based on the steps suggested above and review of existing approaches and protocols, we recommend that the following goals be incorporated into Illinois River Basin watershed assessment:

1) identify defining physical limits of each watersheds or target area) in the Illinois River Basin (physiography, geology, climate, etc.),
2) identify the reference watersheds within targeted sub-basins or areas
3) document past and current conditions in priority watersheds and identify reference conditions in the reference watersheds,
4) identify practices and processes impacting priority watersheds,
5) recommend restoration projects based on identified cause-effect relationships.

Information resulting from meeting these goals will aid practitioners and policy-makers to make more informed, effective, and defensible resource management decisions.

Review of Watershed Assessment Approaches

Watershed assessments have taken place in Illinois through various programs prior to the Illinois River 2020 effort (IEPA 1998b; IDNR 2004). Additional assessments and innovations have recently been developed and/or applied in Illinois watersheds (Keefer and White 2004; White 2004; Locke et al. 2004; and others). While much effort has been focused on unifying and consolidating information for Illinois watersheds in recent years (IEPA 1998b), additional effort needs to be made toward integrating information from various disciplines to evaluate watersheds more effectively. This integration could lead toward a better understanding of the relationships between physical habitat (hydrology, hydraulic, sediment, geomorphology, etc.) and the biotic community (vegetation, fish, macroinvertebrates, etc.).

Several state, federal, and non-governmental organizations have developed watershed assessment procedures. For example, Oregon, Vermont, and Washington have extensive watershed assessment manuals that could serve as models for comprehensive and integrated watershed assessment in the Illinois River Basin. These protocols require varying levels of expertise, data collection, and analysis. Further, some assessment procedures were developed and applied in conditions specific to particular states and regions. Elements of the existing protocols adopted for watershed assessment in Illinois will need to be modified to address the range of conditions in Illinois watersheds.

Watershed Assessment Approaches in Illinois

Illinois Geomorphic Watershed Assessment (IGWA), ISWS

The Illinois State Water Survey (ISWS) is currently developing a geomorphic assessment approach for Illinois watersheds focusing on geomorphology of tributary streams and intended for rapid identification of restoration project sites. The underlying principles behind this effort include systematic assessment, uniform data collection, and quality assurance. Following these principles will aid in the accuracy of assessments. The Vermont Stream Geomorphic Assessment Protocol (VSGAP) serves as the initial foundation for this approach (Kline et al. 2003). The obvious differences in regional geography between Vermont and Illinois necessitated the adaptation of the Vermont protocol to Illinois geography utilizing other studies conducted in the Midwest (Barnard and Melhorn, 1982; Bryan et al., 1995; Kuhnle and Simon, 2000; Rhoads, 2003; Simon and Downs, 1995; Simon and Hupp, 1992; Simon and Rinaldi, 2000; and Rhoads and Urban 1997; Urban 2000). The key goals and principles in the Vermont protocol remain the same in the IGWA approach: determine the past and current physical nature of a stream and its watershed, assess the likely sequence of events that have contributed to initiate a set of stream responses, and assess potential future channel response given past and present conditions. Development of the IGWA approach is ongoing and will be implemented and further tested in 2004.

The purpose of IGWA approach is to provide meaningful guidance in the application of watershed and stream restoration practices (BMPs) that reduce upland, side slope and floodplain or channel erosion, and also address sedimentation or aggradation issues that may result, such as the burial of productive substrates.

The IGWA approach contains two phases 1) Rapid Characterization and 2) Reconnaissance Characterization. This phased approach will integrate progressively detailed levels of investigation at selected stream reaches throughout a watershed. Phase 1 involves gathering existing watershed and stream channel data/information (historical and recent); evaluating watershed characteristics based on geology, soils, hydrology, land cover, and climate; conducting aerial flyovers to quickly assess stream reaches; performing field-based rapid channel stability/physical habitat ranking of many sites distributed throughout a watershed. Based on preliminary evaluation of the Phase 1 information/data, the assessment may continue to Phase 2 when an entire stream system seems to be responding to changes within the watershed. Phase 2 involves a more detailed field reconnaissance of streams reaches at a subset of Phase 1 field sites (Rhoads 2003; Kuhnle and Simon 2000; and Thorne 1998). The data collected at Phase 2 sites is more comprehensive and, when compared and contrasted with historical or recent data (Trimble and Cooke 1991), improves the prediction of potential future channel adjustment. The comprehensive data includes surveyed channel geometries, bed/bank conditions, boundary material descriptions and size distributions, and riparian vegetation as fluvial geomorphic indicators (Hupp 1999; Hupp and Osterkamp 1996).

The IGWA integrates channel stability ranking with stream habitat conditions by collecting data as prescribed in USEPA protocols (Barbour et al. 1999). Over time, relationships and trends between stream channel geomorphology and biotic communities may be drawn from the surveys of biotic communities conducted at the Phase 1 (habitat assessment) sites.

Data included in the IGWA approach include topographic maps, historic aerial photography, GPS aerial video flyovers, geology, a land cover, etc. As the level of assessment increases (from Phase 1 to Phase 2) the scale of assessment remains constant (~1:24000), but stream reach data such as cross-section measurements are collected in greater detail.

Stream Dynamic Assessment (SDA), ISGS and UIUC Dept. of Geography

Phillips et al. (2002) assessed planform changes of representative stream reaches in the Illinois River Basin. Analysis of aerial photographs in time series from 1938 to present was performed to identify mechanisms and rates of planform change, assess the variability of these behaviors across the watershed, and determine the suitability of the method for watershed-scale assessments. The greatest value of SDA for initial watershed assessments is that it quantifies how a given stream changes in a historical perspective giving insight into the concept of stream channel "stability", in particular. Further, the analysis identifies dominant processes and geological targets for more intensive field study, reveals the variability of stream planform dynamics, and demonstrates that total geomorphology of the system needs to be evaluated to understand stream behavior.
In this method, channel centerlines (threads) are traced, rectified, and corrected using GIS methods. Threads were then compared to distinguish "natural" and human-influenced change. These changes were evaluated in context of stream power calculations from gauge data, geology

and soils data, and observed changes in land use and land cover. From GIS analysis mode of stream planform changes (lateral migration, downstream translation, formation and avulsion, and channelization) were characterized and assessed. This assessment provided insight into the mode of planform change and the importance of evaluating the dynamic response of streams, particularly to channelization, for assessing the feasibility of restoration projects. SDA would also aid in evaluating the range extent and rate of planform change.
SDA gives a quantitative understanding of stream change over the past 60 years with limited investment of resources. For the initial study, GIS database for 16 km of reach was compiled and digitized, including calculation of change polygons occurring in less than 20 person-weeks. Analysis of the geological setting and interpretation of change is dependent upon data availability, planform complexity, and the amount of change. The geological setting for initial method testing was developed only generally because of limited data. In most cases geologic maps, are only available at scales of 1:100,000 or smaller. Soil surveys typically give reasonably detailed assessments (~1:16,000) of floodplain materials and their properties, but additional interpretation is required to assess the geological history of the floodplain. As well, only small scale soil surveys are available. The only bed substrate information available was from stream gauge records (USGS, writ. com.) and was mainly anecdotal. Most needed are geological maps at the 1:24,000 scale for establishing the geologic setting, especially the thickness of post-glacial valley fill and depths to older sediments or bedrock. Such maps should be supplemented by focused higher resolution field studies of floodplain and channel sedimentology and river geomorphology.

Channel incision cannot be directly assessed from airphotos. Trends of increasing channel width with time could possibly be surrogate for assessing incision following channel evolution models (Simon 1989), however. We found no such trends, but georeferencing error was quite high relative to channel width for many of the images in this study. Width analysis may be more definitive with expected error reduction through use of crisper source images and georeferencing methods.

Manual methods worked sufficiently well for the initial application of SDA. To examine an entire river or subwatershed would require compiling many more georeferenced digital images. Although our georeferencing method proved adequate for quantification of dominant evolutionary behaviors, more accurate quantification of change and improvement of interpretations are desirable for more precise results.

<u>Methods for Estimating Groundwater Recharge Areas for Illinois Nature Preserves, ISWS and ISGS</u>

The ISWS and ISGS have developed methods assessing and delineating ground-watersheds to determine Class III ground water protection areas for the Illinois Nature Preserves Commission (Locke et al. 2004). The methods for groundwater recharge area estimation have been applied for several nature preserves. Ten preserves were assessed within the Illinois River Basin. Because sufficient groundwater data are typically not available, other data were used to estimate recharge areas. This requires the integration of multiple data sets including best available hydrologic and geologic information, proxy data (e.g., surface watersheds), indicators (e.g., groundwater discharge), raw data when available, and best professional judgment.

Procedures outlined for Class III protection areas are particularly useful in estimating the extent of highly vulnerable (i.e., areas surrounding rare or high quality habitat) sub-watersheds or catchments. An adapted version of this method would be useful for assessing groundwater resources in watersheds.

Data required for this method include 7.5-minute topographic quadrangles, well boring records, local geologic maps information, and local groundwater models. Detailed local information is lacking in many cases where this method has been applied. Datasets should be supplemented by local hydrogeologic studies. This procedure is best applied at scales of 1:24000 or larger.

Ground water recharge areas interpreted from surface watersheds identified much of the estimated regional groundwater recharge area and generally captured the most hydrologically significant areas immediately up-gradient of the preserves were identified. A Class III groundwater area based on an adjusted surface watershed appears to provide significant protection for a preserve even though it will not directly correlate to the groundwater recharge area. Indirect methods are poor in identifying confined groundwater sources, such as where karst terrains exist or in areas influenced by significant groundwater withdrawals. The methods of Locke et al. (2004) allow protection of groundwater recharge areas based on current information, and when additional information is available, delineation of groundwater recharge areas may be amended.

Rapid Assessment Point-Method (RAP-M), Illinois USDA-NRCS

RAP-M (Windhorn 2001)was designed to produce estimates of average annual erosion and sedimentation rates in a watershed. The procedure entails generating initial inventories of physical features, practices, and processes in selected sample areas (e.g., gullying) from existing data. Field information is then collected to identify current practices and conditions within the selected sample areas. Various features identified in office and field inventories are assigned rating factors used in the calculation of sedimentation and erosion estimates. Equations used for the estimates are outlined in the RAP-M manual. In this method, after rate estimates are calculated, it is suggested that results may be summed and extrapolated to illustrate the condition of the larger watershed encompassing the investigation area. The ultimate goal of the RAP-M method is to make local BMP planning decisions based on the rate estimates of erosion and sedimentation.

Data required for RAP-M include topographic maps, aerial photos, and soils maps, land cover and DEMs. Most of these data are available statewide although currentness and scale varies. The suggested scale for RAP-M is not explicitly indicated, but it is recommended that maps are drawn at roughly 1:15000. As with any assessment procedure, results are limited by the smallest scale of data and confidence in results will be reduced at smaller scales and wider sampling distributions.

While interpretation of watershed processes may be inferred, conclusions about geomorphic processes cannot be made using this method. RAP-M is not intended for monitoring purposes. Consistent and uniform application of this method is essential thus workers are urged to be consistent in their field observations. Subjectivity in observation could be a significant source of error in calculations. GIS methods could make RAP-M more systematic but the results still rely heavily on the input from individuals collecting field data. This procedure does not include detailed inventories and evaluation of other environmental and hydraulic parameters and becomes less reliable in larger watersheds. Extrapolation of RAP-M results from larger to smaller scales (smaller watershed to larger watersheds) is tenuous given the likelihood of variability in geology, soils, land cover not captured by sampling. Aspects of RAP-M might be useful as the upland component of a comprehensive watershed assessment protocol in the Illinois River Basin if applied and interpreted at relatively large scales in smaller watersheds.

Rapid Watershed Assessment, USGS

Led by the U.S. Geological Survey, state and federal agencies in Illinois (e.g., USDA-NRCS, IDNR) have co-operated in applying GPS-integrated aerial video technology for rapid watershed assessment (Roseboom et al. 2002). Elements of Rapid Watershed Assessment are currently being incorporated into the Illinois Geomorphic Watershed Assessment approach (White 2004). The technique entails mapping streams with GPS-oriented aerial videotapes acquired during helicopter flyovers. The strongest features of GPS-video mapping are that is provides quick visual documentation of the static condition of long segments of a stream system, and it is useful for communicating with stakeholders. Abrupt changes in channel pattern or form as well as key features of the natural and built landscape can be interpreted from the images.

The weak points of the method are its high cost and a limited ability to distinguish geomorphic process and product. Flyovers are expensive and are most effective during in winter or early spring when canopy conditions are least dense. Interpretations of apparent stream instability would need to be verified by temporal and field studies.

The use of new surveying technology called Light Detection and Ranging (LiDAR) which can be recorded simultaneously with GPS video mapping has been investigated as well. LiDAR is used to obtain continuous channel morphology data (topography) along a particular stream channel. One-time LiDAR flights can provide baseline data, but multiple flights could be used to analyze and document changes in channel morphology from which sediment production and delivery can be estimated. To date, LiDAR has only been applied in a portion of Des Plaines River watershed. Several factors limit the utility of LiDAR, not the least of which is its high cost. Also, the current technology may not have the resolution to obtain accurate bed and bank geometry. Although the level of precision of LiDAR data may be 1-2 orders of magnitude greater than existing DEM data, lack of resolution within stream channels may not warrant the expenditure of monetary and human resources.

Process-based Watershed Assessment Protocol, Herricks et al. (2004)

Herricks et al. (2004) designed a protocol to meet specific reconnaissance study and feasibility study needs, and specifically to integrate these two activities so that reconnaissance study reporting provides direct input to feasibility studies. The objective of this protocol is to make maximum use of existing physical and chemical data while integrating any available biological assessment data into an analysis that will assess location-specific ecosystem vulnerability/impairment issues that will direct ecosystem restoration programs.

The process-based metrics within the protocol are under development. The metrics include formulations that establish source quality and potential, relate the source to the colonization site, identify pathway impediments to organism movement, assess colonization site potential, and provide scale based habitat needs measures for populations and communities. The analysis of performance metrics requires both spatial and temporal integration. Spatial analysis and integration can be as simple as plotting locations on a map, but temporal analysis would be more intensive.

Data requirements for this protocol are broadly defined by necessity. An objective of the protocol is to use existing data and information to characterize state or condition using water quality and biological/ecological quality assessments made as a part of normal water quality analysis under the Clean Water Act. This information is used to both assemble stakeholder groups and provide a focus for discussion at stakeholder meetings. A major objective of the reconnaissance is to identify the opportunities for ecosystem restoration, and provide a foundation for a feasibility assessment. The reconnaissance study is limited by resources, but the resource base may be variable depending on the overall scope of the proposed project. Thus the protocol reflects the need to provide information for initial project review, with a level of effort that reflects a reconnaissance effort and personnel time reflecting overall project size.

The reconnaissance study is intended to provide the foundation for the feasibility study, which is much more complex and comprehensive. It is assumed that the reconnaissance activity has consolidated data/information resources, has identified critical areas in the watershed that are impaired, and from a water quality and general land use perspective has identified general sources of impairment. The protocol is based on the following study objectives: The feasibility study is to develop more detailed data/information from existing data resources to meet the following study objectives: 1) identify specific needs for restoration projects, 2) suggest general design requirements for specific projects, 3) determine the feasibility of ecosystem restoration projects in relation to natural constraints and land use change potential, and 4) assess the long-term potential for project success. These study objectives are achieved by reviewing the basic information resources for the project watershed and making an initial determination as to whether or not new data should be collected. The protocol assumes that there will be sufficient existing data to conduct a general feasibility analysis and that the major need for new data will be associated with specific locations or problems. Development of specific quality assurance documentation before collecting new data is recommended. The basic structure of the feasibility structure protocol is designed to assemble physical, chemical/water quality, and biological/ecological data for use in a range of integrative analyses. The confidence level of assessment would depend on the quality, scale and availability of existing physical and chemical data.

National Guidance and Generalized Approaches

A Framework for Analyzing the Hydrologic Condition of Watershed, USDA-FS and BLM

The *Framework* was developed to provide national guidance for hydrologic assessment of watersheds. It consists of 6 steps: 1) Characterize the watershed, 2) identify rate factors, 3) identify important factors, 4) establish current levels, 5) establish reference levels, 6) identify changes and interpret results. A precursor to these six steps is development of a case file index. The case file index is a data gathering and assessment procedure that can indicate the level of confidence of analysis of a watershed.

Data categories required for watershed characterization are climate, surface water flow, groundwater (location of springs and wells, and aquifers), watershed morphometry (area, topography, etc.), wetlands and riparian areas (NWI-maps), soils, geology, vegetation cover, and human influence. The scale of assessment suggested in the Framework is 1:24000. Much of the required data for this approach are available Illinois although at varying scales and with varying coverage. Soils and topography are among the few data sets have complete statewide coverage. Topography is available at 1:24,000 scale and the scale of soil maps range from 1:63,000 to 1:15,000.

The limitations of the Framework include subjectivity in applying rating factors and treatment of data gaps. Watershed hydrology parameters are rated 1- high influence, 2-moderate influence or 3- low/slight influence. The rating procedure is highly arbitrary. It would be difficult to get uniform results, especially if people from different disciplines and varying levels of expertise are practicing this method. Data gaps are addressed by incorporating surrogate information into the assessment (e.g., road density as a surrogate for infiltration reduction) methodology for use of surrogates would have to be developed prior to implementation of watershed assessment prior to using this procedure. Further, adaptations such as a more detailed rating system are recommended prior to implementing this procedure to for the Illinois River Basin.

Stream Visual Assessment Protocol, USDA-NRCS

Stream Visual Assessment Protocol (SVAP, USDA-NRCS 1998) is not a watershed assessment procedure but rather a channel reach assessment procedure. This procedure is designed for use by conservationists to evaluate stream health. The method relies on ranking using comparator charts for various factors such as channel condition, hydrologic alterations, and barriers to fish movement. Ranking criteria are outlined, somewhat reducing the subjectivity of the assigned numerical values. Ratings are then averaged for a total score which is the index of overall condition of a particular stream reach.

No specific scale of assessment is given in the SVAP, however the protocol suggests assessed stream reaches be 12 times the active channel width. The only data required for this assessment procedure are rudimentary field observations and landowner input.

The crude characterization of channel condition limits the utility of SVAP in comprehensive geomorphic assessment. While guidance is given for the assigning numerical rating, the rationale of the numerical weighting is unclear.

Watershed Vulnerability Analysis

The Center for Watershed Protection (Zielinski 2002) developed Watershed Vulnerability Analysis (WVA) as a rapid planning tool for larger watersheds. It has been used in instances where it was necessary to group and prioritize up to 20 sub-watersheds for restoration and protection. Results of WVA as outlined by the Zielinski (2002) are A) a defensible rationale for classifying sub-watersheds, B) a framework to organize and integrate data, C) a rapid forecast of the most vulnerable watersheds, D) prioritization of watersheds that merit restoration action.

The compartmentalized WVA procedures include initial sub-watershed classification, final sub-watershed classification, watershed vulnerability ranking, and prioritization for implementation.

Suggested size of targeted sub-watersheds is 0.5 to 30 mi^2. The rationale for use of this scale is the relative influence of impervious cover. At smaller scales (larger watersheds) effects of impervious cover and other hydrologic influences may be damped out of the analysis. Of course, confidence of analysis would increase with the scale of data. Essential data include topography, hydrology, impervious cover, current land use (zoning), future land use (zoning master plan), and aerial photos. Auxiliary mapping layers include riparian cover, floodplains, wetlands, forest cover, soils, geology, stormwater management facilities, and others. Aerial photos (DOQQs), topography, soils, and land cover are all available statewide for Illinois at 1:24000 or greater scales. Data such as zoning, geology, and stormwater management are sporadic to non-existent in coverage and scale.

The major limitation of WVA is that is meant as a prioritization tool only. The results of analysis do not lend themselves to interpretation of processes or functions within a watershed. More comprehensive watershed assessment would have to take place in those watersheds that were prioritized for implementation.

Landscape Assessment of Geomorphic Sensitivity (LAGS), State of California

California Environmental Resources Evaluation System (CERES) developed the LAGS procedure to estimate the geomorphic sensitivity of the landscape (watersheds) to land use disturbances. This procedure operates much like WVA however it is more simplistic and incorporates fewer data layer into the analysis. Data used in LAGS are limited to slope, geology, landslide terrain, and unstable and erodible soils. The scale of analysis is limited by the smallest scale data used.

Like WVA, LAGS is design to identify areas that may need further evaluation and is not to be used in a prescriptive sense. An adapted LAGS procedure could be incorporated into a larger comparative assessment procedure for Illinois River Basin watershed assessment.

Rapid Bioassessment Protocols for Use in Wadeable Streams and Rivers, US EPA

The US Environmental Protection Agency (USEPA 1999) developed a rapid bioassessment protocol to determine physiochemical and habitat conditions along with assessing the quality of biotic communities (periphyton, macroinvertebrates, and fish). This protocol is designed to give a general picture of stream integrity or health with minimal field and laboratory efforts. Physiological data obtained from this protocol provides estimates of in-stream, riparian, and watershed features through observational assessment. Water chemistry parameters focus mostly on conditions that affect the biota (i.e., temperature, dissolved oxygen, etc.). For assessment of physical habitat (in-stream and riparian) and biota (periphyton, macroinvertebrates, and fish), a multi-metric index is used to score stream quality based on that particular indicator (habitat, fish, invertebrates, etc.). Collection of physical habitat data is observational and the index is based on a rating of habitat categories (substrate/cover, embeddedness, bank stability, etc.). Biotic data is collected with minimal sampling and course identification with rating of stream quality determined by composition of the assemblages (i.e. taxa richness, % tolerant taxa, etc.)

There are several limitations to the USEPA rapid bioassessment protocol. Assessment of water quality is a "snap shot" view of water conditions and does not include other parameters which may be limiting or affecting the biota (e.g., nutrients). The limitation of the physical habitat assessment stems from the subjectivity in rating individual physical habitat metrics. While biotic assessment under this protocol is time efficient and gives an overall indication of biotic integrity, it gives few details on processes affecting the biota.

Watershed Assessment Protocols from Other States

Oregon Watershed Assessment

The Oregon Watershed Assessment Manual (OWAM) is a comprehensive assessment guide with the aim of 1) identifying features and processes important to fish habitat and water quality, 2) determining how natural processes are influencing those resources, 3) understanding how human activities are affecting fish habitat and water quality, 4) evaluating the cumulative effects of land management practices over time (Watershed Professionals Network 1999). The OWAM was designed for a widely varying range of landscapes. The method employs ecoregions (large areas each with similar geology, flora, fauna, and landscape) at the broad scale and Channel Habitat Types (CHTs – stream channels with similar gradient, channel pattern and confinement) at the channel reach scale. The OWAM is divided into components that combined comprise "Watershed Characterization". Each component can be completed separately so different specialty teams may work on various assessment components simultaneously. Components are then brought together in the final "Watershed Assessment" phase.

Basic data requirements for OWAM watershed characterization are 7.5-minute topographic quadrangles, land cover maps, ecoregion maps, and aerial photography and topographic maps. Supplemental data for Watershed Characterization include mean annual precipitation maps, habitat assessment maps, street-level road maps, peak flow data, landslide inventories, National Wetlands Inventory maps, FEMA maps, soil surveys, etc. The suggested scale of assessment by the OWAM is at least 1:24000. In some cases (aerial photo interpretation) scales at large as 1:12000 are employed.

This manual would need to be adapted to conditions in the Illinois River Basin. Components of the OWAM could be adapted or replaced by assessment techniques developed specifically for Illinois. For example, the "Channel Modification" component which focuses on location, type, and magnitude of channel disturbance, could be replaced with the IGWA approach outlined above.

Vermont Stream Geomorphic Assessment (VSGAP)

The Vermont Agency of Natural Resources recently designed protocols to assess the geomorphic conditions in streams and watersheds (Kline et al. 2003). Focus on geomorphic principles and physical habitats are key elements in this approach. The VSGAP is divided into three handbooks, Watershed Assessment, Rapid Stream Assessment, and Survey Assessment. Like the OWAM, VSGAP outlines training, personnel, and material needs to conduct each phase of the protocol.

For the Watershed Assessment phase, VSGAP requires aerial photographs (the most recent and historical photos at least 20 years old), 7.5-minute quadrangles for the watershed. For GIS analysis digital layers such as streams, soils, and land cover at 1:5000 are needed. These GIS layers are available for most of Illinois at scale of 1:24000. Methodology for calculating various geomorphic variables from available map resources are given in the Phase 1 handbook.

Limitations of application of VSGAP in Illinois are currently being resolved within the IGWA approach (Keefer and White 2004).

Washington Watershed Analysis Manual (WWAM)

The Washington Watershed Analysis Manual objectives are to assessing resources, define problems, identify sensitivities, produce management prescriptions, and monitor the effectiveness of those prescriptions (Washington Forest Practices Board 1997). A helpful feature of this manual is the use of guidance questions to help keep focus on the objectives of the assessment.

The components of the Washington Manual include "Mass Wasting", "Surface Erosion", "Hydrology", "Riparian" and "Stream Channel". While each of these components is qualitative, guidance matrices give criteria for the assignment of ratings making the procedure somewhat systematic.

Basic data requirements for the geomorphological components of the Washington analysis are: aerial photography, geologic maps, watershed base maps, soils maps, precipitation maps, land use /land cover, vegetation type, streamflow (if available), field observation in stream channels.

As with the OWAM and VSGAP, components of the WWAM would have to be altered to assess the range conditions (climate, physiography, and dominant land use) and policy in the Illinois River Basin. For example, the surface erosion module focuses on assessment of forest practices and hill slope and road erosion and does not address erosion from agricultural or urban land uses in a manner that would be appropriate for the Illinois River Basin. Also, the riparian assessment module treats the supply of large woody debris (LWD) to streams as positive indicator. Policy regarding the treatment of LWD in the Illinois River Basin would need to be resolved prior to conducting watershed assessment.

The stream channel module is executed through classifying streams somewhat similar to the Rosgen (1994) method. The guiding questions in this module focus partially on the "likely responses" of channels to changes in the watershed and this procedure employs the use of "channel response types". Interpretation of "likely response" is not recommended for use as the basis of restoration design.

Proposed Watershed Assessment Framework

The watershed assessment manuals and other procedures reviewed above give valuable guidance for watershed assessment in the Illinois River Basin. The framework we recommend is based on our review of these existing strategies. Comparative techniques such as WVA and LAGS provide logical, systematic procedures using existing data sets (e.g., land cover, DEMs). Though the scale of existing datasets may limit the resolution of assessment, adapted versions of these types of GIS-driven assessment may be sufficient for general, rapid comparison of watersheds in the Illinois River Basin.

The watershed assessments produced by Oregon, Vermont, and Washington state governments are comprehensive assessments that focus on examining those factors that significantly impact a particular watershed. These assessment manuals were developed for regions with geographies that differ vastly from Illinois and would have to be adapted to assess conditions specific to the Illinois River Basin. Nevertheless, these manuals provide guidance for comprehensive watershed assessment (specifically, watershed characterization) for Illinois and are valuable references.

We recommend that watershed assessment in Illinois follow the comprehensive approaches developed by Oregon, Vermont and Washington. We outline the following framework base on synthesis of the reviewed materials:

1) Watershed comparison and prioritization
2) Establishment of reference watersheds
3) Rapid assessment of reference watersheds
4) Watershed characterization of prioritized watersheds

5) Integrated assessment and evaluation
6) Project recommendations

A crucial first step in addressing restoration needs for the Illinois River Basin is identifying watersheds where restoration efforts can be most effectively applied. This approach is aimed solely at scientific evaluation of the watershed. Many other criteria can and should also be involved in the prioritization process to ensure proper site selection. A comparative assessment considers many watersheds (e.g., within a sub-basin) rapidly and simultaneously to quickly identify relative sensitivity, value, or level of degradation. A watershed found to be highly degraded by comparison, might not warrant restoration action in that watershed if degradation is consider irrevocable. Alternatively, restoration may be focused outside of that watershed if functions or processes in other parts of the system are contributing to the degradation. In this case, restoration efforts (priority) would be best focused in a tributary watershed or catchment. Key elements of comparative watershed assessment include systematic assessment, uniform data interpretation, resolution and scale that will uncover contrasts among watersheds, and recognition of systematic impacts. The results of a comparative assessment aid prioritization of watersheds for characterization. Comparative assessments, such as the Unified Watershed Assessment (IEPA 1998), have already been conducted for Illinois. These could be used for the initial comparative assessment, but updates are recommended where significant datasets have been acquired.

After priority watersheds have been identified, we recommend establishing reference watersheds within the sub-basin. The reference watersheds should represent the least impacted, most impacted, and "typical" cases. The establishment of the references will give watershed assessors, contracting agencies, policy makers and local stakeholders a frame of reference for ensuing watershed assessments and future decision making. The purpose of establishing reference watersheds is to justify the prioritization, to document the range of conditions within a sub-basin, and to provide a context for allocating project effort. The reference watersheds would be assessed rapidly to identify basic characteristics in each. This phase is based mainly on GIS and office work rather than on fieldwork, but cursory fieldwork may have to be done to corroborate the office assessment. We suggest that the Unified Watershed Assessment (www.epa.state.is.us/ water/unified-watershed-assessment/) be used as a starting point helping to focus on reference watersheds.

Once reference watersheds are established, we recommend conducting watershed characterization in those watersheds that have been identified through the prioritization process. The purpose of watershed characterization would be to identify the processes (e.g. channel degradation) and impacts (e.g. prevalence of invasive species) that contribute to the actionable condition of the watershed. We suggest simultaneous watershed assessments per discipline (hydrology, geomorphology, biology).

After each component of the watershed characterization is complete, integrated assessment and evaluation of the priority watershed is recommended. The purpose of this step is for watershed assessment teams to compare notes, collaborate, and identify consensus issues. If consensus cannot be found then more rigorous and objective techniques may need to be applied before project recommendation.

Project recommendation is the overarching goal and result of the watershed assessment for the Illinois River Basin. Effective use of restoration project funding relies on accurate assessment of causes and effects of degradation in the watershed system. Therefore it is imperative that cause-effect relationships (i.e., processes) be identified prior to project recommendation.

A summary of our recommended watershed assessment framework is as follows. Framework goals are outlined under each step. The outlined tasks under respective headings cannot be considered exhaustive or comprehensive, but rather exemplify the nature of each step in the procedure.

Recommended Framework

1) Compare and prioritize watersheds

Based on existing information, identify priority watersheds largely through GIS and other remote sensing methods

- Suite of watersheds for rapid comparison should be manageable within allotted time frames and funding schedules.
- Existing comparative assessments may need to be updated a significant amount of new data was collected or assessments have been updated (It has been 6 years since the Unified Assessment by IEPA (1998)).

2) Establish a reference *watershed*

Identify a "best" watershed in the target area (e.g., sub-basin) based on the existing knowledge.

- The reference watershed may be derived from the previous step with local stakeholder input and some field corroboration.
- Establishing a reference watershed will aid in resolving questions about restoration priorities raise in Step 5 (below).
- NOTE: At this level of assessment, the reference watershed is a simple identification. Reference conditions cannot be inferred at this level. To obtain reference conditions watershed characterization is necessary.

3) Rapid watershed assessment

Establish initial estimates of the current condition of each of the three reference watersheds in the target area.

- Conduct separate, simultaneous rapid assessments according to discipline.
- GPS-video mapping from helicopter flyovers may be conducted during a rapid watershed assessment to obtain a "quick glance" at conditions in a watershed where data are limited. However watershed characterization is needed to establish inferences about the processes contributing to the conditions observed from

flyovers.

• The purpose of this step is to gather available data from various disciplines to become familiar with the watershed. Several data sources exist in Illinois. Some potentially useful datasets and sources include:

Water quality - The Illinois Environmental Protection Agency (IEPA) conducts a variety of stream monitoring including: a 213-station Ambient Water Quality Monitoring Network (AWQMN), an Intensive Basin Survey Program that covers all major watersheds on a five-year rotation basis, and a Facility-Related Stream Survey Program (FRSS) that conducts approximately 20-30 stream surveys each year (IEPA 2002). The AWQMN includes sampling water chemistry and core pesticides at each site nine times per year on a cycle of once every 6 weeks. Intensive Basin Surveys include sampling water chemistry, habitat quality, fish, macroinvertebrates, sediment chemistry, and fish tissue on a 5-year cycle. This program is a cooperative venture between the Illinois DNR and the IEPA. Each basin survey may consist of approximately 10 to 35 stations. Water Chemistry, effluent, habitat quality, macroinvertebrates, and occasionally fish are sampled as part of the FRSS. Each FRSS consists of sampling conducted upstream and downstream of wastewater treatment plants and the number of sites may vary from three to seven or more.

Aquatic biota - Stream habitat quality, fish, macroinvertebrates, and fish tissue are sampled on a 5-year cycle as part of cooperative Basin Survey Program, administered by the Illinois DNR and the IEPA (Table16, Figure12).

Streamflow Records - In Illinois there are currently 97 active continuous discharge gages in the Illinois River Basin (IRB) of which 89 are operated by the USGS (Figure 12) and 8 are operated by the ISWS. The names and locations of these active gaging stations are presented in Table 11. Also identified in Table 11 are the 80 discontinued gaging stations in the IRB, the number of years over which data have been collected at each station, and whether these data are a full 12-month record (F) or partial (P) record.

Suspended Sediment Records - In Illinois there are 21 active monitoring sites collecting suspended sediment data in the IRB. Figure 4 shows the locations of these sites.

Critical Trends Assessment Program (CTAP) - The CTAP program (Milano-Flores 2003) is designed to monitor the condition of forests, grasslands, wetlands, birds, insects, and streams in Illinois (Figure14). For each habitat type, 150 sites are monitored on a rotating, 5-year cycle. Site selection is based on randomly selected patches within randomly selected townships throughout the state.

Ecowatch - The Ecowatch program relies on trained volunteers to monitor Illinois' forests, rivers, and prairies. Location of existing Ecowatch sites located in the Illinois River Basin are shown in Figure 15.

Inventory of Other Datasets - There are a variety of digital databases available for use by project participants; these include scientific data, infrastructure data, and digital photography (Table 17, Appendix A). These data vary widely in scale, temporal and spatial completeness, quality, and availability.

Known information, specific to the Illinois River Basin, were inventoried to determine what spatial data are currently available to use for baseline watershed assessments as well as to assist with long-term monitoring protocols. This data identification exercise has been run for previous Illinois River-related projects and each effort has added to the accessible knowledge-base associated with the Illinois River Basin. The intention in this effort is not only to identify relevant digital data, but to track down sources of useful information that, as yet, may not be as readily available. There are a variety of potential sources of useful data, some of which may have previously been underutilized by IDNR watershed research. These potential sources include local Soil and Water Conservation Districts (SWCD), County Farm Bureaus (FB), Farm Service Associations (FSA), etc.. Another important objective is to evaluate the resolution of the data sets to determine if they are appropriately-scaled for main-stem, sub-basin, and project specific work discussed elsewhere in this document, so that when utilized for baseline assessment, scientific query, or planning task, will lead the data user to meaningful and defensible conclusions.

Preliminary searches revealed a wide variety of small-scale (ranging from1:15:000 to 1:3,000,000) remotely-sensed and mapped data available in a variety of digital formats that can be readily incorporated into a digital-based analysis (see Appendix A). These small-scale data are suitable for regional studies but are often out of date. Larger-scale data (ranging from sub-meter resolution to 1:10:000) are available in digital format but on a much more limited basis.

These data, and other information, would be used to develop a baseline dataset for monitoring during the preliminary watershed assessment. Assessments would minimally include surficial geology, landscape history (over 100 years or more including changes in land cover (c.f., IDNR et al. 2003; Szafoni et al. 2003)), land use (agricultural practices, modes of urban development, installation of drainage networks, occurrence of levees, channelization, etc.), channel pattern (e.g., Phillips et al. 2002; Collins and Knox 2003), and climate (precipitation or flow). The initial assessment identifies the existing static condition as well as establishes intrinsic rates of change (e.g., meander migration), and may reveal some long-term system responses to historical change. In addition, the assessment will identify additional data gaps that might be filled by monitoring, potential problems for remediation, sampling locations and appropriate techniques, and tune sampling protocols (c.f., Osterkamp and Schumm 1996).

The need for higher resolution data is evident. While high resolution (1:24,000 or greater) geologic mapping establishes a baseline configuration for small scale monitoring, it is insufficient for the large scale assessment and monitoring proposed in this plan. For example, much of the surficial geology on 1:24000 scale maps is derived from interpretation of parent materials from 1:15,000 scale soils maps. Variability in alluvial valley sediments is highly overgeneralized at these scales and, in particular, channel bed and sub-bed materials are not identified. Thus, larger scale (higher resolution) geologic mapping may be needed in sub-watershed and project scale assessment. The mapping is especially important where subsurface units are shallowly buried, and thus streams may tap significantly different geologic materials than occur at the surface of the adjacent floodplain or upland.

The question then becomes, "where will the higher resolution data come from". Some agencies conduct field-scale monitoring, but data are sparse and observations are not necessarily geared towards the indicators we have identified as most suitable for this plan. When it does exist, larger-scale information (ranging from sub-meter resolution to 1:10:000) that are not digital will have to be obtained, permissions granted, and processed before the actual value to assessment and/or monitoring tasks can be determined. Conversely, when a data gap has been identified, the information will have to be gathered in the field, or from high resolution imagery, and processed from scratch. This is where the garnering of distributive database design and compilation efforts will prove to be beneficial. An effort should be made to capitalize on the multi-disciplinary nature of this project to develop digital databases. An excellent example of this kind of opportunism involves the Illinois FSA.

Illinois FSA is in the process of implementing a geographic information system (GIS) in local field offices, where many years of field boundary, nutrient and pesticide application, land use practices influencing erosion, and crop management information (especially BMP lands) have been documented in paper form (IDA 2002). Illinois FSA intends to use the GIS technology to efficiently administer programs, monitor compliance, and respond to natural disasters while making FSA data more accessible to their constituents. Their first step in this implementation has been to establish a common land unit (CLU) data layer. A CLU is the smallest unit of land that has a permanent contiguous boundary, common land cover, and a common owner (i.e. a field containing row crop). To accomplish this, hard-copy aerial maps are being transferred to a digital orthophoto quadrangle (DOQQs) base; then reference lines such as field, track, and farm boundaries, roads, and waterways are being reconciled to the imagery. As the digital CLU layers are processed, the county FSA Offices that generated the common land unit inventory are checking the accuracy of the digital reference lines. Once the CLU data layer is certified by the originating FSA, it will supersede other aerial photos as the official USDA photography (see http://www.fsa.usda.gov/il/GIS.asp). In Illinois, it is anticipated that all county FSA Offices will be using the CLU layers by October of 2004. The spatial data will include an accurate inventory of fields, measure of acres, and land-use categories. The data will also contain areas of environmental concern, including easements, wetlands, and highly erodible land which helps identify and map environmentally sensitive acreage, as well as locate potential environmental hazards. All potentially relevant to watershed biotic (i.e., presence of invasive plant species) and abiotic (i.e., erosion estimates along waterways) metrics.

Access to new high resolution digital data will contribute to the implementation and success of purposed restoration in the Illinois River Basin as well as to future research/restoration activities.

4) Watershed characterization

Identify and assess specific habitats, processes, and functions at work in the priority watershed(s) and the sources of impact (i.e., linking cause and effect).

- Watershed characterization will be conducted for a small subset (2 or 3) of prioritized watersheds that require focused effort.
- A watershed characterization may be conducted due to vulnerability, restoration potential, or relatively high rates of change in habitats, functions or processes.

5) Integrated assessment and evaluation

Gather contracting agencies, stakeholders and scientists to establish consensus on factors affecting watershed habitats, processes and functions. If consensus is reached go on to recommending projects. If no consensus is reached then more evaluation is needed to identify causes of undesirable watershed symptoms.

- Technical personal meet to assess data gaps, supplement data with fieldwork or local data and integrate findings.
- Relate conditions in the priority watershed to reference conditions in the reference watershed.
- Describe factors that have created current conditions.
- Technical personnel and stakeholders should meet at this point to discuss results and determine consensus action base on findings.

6) Project recommendations.

Recommendations follow from the documented conditions of habitats, processes and functions and causes of those conditions identified in the preceding steps.

Recommended Watershed Assessment Approaches

Geomorphic component

- ISWS Illinois Geomorphic Watershed Assessment (White 2004; Keefer and White 2004), and Stream Dynamic Assessment (Phillips et al. 2002)

Hydrologic component

- Adapted guidelines and procedures set out by White (2004), Keefer and White (2004), Rhoads (2003), VSGAP (Kline et al. 2003), Locke et al. (2004), and McCammon et al. (1998).

Aquatic Ecology component

- LTRMP protocols for mainstem (Gutrueter et al. 1995), water quality and biota according to IEPA (1994) and IDNR (2001), macroinvertebrates (Dodd et. al 2003), and instream habitat (modified protocol from Stanfield et al. 1998).

Terrestrial Wildlife component

- Modified protocols set out by (Milano-Flores 2003).

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Table 1. Ongoing restoration programs within the Illinois River Basin. Parenthesis surround the acres enrolled in the State - Conservation Reserve Enhancement Program (CREP) because these acres are also included in the Federal - CREP acres. The Cost column includes both annual allocations ([a]) and total funds spent over several years ([t]).

PROGRAM	ACRES	COST (mill)
Conservation Reserve Program	287,020	$36.46[a]
Conservation Reserve Enhancement Program (Federal)	109,557	$11.08[a]
Conservation Reserve Enhancement Program (State)	(67,110)	$ 6.49[a]
Wetland Reserve Program, Environmental Quality Incentive Program, Wildlife Habitat Incentive Program	296,906	$ 9.88[a]
IL Environmental Protection Agency - 319	variety of practices	$ 2.80[a]
IL Dept. of Agriculture Streambank Stabilization and Restoration Program, Conservation Practices Program	10 stream miles + others	$ 2.38[a]
IL Dept. of Natural Resources - C2000	variety of practices	$ 3.10[a]
U. S. Army Corps of Engineers		-------
Non-Government Organizations (e.g., The Nature Conservancy)	9,000+	$13.00[t]
Total		**$85.19**

Table 2 . Geomorphic monitoring measures for the Illinois River Basin.

Parameter	Ecological Relevance	Assessment Method	Assessment Frequency	Ability to Detect Change	Key References
Groundwater quality	Habit support and human consumption	Monitoring wells	Seasonal to annual	High	Appelo and Postma (1993)
Groundwater chemistry in the unsaturated zone	Reflects changing weathering rates by changing groundwater flow, inputs from human activities; influences habitat and human consumption	Coring or well sampling	5-10 yr	10-100 yr resolution of changing inputs	Appelo and Postma (1993); Geake and Foster (1989)
Karst activity	Affected by natural and human influences on groundwater flow and drift thickness; rapid pollutant transport in groundwater	Water chemistry in caves and springs; surficial mapping	Various, depending on target	Sub-annual to long-term changes in climate and human activity	Beck (1989); Ford and Wiliams (1989)
Sediment sequence and composition	Accumulation rate indicates sediment yield or storage potential; reflects physical, chemical, biological changes in environment from natural and human causes	Various coring techniques in lakes and floodplain sediment, depending on sediment thickness and character	Annually to 10 years, depending on accumulation rate	Potentially high resolution of environmental changes at project to regional scale	Berglund (1986); Goudie (1990)
Slope failure	Stream sediment source; changing frequency reflects changing groundwater flow, landuse, or stream undercutting	Mapping from airphotos, DEM data, or fixed-site photography	5-10 years or after extreme climatic events	Most active after flooding and especially after extreme events; May require detailed mapping. Project to subwatershed scale.	Brabb (1984); Forest Practices Code (1999); Sierra and Straub (in review)
Soil and sediment erosion	Soil productivity reduce if loss is greater than soil formation rate; sediment delivered to streams influences habitat	Soil profile surveys; repeated topographic profiling; modeling; airphoto interpretation of bluff recession; erosion pins	Seasonally to decadal, depending on target, setting, and specific parameters	Erosion occurs irregularly in time and space; high resolution of short- and long-term changes possible; Project to basin scale.	Renard et al. (1997); Commission on Applied Geomorphology (1967); OTHERS
Soil quality	Soils may be degraded by erosion, compaction, addition of pollutants	Soil surveys	1-25 years, depending on target	High variability in 3 spatial dimensions makes selection of representative sites difficult. Project to basin scale	Buol et al. (1997)

Stream channel morphology	Changes caused by direct human modification as well as intrinsic variability, climate, natural and human-induced landscape evolution. Progressive rates of change may indicate habitat instability	Airphoto analysis of stream pattern; repeated cross-sectional surveying and longitudinal profiling; flow and sediment gauging ; fixed-site photography	1-10 years, depending on target and scale of interest	Potentially high, but sampling must be highly targeted. May not be useful for adaptive management. Most useful at project scale.	Osterkamp and Hedman (1982); Phillips et al. (2002); Rhoads and Miller (1991); Rhoads (1995); Schumm et al. (1984); Simon (1989)
Stream flow	Reflects climatic and landscape variability	Gauging stations; regional modeling for ungauged streams	Daily to monthly, depending on target and scale of interest	High, given sufficient understanding of climatic and landscape evolution. Project to basin scale.	Edwards and Glysson (1999); Wolman and Riggs (1990)
Sediment storage and load	Sediment load is a function of stream power, sediment yield, and carrying capacity; Affects channel morphology; stored sediment may be future sediment load or contaminant trap; load ultimately delivered to Illinois River mainstem	Suspended sediment sampling at gauging stations; bedload sampling probably prohibitive except for large-scale, short-term monitoring; supported by direct observations of channel morphology and sediment sequence on floodplains	Daily to monthly, depending on target and scale of interest. Sediment storage observations at least every 5 years	When combined with historical analysis of watershed, potential to distinguish natural and human-induced effects. Project to basin scale	Edwards and Glysson (1999); Robertson and Roerish (1999); Wolman and Riggs (1990)
Surface water quality	Determined by interaction with groundwater, soils, and direct inputs; degraded water quality has direct effect on ecosystems	Testing for targeted physical, chemical, and biological parameters at gauging stations,	Sub-annually	Can indicate both short and long-term changes at project to basin scales	Adolphson et al. (2002); Hirsch et al. (1988); Robertson and Roerish (1999); Sullivan (1999)
Wetlands extent, structure, hydrology	Key ecosystem component, geohydrologic and geochemical buffer; sensitive to landscape evolution and archive of ecological change	Mapping of distribution and extent; intensive monitoring of individual wetlands.	5-10 yr for distribution, extent, and structure; continuously for preliminary observation of hydrology and chemistry	Seasonality must be distinguished from long-term change; Project to basin scale	

Table 3. General aquatic monitoring parameters for the mainstem Illinois River Basin.

Parameter	Ecological Relevance	Assessment Method	Frequency	Ability to Detect Change
Water Quality	Indicates immediate changes in nutrients and other water quality parameters to base other biotic responses.	Standardized USGS water quality sampling protocols	weekly to seasonal	Immediate changes and long term trends
Planktonic Algae	Predictable and quick response to changes in nutrients, habitat alteration, etc.	Chlorophyll a	weekly to seasonal	Rapid biotic response to environmental changes
Aquatic Plants	Provide habitat for several aquatic taxa and can reflect localized improvements in water quality	Remote sensing and field-based assessments	annual	High in local areas but may also reflect systemic changes over longer periods of time.
Zooplankton	Food resource for many aquatic organisms.	Filtered water sample	weekly to seasonal	May be good for systemic responses, but may not integrate local mainstem changes.
Macroinvertebrates	Important food resource for higher trophic levels. Respond to stressors well.	Ponar dredge, emergence traps, kick nets	seasonal	Response may be limited to smaller scales
Fish	Consolidate responses from the lower trophic levels.	Standard fish collection techniques (Electrofishing, fyke nets, gill nets, etc.)	seasonal	Can reflect localized changes relatively rapidly and also systemic changes on longer temporal scales
Amphibians/Reptiles	Can indicate degraded local environmental conditions	Calling surveys, drift nets, funnel traps	seasonal to annual	Assemblages are not as distinctly tied to aquatic areas, but may reflect a composite aquatic-riparian response.

Table 4. Physical habitat and biotic parameters used as environmental indicators in sub-basins and tributaries.

Parameter	Ecological Relevance	Assessment Method	Assessment Frequency	Ability to Detect Change	Key References
Channel morphology	Reflects changes in sedimentation or stream bed degradation as a result of landscape changes from natural or anthropogenic causes; can indicate potential changes in fish and invertebrates communities	Surveying at permanent transects along stream gradient; Point transect method along equally spaced transects	Seasonal to annual	High at project sites; moderate at the sub-basin scale	Platts et al. 1983; Rosgen 1996; Stanfield et al. 1998
Percent Substrate types	Indicates changes in sedimentation and flow resulting from changes in landuse; links improvement in habitat with changes in fish and invertebrate communities	Point transect method along equally spaced transects; qualitative observations along extensive reaches of stream	Seasonal to annual	High at project sites; moderate to low at sub-basin scale	Platts et al. 1983; Rosgen 1996; Simonson et al. 1994; Wang et al. 1996; Stanfield and Jones 1998; Stanfield et al. 1998; Wang et al. 1998
Percent Habitat Types (i.e. riffle, run, pool, etc.)	Gives indication of habitat diversity and shifts in habitat types as a result of changes in sedimentation and peak flows; potenital mechanism for shifts in fish and invertebrates as diversity in habitat types change.	Point transect method along equally spaced transects; measuring and mapping individual habitats within stream	Seasonal to annual	High at project sites; high to moderate at the sub-basin scale	Platts et al. 1983; Simonson et al. 1994; Wang et al. 1996; Stanfield et al. 1998; Wang et al. 1998

Bank Stability	Reflects changes in stream stability and potential for bank erosion as a result of changes in peak flows and riparian landuse; indicates overall channel stability needed for fish and invertebrates.	Surveying at permanent transects; Point transect method at specific locations in watershed; assessment of percent bank/riparian cover types	Frequently at individual practice sites which potentially change riparian vegetation; Annual at permanent transects	Dependant on types of practices; High at project sites; moderate to low at the sub-basin scale	Platts et al. 1983; Simonson et al. 1994; Stanfield et al. 1998;
Fish composition, diversity, and abundance	Indicates shifts in fish assemblages as a result of improved water quality and habitat conditions	Electrofishing - single or multi-pass	Seasonal to annual	High at project sites; moderate at sub-basin scale	Bayley et al. 1989; Simonson and Lyons 1995; Barbour et al. 1999; Attrill 2002
Index of Biotic Intgrity	Gives an overall stream quality rating based on fish assemblage composition, abundance, and health	Based on electrofishing data	Seasonal to annual	High at project sites; moderate at sub-basin scale	Karr et al. 1986; Hite and Bertrand 1989; Attrill 2002
Fish size structure	Indicates habitat quality/conditions, degree of competition, size selective mortality (fishing pressure), and age at maturation	Based on electrofishing data	Seasonal to annual	High at project sites; moderate to low at sub-basin scale	Atrill 2002
Fish age and growth	Changes reflect shifts in habitat suitablilty/quality and prey availability (competition for food) and indicates overall health of fish assemblages	Use of boney structures (scales, fin rays, spines, or otoliths) to count and measure growth rings; backcalculation of growth rates through Fraser-Lee method	At least once before and once after restoration practices; annual for more	Moderate depending on sampling frequency, number of fish analyzed and species of fish	Macina 1992; Putnam et al. 1995; Devries and Frie 1996; Power 2002

Invertebrate composition, diversity, and abundance	Shifts reflect changes in habitat/water quality (sedimentation and nutrients) and stability of the system; gives information on life cycle/life history requirements	Stratified Random sampling using Hess and core samplers (quantitative) and dipnets (semi-quantitative)	Seasonal to annual	High to moderate at the site and sub-basin scale	Rosenburg and Resh 1996; Barbour et al. 1999; Atrill 2002
Invertebrate indices	Indicates stream quality based on invertebrates as indicator taxa; reflects shifts in habitat and water quality	Stratified Random sampling using quantitative and semi-quantitative sampling devices	Seasonal to annual	High at the sub-basin scale and project sites	Hilsenhoff 1982; Rosenburg and Resh 1993; Rosenburg and Resh 1996; Resh et al. 1996; Atrill 2002
Intolerate Invertebrate Taxa	Reflects changes in non-point source pollution (sedimentation; nutrients) as a result of landuse changes	Stratified Random sampling using quantitative and semi-quantitative sampling devices	Seasonal to annual depending on objectives	High to moderate at the site and sub-basin scale	Rosenburg and Resh 1993; Rosenburg and Resh 1996;Barbour et al. 1999; Resh et al. 1996; Atrill 2002

Table 5. Wildlife and terrestrial habitat monitoring parameters for the Illinois River basin.

Parameter / Species Group	Critical Measures	Indicator Species, Measures	Ecological Relevance	Assessment Method	Assessment Frequency	Ability to Detect Change	References
Critical Response Measures							
A. Landscape habitat composition and metrics	Amount of natural vegetation, patch size, connectivity, width of riparian habitat	Positive - wetland, forest, grassland Negative - urban, roads, cropland	Watershed protection and wildlife habitat suitability	GIS analysis of classified satellite imagery	3-5 year intervals	Depends on rate and scale of changes relative to classification accuracy	Illinois Department of Natural Resources et al. 2003
B. Wetland habitat communities in floodplain	Declining communities	Submergent, floating-leaved, emergent, and moist-soil communities	Amounts reflect hydrologic change and wildlife habitat	Photointerpretation and ground truthing	5-10 year intervals	Good, depending on classification accuracy and photographic data	Upper Midwest Environmental Sciences Center – LTRMP High Resolution Land Cover/Use Data, Bellrose et al. 1979, Havera 1999
C. Site specific habitat/vegetation monitoring	Species composition, habitat structure, and presence of exotic species	Positive – mast producing trees, species richness Negative – exotic and/or invasive species	Combined with landscape and community habitat evaluation, provides a multiscale assessment of habitat quality and system function	Transects	Monitoring sites revisited once each 5 years on a rotation	Good for measuring structure and detecting indicators	Rogers and Owens 1995, Mack 2001, Milano-Flores 2003
D. Waterfowl	Waterfowl use days	Dabbling and diving ducks	Trends reflect habitat conditions including hydrology and water quality	Aerial and ground surveys	Weekly during fall and spring migration	Good using trends and comparing to historical data	Havera 1999, Horath et al. 2003
E. Wading birds and cormorants	Rookeries, number of active nests	Black-crowned night heron, great egret, snowy egret, little blue heron, double-crested cormorant	Sensitive to wetland hydrologic conditions, undisturbed nest sites, and drydown fishing opportunities	Aerial and ground complete counts	Annually	Good combining aerial counts and monitoring of rookeries	Gibbs et al. 1988, Dodd and Murphy 1995, Bjorklund and Holm 1997, Bjorklund 1998, Gawlik et al. 2003
F. Marsh birds	Presence and abundance of rare species, breeding species	Marsh – American and least bittern, common moorhen Large marsh - pied-billed grebe Wet meadow - black rail	Wetland obligates requiring declining emergent communities	Point call counts using taped play-back surveys	Monitoring sites revisited once each 5 years on a rotation	Presence/absence during breeding season is a good indicator of habitat suitability	British Columbia Ministry of Environment, Lands and Parks 1998
G. Shorebirds	Seasonal abundance, migration use days	Rare species, breeding species, and those intolerant of disturbance	Utilize unique and rare habitats such as predator free islands and moist soil areas; sensitive to disturbance	Ground counts from vantage points	3 times per month during spring and fall migration	Good with regular monitoring at known and potential habitat areas	de Szalay et al. 2000, Bart et al. 2002, Horath et al. 2002
H. Bald eagles and ospreys H. Cont.	Number of nests, active nests, and mid-winter abundance	Breeding activity	Dependent on large floodplain trees for nesting, sensitive to human disturbance, fish abundance, water quality (clarity)	Documentation and monitoring of nests, winter aerial and ground surveys	Annually	Good with widespread reporting and monitoring of nests; good for winter surveys	Havera and Kruse 1988, Jacques Whitford Environment Limited 2000, IDNR midwinter eagle survey
I. Terrestrial mammals	Wetland/riparian	Otter, beaver,	High on the food chain,	Transects,	Annually	Good for long	Bluett et al. 2001, Illinois

	obligates, mesopredators	muskrat, mink, gray fox, bobcat, coyotes, raccoons, possums, skunks	indicators of system "health" and function, some require large habitat areas	nightlighting, trapper data, archer index, etc.		term programs and utilizing multiple data sources	Department of Natural Resources 2003
J. Bats	Riparian roosting and nesting species	Presence/absence; foraging species richness; Indiana bat, red bat, hoary bat, silver-haired bat	Indicators of riparian system integrity in small watersheds, disturbance, organochlorine contamination	Night trapping and acoustic surveys	Annually	Good; further refinement of methods may provide similar information at less cost	Gannon et al. 2003, O'Shea et al. 2003, Texas Parks and Wildlife 2003
K. Bottomland/riparian forest birds	Presence and abundance of breeding species, obligates and area sensitives	Brown creeper, red-shouldered hawk, prothonotary warbler, cerulean warbler, red-eyed vireo	Indicators of bottomland forest extent, composition, and function	Point call counts	Monitoring sites revisited once each 5 years on a rotation	Best for abundant and widespread species	US Geological Survey 1998, Milano-Flores 2003, Sauer et al. 2003
L. Grassland birds	Presence and abundance of breeding species, obligates and area sensitives	Upland sandpiper, Henslow's sparrow, northern harrier	Grassland habitat quality indicators including patch size and fragmentation	Point call counts	Monitoring sites revisited once each 5 years on a rotation	Best for abundant and widespread species	Herkert 1994, US Geological Survey 1998, Milano-Flores 2003, Sauer et al. 2003
M. Amphibians	Species richness and abundance	Frogs and toads	Good indicators of water and overall habitat quality for fishless wetlands	Point call counts	Monitoring sites revisited once each 5 years on a rotation	Good using long-term programs	Thompson et al. 1998, US EPA 2002, Micacchion 2002
N. Aquatic reptiles	Abundance of snakes, turtles, and basking sites; aquatic turtles sensitive to water quality	Illinois mud turtle, alligator snapping turtle, map turtles, smooth softshell, water snakes (Nerodia spp.)	Sensitive to availability of basking sites; water snakes and some aquatic turtles are sensitive to water quality, dredging, and dam construction	Basking transects, aquatic turtle trapping	Two or more searches and trapping sessions during active months of year	Potentially good in appropriate habitats but methods largely untested	Thompson et al. 1998
Desirable Response Measures							
O. Avian reproduction	Reproductive effort and success, nest parasitism, patch size	All species with emphasis on rare, habitat obligates, and area sensitive species	Incorporates and synthesizes many complex factors to indicate ecosystem habitat quality and function	Nest searches and monitoring	Nest searching and monitoring every 3 days during the nesting season	Requires large sample sizes for accurate assessment	Knutson et al. 1996
P. Amphibian reproduction	Reproductive effort and success	Egg mass counts, viable eggs	Good indicators of water and overall habitat quality for fishless wetlands; highly sensitive to environmental factors like pollution, water temperature, etc.	Egg mass counts, drift fence surveys	Annually	Trends can be detected in areas of concentration	Micacchion 2002, US EPA 2002

Table 6. Estimated costs for the proposed long-term monitoring plan at critical and desirable levels. Desirable costs are additional dollars. The costs estimates for each discipline encompass all spatial scales of monitoring (i.e., mainstem, sub-basin, project). For more detailed cost estimates at each spatial scale, please refer to the text.

	Critical Level		**Desirable Level**	
	Year One	**Subsequent Years**	**Year One**	**Subsequent Years**
Geomorphological Features	$192,000	$192,000	$184,000	$184,000
Hydrological Features	$1,618,000	$1,134,000	$305,000	$181,000
Ecological Features				
Aquatic	$655,000	$605,000	$105,000	$105,000
Terrestrial	$1,486,000	$1,486,000	$185,000	$185,000
Total Estimated Costs:	$3,951,000	$3,417,000	$779,000	$655,000

Table 7. Data needs and objectives for river inventories (Rosgen 1994)

Level of detail	Inventory description	Information required	Objectives
I	Broad morphological characterization	Landform, lithology, soils, climate, depositional history, basin relief, valley morphology, river profile morphology, general river pattern	To describe generalized fluvial features using remote sensing and existing inventories of geology, landform evolution, valley morphology, depositional history and associated river slopes, relief and patterns utilized for generalized categories of major stream types and associated interpretations.
II	Morphological description (stream types)	Channel patterns, entrenchment ratio, width/depth ratio, sinuosity, channel material, slope	This level delineates homogeneous stream types that describe specific slopes, channel materials, dimensions and patterns from "reference reach" measurements. Provides a more detailed level of interpretation and extrapolation than Level 1.
III	Stream "state" or condition	Riparian vegetation, depositional patterns, meander patterns, confinement features, fish habitat indices, flow regime, river size category, debris occurrence, channel stability index, bank erodibility.	The "state" of streams further describes existing conditions that influence the response of channels to imposed change and provide specific information for prediction methodologies (such as stream bank erosion calculations, etc.). Provides for very detailed descriptions and associated prediction/interpretation.
IV	Verification	Involves direct measurements and observations of sediment transport, bank erosion rates, aggradation/degradation processes, hydraulic geometry, biological data such as fish biomass, aquatic insects, reparian vegetation evaluations, etc.	Provides reach-specific information on channel processes. Used to evaluate prediction methodologies; to provide sediment, hydraulic and biological information related to specific stream types and to evaluate effectiveness of mitigation and impact assessments for activities by stream type.

Table 8. Channel morphometrics in channel evolution model of Schumm et al. (1984).

Stage	Location	Top Width (ft)	Depth (ft)	Width Depth Ration (ft)	Thalweg Slope (ft/ft)	Depth of Sediment (ft)	Dominant Process
I	Upstream of headcut (580+00)	82	17.3	4.7	0.0020	0	Transport of sediment
II	Immediately down-stream of headcut (560+00)	82	21,6	3.8	0.0018	variable 0-2	Degradation
III	Downstream of II (520+00)	100	20.1	4.9	0.0018	1.5	Rapid widening
IV	Downstream of III (450+00)	115	19.2	6.0	0.0016	2.5	Aggradation and development of meandering thalweg
V	Downstream of IV (435+00)	119	15.3	7.8	0.0010	6.3	Aggradation and stabilization of alternate bars

Table 9. Elements of selected ecosystem monitoring and baseline investigations.

Reference	Practice Evaluated	Setting	Target Area or Length	Data Types	Spatial Scale	Temporal Scale
Simon (1989)	channel response to dredging, straightening, clearing, & snagging	Western TN	1.3 km to 75.1 km reaches	channel morpology data (width, slope, depth, gradient, stage, soil mechanics variables (cohesion, friction angle, field density of stream banks	Western 1/4 of TN	2 years of current monitoring data compared to 19 years of surveys for channel modifications
Collins and Knox (2003)	Long term modification of land use, climate fluctuation, channel navigation improve - ments to quantify mag- - nitude, direction, and rates of floodplain change	Upper Mississippi River Pool 10	52.8 km	GIS coverage of scanned USGS reports, stage data, climate data, floodplain, water &geomorphic features	205,567 km^2 drainage basin	1866 - 1989
Adolphson et al. (2002)	Landuse affects on stream habitats	rural to urban settings along Fox, DesPlaines Rivers, Illinois	12-36 km^2 subwatersheds	GIS watershed morphology, geology, landcover; channel morphology, bed material, habitat inventory	28K km^2	3 year (1999-2001) baseline investigation for long term monitoring
Erskine (2001)	Clearing, Channel Shaping, diking, bank armoring	relatively steep, large capacity, gravel bed channel with in channel benches, gravel and bedrock bars	Individual sites = 0.1 to 7.8 km	Plans, tabular, Photographic, theoretical models	+1000 km^2	30 years
Harvey (2001)	Coupling between hill-slopes & channels in upland fluvial systems	Pleistocene glacial and periglacial sediments over folded Silurian mudrocks Northwest England	mainstream length approx 4 km, valley was appox. 3.5 km long by 1-2 km wide	1948 photos 1:30K, 1960 photos 1:10K, rainfall, dating, various large scale sediment and geomorphic studies	1:10K to 1:30K with large scale studies probably larger scale then 1:10K	30 year monitoring program
Owens and Walling (2002)	Landuse, climate effects on sediment yield	River Tweed watershed, gravel bed river in Scotland	160 km river; 4390 km^2 watershed	sediment cores, flow, precipitation, landuse, geochemistry	1:20K to 1:100K, with larger scale supporting studies	85-140 yr of records
Hession et al. (2003)	Urbanization of forested watersheds	26 paired stream reaches (urban vs. forest) alluvial channels, gravelly beds & cohesive banks of sandy silt	0.34 - 50 km^2	tabular stream characteristics 9width, slope, xsec, etc) land cover from aerial photos, Landsat	sample reach approx = 100-200 meters	2 years
Spittler (1995)	Monitoring hillslope processes following logging activity	CA Coastal Range watersheds	40-170 km^2 (sub-) watersheds	Geology, geomorphology features, climate types, logging activity	1:24K, 1:12K maps of wtrsheds from aerial photos, slope stability maps	2 year pilot watershed study

Reference	Practice Evaluated	Setting	Target Area or Length	Data Types	Spatial Scale	Temporal Scale
Rae (1995)	test of in-stream monitoring techniques	CA Coastal Range watersheds	40-170 km^2 (sub-) watersheds	habitat inventory, channel morphology, bed material, floodplain/hillslope landcover and landuse	1000 m reaches	2 year pilot watershed study
Rhoads (2003)	Bendway weirs	Illinois	project reaches	channel morphology, bed material	1:24K to reach scale (topographic maps, airphotos, soil surveys, site photographs, field measurements	Manual for site assessment; indefinite temporal scale
Rhoads and Miller (1991)	River Channel response to various short-term flow variability including 100yr flood, multiple bankfull floods and 1 extreme low flow event	River channel in glacial sediments in NE IL	7.2 km of stream channel	Flow, discharge, Width & depth at 26 cross sections, gradient, calculated stream power, bed and bank sediment particle size.	7.2 km of channel	2 years, 1986-1988.
Swanson Hydrology and Geomorphology (2002)	evaluation of management and restoration actions in a watershed	freshwater stream to estuary, California	3.5km stream segment	Historic vegetation, wildlife, birds, reptiles, aquatic macro-invert, Water Quality, flow, bed material, monumented cross sections		15 years in 5 year increments with annual monitoring of baseline data set information
Landwehr and Rhoads (2003)	depositional response of headwater Ag Stream to Channelization with oversized channel bottoms	100 meter reach of Spoon River near Gifford IL	100 meter length with 19 km^2 drainage basin	series of historical air photos. Field surveys of micro topography, soil core description	1:20K & 1:40K photos converted to digital form by scanning	1940 - 1998
Stewardson (1999)	Channel stabilization with addition of Large woody debris and boulders with rip-rap banks and rock-riffle construction	NE Victoria, Australia	2 stream reaches, a 300 m sand and gravel bed stream and a 350 m cobble bedded stream	X-sections, profiles, modeling	300 and 350 meter reach of stream channel	2 years (1996 - 1998)
Aust et al. (2003)	Evaluation of various vegetation management methods on Civil War Earthworks by USLE modification by Dissmeyer and Foster 1984	Civil War Battlefields on Atlantic Coastal Plain	Plots for all treatments were 5 meters wide with variable length slopes. Plots extended top to bottom of slope.	Rainfall, runoff, soil erodibility, slope length, slope steepness, cover management, support practices	plots were 10s of meters square	1 year, March 2000 through February 2001

Table 10. Spatial structure for high resolution monitoring framework by Hydrologic Catalog Unit. Critical response measures shaded white and desirable response measures shaded gray.

Monitoring (HUC) Unit	Catalog Number	Land Area (sq. mi.)	Subregion	Monitoring Parameters															
				A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P
Project Areas	-			Monitoring components determined by project location and habitat type.															
Kankakee	07120001	3,010	Upper Illinois	X		X			X			X	X	X	X	X		X	X
Iroquois	07120002	2,110		X		X			X			X	X	X	X	X		X	X
Chicago	07120003	622		X		X			X			X	X	X	X	X		X	X
Des Plaines	07120004	1,440		X		X			X			X	X	X	X	X		X	X
Upper Illinois	07120005	1,010		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Upper Fox	07120006	1,570		X		X			X			X	X	X	X	X		X	X
Lower Fox	07120007	1,090		X		X			X			X	X	X	X	X		X	X
Lower Illinois – Senachwine Lake	07130001	1,950	Lower Illinois	X	X	X	X	X	X	X	X	X		X	X	X	X	X	X
Vermilion	07130002	1,290		X		X			X			X	X	X	X	X		X	X
Lower Illinois – Lake Chautauqua	07130003	1,520		X	X	X	X	X	X	X	X	X		X	X	X	X	X	X
Mackinaw	07130004	1,130		X		X			X			X	X	X	X	X		X	X
Spoon	07130005	1,860		X		X			X			X	X	X	X	X		X	X
Upper Sangamon	07130006	1,420		X		X			X			X	X	X	X	X		X	X
South Fork Sangamon	07130007	1,130		X		X			X			X	X	X	X	X		X	X
Lower Sangamon	07130008	928		X		X			X			X	X	X	X	X		X	X
Salt	07130009	1,890		X		X			X			X	X	X	X	X		X	X
La Moine	07130010	1,340		X		X			X			X	X	X	X	X		X	X
Lower Illinois	07130011	2,280		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Macoupin	07130012	966		X		X			X			X	X	X	X	X		X	X

Table 11. Gaging Stations in the Illinois River Watershed including the periods of record.

Station ID	*Station name*	*Major river basin (sub-basin)*	*Primary monitoring agency*	*Years of record*	*Drainage area (sq. miles)*	*Records (F)ull (P)artial*	*Period of record*
Active gages							
5536290	Little Calumet River at South Holland	Chicago/Calumet	USGS	54	208	F	1948-2003
5536105	Nb Chicago River at Albany Avenue at Chicago	Chicago/Calumet	USGS	11	113	F	1990-1998,2000-2003
5536275	Thorn Creek at Thornton	Chicago/Calumet	USGS	54	104	F	1948-2003
5536000	North Branch Chicago River at Niles	Chicago/Calumet	USGS	51	100	F	1951-2003
5536215	Thorn Creek at Glenwood	Chicago/Calumet	USGS	53	24.7	F	1949-2003
5536255	Butterfield Creek at Flossmoor	Chicago/Calumet	USGS	54	23.5	F	1948-2003
5536235	Deer Creek near Chicago Heights	Chicago/Calumet	USGS	54	23.1	F	1948-2003
5535070	Skokie River near Highland Park	Chicago/Calumet	USGS	35	21.1	F	1967-2003
5534500	North Branch Chicago River at Deerfield	Chicago/Calumet	USGS	50	19.7	F	1952-2003
5535000	Skokie River at Lake Forest	Chicago/Calumet	USGS	50	13	F	1952-2003
5536340	Midlothian Creek at Oak Forest	Chicago/Calumet	USGS	51	12.6	F	1951-2003
5535500	West Fork of North Branch Chicago River at Northbrook	Chicago/Calumet	USGS	50	11.5	F	1952-2003
5536500	Tinley Creek near Palos Park	Chicago/Calumet	USGS	51	11.2	F	1951-2003
5536265	Lansing Ditch near Lansing	Chicago/Calumet	USGS	54	8.84	F	1948-2003
5536995	Chicago Sanitary and Ship Canal at Romeoville	Des Plaines	USGS	18	739	F	1984-2003
5532500	Des Plaines River at Riverside	Des Plaines	USGS	58	630	F	1944-2003
5529000	Des Plaines River near Des Plaines	Des Plaines	USGS	61	360	F	1941-2003
5540500	Du Page River at Shorewood	Des Plaines	USGS	61	324	F	1941-2003
5528000	Des Plaines River near Gurnee	Des Plaines	USGS	46	232	F	1946-1958,1969-2003
5527800	Des Plaines River at Russell	Des Plaines	USGS	35	123	F	1967-2003
5531500	Salt Creek at Western Springs	Des Plaines	USGS	56	115	F	1946-2003
5539000	Hickory Creek at Joliet	Des Plaines	USGS	57	107	F	1945-2003
5531300	Salt Creek at Elmhurst, IL	Des Plaines	USGS	13	91.5	F	1989-2003
5540095	West Branch Du Page River near Warrenville	Des Plaines	USGS	33	90.4	F	1969-2003
5540250	East Branch Du Page River at Bolingbrook, IL	Des Plaines	USGS	13	75.8	F	1989-2003
5527950	Mill Creek at Old Mill Creek	Des Plaines	USGS	12	61	F	1990-2003
5530990	Salt Creek at Rolling Meadows	Des Plaines	USGS	29	30.5	F	1973-2003

Table 11. (continued)

Station ID	Station name	Major river basin (sub-basin)	Primary monitoring agency	Years of record	Drainage area (sq. miles)	Records (F)ull (P)artial	Period of record
Active gages							
5539900	West Branch Du Page River near West Chicago	Des Plaines	USGS	41	28.5	F	1961-2003
5540160	East Branch Du Page River near Downers Grove, IL	Des Plaines	USGS	12	26.6	F	1990-2003
5537500	Long Run near Lemont	Des Plaines	USGS	51	20.9	F	1951-2003
5528500	Buffalo Creek near Wheeling	Des Plaines	USGS	50	19.6	F	1952-2003
5540060	Kress Creek at West Chicago	Des Plaines	USGS	16	18.1	F	1986-2003
5532000	Addison Creek at Bellwood	Des Plaines	USGS	51	17.9	F	1951-2003
5533000	Flag Creek near Willow Springs	Des Plaines	USGS	51	16.5	F	1951-2003
5530000	Weller Creek at Des Plaines	Des Plaines	USGS	51	13.2	F	1951-2003
5533400	Sawmill Creek near Lemont	Des Plaines	USGS	16	13	F	1986-2003
5540195	St. Joseph Creek at Route 34 at Lisle, IL	Des Plaines	USGS	13	11.1	F	1989-2003
5540275	Spring Brook at 87th Street near Naperville, IL	Des Plaines	USGS	14	9.9	F	1988-2003
5529500	McDonald Creek near Mount Prospect	Des Plaines	USGS	50	7.93	F	1952-2003
5540091	Spring Brook at Forest Preserve near Warrenville, IL	Des Plaines	USGS	10	6.83	F	1992-2003
5552500	Fox River at Dayton	Fox	USGS	87	2642.24	F	1915-2003
5551540	Fox River at Montgomery	Fox	USGS	0	1732	F	2003
5550000	Fox River at Algonquin	Fox	USGS	86	1403	F	1916-2003
5548280	Nippersink Creek near Spring Grove	Fox	USGS	35	192	F	1967-2003
5551700	Blackberry Creek near Yorkville	Fox	USGS	41	70.2	F	1961-2003
5551675	Blackberry Creek near Montgomery, IL	Fox	USGS	4	55	F	1998-2003
5551200	Ferson Creek near St. Charles	Fox	USGS	41	51.7	F	1961-2003
5550300	Tyler Creek at Elgin, IL	Fox	USGS	4	38.9	F	1998-2003
5550500	Poplar Creek at Elgin	Fox	USGS	51	35.2	F	1951-2003
5551330	Mill Creek near Batavia	Fox	USGS	4	27.6	F	1998-2003
5547755	Squaw Creek at Round Lake, IL	Fox	USGS	12	17.2	F	1990-2003
5550130	Brewster Creek at Valley View	Fox	USGS	0	14	F	2003
5587060	Illinois River at Hardin	Illinois	USGS	0	28690	F	2003
5586100	Illinois River at Valley City	Illinois	USGS	63	26744	F	1939-2003

Table 11. (continued)

Station ID	*Station name*	*Major river basin (sub-basin)*	*Primary monitoring agency*	*Years of record*	*Drainage area (sq. miles)*	*Records (F)ull (P)artial*	*Period of record*
Active gages							
5568500	Illinois River at Kingston Mines	Illinois	USGS	62	15818	F	1940-2003
5558300	Illinois River at Henry	Illinois	USGS	21	13543	F	1981-2003
5543500	Illinois River at Marseilles	Illinois	USGS	82	8259	F	1920-2003
5542000	Mazon River near Coal City	Illinois	USGS	30	455	F	1940-1966,1999-2003
5585830	McKee Creek at Chambersburg	Illinois	USGS	0	341	F	2003
5556500	Big Bureau Creek at Princeton	Illinois	USGS	66	196	F	1936-2003
5560500	Farm Creek at Farmdale	Illinois	USGS	53	27.4	P	1949-2003
5561500	Fondulac Creek near East Peoria	Illinois	USGS	54	5.54	P	1948-2003
5526000	Iroquois River near Chebanse	Iroquois	USGS	79	2091	F	1923-2003
5525000	Iroquois River at Iroquois	Iroquois	USGS	57	686	F	1945-2003
5525500	Sugar Creek at Milford	Iroquois	USGS	54	446	F	1948-2003
5527500	Kankakee River near Wilmington	Kankakee	USGS	86	5150	F	1915-1933,1935-2003
5520500	Kankakee River at Momence	Kankakee	USGS	89	2294	F	1905-1906,1915-2003
5585000	La Moine River at Ripley	La Moine	USGS	81	1293	F	1921-2003
5584500	La Moine River at Colmar	La Moine	USGS	57	655	F	1945-2003
5568000	Mackinaw River near Green Valley	Mackinaw	USGS	50	1073	F	1921-1956,1988-2003
5567500	Mackinaw River near Congerville	Mackinaw	USGS	57	767	F	1945-2003
5587000	Macoupin Creek near Kane	Macoupin	USGS	74	868	F	1921-1933,1941-2003
5583000	Sangamon River near Oakford	Sangamon	USGS	75	5093	F	1910-1911,1915-1919, 1922,1929-1933, 1940-2003
5576500	Sangamon River at Riverton	Sangamon	USGS	62	2618	F	1909-1912,1915-1956,1986-2003
5582000	Salt Creek near Greenview	Sangamon	USGS	60	1804	F	1942-2003
5573540	Sangamon River at Rt. 48 at Decatur	Sangamon	USGS	19	938	F	1983-2003
5576000	South Fork Sangamon River near Rochester	Sangamon	USGS	53	867	F	1949-2003
5572000	Sangamon River at Monticello	Sangamon	USGS	93	550	F	1908-1912,1914-2003
105*	Sangamon River near Mahomet (Shiverly Bridge)	Sangamon	ISWS	11	368	P	1993-2003
5578500	Salt Creek near Rowell	Sangamon	USGS	59	335	F	1943-2003
5570910	Sangamon River at Fisher	Sangamon	USGS	23	240	F	1979-2003

Table 11. (continued)

Station ID	Station name	Major river basin (sub-basin)	Primary monitoring agency	Years of record	Drainage area (sq. miles)	Records (F)ull (P)artial	Period of record
Active gages							
5580000	Kickapoo Creek at Waynesville	Sangamon	USGS	54	227	F	1948-2003
5579500	Lake Fork near Cornland	Sangamon	USGS	54	214	F	1948-2003
5572450/102*	Friends Creek at Argenta	Sangamon	ISWS	28	112	F	
5577500	Spring Creek at Springfield	Sangamon	USGS	54	107	F	1948-2003
101*	Long Creek near Decatur (Twin Bridge Road)	Sangamon	ISWS	11	46	P	1993-2003
5580950	Sugar Creek near Bloomington	Sangamon	USGS	27	34.4	F	1975-2003
201*	Panther Creek at Site M	Sangamon	ISWS	5	15	F	1999-2003
202*	Cox Creek near Newmansville (CR 2830N)	Sangamon	ISWS	5	9	F	1999-2003
5570000	Spoon River at Seville	Spoon	USGS	88	1635.8	F	1914-2003
5569500	Spoon River at London Mills	Spoon	USGS	59	1072	F	1943-2003
5568800	Indian Creek near Wyoming	Spoon	USGS	42	62.7	F	1960-2003
303*	Haw Creek near Maquon (CR 550N)	Spoon	ISWS	5	55	F	1999-2003
301*	Court Creek near Appleton (CR 1500E)	Spoon	ISWS	5	44	F	1999-2003
302*	North Creek near Oak Run (CR 1700N)	Spoon	ISWS	5	26	F	1999-2003
5555300	Vermilion River near Leonore	Vermilion	USGS	31	1251	F	1931-1931,1972-2003
5554500	Vermilion River at Pontiac	Vermilion	USGS	59	579	F	1943-2003
Inactive Gages							
5536325	Little Calumet River at Harvey	Chicago/Calumet	USGS	17	252	F	1917-1933
5536210	Thorn Creek near Chicago Heights	Chicago/Calumet	USGS	17	17.2	F	1964-1980
5536270	North Creek near Lansing	Chicago/Calumet	USGS	32	16.8	F	1948-1979
5539660	Des Plaines River Ab Kankakee R. nr Channahon, IL	Des Plaines	USGS	1	2093	F	1903-1903
5538000	Des Plaines River at Joliet	Des Plaines	USGS	18	1503	F	1915-1932
5533500	Des Plaines River at Lemont	Des Plaines	USGS	30	684	F	1915-1944
5528230	Indian Creek at Prairie View, IL	Des Plaines	USGS	7	36	F	1990-1996
5531000	Salt Creek near Arlington Heights	Des Plaines	USGS	23	32.1	F	1950-1971,1973-1973
5530500	Willow Creek near Park Ridge	Des Plaines	USGS	8	19.7	F	1951-1958
5538500	Spring Creek at Joliet	Des Plaines	USGS	10	19.6	F	1925-1934

Table 11. (continued)

Station ID	Station name	Major river basin (sub-basin)	Primary monitoring agency	Years of record	Drainage area (sq. miles)	Records (F)ull (P)artial	Period of record
Inactive gages							
5540200	St. Joseph Creek at Lisle	Des Plaines	USGS	4	11.8	F	1986-1989
5528030	Bull Creek near Libertyville, IL	Des Plaines	USGS	7	6.3	F	1990-1996
5551000	Fox River at South Elgin	Fox	USGS	9	1556	F	1990-1998
5548500	Fox River at Johnsburg	Fox	USGS	2	1205	F	1998-1999
5547350	Grass Lake Outlet at Lotus Woods, IL	Fox	USGS	2	919	F	1998-1999
5548110	Nippersink Creek below Wonder Lake	Fox	USGS	4	97.3	F	1994-1997
5548105	Nippersink Creek above Wonder Lake	Fox	USGS	7	84.5	F	1994-1997,1999-2001
5549850	Flint Creek near Fox River Grove, IL	Fox	USGS	7	37	F	1990-1996
5549000	Boone Creek near McHenry	Fox	USGS	36	15.5	F	1948-1983
5584000	Illinois River at Beardstown	Illinois	USGS	18	24229	F	1921-1938
5570500	Illinois River at Havana	Illinois	USGS	11	18299	F	1922-1927,1985-1989
5560000	Illinois River at Peoria	Illinois	USGS	32	14165	F	1904-1906,1910-1938
5553500	Illinois River at Ottawa	Illinois	USGS	1	10949	F	1903-1903
5558000	Big Bureau Creek at Bureau	Illinois	USGS	11	485	F	1941-1951
5563500	Kickapoo Creek at Peoria	Illinois	USGS	30	297	F	1942-1971
5563000	Kickapoo Creek near Kickapoo	Illinois	USGS	18	119	F	1945-1962
5559500	Crow Creek near Washburn	Illinois	USGS	28	115	F	1945-1972
5557500	East Bureau Creek near Bureau	Illinois	USGS	31	99	F	1936-1966
5557000	West Bureau Creek at Wyanet	Illinois	USGS	31	86.7	F	1936-1966
5562000	Farm Creek at East Peoria	Illinois	USGS	39	61.2	F	1943-1981
5558500	Crow Creek (West) near Henry	Illinois	USGS	24	56.2	F	1949-1972
5586000	N Fk Mauvaise Terre Creek near Jacksonville	Illinois	USGS	26	29.1	F	1950-1975
5568660	Duck Creek near Liverpool	Illinois	USGS	4	20	F	1972-1975
5561000	Ackerman Creek at Farmdale	Illinois	USGS	27	11.2	F	1954-1980
5559000	Gimlet Creek at Sparland	Illinois	USGS	24	5.66	F	1946-1947,1950-1971
5586500	Hurricane Creek near Roodhouse	Illinois	USGS	26	2.3	F	1950-1975
5527000	Kankakee River at Custer Park	Kankakee	USGS	20	4810	F	1915-1934

Table 11. (continued)

Station ID	Station name	Major river basin (sub-basin)	Primary monitoring agency	Years of record	Drainage area (sq. miles)	Records (F)ull (P)artial	Period of record
Inactive gages							
5526500	Terry Creek near Custer Park	Kankakee	USGS	27	12.1	F	1950-1976
5584685	Grindstone Creek near Birmingham	La Moine	USGS	1	46.5	F	1981-1981
5584680	Grindstone Creek near Industry	La Moine	USGS	1	35.5	F	1981-1981
5584400	Drowning Fork at Bushnell	La Moine	USGS	24	26.3	F	1960-1983
5584683	Grindstone Creek Trib. near Doddsville	La Moine	USGS	3	0.22	F	1980-1982
5584682	Grindstone Creek Trib. NO. 2 near Doddsville	La Moine	USGS	3	0.17	F	1981-1983
5567510	Mackinaw River below Congerville	Mackinaw	USGS	3	776	F	1984-1986
5567000	Panther Creek near El Paso	Mackinaw	USGS	13	93.9	F	1950-1960,1997-1998
5565500	Money Creek at Lake Bloomington	Mackinaw	USGS	2	69.1	F	1957-1958
5564500	Money Creek above Lake Bloomington	Mackinaw	USGS	26	53.1	F	1933-1958
5564400	Money Creek near Towanda	Mackinaw	USGS	26	49	F	1958-1983
5566500	East Branch Panther Creek at El Paso	Mackinaw	USGS	34	30.5	F	1950-1983
5565000	Hickory Creek Above Lake Bloomington, IL	Mackinaw	USGS	20	10.1	F	1939-1958
5566000	East Branch Panther Creek near Gridley	Mackinaw	USGS	11	6.3	F	1950-1960
5586800	Otter Creek near Palmyra	Macoupin	USGS	22	61.1	F	1960-1981
5578000	Sangamon River at Petersburg	Sangamon	USGS	2	3063	F	1948-1949
5573500	Sangamon River at Decatur	Sangamon	USGS	3	925	F	1949-1951
5572500	Sangamon River near Oakley	Sangamon	USGS	16	774	F	1952-1962,1964-1964,1974-1977
5575500	South Fork Sangamon River at Kincaid	Sangamon	USGS	29	562	F	1917-1927
5575000	South Fork Sangamon River near Taylorville	Sangamon	USGS	10	434	F	1908-1917
5579000	Salt Creek near Kenney	Sangamon	USGS	5	390	F	1908-1912
5571000	Sangamon River at Mahomet	Sangamon	USGS	32	362	F	1948-1979
5581500	Sugar Creek near Hartsburg	Sangamon	USGS	28	333	F	1945-1972
5581000	Sugar Creek near Armington	Sangamon	USGS	2	314	F	1948-1949
5580500	Kickapoo Creek near Lincoln	Sangamon	USGS	28	306	F	1945-1972
5574500	Flat Branch near Taylorville	Sangamon	USGS	35	276	F	1949-1983
5575800	Horse Creek at Pawnee	Sangamon	USGS	18	52.2	F	1968-1985

Table 11. (concluded)

Station ID	Station name	Major river basin (sub-basin)	Primary monitoring agency	Years of record	Drainage area (sq. miles)	Records (F)ull (P)artial	Period of record
Inactive gages							
5571500	Goose Creek near De Land	Sangamon	USGS	9	47.9	F	1951-1959
104*	Camp Creek near White Heath	Sangamon	ISWS	10	47	F	1993-2002
103*	Goose Creek near Deland	Sangamon	ISWS	8	45	F	1993-2000
106*	Big Ditch near Fisher	Sangamon	ISWS	11	38	P	1993-2003
5575830	Brush Creek near Divernon	Sangamon	USGS	10	32.4	F	1974-1983
5582500	Crane Creek near Easton	Sangamon	USGS	26	26.5	F	1950-1975
5574000	South Fork Sangamon River near Nokomis	Sangamon	USGS	26	11	F	1951-1976
5570370	Big Creek near Bryant	Spoon	USGS	21	41.2	F	1972-1992
5570350	Big Creek at St. David	Spoon	USGS	15	28	F	1972-1986
5569968	Turkey Creek near Fiatt	Spoon	USGS	3	11.5	F	1978-1980
5570380	Slug Run near Bryant	Spoon	USGS	18	7.12	F	1975-1992
5570360	Evelyn Branch near Bryant	Spoon	USGS	21	5.78	F	1972-1992
5570330	West Branch Big Creek near Canton	Spoon	USGS	3	4.31	F	1978-1980
5555500	Vermilion River at Lowell	Vermilion	USGS	40	1278	F	1932-1971
5555000	Vermilion River at Streator	Vermilion	USGS	17	1084	F	1914-1920,1922-1931
5554000	N Fork Vermilion River near Charlotte	Vermilion	USGS	20	186	F	1943-1962

Table 12. Suspended sediment monitoring sites in the Illinois River Watershed.

Station ID	Station name	Major river basin (sub-basin)	Primary monitoring agency	Years of record	Currently monitoring Sediment (Y)es, (N)o	Currently monitoring Discharge (Y)es, (N)o	Drainage area (sq. mi)	Combined Periods (USGS, USACOE & ISWS) of sediments sampling
Active Suspended Sediment Monitoring Sites within the Illinois River Watershed								
5532500	Des Plaines River at Riverside	Des Plaines	USGS	4	Y	Y	630	1979-82,2003
5552500	Fox River at Dayton	Fox	USGS	1	Y	Y	2642	1981,2003
5586100	Illinois River at Valley City	Illinois	USGS	22	Y	Y	26743	1980-2003
5559600	Illinois River at Chillicothe	Illinois	USGS	9	Y	Y	13543	1993-2003
5543500	Illinois River at Marseilles	Illinois	USGS	1	Y	Y	8259	2003
5542000	Mazon River near Coal City	Illinois	ISWS	21	Y	Y	455	1981-2003
5527500	Kankakee River near Wilmington	Kankakee	ISWS	27	Y	Y	5150	1979-2003
5520500	Kankakee River at Momence	Kankakee	ISWS	23	Y	Y	2294	1979-85, 88-90, 93-2003
5585000	LaMoine River at Ripley	La Moine	ISWS	21	Y	Y	1293	1981, 83-90, 93-2003
5584500	LaMoine River at Colmar	La Moine	ISWS	17	Y	Y	655	1981-88, 93-2003
5567500	Mackinaw River near Congerville	Mackinaw	USACOE	1	Y	Y	767	1983, 97-2003
5583000	Sangamon River near Oakford	Sangamon	USACOE	8	Y	Y	5093	1981, 83-86, 95-97
5572000	Sangamon River at Monticello	Sangamon	ISWS	21	Y	Y	550	1981-2003
201*	Panther Creek at Site M	Sangamon	ISWS	3	Y	Y	15	1999-2003
202*	Cox Creek near Newmansville (CR 2830N)	Sangamon	ISWS	3	Y	Y	9	1999-2003
5570000	Spoon River at Seville	Spoon	USGS	4	Y	Y	1636	1981, 95-97,2003
5569500	Spoon River at London Mills	Spoon	ISWS	15	Y	Y	1072	1981-87, 94-2003
303	Haw Creek near Maquon (CR 550N)	Spoon	ISWS	3	Y	Y	55	1999-2003
301*	Court Creek near Appleton (CR 1500E)	Spoon	ISWS	3	Y	Y	44	1999-2003
302*	North Creek near Oak Run (CR 1700N)	Spoon	ISWS	3	Y	Y	26	1999-2003
5555300	Vermilion River near Lenore	Vermilion	ISWS	21	Y	Y	1251	1980-81, 84-2003
Inactive Suspended Sediment Monitoring Sites within the Illinois River Watershed								
5536000	North Branch Chicago River at Niles	Chicago/Calumet	USGS	2	N	Y	100	1985-86
5529000	Des Plaines River near Des Plaines	Des Plaines	ISWS	1	N	Y	360	1981
5539000	Hickory Creek at Joliet	Des Plaines	ISWS	1	N	Y	107	1981

Table 12. (continued)

Station ID	Station name	Major river basin (sub-basin)	Primary monitoring agency	Years of record	Currently monitoring Sediment (Y)es, (N)o	Currently monitoring area (sq. mi)	Drainage area (sq. mi)	Combined periods (USGS, USACOE & ISWS) of sediment sampling
5540500	DuPage River at Shorewood	Des Plaines	ISWS	1	N	Y	324	1981
5551540	Fox River at Montgomery	Fox	ISWS	3	N	N	1732	1981-83
5550000	Fox River at Algonquin	Fox	ISWS	2	N	Y	1403	1981-82
5548500	Fox River at Johnsburg	Fox	USGS	2	N	N	1205	1998-99
5547350	Grass Lake Outlet at Lotus Woods	Fox	USGS	2	N	N	919	1998-1999
5546500	Fox River at Wilmot, WI	Fox	USGS	2	N	N	868	1998-1999
5548280	Nippersink Creek near Spring Grove	Fox	USGS	2	N	Y	192	1998-99
5548110	Nippersink below Wonder Lake	Fox	USGS	4	N	N	97.3	1994-97
5548105	Nippersink above Wonder Lake	Fox	USGS	7	N	N	84.5	1994-97; 1999-2001
5551200	Ferson Creek near St. Charles	Fox	ISWS	2	N	Y	51.7	1981-82
5563800	Illinois River at Pekin	Illinois	USGS	3	N	N	14585	1995-97
5558300	Illinois River at Henry	Illinois	USGS	5	N	Y	13543	1984-1986: 1999
5556500	Big Bureau Creek at Princeton	Illinois	ISWS	10	N	Y	196	1981-90
5526000	Iroquois River near Chebanse	Iroquois	ISWS	9	N	Y	2091	1979-83, 93-96
5525000	Iroquois River at Iroquois	Iroquois	ISWS	8	N	Y	686	1979-82, 93-96
5525500	Sugar Creek at Milford	Iroquois	ISWS	3	N	Y	446	1981-83
5584685	Grindstone Creek near Birmingham	La Moine	USGS	1	N	N	45.4	1981
5584680	Grindstone Creek near Industry	La Moine	USGS	1	N	N	35.5	1981
5568000	Mackinaw River near Green Valley	Mackinaw	ISWS	4	N	Y	1073	1981, 1995-1997
5567510	Mackinaw River below Congerville	Mackinaw	ISWS	6	N	N	776	1981-86
5564400	Money Creek near Towanda	Mackinaw	ISWS	1	N	N	49	1981
5566500	East Branch Panther Creek at El Paso	Mackinaw	ISWS	2	N	N	30.5	1981-82
5587000	Macoupin Creek near Kane	Macoupin	ISWS	1	N	Y	868	1981
5576500	Sangamon River at Riverton	Sangamon	ISWS	3	N	Y	2618	1981-83
5582000	Salt Creek near Greenview	Sangamon	ISWS	3	N	Y	1804	1981-83
5576022	South Fork Sangamon River below Rochester	Sangamon	ISWS	2	N	Y	870	1981-82

Table 12. (concluded)

Station ID	Station name	Major river basin (sub-basin)	Primary monitoring agency	Years of record	Currently monitoring Sediment (Y)es, (N)o	Sediment (Y)es, (N)o	Drainage area (sq. mi)	Combined periods (USGS, USACOE & ISWS) of sediment sampling
5578500	Salt Creek near Rowell	Sangamon	ISWS	3	N	Y	335	1981-83
104*	Camp Creek near White Heath	Sangamon	ISWS	3	N	N	47.2	1999-2002
106*	Big Ditch near Fisher	Sangamon	ISWS	3	Y	Y	38.2	2000-2003
5568800	Indian Creek near Wyoming	Spoon	USGS	1	N	Y	62.7	1981
5570370	Big Creek near Bryant	Spoon	USGS	15	N	N	41.2	1972-86
5570350	Big Creek at St. David	Spoon	USGS	9	N	N	28	1972-80
5570380	Slug Run near Bryant	Spoon	USGS	5	N	N	7.1	1976-80
5554490	Vermilion River at McDowell	Vermilion	ISWS	2	N	N	551	1981-82

Table 13. Summary of active suspended sediment and discharge monitoring sites by major river basins.

Major sub-basins	***Sediment sites***	***Stream-gages***	***Major physiographic region(s) of the sub-basin***
Chicago/Calumet	0	14	Chicago Lake Plain
Des Plaines	1	26	Wheaton Morainal Country
Fox	1	12	Bloomington Ridged Plain & Wheaton Morainal Country
Illinois	4	10	Bloomington Ridged Plain, Galesburg Plain, & Springfield Plain
Iroquois	0	3	Kankakee Plain
Kankakee	2	2	Kankakee Plain
La Moine	2	2	Galesburg Plain
Mackinaw	1	2	Bloomington Ridged Plain
Macoupin	0	1	Springfield Plain
Sangamon	4	17	Bloomington Ridged Plain & Springfield Plain
Spoon	5	6	Galesburg Plain
Vermillion	1	2	Bloomington Ridged Plain
Total	21	97	

Table 14. Summary of site-scale habitat variables. Each site is approximately 35 times mean stream width to sample at least one riffle-run-pool sequence (Lyons 1992; IDNR 2001).

Variable	Sample Frequency	Method
1) Drainage area (km^2)	1 time only	1:24,000 topographic maps; GIS
2) Stream order	1 time only	1:24,000 topographic maps
3) Site length (m)	annual	Site length = 35 times mean stream width
4) Water temperature (ºC), Dissolved Oxygen, pH, conductivity, turbidity	Critical: annually during biotic sampling Desirable: continuous	Hand held meters for temperature & DO, pH, conductivity, and turbidity (INHS) YSI Hydrolabs (INHS/ISWS)
5) Nutrients and sediment	Critical: biweekly Desirable: continuous	Water samples taken manually (ISWS) Gaging Stations (ISWS)
6) Discharge (m^3/s)	Critical: annual Desirable: continuous	Ten-transect method (INHS) Gaging Stations (ISWS)
7) Periphyton (m2)	Critical: annual Desirable: seasonal	Artificial substrates for algae colonization; chlorophyll a content of sampled substrates

Table 15. Summary of transect-scale habitat variables. Variables must be sampled once/year using the ten transect method and should be completed when fish and invertebrate sampling is conducted.

Variable	Description
Width of Top of Bank (m)	Horizontal distance along transect, measured perpendicular to stream flow, from top of left to top of right bank. Measured at three transects at a site.
Stream width (m)	Horizontal distance along each of 10 transects, measured perpendicular to stream flow from bank to bank at existing water surface
Depth (mm)	Vertical distance from water surface to stream bottom, measured at 6 equally spaced points along each of 10 transects
Velocity (m/s)	Measurement of stream velocity at 6 points along each of 10 transects using a flow meter
Bottom substrate type (mm)	Composition of stream bed measured at each point (point particle) and in a 30 cm circle around each point (maximum particle) where stream depth & velocity is measured; particle diameters in each category are: Clay: 0.004 mm Silt: 0.004 – 0.062 mm Sand: >0.062 – 2 mm Gravel: >2 – 64 mm Cobble: >64 – 256 mm Small boulder: >256 – 512 mm Large boulder: >512 mm
Cover (%)	Object(s) that are 10 cm wide along median axis and blocks greater than 75% of sunlight; the largest object which is partially or wholly within a 30 cm circle around each point along the transect are measured. Cover types: wood, flat rock, round rock, bank, other
Shading (%)	Proportion of densiometer grid squares covered at the center of each transect to indicate amount of canopy cover over the stream.
Bank vegetation cover (%)	Proportion of bank which is covered with live vegetation; based on number of 5 X 6.25cm grids out of 16 grids that contain live vegetation.
Undercut bank (mm)	Distance at each side of transect between maximum extent that streamside overhangs channel to furthest point under the bank, to nearest 5 millimeters.
Bank height (m)	Height from bottom to top of bank; measured using a rangefinder and an Abney level at 3 transects
Riparian land use (left and right bank)	Composition of riparian zone at distances of 1.5-10 m, 10-30 m, and 30-100 m along each transect: largest land use category is recorded and is estimated visually; categories are: Cultivated, Herbaceous, Woody, Mature Trees, Tree roots.

Table 16. List of agencies and projects collecting physical habitat and biotic information in sub-basins and tributaries of the Illinois River basin. Ceratin agencies collect data once every five or ten years (i.e., five to ten year rotation).

Agency	Project	Data Collected	Frequency
Illinois Environmental Protection Agency	Basin Surveys (Quantitative and Qualitative data)	water quality, habitat and invertebrates	1981-1995; 10 yr rotation 1995-present; 5yr. rotation
Illinois Department of Natural Resources	Basin Surveys (Quantitative and semi-quantitative data)	fish community mussels (recently added)	1952 – present; 1981-1995 10 yr. rotation; 1995-present 5 yr. rotation
	Jim Edger - Panther Creek Fish & Wildlife (Quantitative data)	habitat and fish	1995-1998, 2001, 2003 habitat, fish - each year
	Ecowatch - Riverwatch (Qualitative data)	habitat; invertebrates	1995-present; annually
	Harvest Surveys (Quantitative data for indices)	harvest by species; sightings of other species by hunters	long term data, varies depending on species; annually
	Riparian Mammal Survey	riparian mammals, habitat	annually
	Upland Wildlife Survey	upland wildlife	annually
Illinois Natural History Survey	Pilot Watershed Program Spoon River – Court and Haw Creeks (Quantitative data)	habitat; invertebrates; fish water quality (ISWS gauging)	1998 - present habitat, fish - annually invertebrates - seasonal
	Evaluation of Dam Removal on Fox River (Quantitative and qualitative data)	water quality; habitat; invertebrates; mussels; fish	2002 – present water quality – biweekly in summer habitat, fish – annually fish movement - seasonal invertebrates - summer & fall

Table 16. (Continued)

	Critical Trends Assessment Program (CTAP)	habitat; birds; invertebrates	1997-present; 5 yr rotation
Nature Conservancy (in cooperation with IDNR and INHS)	Mackinaw River Restoration (Quantitative and semi-quantitative data)	invertebrates; mussels; fish	1998-2000; 2002-2003 mussels - annually 1999-2003 fish - annually invertebrates - seasonal
U.S. Geological Survey	Breeding Bird Survey	birds	1966-present; annually
National Audubon Society	Christmas Bird Count	birds	1900-present; annually
U.S. Fish and Wildlife Service	Mourning Dove Call-count Survey	mourning doves	1966-present; annually

Table 17. Inventory of available data sets and agencies involved in watershed related research.

Database Parameter and Title for the IL River Basin	Resolution	Format	Access	Original Source or Current Accessible Location
Land Cover:				
Land Cover - Early European Settlement (1804 - 1843)		digital	open	*INHS data - will be available from open source*
Land Use and Land Cover 1970s & 1980s (LULC)	1:100,000	hdcpy/digital	open	http://edcwww.cr.usgs.gov/products/landcover/lulc.html
Illinois Land Cover Data Set - 1992	30 M		open	http://edcsgs9.cr.usgs.gov/pub/data/landcover/states/
Land Cover of Illinois 1991 - 1995		digital	open	http://www.agr.state.il.us/gis/landcover91-95.html
Land Cover of Illinois 1999-2000		digital	open	http://www.agr.state.il.us/gis/landcov99-00.html
NASS Cropland Data Layer		digital		http://www.nass.usda.gov/research/Cropland/
Illinois Common Land Units (CLU) 2004		digital	restricted	*under construction*
Bank-side Land Cover		dig/photo	open	*ISIS Project Data - will be available from open source*
Pre-settlement Vegetation				*INHS data - will be available from open source*
Photography:				
Illinois Historical Aerial Photography 1036 -1941	1:20,000	hdcpy/digital	open	http://www.isgs.uiuc.edu/nsdihome/webdocs/ilhap
Digital Ortho-Quarter Quads 1998 - 1999	1:12,000	digital	open	http://www.isgs.uiuc.edu/nsdihome/webdocs/doqs/
Large Scale Photos from Local Governments	1:100-400	hdcpy/digital	restricted	*census bureau is gathering this data*
Des Plaines River Watershed High Resolution Orthophotography	1 x 1 ft	digital	open	http://www.isgs.uiuc.edu/nsdihome/webdocs/desplaines/
Color Infrared Aerial Photos				USGS
B&W 1973 IL River Bank Photos		9in photos		IL State Water Survey - bogner@sparc.sws.uiuc.ed
B&W 1938 - 1973 County Photos		9in photos		Water Resources - vrichardson@dnrmail.state.il.us
NAPP Panchromatic Photographs	1:40,000	hdcpy	open	ISGS Library, U of I Map &Geography Library
NAPP and other aerial photos from 1940's	1:20-40,000	hdcpy	open	http://mapping.usgs.gov/digitalbackyard/
Visualizations/Video:				
Illinois River Videos -Sediment handling and Use.		digital	open	http://www.wmrc.uiuc.edu/special_projects/il_river/videos.cfm
3-D animation IL River Basin - Emiquon Series		digital	open	http://ilrdss.sws.uiuc.edu/maps/gis_anim.asp
3-D animation IL River Basin - Lower Peoria Lake		digital	open	http://ilrdss.sws.uiuc.edu/maps/gis_anim.asp
3-D animation IL River Basin - IL River Basin Series		digital	open	http://ilrdss.sws.uiuc.edu/maps/gis_anim.asp
3-D animation IL River Basin - Kankakee River Series		digital	open	http://ilrdss.sws.uiuc.edu/maps/gis_anim.asp
Raster Graphics:				
Digital Raster Graphics - USGS 7.5 Minute Quadrangles		digital	open	http://www.isgs.uiuc.edu/nsdihome/webdocs/drgs/
Land Ownership by Plat Map		hdcpy/digital	restricted	*can be purchased from NRCS and vendors*
Related to Digital Elevations:				
Digital Elevation Model - 30M	30 meter	digital	open	*ISGS derivative data - not available on-line as yet*
Digital Elevation Model - 60 M	60 meter	digital	open	*ISGS derivative data - not available on-line as yet*
Digital Elevation Model - 90 M	90 meter	digital	open	*ISGS derivative data - not available on-line as yet*
Color Shaded Relief of the Illinois River Basin	30 meter	hdcpy/digital	open	*ISGS derivative data - not available on-line as yet*
Terrain Slope Map of the Illinois River Basin	30 meter	digital	limited	*ISGS derivative data - not available on-line as yet*

Local Relief from 30 Meter DEM of the Illinois River Basin	30 meter	digital	limited	*ISGS derivative data - not available on-line as yet*
Terrain Aspect from 30 Meter DEM of the Illinois River Basin	30 meter	digital	limited	*ISGS derivative data - not available on-line as yet*
Landslide Inventory	1:500,000	hdcpy/digital	open	http://www.isgs.uiuc.edu/nsdihome/webdocs/st-geolq.html
Elevation Changes Along Streams	NA	digital	NA	*under construction*
Streams in Bedrock	NA	digital	NA	*under construction*
Surface and Groundwater Related Data Sets:				
Hydrologic Model of Illinois River Basin		digital	NA	*under construction*
Hydrographic Model of IL River Basin (Stream Order)		digital	NA	*under construction*
Gauging Station Locations		hdcpy/digital	open	*will be extracted from available data*
One-hundred and Five-hundred Year Floodzones		hdcpy/digital	limited	*will be extracted from available data*
Wetlands in the Illinois River Basin		digital	open	http://www.nwi.fws.gov/
Drainage and Levee Districts		digital	open	*will be extracted from available data*
Channelized River Segments		digital	open	*will be extracted from available data*
Reservoirs in IL River Basin		digital	open	*will be extracted from available data*
Levees		digital	open	*will be extracted from available data*
Locks, Dams, and Bridges in the Illinois River Basin		digital	open	*will be extracted from available data*
Field Drainage Tiling Data		hdcpy/digital	limited	*under construction*
Sub-watershed USGS Hydrologic Unit Code - 8		digital	open	http://www.isgs.uiuc.edu/nsdihome/webdocs/st-hydro.html
Sub-watershed USGS Hydrologic Unit Code - 10		digital	open	http://www.isgs.uiuc.edu/nsdihome/webdocs/st-hydro.html
Sub-watershed USGS Hydrologic Unit Code - 12		digital	open	http://www.isgs.uiuc.edu/nsdihome/webdocs/st-hydro.html
Hydrography - 1:100,000 in IL River Basin		digital	open	*will be extracted from available data*
Hydrography - 1:24,000 or better (DLG) in the IL River Basin		digital	open	*will be extracted from available data*
Tributaries of the Illinois River		digital	open	*will be extracted from available data*
Tributaries of the Major Rivers in the IL River Basin		digital	open	*will be extracted from available data*
IL River Pools		digital	open	*will be extracted from available data*
IL River Mileage with Pools		digital	open	*will be extracted from available data*
Surface Impoundments		hdcpy/digital	restricted	*will be extracted from available data*
USEPA Historical Water Quality Data (STORET)		hdcpy/digital	open	http://oaspub.epa.gov/storpubl/warehousemenu
USGS Watershed Contamination from Agri-chemicals		hdcpy/digital	restricted	http://toxics.usgs.gov
USGS Groundwater Data		hdcpy/digital	open	http://tocics.usgs.gov
USGS Surfacewater Data		hdcpy/digital	open	http://www.water.usgs.gov/nsip
IEPA 305(b) Assessed Lakes (Last updated: Mar 5, 2003)		hdcpy/digital	open	http://www.maps.epa.state.il.us/website/wqinfo/layers/
IEPA 305(b) Assessed Streams (Last updated: May 20, 2002)		hdcpy/digital	open	http://www.maps.epa.state.il.us/website/wqinfo/layers/
IEPA 305(b) Stream Monitoring Sites (Last updated: Sept 24, 2001)		hdcpy/digital	open	http://www.maps.epa.state.il.us/website/wqinfo/layers/
IEPA 305(b) Watersheds (Last updated: Apr 16, 2001		hdcpy/digital	open	http://www.maps.epa.state.il.us/website/wqinfo/layers/
IEPA 305(b) Monitored Basins (Last updated: Sept 25, 2001)		hdcpy/digital	open	http://www.maps.epa.state.il.us/website/wqinfo/layers/
IEPA 303(d) Streams (Last updated: Sept 11, 2002		hdcpy/digital	open	http://www.maps.epa.state.il.us/website/wqinfo/layers/

IEPA 303(d) Lakes (Last updated: Mar 5, 2003)		hdcpy/digital	open	http://www.maps.epa.state.il.us/website/wqinfo/layers/
Public Waterwells and Surface Water Intakes		hdcpy/digital	restricted	IEPA, ISWS, ISGS
ISGS Wells Database		hdcpy/digital	open	http://www.isgs.uiuc.edu/nsdihome/webdocs/st-hydro.html
Bedrock Aquifers in the IL River Basin		hdcpy/digital	open	http://www.isgs.uiuc.edu/nsdihome/webdocs/st-hydro.html
Coarse-grained Materials within 50ft of Ground Surface		hdcpy/digital	open	http://www.isgs.uiuc.edu/nsdihome/webdocs/st-hydro.html
Sources of Potential Water Flow Impairments		photo	limited	under construction
Nitrate Leaching Classes of Soils		digital	open	http://www.isgs.uiuc.edu/nsdihome/webdocs/st-hydro.html
Aquifer Sensitivity to Contamination by Nitrate Leaching		digital	open	http://www.isgs.uiuc.edu/nsdihome/webdocs/st-hydro.html
Pesticide Leaching Classes of Soils		digital	open	http://www.isgs.uiuc.edu/nsdihome/webdocs/st-hydro.html
Aquifer Sensitivity to Contamination by Pesticide Leaching		digital	open	http://www.isgs.uiuc.edu/nsdihome/webdocs/st-hydro.html
Related to Biologic Resources:				
IL Biological Stream Characterization		digital	open	*INHS data - when extracted from available data*
IL Natural Areas Inventory		digital	restricted	INHS
Threatened and Endangered Species		digital	restricted	IDNR, INHS, US Fish and Wildlife Service
USGS Bird Survey Data		hdcpy/digital		http://www.mbr-pwrc.usgs.gov/bbs/bbs.html
IDNR Bird Survey Data		hdcpy/digital		http://www.inhs.uiuc.edu/chf/pub/ifwis/birds/
IL Autobahn Bird Survey Data		hdcpy/digital		Illinois Autobahn
Inventory of Research Rich Areas		digital		INHS
IL Gap Analysis Project Data		digital		INHS
Distribution of Amphibians and Reptiles in the IL River Basin		hdcpy/digital		INHS
Related to Geologic Resources:				
Quaternary Deposits of Illinois, 1996		hdcpy/digital		http://www.isgs.uiuc.edu/nsdihome/webdocs/st-geolq.html
Quaternary Deposits of Illinois, 1979		digital		http://www.isgs.uiuc.edu/nsdihome/webdocs/st-geolq.html
Surficial Geology 1:24,000		hdcpy/digital		ISGS
Surficial Geology 1:63,360		hdcpy/digital		ISGS
Drift Thickness		digital		http://www.isgs.uiuc.edu/nsdihome/webdocs/st-geolq.html
Glacial Boundaries		digital		http://www.isgs.uiuc.edu/nsdihome/webdocs/st-geolq.html
Bedrock Geology Map of Illinois		hdcpy/digital		*ISGS under construction*
Bedrock Surface Topography of Illinois		hdcpy/digital		http://www.isgs.uiuc.edu/nsdihome/webdocs/st-geolb.html
Bedrock Outcrop (near where streams lay in bedrock)		hdcpy/digital		*ISGS under construction*
Earthquake Potential		hdcpy/digital		http://www.isgs.uiuc.edu/nsdihome/webdocs/st-geolb.html
Bedrock Valleys in the IL River Basin		hdcpy/digital		http://www.isgs.uiuc.edu/nsdihome/webdocs/st-geolb.html
Soils:				
STATSGO Soil Database			open	http://www.il.nrcs.usda.gov/technical/soils/index.html
SSURGO Soil Database			open	http://www.il.nrcs.usda.gov/technical/soils/index.html
Highly Erodible Land (HEL)				http://www.il.nrcs.usda.gov/technical/soils/index.html
Mineral Extraction:				
Gas Storage Fields in the IL River Basin		digital	restricted	ISGS

Surface Coal Mines in the Illinois River Basin		digital	open	http://www.isgs.uiuc.edu/nsdihome/webdocs/st-geolb.html
Coal Reserves in the IL river Basin		digital	open	http://www.isgs.uiuc.edu/nsdihome/webdocs/st-geolb.html
Non-coal Underground Mines in the IL River Basin		digital	open	http://www.isgs.uiuc.edu/nsdihome/webdocs/st-geolb.html
Non-coal Pits and Quarries in the Illinois River Basin		hdcpy/digital	restricted	ISGS
Public Holdings:				
Federal Conservation Areas/Parks/Preserves				http://www.isgs.uiuc.edu/nsdihome/webdocs/st-naths.html
Archeological Resource Potential				IL State Museum - will be extracted from available data
County Conservations Areas/Parks/Preserves				*will be extracted from available data*
State Forest				http://www.isgs.uiuc.edu/nsdihome/webdocs/st-naths.html
State Parks				http://www.isgs.uiuc.edu/nsdihome/webdocs/st-naths.html
State Fish and Wildlife Preserves				http://www.isgs.uiuc.edu/nsdihome/webdocs/st-naths.html
State Conservation Areas				http://www.isgs.uiuc.edu/nsdihome/webdocs/st-naths.html
Administrative Units:				
State Boundary		digital	open	http://www.isgs.uiuc.edu/nsdihome/webdocs/st-basem.html
County Boundaries		digital	open	http://www.isgs.uiuc.edu/nsdihome/webdocs/st-basem.html
Township Boundaries		digital	open	http://www.isgs.uiuc.edu/nsdihome/webdocs/st-admin.html
Municipal Boundaries		digital	open	http://www.isgs.uiuc.edu/nsdihome/webdocs/st-admin.html
Towns - point location with names		digital	open	*US Census Bureau - will be extracted from available data*
Census Data		digital	open	*US Census Bureau - will be extracted from available data*
US Congressional Districts		digital	open	*US Census Bureau - will be extracted from available data*
IL State Senate Districts		digital	open	http://www.isgs.uiuc.edu/nsdihome/webdocs/st-admin.html
IL State House of Representatives Districts		digital	open	http://www.isgs.uiuc.edu/nsdihome/webdocs/st-admin.html
USGS 7.5 Minute Quadrangle Boundaries (1:24,000)		digital	open	http://www.isgs.uiuc.edu/nsdihome/webdocs/st-basem.html
USGS 30 x 60 Minute Quadrangle Boundaries (1:100,000)		digital	open	http://www.isgs.uiuc.edu/nsdihome/webdocs/st-basem.html
Public Land Survey (PLSS)		digital	open	http://www.isgs.uiuc.edu/nsdihome/webdocs/st-basem.html
C2000 Watershed Partnerships boundaries		digital	open	*will be available from ISGS - extracted from available data*
SWCD jurisdictional boundaries		digital	open	*will be available from ISGS - extracted from available data*
EPA jurisdictional boundaries		digital	open	*will be available from ISGS - extracted from available data*
Industry & Household Related Data Sets:				
Wastewater Treatment Plants		hdcpy/digital	restricted	village, city, county government
Landfills (active and abandoned)		hdcpy/digital	restricted	under construction
Power Plants Along the Illinois River		hdcpy/digital	restricted	USCOE, IEPA, village, city, county government
Commercial Docks Along the Illinois River		hdcpy/digital	restricted	USCOE, IEPA, village, city, county government
Dairy and Animal Confinement Locations		hdcpy/digital	restricted	NRCS, IFS, CSWD, village, city, county govt.
Septic Systems Proximity to Streams		paper	restricted	IFS, CSWD, IEPA, village, city, county govt
Related to Potentially Harmful Materials:				
National Pollutant discharge elimination System (NPDES)		digital	restricted	http://www.epa.state.il.us/fees/npdes.html

Biennial Reporting System (BRS)		digital	restricted	http://www.epa.state.il.us/
CERCLA Information System (CERCLAIS)		digital	restricted	http://www.epa.state.il.us/
Permit Compliance System (PCS)		digital	restricted	http://www.epa.state.il.us/
Toxic Release Inventory System (TRI)		digital	restricted	http://www.epa.state.il.us/
Superfund National Priorities List (NPL)		digital	restricted	http://www.epa.state.il.us/
Climate Related Data:				
Rainfall Intensity - current and historical back to 1895		hdcpy/digital	open	http://www.crh.noaa.gov/fldof.html
Temperature Data - current and historical back to 1895		hdcpy/digital	open	http://www.crh.noaa.gov/fldof.html
Evaporation Data - Pan evaporation (limited)		hdcpy/digital	open	http://www.sws.uiuc.edu/atmos/statecli/index.htm
Modeled Soil Moisture back to 1949			open	http://www.sws.uiuc.edu/atmos/statecli/index.htm
National Atmospheric Deposition Program (NADP)		digital	open	http://www.sws.uiuc.edu/atmos/statecli/General/available.htm
Midwestern Climate Information System (MICIS)		digital	open	http://mrcc.sws.uiuc.edu/html/prodserv.htm#
Related to Agricultural Practices:				
Cropping Practices (NRCS, CSWD, FS)		hdcpy/digital	restricted	
NASS Cropland Data Layer		digital	open	
Illinois Common Land Units (by County) 2004		digital	restricted	Farm Service data - under construction
Erosion/Productivity Impact Calculator (EPIC)			open	
Agricultural Non-Point Source Pollution Model (AGNPS)			open	http://pasture.ecn.purdue.edu/~aggrass/models/agnps/intro.html
Nitrate Leaching and Economic Analysis Package (NLEAP)			open	http://www.wcc.nrcs.usda.gov/nutrient/nutrient-nitrogen.html
Transportation Infrastructure:				
Interstates			open	http://www.isgs.uiuc.edu/nsdihome/webdocs/st-admin.html
Roads and Streets			open	http://www.isgs.uiuc.edu/nsdihome/webdocs/st-admin.html
State Routes			open	http://www.isgs.uiuc.edu/nsdihome/webdocs/st-admin.html
US Routes			open	http://www.isgs.uiuc.edu/nsdihome/webdocs/st-admin.html
Railroads			open	http://www.isgs.uiuc.edu/nsdihome/webdocs/st-admin.html
Oil and Gas Pipelines			restricted	USDOT Office of Pipeline Safety
Natural Boundaries				
Illinois River Basin Boundary in State of Illinois				
Natural Divisions in IL River Basin				
Physiographic Divisions in Il River Basin				http://www.isgs.uiuc.edu/nsdihome/ISGSindex.html
Watershed Assessment Related Programs:				
Illinois Stream Information System (ISIS)				available from IDNR ORC, Springfield, IL
IL River Restoration Needs Assessment GIS (RNA-GIS)				available from USCOE CERL, Champaign, IL
Biological Stream Characterization (BSC)				IDNR INHS
Toxic Substance Hydrology Program				http://toxics.usgs.gov
Environmental Monitoring and Assessment Program				EPA
Agricultural Research Service (ARS)				USDA

Illinois Rivers Decision Support System (ILRDSS)				IDNR
Illinois Streamflow Assessment Model (ILSAM)				http://gismaps.sws.uiuc.edu/ILSAM/
Critical Trends Assessment Program (CTAP)				IDNR
Illinois Conservation Reserve Enhancement Program (CREP)				http://www.fsa.usda.gov/dafp/cepd/crep.htm
Water and Atmospheric Resources Monitoring (WARM)				http://www.sws.uiuc.edu/warm/warmdb/WarmList.asp
Benchmark Sediment Monitoring Program				http://www.sws.uiuc.edu/warm/sediment/
IL River Ecosystem Restoration				http://www.mvr.usace.army.mil/ILRiverEco/default.htm
Agencies Participating in Watershed Related Research:				
National Oceanic and Atmospheric Administration (NOAA)				
Great Lakes Commission (GLC)				
US Department of Agriculture (USDA)				
US National Park Service (NPR)				
Upper Midwest Environmental Sciences Center (UMESC)				
Upper Mississippi River Basin Association (UMRBA)				
US Forest Service (USFS)				
US Fish and Wildlife Service (USFWS)				
US Army Corps of Engineers (USACE)				
US Geological Survey (USGS)				
US Environmental Protection Agency (US EPA)				
IL Department of Natural Resources (IDNR)				
IL State Geological Survey (ISGS)				
IL State Water Survey (ISWS)				
IL Natural History Survey (INHS)				
IL Waste Management and Research Center (WMRC)				
IL Pollution Control Board				
IL Historic Preservation Agency				
IL Department of Agriculture (IDOA)				
IL Environmental Protection Agency (IEPA)				
Association of Illinois Soil and Water Conservation Districts				
IL Farm Service Agency (IFSA)				
IL Natural Resources Conservation Service (INRCS)				
University of Illinois Extension				
IL Department of Transportation (IDOT)				
Il Department of Public Health (IDPH)				
USDA National Agricultural Statistics Service				http://www.usda.gov/nass/

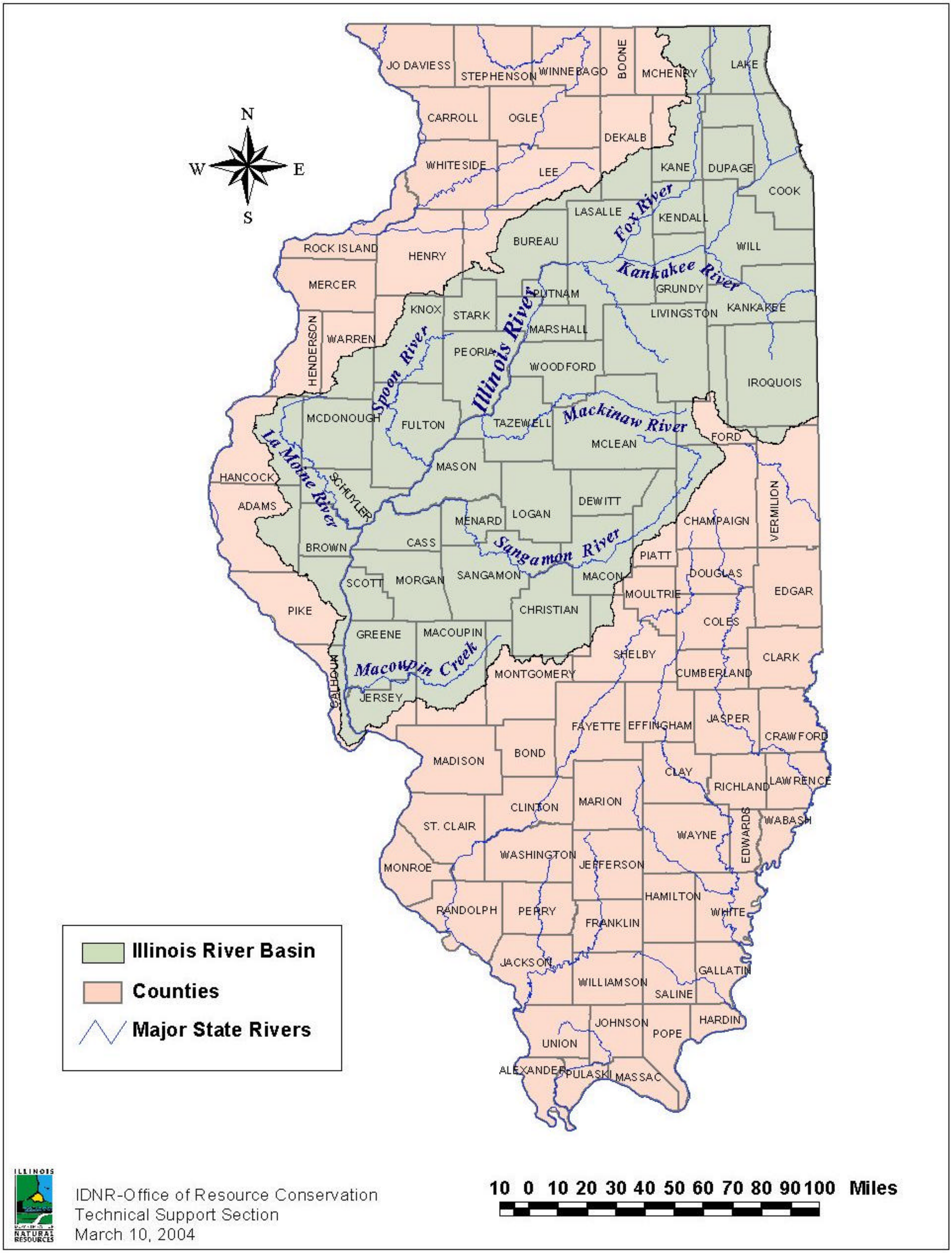


Figure 1. Map of the Illinois River Basin.

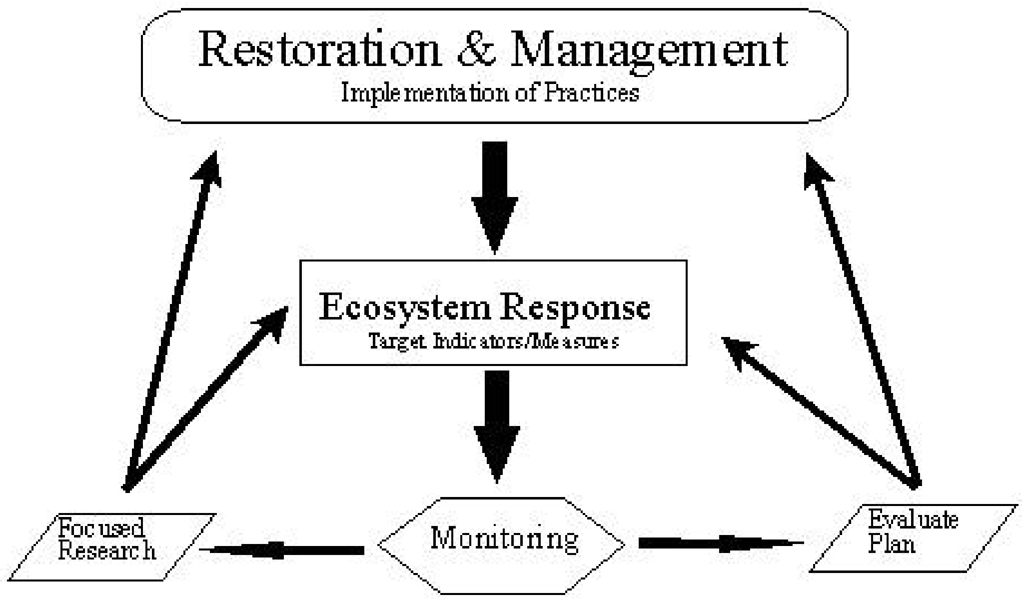


Figure 2. Iterative framework for ecosystem response measures (Modified from Keddy et al. 1993).

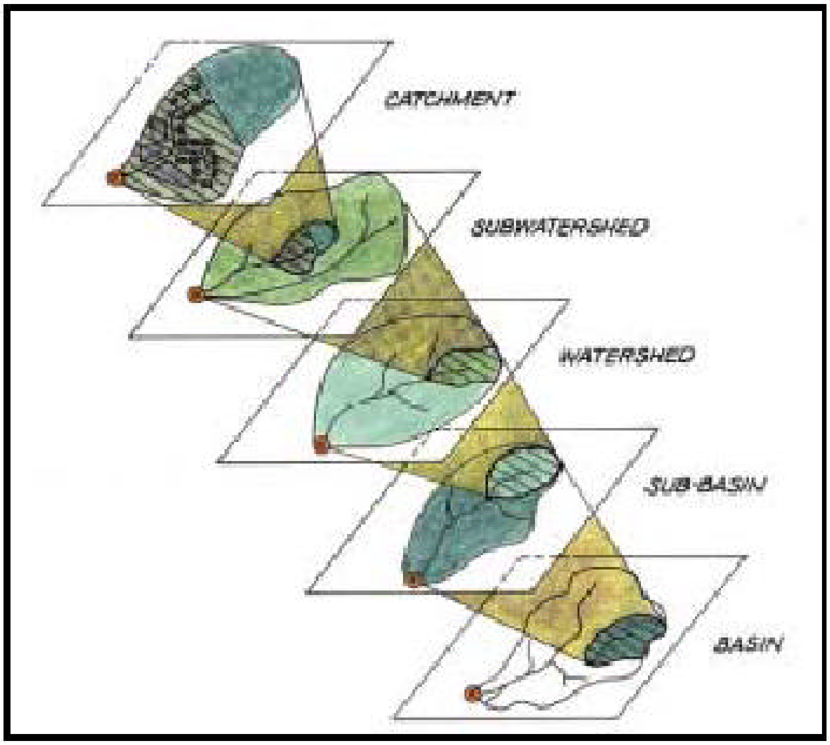


Figure 3. Units for watershed assessment and management. For this proposed monitoring plan, we define sub-basin = HUC 8, watershed = HUC 10, subwatershed = HUC12, and catchment = project. This figure is from the Center for Watershed Protection (1998), Watershed Vulnerability Analysis, www.cwp.org, Ellicott City, MD.

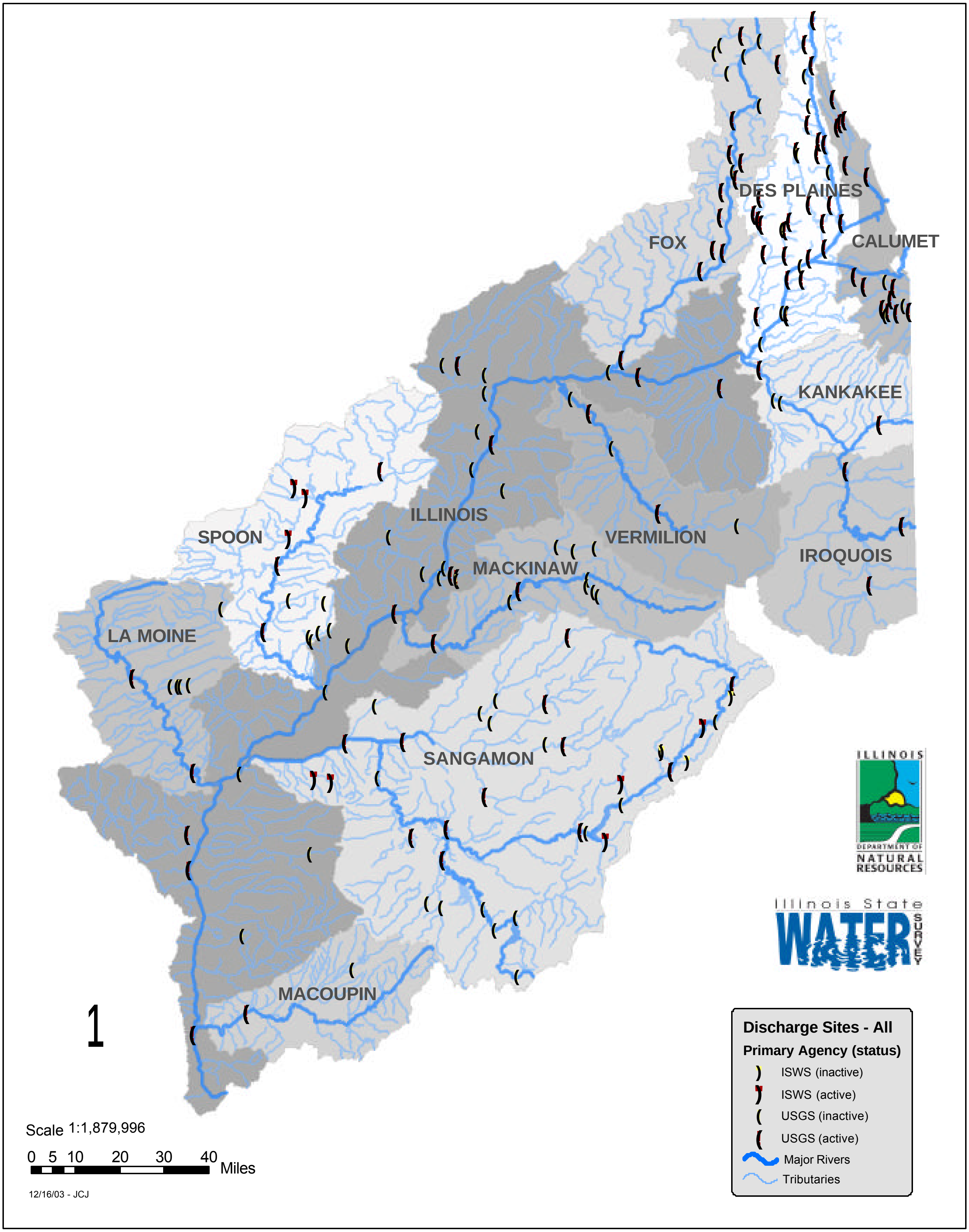


Figure 4. Discharge monitoring sites in the Illinois River watershed.

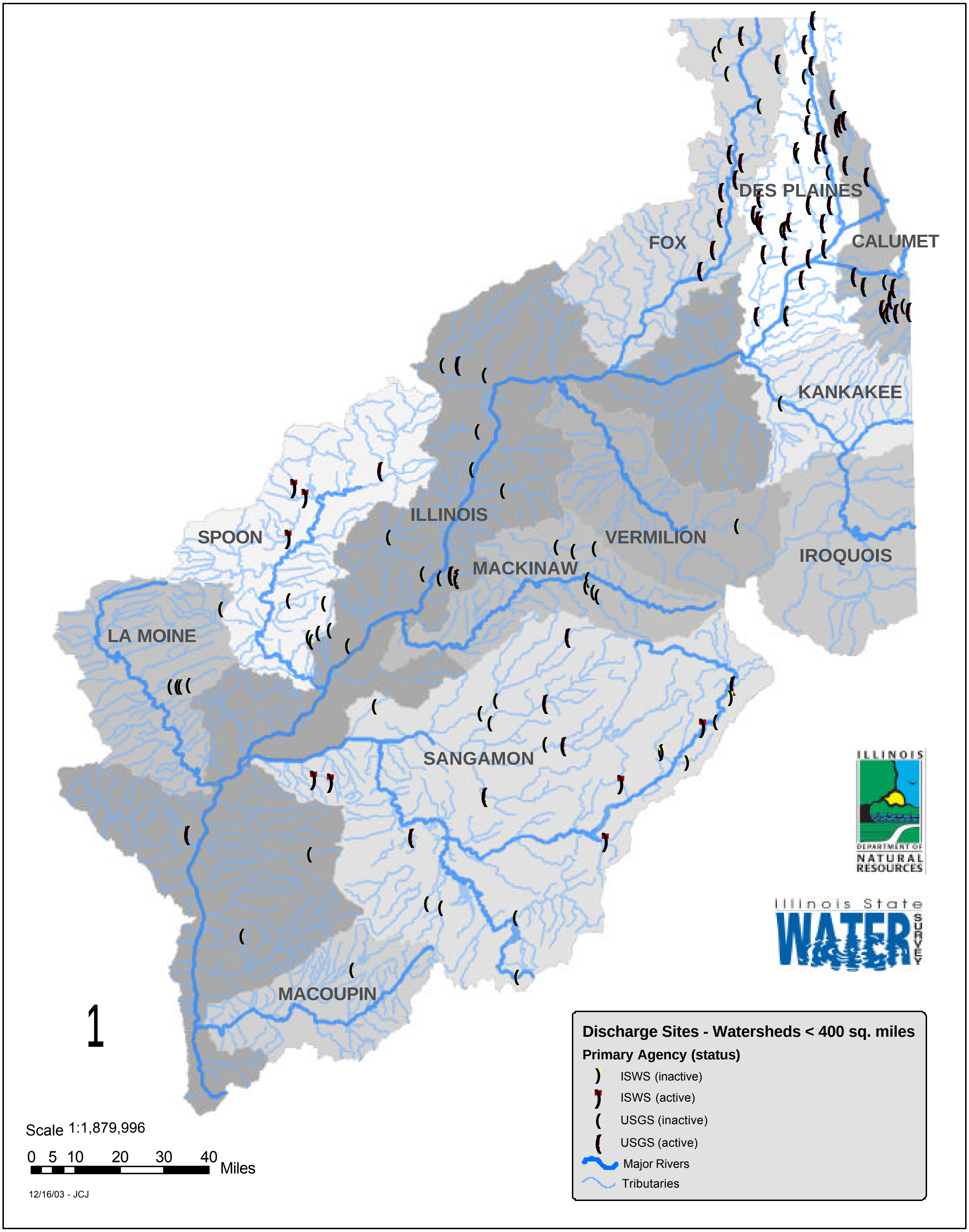


Figure 5. Discharge monitoring sites in Illinois River sub-basins with drainage areas less than 400 square miles.

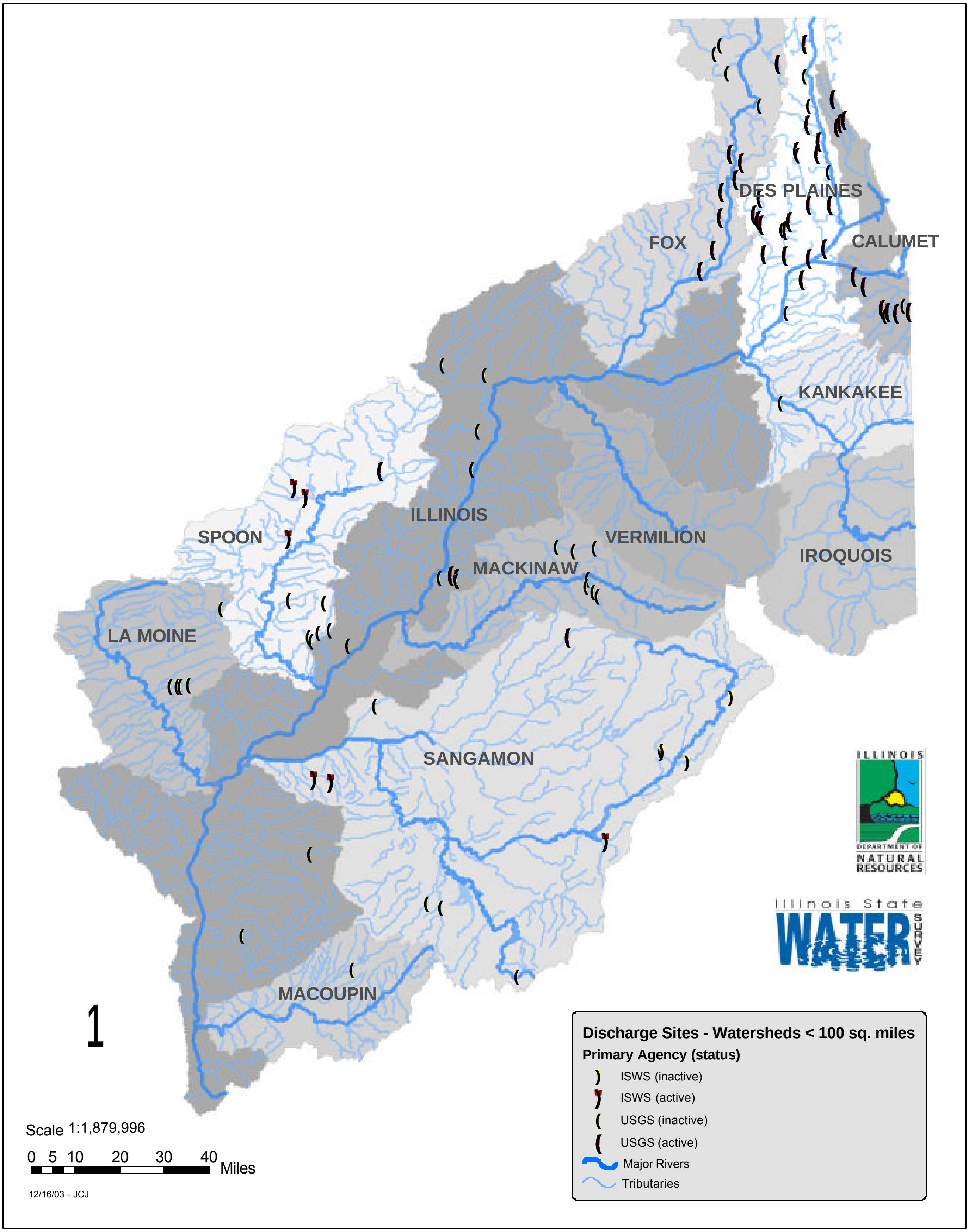
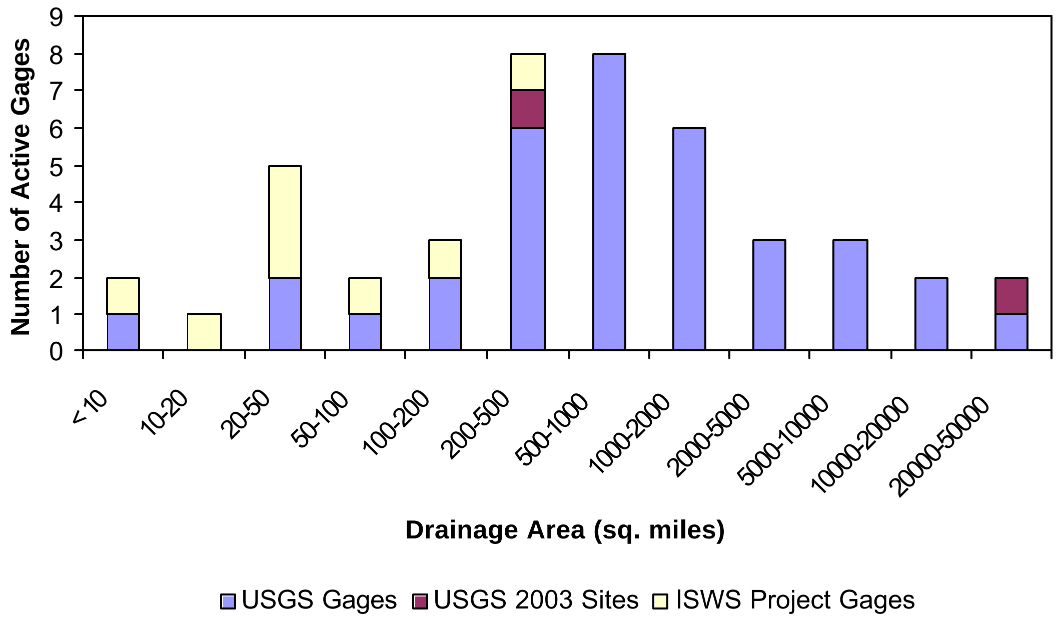
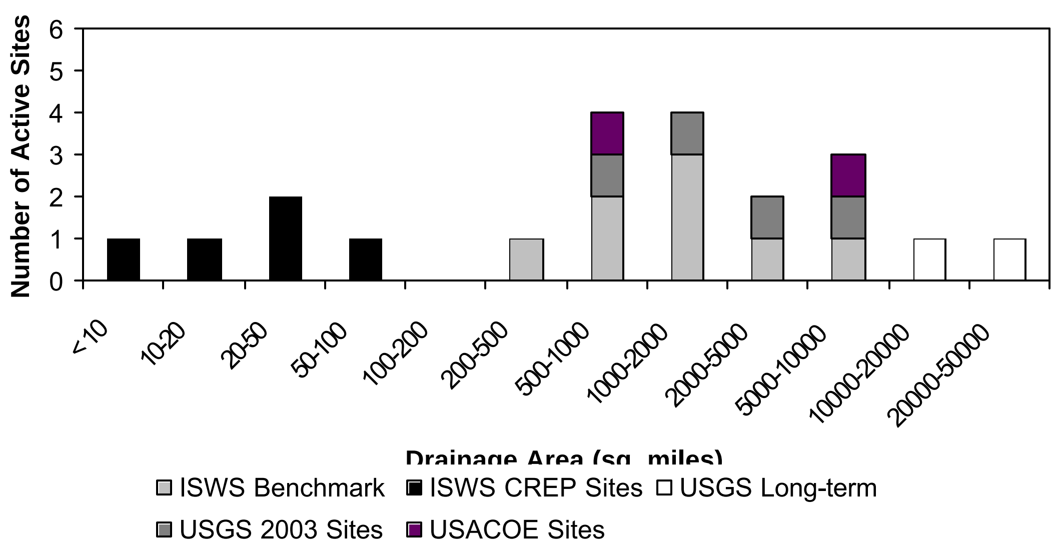


Figure 6. Discharge monitoring sites in Illinois River sub-basins with drainage areas less than 100 square miles.



(a)



(b)

Figure 7. Drainage areas being monitored in the Illinois River Basin: a) discharge monitoring sites (excluding gages in the Chicago/Calumet, Des Plaines and Fox Sub-basins), and b) suspended sediment monitoring sites

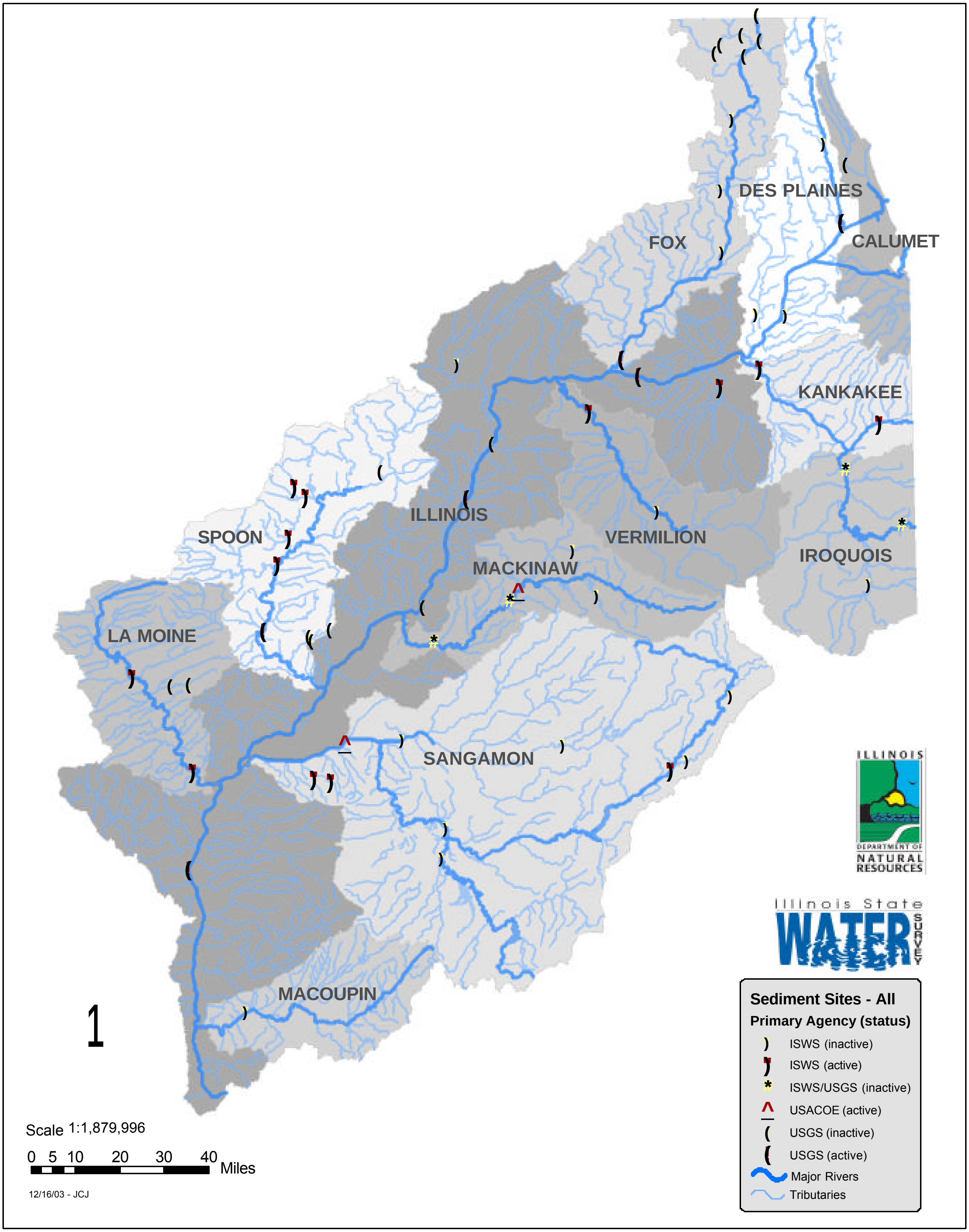


Figure 8. Suspended sediment monitoring sites in the Illinois River watershed.

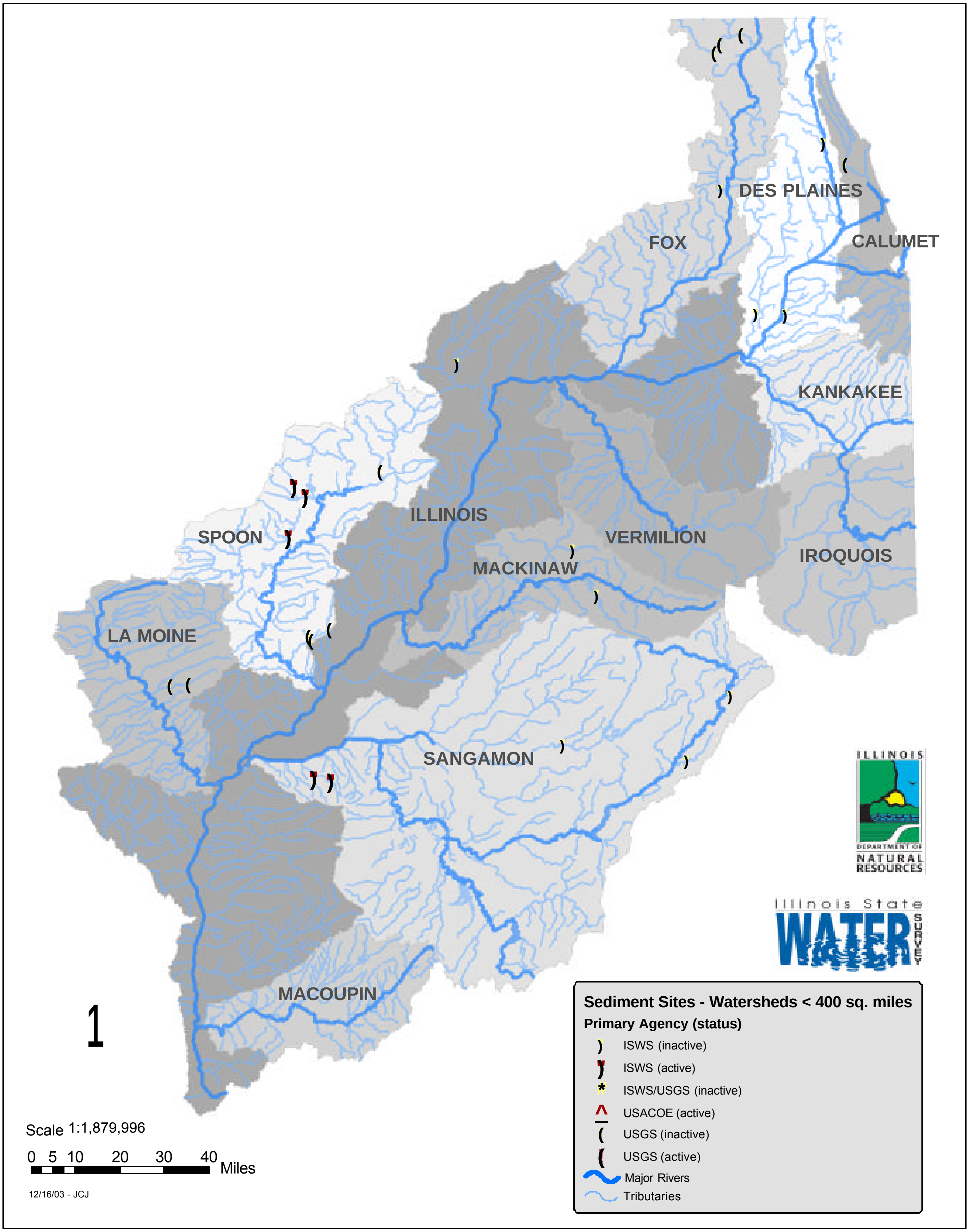


Figure 9. Suspended sediment monitoring sites in Illinois River sub-basins with drainage areas less than 400 square miles.

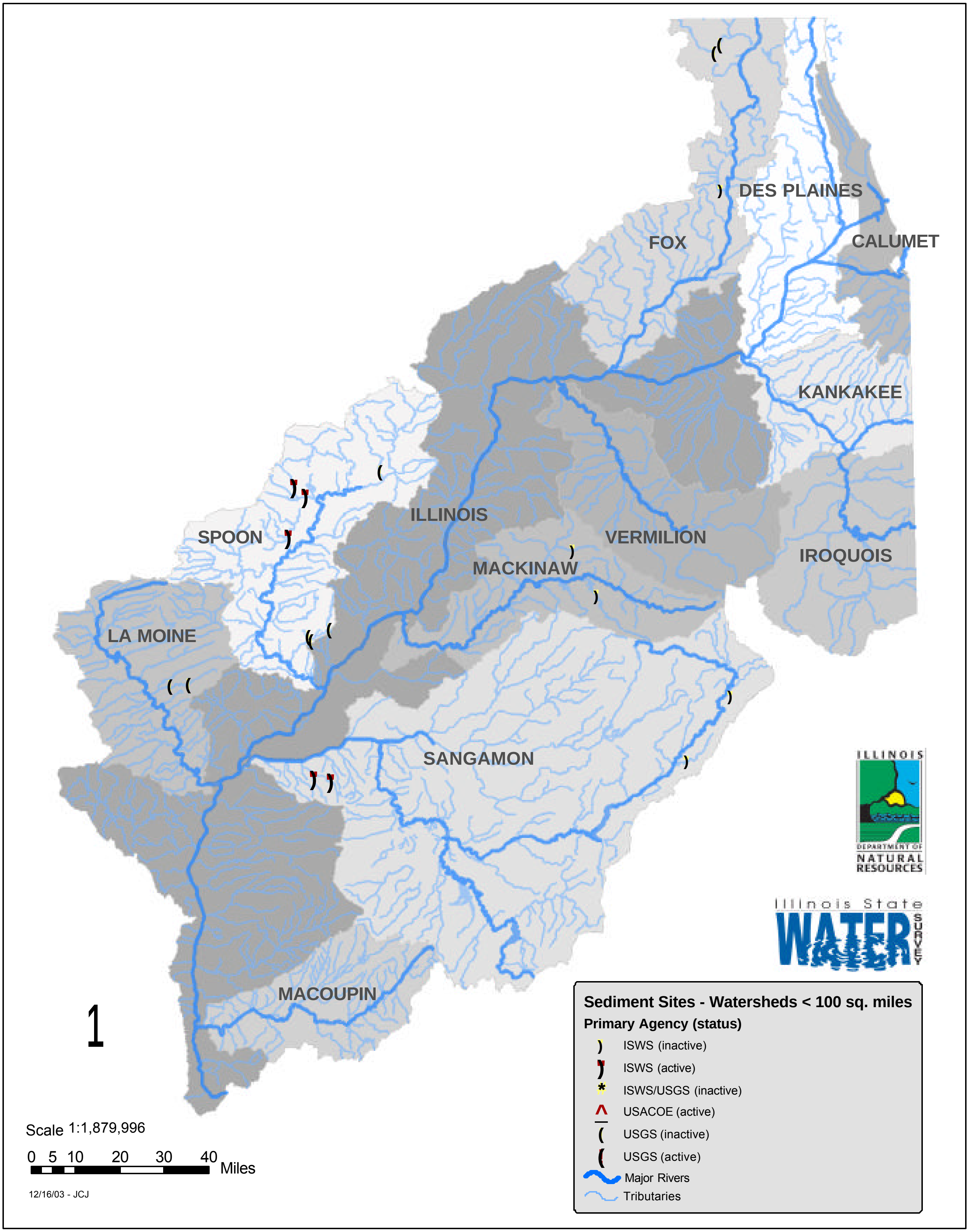


Figure 10. Suspended sediment monitoring sites in Illinois River sub-basins with drainage areas less than 100 square miles.

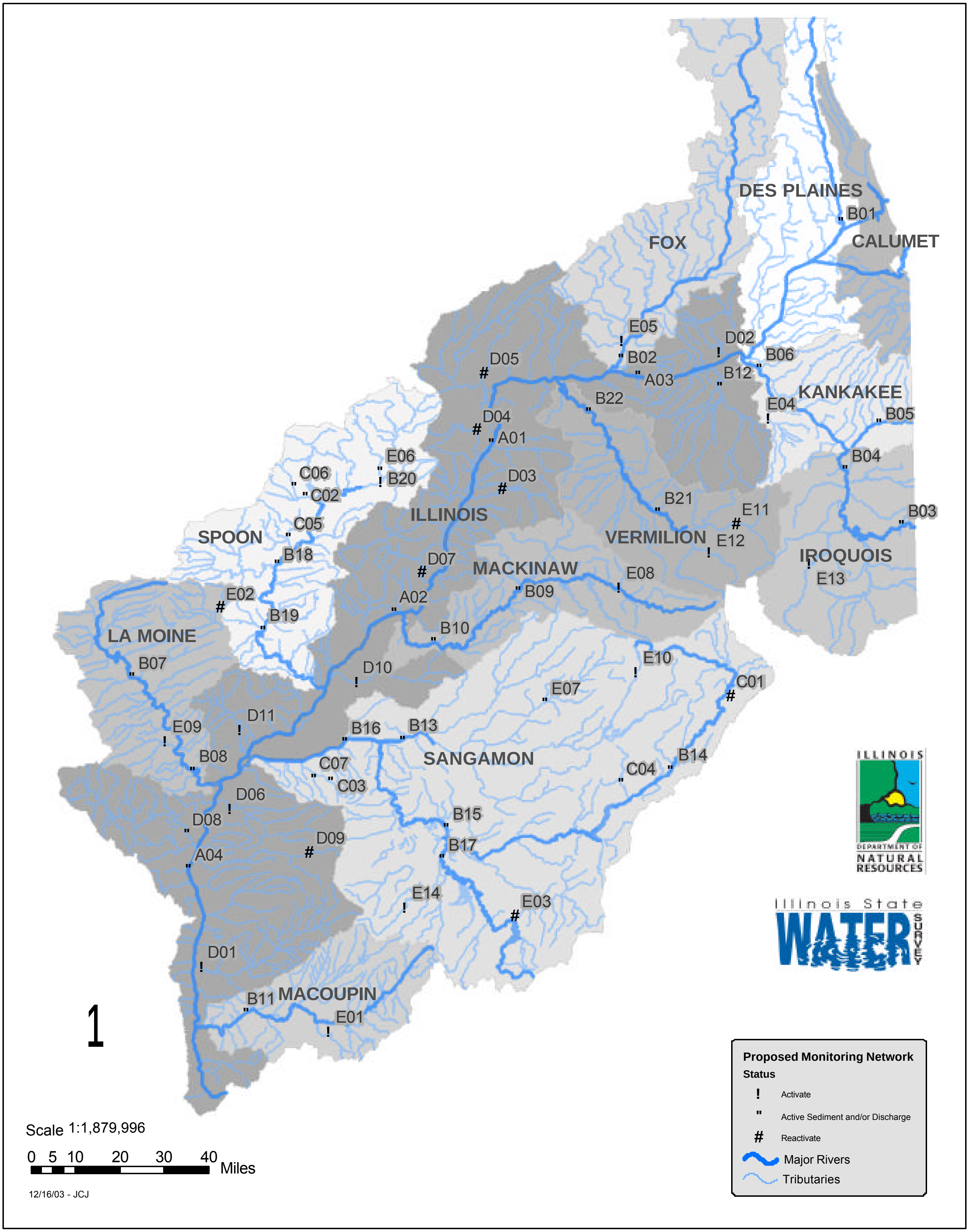


Figure 11. Proposed Monitoring Network in the Illinois River Basin.

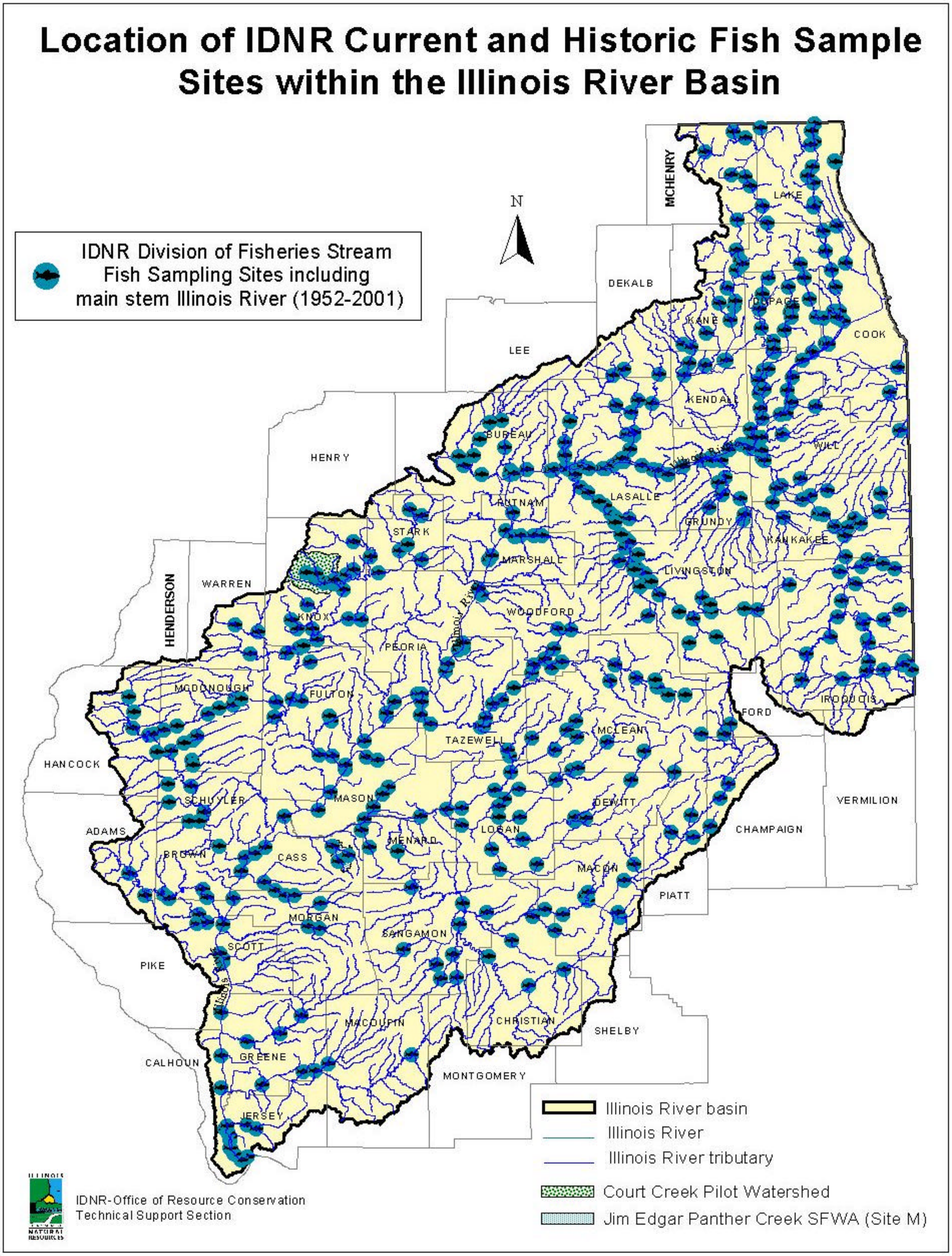


Figure 12. Location of current and historic fish samples within the Illinois River Basin.

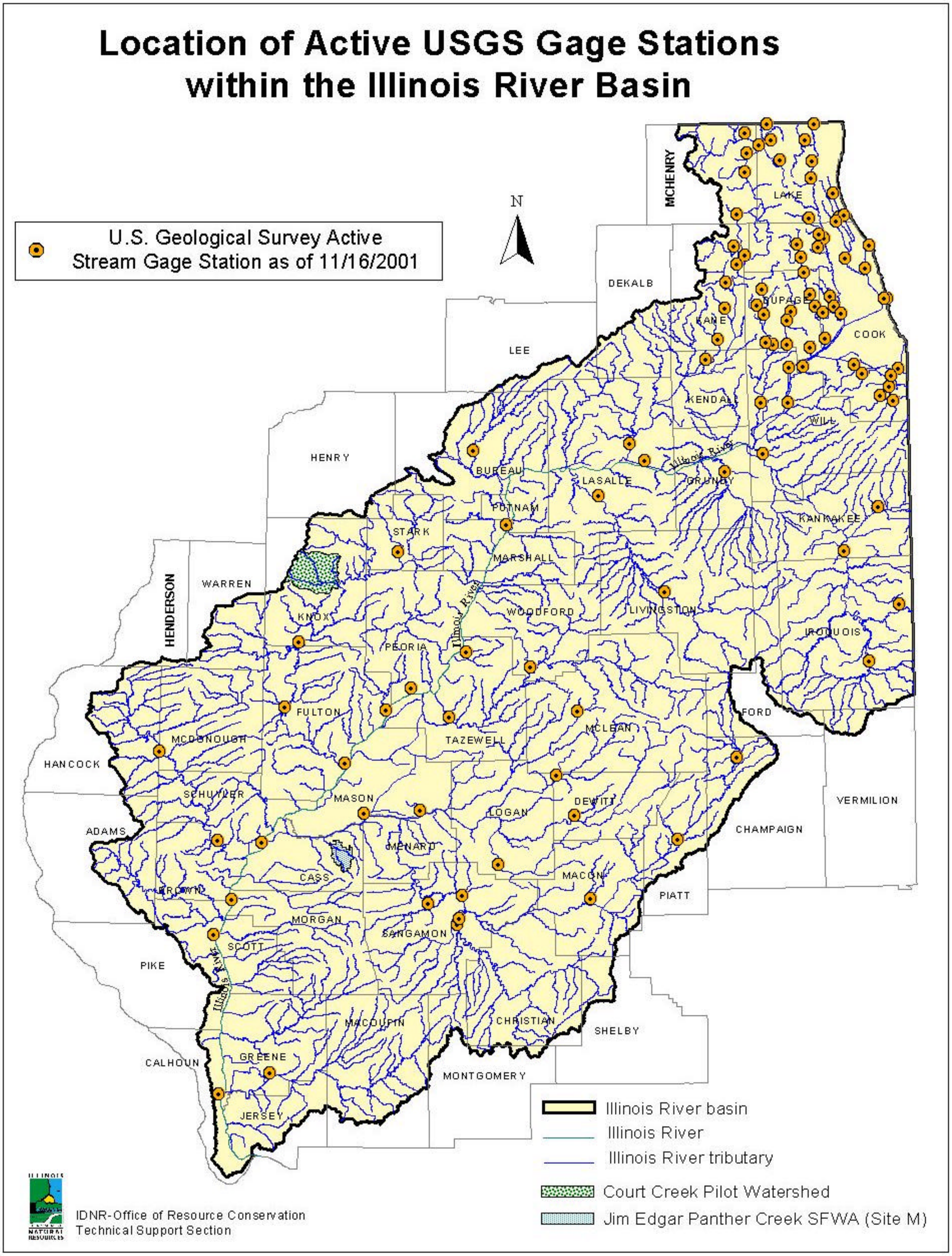


Figure 13. Location of active USGS gages within the Illinois River Basin.

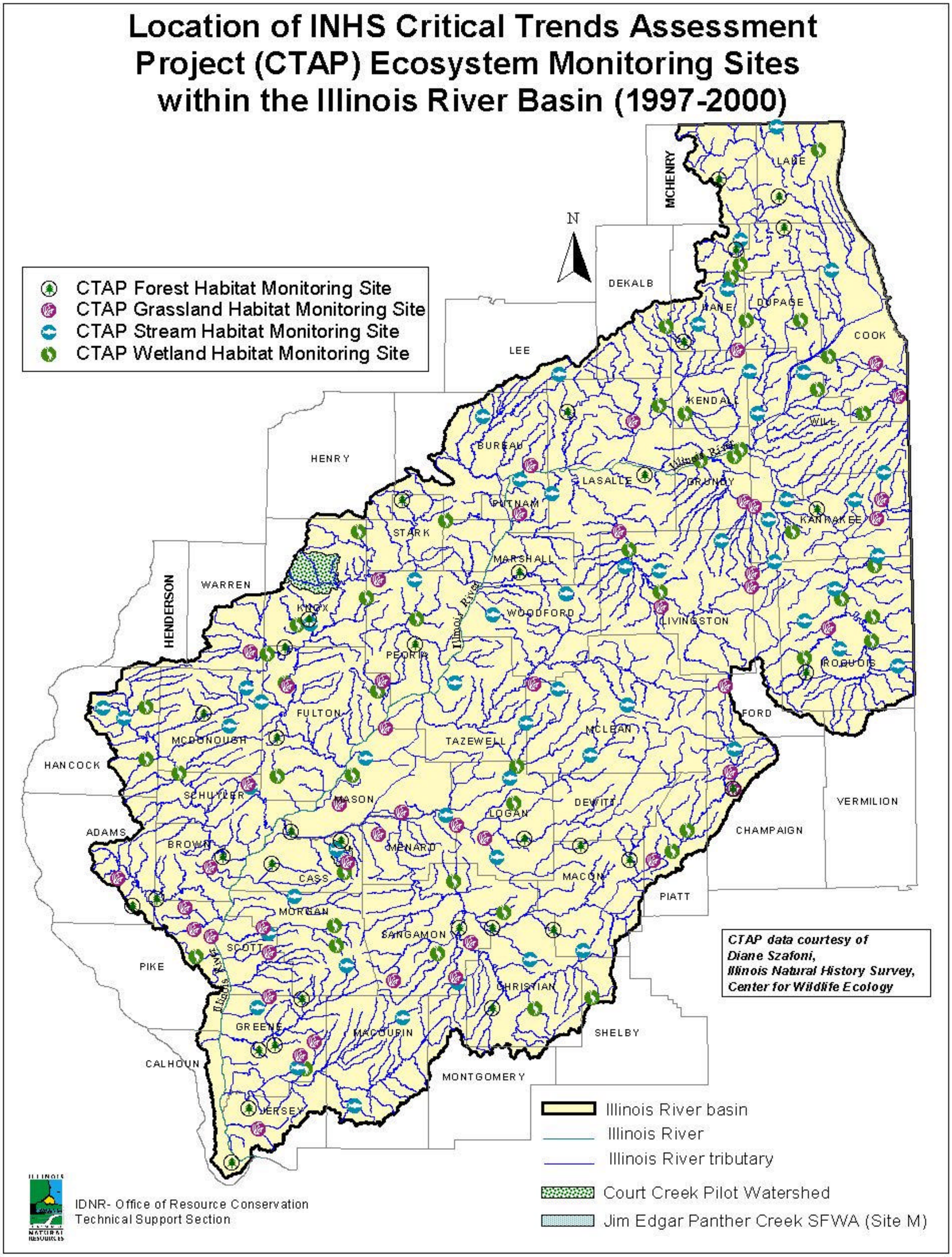


Figure 14. Location of Critical Trends Assessment Program (CTAP) monitoring sites within the Illinois River Basin.

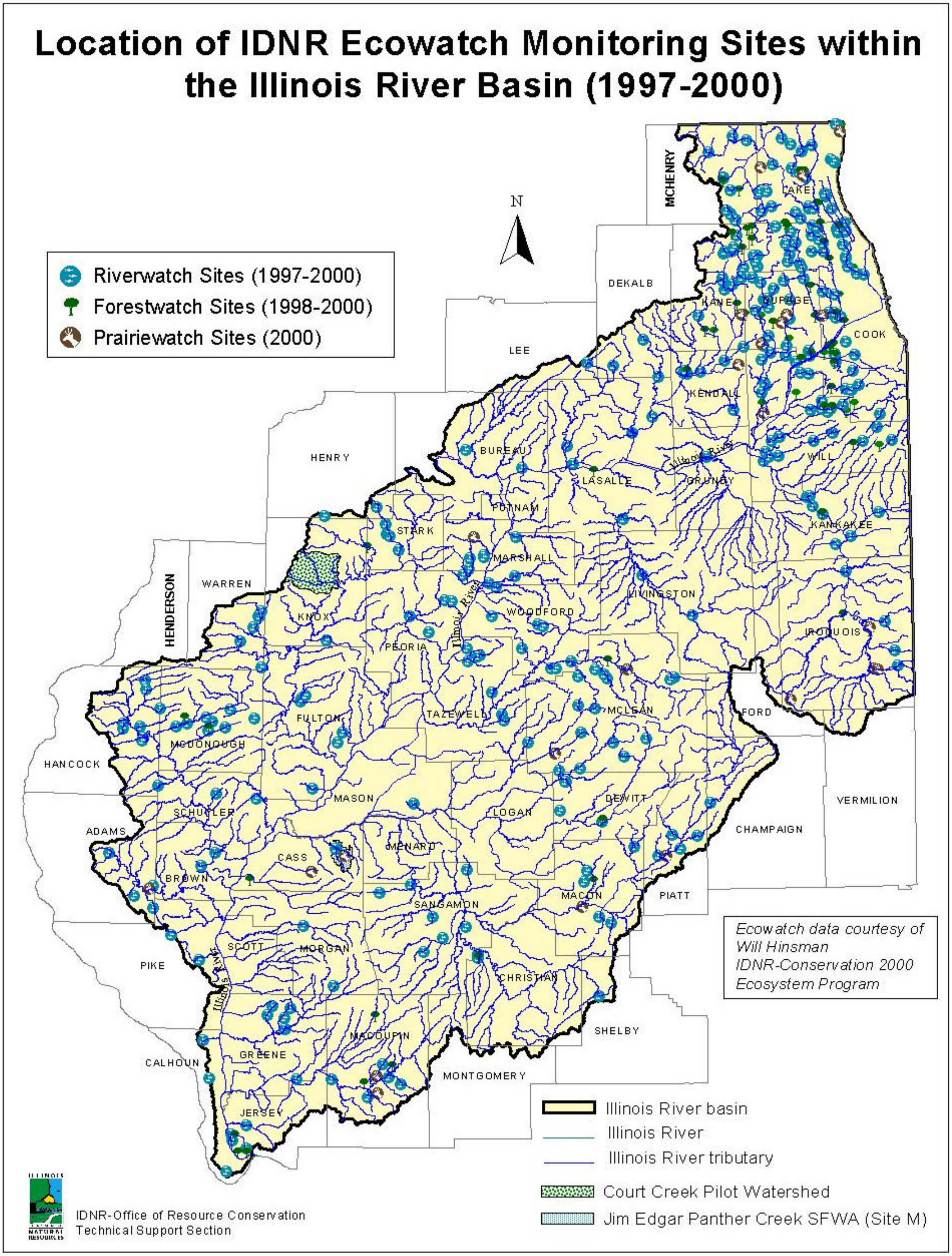


Figure 15. Location of IDNR Ecowatch monitoring sites within the Illinois River Basin.

ILLINOIS RIVER BASIN RESTORATION
COMPREHENSIVE PLAN
WITH INTEGRATED ENVIRONMENTAL ASSESSMENT

APPENDIX I

CULTURAL HISTORY

ILLINOIS RIVER BASIN RESTORATION
COMPREHENSIVE PLAN
WITH INTEGRATED ENVIRONMENTAL ASSESSMENT

APPENDIX I

CULTURAL HISTORY

I. INTRODUCTION

This cultural history was primarily obtained from Hajic et al (1999). A general overview of the prehistoric inhabitants of the Illinois Waterway and the surrounding region can be assimilated with reference to four major cultural traditions: Paleo-Indian, Archaic, Woodland and Mississippian. These traditions, defined on the basis of chronology, material culture, and lifeways, are commonly recognized and referred to throughout the mid-continent and the northeastern United States and Canada (e.g., Willey 1966; Jennings 1974). These traditions are further subdivided into more specific cultural complexes as warranted by differences in chronologies, artifacts (i.e., different artifact types and stylistic variations), and living patterns within a given region. The historic period begins with the introduction of writing and other forms of documentation and includes the Native American, European and American settlement. The following discussion includes broad definitions of the major cultural traditions.

II. MAJOR CULTURAL/TEMPORAL PERIODS

A. Paleo-Indian Tradition (12,500-9,500 B.P.). The earliest period during which strong evidence exists for prehistoric occupations in the American Midwest is the Paleo-Indian period. The Paleo-Indian Tradition has been divided into two stages: Early Paleo-Indian (Fluted Projectile Point Pattern; ca. 12,500-10,500 B.P.) and Late Paleo-Indian (Plano/Lanceolate Projectile Point Pattern; 10,500-9,500 B.P.). Early Paleo-Indian artifact assemblages include fluted Clovis and Folsom style projectile points as well as small endscrapers, gravers or "spurred" flakes, hammerstones, pitted stones, bifacial knives, and other flake tools. The Late Paleo-Indian Lanceolate Point Pattern represents a continuation and elaboration of the technological tradition of the Fluted Point Pattern of the Early Paleo-Indian period. The period is characterized by an increasing regionalization of tool styles and adaptive strategies. Late Paleo-Indian artifact assemblages include unfluted lanceolate points, typically with collateral flaking and basal/shoulder grinding. The latter assemblage also includes adzes and specialized tools made from resharpening projectile point blades. These materials are often found in association with extinct Pleistocene megafauna or bison remains (Frison 1974, 1978; Frison and Stanford 1982).

Paleo-Indian people are commonly characterized as small groups of highly mobile hunters and foragers who specialized in stalking the megafauna of the Late Wisconsinan glacial age (Frison 1978), but evidence from Kimmswick, Missouri (Graham, et al. 1981) reveals a more varied subsistence base for its Clovis inhabitants, one which utilized mammals ranging from squirrels to mastodons. Similar subsistence strategies have been noted for Paleo-Indian inhabitants of the upper Midwest. Harrison (1985:15) has suggested that the Paleo-Indian inhabitants of the western Great Lakes region adapted to forested environments and subsisted on less specialized hunting as well as fishing.

Due to the low population density and nomadic lifestyle of Paleo-Indian groups, archaeological evidence for the tradition is extremely rare. Within the Illinois Waterway, evidence of Paleo-Indian occupations is represented primarily by surface finds of diagnostic fluted spear points on high river terraces. Nonetheless, based primarily on the Lincoln Hills site in the central Mississippi River Valley, Winters (Wiant and Winters 1991:11) has defined a *Lincoln Hills Tradition* for the Early Paleo-Indian period in the lower Illinois River Valley and surrounding region. Artifact assemblages of this tradition include Lincoln Hills bifaces, steeply retouched, spurred end scrapers, side scrapers and disk cores.

Lincoln Hills bifaces are fluted from a nipple striking platform, beveled along basal edges, frequently unifacially fluted and of unusually large size. These points are found as far north as Pike County, Illinois, about 31 miles north of the confluence of the Illinois and Mississippi Rivers. Winters has suggested an age range of 11,000-10,000 B.P. for this tradition.

B. Archaic Tradition (9,500-2,750 B.P.). The Archaic Tradition is commonly characterized as Early (ca. 9,500-8,000 B.P); Middle (8,000-4,500 B.P.); or Late Archaic (4,500-2,400 B.P.), based at least in part on changes in socio-economic, technological, and religious trends. The Early Archaic population, though small, appears to have been on the increase. Interacting social groups remained small and relatively mobile and may have been linked by familial bonds, such as patrilineages (Griffin 1952; Brose 1975; Warren and O'Brien 1982a). Most Early Archaic sites seem to represent low density, temporary encampments occurring in a variety of ecological settings. This pattern reflects a subsistence strategy of seasonal hunting and gathering of resources dispersed throughout a number of different ecological zones (Brose 1975).

Based on research at the Koster site (J. Brown and Vierra 1983:175,181-183), two Early Archaic phases have been proposed for the lower Illinois River Valley, including *Early Archaic 1* (est. 9,000 B.P.) and *Early Archaic 2* (8,450-8,700 B.P.). Various projectile point styles were recovered from the Early Archaic component of the Koster site, including Graham Cave Side-Notched, Kirk Notched, Rice Stemmed, and LeCroy. Other patterned chipped stone tools included end scrapers, gravers and burins on various artifacts, drill tips and chert hammers. Ground stone tools included hammerstones/manos, cylindrical pestles, adzes, axes, choppers and grinding slabs. Bone and antler tools included socketed antler points, socketed bone tool-hafts, split-bone awls and bird-bone awls (J. Brown and Vierra 1983:181-183). Well-defined Early Archaic phases have not been developed for the middle and upper Illinois Waterway.

During the Middle Archaic, a noticeable shift occurred in the economic orientation toward circumscribed forest and riverine resources. During the Hypsithermal, a time of generally warming temperatures and drier climates, mesic river valleys provided human inhabitants with forested enclaves that were sheltered from the encroaching prairies (Cook 1976:118-119; D. Anderson, et al. 1980:266; Joyer and Roper 1980:19; Warren and O'Brien 1982,:392). Occupation of upland areas would have been limited to temporary resource procurement sites. The *Helton* phase has been well-defined for the Middle Archaic in the lower Illinois River Valley (Houart 1971; Cook 1976:69-108; J. Brown and Vierra 1983:185). This phase dates between 5,800-4,900 B.P. and is characterized by small- to medium-sized side notched projectile points in the Matanzas cluster with lesser numbers of Helton, Brannon and Apple Blossom Stemmed points (cf. Conrad 1981:125). Winged T-drills, grooved axes, large scrapers and other bifaces, and ground stone plummets and other ornaments are also found in Helton phase artifact assemblages. Two additional Middle Archaic phases, *Middle Archaic 1* (8,300-7,600 B.P.) and *Middle Archaic 2* (7,300-6,850 B.P.), are not as well defined as the Helton phase, but have been reported for sites in the lower Illinois River Valley (J. Brown and Vierra 1983:175). A wide range of projectile points characterize these phases, including unnamed corner-notched forms, Table Rock, Jakie Stemmed, Godar, Karnak and Mantanzas points (Stafford, ed. 1985:10). Although not considered a phase, a Middle Archaic *Napoleon* component was identified at the Napoleon Hollow site in the lower Illinois River Valley. This component dates from 6,000-6,800 B.P. (Wiant, et al. 1983:160). Well-defined Middle Archaic phases have not been developed for the middle and upper Illinois Waterway.

By the Late Archaic, ecological conditions in the Midwest appear to have become stabilized to conditions similar to the historic era. Culturally, a trend toward sedentism begins to appear across much of the Midwest in the form of semi-permanent settlements and seasonal return to specific resource procurement locations (Warren and O'Brien 1982a). In the Illinois River Valley, Late Archaic inhabitants were beginning to mix intensive exploitation of floodplain resources with cultivation of plants. Bender (1985) has suggested that this was a time of "social closure," a time when corporate groups (i.e., bands or tribes) were becoming socially bonded so that family groups had fewer choices about moving or changing allegiance. Despite this social closure, extensive interregional trade networks developed in which copper from the Great Lakes, marine shells from the Gulf Coast, and high quality lithic materials from a number of areas were traded.

Cole and Deuel (1937) defined a *Red Ochre* mortuary complex for the Late Archaic period in much of Illinois (including the central and upper segments of the Illinois Waterway) and adjacent states. As summarized by Hall (1974:68), the Red Ochre Culture dates to about 3,200-2,800 B.P. and can be recognized by distinctive "Turkey Tail" points of bluish chert from southern Illinois and Indiana. Large quantities of oval preforms and occasional copper tools are often associated with these points. Powdered hematite is sprinkled over burials and grave furnishings.

Two different Late Archaic mortuary complexes have been defined for the lower Illinois River Valley. The Titterington mortuary complex, which dates between ca. 4,200-3,800 B.P. (Cook 1976), is characterized by Wadlow, Karnak, Sedalia, Nebo Hill and Etley/Atalissa projectile point types. The lithic assemblages of these sites are further comprised of gouges, drills, heavy scrapers, axes and various ground stone implements, including hammerstones/manos, three-quarter-grooved axes, hematite beads, hematite rubstones and sandstone abraders (J. Brown and Vierra 1983:186). The Kampsville mortuary complex has been described by Farnsworth and D. Asch (1986:348) as the regional counterpart of the Red Ochre mortuary complex to the north. Kampsville style projectile points (Farnsworth and D. Asch 1986:347) are diagnostic of the Kampsville mortuary complex.

In general, the stone assemblages of the previous Paleo-Indian Tradition evolved to more varied styles and forms during the Archaic period. Other artifacts associated with Archaic occupations include a variety of polished and ground stone woodworking tools, including axes, adzes and wedges; plant processing equipment such as manos and metates; masses of fire-cracked rock used in pit-roasting and stone boiling; and other types of specialized artifacts such as drills, awls, needles and gouges (Frankforter 1961; Jennings 1974; Cook 1976). Grooved stone axes are somewhat diagnostic for the Middle and Late Archaic periods, shifting from a full-grooved form in the Middle Archaic to a three-quarter grooved form in the Late Archaic.

C. Woodland Tradition (2,750-1,000 B.P.). The Woodland Tradition is an archaeological complex of the eastern woodlands that is marked by the consistent manufacture of pottery, use of some cultigens, and the regular use of earthen mounds for burial of the dead. The tradition, which is divided into the Early, Middle and Late Woodland periods, developed within a climatic and vegetational setting relatively similar to recent times.

During the Early Woodland period, the Illinois River Valley was hydrologically similar to that encountered by early 19th century Euro-American settlers (Farnsworth and D. Asch 1986:327). Broad similarities exist between Late Archaic and Early Woodland occupations in the Illinois River Valley. Faunal remains indicate exploitation of a wide variety of aquatic and terrestrial species, while floral remains indicate the use of upland and bottomland plant species as well as domesticated squash, barley, and goosefoot. Nut collecting was also an important contributor to the Early Woodland diet.

Marion Thick pottery is the first pottery to appear within the Illinois River Valley. The thick, coarse, flat-based pottery was first identified at the Oliver Farm site in Marion County, Indiana (Helman 1951). This pottery is often associated with Kramer projectile points and hearths which contain an abundance of fire-cracked rock. Munson (1966) has termed these associations the “Marion Culture.” The Marion Culture is particularly well known from sites in Fulton and La Salle counties in Illinois (Hall 1974:70; A. Harn 1986:244-279; Santure, et al. 1990:15), but Marion Thick pottery has also been reported in the northern part of the lower Illinois River Valley (Farnsworth and D. Asch 1986:406; Wiant and McGimsey, eds. 1986:372-374), Starved Rock (Ferguson, ed. 1995:357), Bowmanville (Markman 1991:62) and elsewhere in the state. Farnsworth and D. Asch (1986:356) have defined three geographically segregated phases for the Marion Culture, including the *Marion* phase in the central Illinois River Valley and the northern part of the lower Illinois valley, the *Carr Creek* phase in the American Bottom, and the *Seehorn* phase in the Mississippi River Valley near Quincy, Illinois. Munson (1986:291-292) has proposed the addition of a *Late Marion/Early Morton* phase (2,400-2,250 B.P.) to the central Illinois River Valley. Munson has also suggested that the Marion phase continues into the early Middle Woodland period in the central valley (Munson 1986:291).

Another Early Woodland culture, the Black Sand Culture, is distinguished by Florence or Liverpool series pottery (Griffin 1952:98; Fowler 1955; Farnsworth and D. Asch 1986:356-370). Although this culture is perhaps better known in the lower reaches of the Illinois River Valley (Farnsworth and D. Asch 1986:406), Black Sand material also occurs in northern Illinois and well into Wisconsin (Hall 1974:71). Farnsworth and D. Asch (1986:364-419) have defined a *Cypress* phase, *Liverpool* phase and *Schultze* phase for the Black Sand Culture in the lower Illinois River Valley. Munson suggests a *Late Morton/Caldwell* phase (2,250-2,150 B.P.) for the central Illinois valley.

The Middle Woodland period in Illinois is probably best known from village sites in the Illinois River Valley, including the Havana, Pool and Dickison sites, the mounds at Ogden-Fettie and Liverpool, Illinois (McGregor 1952, 1958; Deuel, ed. 1952) and others. These sites occur in a variety of physical settings, including natural levees, alluvial and colluvial fans, adjacent to backwater lakes, in tributary valleys, along the bluff base and in the floodplain (Titus, et al. 1995:17). Middle Woodland floodplain settlements include extractive camps located adjacent to backwater lakes and possible mortuary sites (Farnsworth 1976; McGimsey and Wiant 1986; Stafford and Sant 1985). Subsistence data indicate intensive utilization of backwater fauna, collection of hickory and hazel nuts, and cultivation of starchy seed annuals including maygrass, little barley, and goosefoot (Stafford and Sant 1985:453).

Distant Middle Woodland groups were connected by a highly developed socioreligious organization referred to as the Hopewellian Interaction Sphere (Struever 1964). Large Middle Woodland sites with

groups of conical shaped burial mounds served as ceremonial centers. The inhumation of individuals with status probably included a great deal of ceremony. Various grave offerings, including carved stone pipes, copper axe blades, necklaces of river pearls, pottery vessels, spear points, ear ornaments of sheet copper and other objects often accompany these burials. Dentate stamped pottery and Snyders Corner-Notched projectile points are diagnostic of Middle Woodland sites within the Illinois River Valley (Hall 1974:72-73).
The *Havana-Hopewell* or *Ogden* phase of the Middle Woodland period in the central Illinois River Valley spans a period of about 2,000 B.P. to 1,800 B.P. (Hall 1974:74; Munson 1986:293-294). Within the central Illinois valley, the Havana-Hopewell phase is preceded by the *Late Morton/Caldwell* (2,250-2,150 B.P.) and *Fulton* (2,150-2,000) phases. It is succeeded in the central Illinois valley by the *Frazier phase* which dates from 1,900 B.P. to 1,650 B.P. The Frazier Phase marks the beginning of the breakdown of Hopewell and is characterized by the appearance of Baehr and Weaver series pottery. The Middle Woodland period in the lower Illinois River is defined by the *Marion* (2,600-2,400 B. P.), *Cypress* (2,600-2,200 B.P.) and *Mound House* (2,050-1,750 B.P.) phases. No phase chronology for the Middle Woodland period has been established for the upper Illinois River Valley.

A reduction in interregional trade, a decrease in the complexity of ceremonial/mortuary practices, and a reduction in the elaborateness of pottery decoration mark the end of the Middle Woodland period. The Late Woodland period was a time of markedly uneven sociocultural development. There was considerable variation in social relations, ideology, subsistence, technology and other realms (Nassaney and Cobb 1991:1,6). Late Woodland culture persisted in northern Illinois after the appearance of Mississippian culture to the south. The *Weaver phase* (1,650-1,500 B.P.) is the earliest defined Late Woodland phase in the middle and upper Illinois River Valley. During this time, the first arrowpoints make their appearance in this part of the valley. The Weaver Phase is succeeded in the central Illinois valley by the *Myer-Dickson* (1,400-1,200 B.P.), *Sepo* (1,300-900 B.P.), *Bauer Branch* (1,300-1,000 B.P.) and *Maples Mills* phases (1,200-900 B.P.) and the *Mossville* complex (ca. 1,000 B.P.) (D. Esarey 1997). These phases survived into the early Mississippian period and probably helped form the Spoon River Mississippian complex (Hall 1974:76).

The *White Hall* phase (1550 - 1350 B.P.) is the earliest Late Woodland phase in the lower Illinois River Valley (Styles 1981). This phase represents a continuation of the Middle Woodland period, as reflected in a subsistence strategy that involved the utilization of terrestrial and riverine species, nuts and cultivated plants. Settlements tended to be small and located in a variety of ecological zones (Connor 1985:2). The following *Early Bluff* phase (1,400 - 1,200 B.P.) in the lower Illinois valley is typified by an apparent population increase as indicated by an increase in the number, size and complexity of sites. The appearance of arrowpoints during this time indicates the adoption of the bow and arrow in the lower Illinois valley. The addition of maize to the Late Woodland diet marks the beginning of the *Late Bluff* phase (1,200-1,000 B.P.). The subsistence strategies and pottery styles associated with the Late Bluff phase gradually changed to those of the following Mississippian Tradition (Connor 1985:3). The term *Jersey Bluff* phase has been used by some researchers to refer to the final Bluff-culture occupants in the southernmost portion of the lower Illinois River Valley (Maxwell 1959:27; Perino 1971:65, 1972:310, 335-347). Again, a phase chronology for the Late Woodland period in the upper Illinois Waterway has not been established.

D. Mississippian Tradition (1,000-500 B.P.). The Mississippian Tradition represents a culmination of social, economic, political, and technological trends which began in the Late Woodland period

(Titus, et al. 1995:18). Although this period is generally characterized as a time of increased reliance on agriculture as a subsistence base and increased social stratification and complexity, there were major differences which distinguished the Mississippians of present-day southern Illinois (Middle Mississippian) and those which inhabited the northern part of the state (Upper Mississippian).

The Mississippian cultures of the Central Mississippi River Valley and its major tributary valleys are characterized by numerous elements that reflect the achievement of new levels of social complexity. Large villages and towns with flat-topped temple mounds, such as the Cahokia site in the American Bottom, served as economic, political and ceremonial centers for surrounding homesteads and hamlets. Status differences within the society are indicated by variations in the treatment of burials. A diverse subsistence economy with increased reliance on the cultivation of maize sustained large sedentary communities (Markman 1991:73).

In the lower Illinois River Valley, *Stirling* phase pottery is restricted to the southern half of the lower valley and is found primarily in a grouped cluster along twelve miles of eastern bluffline bracketed by Apple and Macoupin creeks. *Sand Prairie* phase pottery occurs only in approximately the northern half of the lower Illinois River Valley. Within the central Illinois River Valley, the Spoon River Mississippian complex is divided into *Eveland* (950 - 850 B.P.), *Orendorf* (850 - 750 B.P.), and *Larson* (750 - 700 B.P.) phases (Smith 1951; A. Harn 1970, 1971; Conrad and A. Harn 1972; Conrad 1973, 1991:119-156).

As discussed by Markman (1991:73-74), those cultural markers which show an affinity between Upper and Middle Mississippian cultures consist primarily of small, portable artifacts that were used daily in most households. The elaborate ceremonial objects that often accompanied the Middle Mississippian elite to the grave are rare at Upper Mississippian sites and large temple mounds are absent. In addition, Upper Mississippian hunter-farmers relied less on cultivated plants than Middle Mississippians. Upper Mississippians were more mobile and were prone to moving whole villages to take advantage of seasonally available wild food resources. While Hall (1974:78) has suggested that Upper Mississippians were probably Late Woodland peoples who were changing in the direction of the Mississippian Tradition, others refer to Upper Mississippian sites as part of the *Oneota* tradition or the *Huber* phase of the Oneota tradition (Michalik 1982; J. Brown, ed. 1985, 1990). Gibbon (1972) defines the Oneota tradition as an Upper Mississippian development that was concentrated on the Prairie Peninsula. Markman (1991:77) suggests that Upper Mississippian actually encompassed a number of ethnically distinct tribal groups.

The Langford (Upper Mississippian; Jeske 1989, 1990) and Fisher-Huber (Oneota) (Emerson and Brown 1992:86-89) pottery series are diagnostic of late prehistoric sites in northern Illinois (Markman 1991:87-93). Oneota manifestations further south include the *Bold Counselor* phase (700-650 B.P.) in the central Illinois River Valley and the *Vulcan* phase (including the *Groves* complex) in the lower valley (Milner, et al. 1984:182; Jackson 1992:389-391). Milner, et al. (1984:182) have suggested a date of 600-400 B.P. for the Vulcan phase.

Artifacts diagnostic of both the Middle and Upper Mississippian cultures include distinctive short-necked jars and other pottery forms tempered with shell. These vessels have plain or smoothed surfaces with trailed designs. Small triangular projectile points with side-notches, known as Cahokia points, are present in both Middle and Upper Mississippian artifact assemblages (Markman 1991: 74-75).

E. Historic Native American Occupation (1673 - 1830). In any discussion of the historic Native American occupation of Illinois, two caveats are necessary. First, the territories or ranges of early historic peoples are not precise. Unlike their European contemporaries, 17^{th} and 18^{th} century Native Americans did not draw lines on maps indicating distinct territories for specific groups of people. Furthermore, while most of the Great Lakes people were not nomadic, they did move seasonally. Most maintained large, relatively permanent, farming villages in the summer, and broke up into smaller hunting villages in the winter. The region over which these villages and camps were established varied over the years. With increasing pressures of European colonization, the territory occupied by any given tribe shifted more and more rapidly. To say that the Illinois River Valley was within the range of the Potawatomi in the 1790s, is to say that one might well have found Potawatomi villages or camps along the Illinois in those years. It is not to say that the Potawatomi could be found there every year, or that villages of other tribes might not have been present.

The second caveat regards tribal attribution. Europeans made most of the familiar tribal designations, but tribal identity was far more fluid for Native Americans than it was in the minds of Europeans. Although the Iroquois, Sioux, Miami and Illini are referred to as if they were tribes, they were actually confederations of tribes. Bands are sometimes mistaken for separate tribes. Also, a village in which a third of the inhabitants are Mascouten might BE described as Miami. This tendency for portions of two or more tribes to live together seems to have increased through the 18^{th} and early 19^{th} centuries as the pressures of war, trade, and colonization grew. Also, as Tanner points out, a village might have any number of people with various ethnic backgrounds: African traders, servants, and runaway slaves; Scottish, Irish and French traders and blacksmiths; French missionaries; European travelers or dignitaries; and spouses, relatives, captives, couriers, and traders from other tribes (Tanner 1987:4).

All of the tribes living in the Illinois Country in historic times had similar cultures. They spoke languages of the Algonquian family and they relied on diverse subsistence practices. The Illini, Miami, Kickapoo, Mascouten, and Potawatomi all lived in large, relatively permanent villages in the summer. The Illini, like the Iroquois, favored large multiple family lodges. The houses consisted of a pole structure covered with rush mats. Late in the 18^{th} century, prominent leaders and métis would adopt the log cabin.

The summer villages were agricultural towns. Situated on streams or near springs, the villages often faced extensive fields on the opposite bank (Tanner 1987:5). The French reported that the Indians grew corn, beans, squash, pumpkin, gourds, and melons (Kinietz 1972:172). After the fall harvest, with seeds and surplus food cached, most of the people left for the winter hunt. A few of the elderly might stay behind to watch over the village. Antoine Raudot described the hunt in 1710:

> These Ilinois [*sic*] savages leave their village in winter; there remain only a few women and some old men who absolutely cannot march. They go to hunt buffalo, deer, wapiti, beaver, and bear. They camp always in the prairies far from the woods, . . . and use mats of rushes tied together to cover their cabins (Kinietz 1972:407).

Winter hunting camps were smaller and usually confined to family groups. Where maples grew, the people came together in sugar camps in the early spring. Spring and fall might also mean extensive fishing. Later in the spring, the people returned to the summer village and planted their crops. Once the crops were started, some might leave on a summer hunt.

Europeans, as well as modern American historians and archaeologists, tended to view the winter hunting villages as relatively insignificant camps. However, as Esarey (M. Esarey, 1997:182-183) has pointed out, the contact-era Native Americans of the Illinois country spent about equal amounts of the year in their winter and summer villages.

The presence of the Europeans changed the nature of both hunting and agriculture. As the French and English moved westward, hunting became important for the fur trade as well as for food. Native Americans in the Illinois Country now needed to produce enough food to sustain more extensive hunting and to feed the French. The Illini began to grow wheat as early as 1700, and in 1711 or 1712 the French introduced draft animals and built windmills for the use of the Kaskaskia on the Mississippi (Zitomersky 1994:9, 40-41). Much of the wheat flour produced was shipped south to French military installations on the coast of the Gulf of Mexico. Nevertheless, corn remained the staple crop throughout the French colonial period.

Natural resources of game, soil and fuel wore out more rapidly. This contributed to the accelerating mobility of both the French and the Indians throughout the colonial period. The move from Le Rocher to Peoria in 1691, for example, is thought to have been largely due to the depletion of resources around the Rock. As a result of the fur trade, small, fur-bearing animals, particularly beaver and the mustelids, all but disappeared from the Illinois country. By the late 18th century the focus of the fur trade shifted to raccoons and deer. At the turn of the 19th century, the demands of the fur trade, the introduction of the horse, and the wholesale slaughter of large game animals by American settlers seriously depleted the deer, bear, elk and bison in the Illinois Country (White1991:489-490).

When the French explorer Louis Jolliet and Jesuit missionary Jacques Marquette came to the Illinois Country in 1673, they found villages of the Illini tribes along the Illinois River. The Illini spoke an Algonquian language similar to that of the Miami (Temple 1977:11). Although not so highly organized as the Iroquois, they are usually referred to as a confederacy. The Illini are thought to have included the Cahokia, Kaskaskia, Michigamea, Moingwena, Peoria, Tamaroa, Korakoenitanon, Chinko, Tapouro, Omouahoas, and Chepoussa. Virtually nothing is known about the last five of these. Other groups presumably absorbed them early in the Contact Period.

Shortly before the French began to push into the Illinois Country from the north, the Iroquois had begun raiding Illini villages from the east. For a time the Illini retreated west of the Mississippi, but by the arrival of Marquette and Jolliet in 1673, they had returned to Illinois and established as their central town the Kaskaskia village near Le Rocher, now known as Starved Rock.

Most scholars have assumed that the permanent town of the Peoria was probably already at Lake Peoria by 1673, although the earliest sources on the Marquette and Jolliet expedition are vague. Marquette and Jolliet visited an "Ilinois" town on their descent down the Mississippi River in June. Marquette refers to these people as being "divided into many villages, some of which are quite distant from that of which we speak, which is called peouarea." This village was located in Iowa or Missouri (M. Esarey 1997:166; Franke 1995:10). Temple (1977:17) believes it was a summer hunt in Iowa, and that the permanent village was already located on Lake Peoria.

The Mississippi expedition turned around on July 17, and began to "reascend" the Mississippi:

> It is true that we leave it [the Mississippi], at about the 38th degree, to enter another river, which greatly shortens our road, and takes us with but little effort

> to the lake of the Ilinois [Lake Michigan].We have seen nothing like this river that we enter, as regards its fertility of soil, its prairies and woods; its cattle, elk, deer, wildcats, bustards, swans, ducks, parroquets, and even beaver. There are many small lakes and rivers. That on which we sailed is wide, deep, and still, for 65 leagues. In the spring and during part of The summer there is only one portage of half a league. We found on it a village of Ilinois [*sic*] called Kaskasia [*sic*], consisting of 74 Cabins (Thwaites 1900:161).

Marquette concludes his narrative with the report that he had saved a single soul, that of a dying infant, on this voyage. Here he makes an incidental reference that has confused scholars ever since: "For, when I was returning, we passed through the Ilinois of Peouarea, and during three days I preached the faith in all their Cabins...."

It will never be clear whether this was the same Peoria village visited on the descent of the Mississippi, whether "of Peouarea" refers to the people or the place, or whether this was the same village (in population or location) as the Kaskaskia. Nor will it ever be known whether Marquette and Jolliet saw more villages on the Illinois River than the single Kaskaskia village and the possible Peoria village mentioned. In fact, Marquette does not even state that he found the Kaskaskia at Le Rocher, as scholars have always assumed (Howard 1972:28; Franke 1995:11; Temple 1977:18)

Marquette returned to the Kaskaskia in 1675 to establish his Mission of the Immaculate Conception. By 1679 the village had grown to 460 lodges, each housing five or six families (Temple 1977:14-21). Tanner (1987:5) estimates the Grand Village of the Kaskaskia had 7,000 to 8,000 inhabitants in 1680.

The La Salle expedition of 1679 found the Peoria living thirty leagues down river from the Kaskaskia, in a village on the southern end of Lake Peoria. Esarey (M. Esarey 1997:187) maintains that, in fact, this was the winter village, of about 80 cabins, of the same group which maintained the large summer village at Le Rocher. Indeed, La Salle and his men, passing through the village at Le Rocher in December, had found it deserted and raided its corn caches. Esarey points out that the Lake Peoria inhabitants moved to Le Rocher in April of 1680, and that some of the people from the Grand Village are known to have wintered at Lake Peoria in 1681-82 and 1686-87 (1997:87). However, historians have generally considered the April, 1680 removal to Le Rocher to have been prompted by a pending Iroquois attack (Temple 1977:22-23).

La Salle and Tonti built the ill-fated Fort Crèvecoeur across the river from the Peoria, in April Tonti moved with the Illini to Le Rocher, and the Iroquois attacked in September. Following ill-fated negotiations with the Iroquois, Tonti returned to Green Bay. The Kaskaskia and Cahokia fled up the Mississippi, the Peoria across it, and the Moingwena down it. The Tamaroa remained in Illinois and lost 1,200 of their people to the Iroquois (Temple 1977:23-24).

La Salle and Tonti found both the Le Rocher and Peoria villages deserted when they returned in 1682 (Temple 1977:26). On Le Rocher, they proceeded to construct Fort St. Louis. In the absence of the Illini, La Salle gathered Miami, Mascouten and Shawnee around the fort for trade and protection, and by 1684 the Kaskaskia, Peoria, Moingwena, Tamaroa, and Cahokia had returned (Temple 1977:27). The population around Le Rocher rose to an estimated 18,000 (Tanner 1987:29). Tonti held the alliance together throughout the 1680s, but in 1691 the French and Indians abandoned Le Rocher and re-established Fort St. Louis at Peoria. Six villages of Illini settled on the west bank of southern Lake Peoria (Temple 1977:21-31; Tanner 1987:30-31).

The Illini settlements at Lake Peoria continued through the end of the 17th century, but in 1700 the Kaskaskia moved down river to the present site of St. Louis, and the Illini presence in the Illinois Country began to lessen. When one faction of the Peoria drove their Jesuit missionary away in 1706, the Christian faction moved south to join the Kaskaskia. By 1712 the Peoria had apparently split again, for another group had started a new village at Le Rocher. Because of the absence of a missionary in these years, there is no extant documentation of the location of the Illini between 1706 and 1711 (M. Esarey 1997:189, 191).

By the early 1700s the Kickapoo and Mascouten had extended their hunting ranges into the northern reaches of the Illinois River watershed, and the Potawatomi were rounding the tip of Lake Michigan. The Le Rocher Peoria allied with the Potawatomi in an attempt to push back the Kickapoo and Mascouten.

The Peoria and Potawatomi also assisted the French in their wars against the Mesquakie (Fox). Throughout the 1710s and early 1720s the Le Rocher Peoria engaged in almost constant warfare with the Kickapoo, Mascouten and Mesquakie. In the fall of 1721, the Mesquakie besieged both the Le Rocher and Peoria Illini, and the following year the two groups combined at Le Rocher. After surrendering 80 women and children to the Mesquakie, the Peoria left Le Rocher for the down river settlements. Although internal disagreements and attacks by the Iroquois and Mesquakie weakened the Illini, the French continued to rely on them as allies.

As late as 1728 the Peoria raided the Kickapoo upriver. In 1730 they were still at Le Rocher when the Mesquakie, pursued by the French-allied Kickapoo, Mascouten and Potawatomi, attacked. The Peoria appealed for reinforcements from Kaskaskia, and the Mesquakie retreated to the south, where they were all but annihilated by the French allies. By 1733 the Peoria had returned to both Le Rocher and Lake Peoria. However, the Illini continued to fight with the Mesquakie, and by the end of the decade they had also become embroiled in a feud with the Sioux. By the 1750s the Illini had incurred the wrath of most of their northern neighbors, and when the French and Indian War reached the Illinois Country, the Illini chose the losing side. Along the Illinois River their numbers dwindled throughout the 1760s and 1770s. They ceded their Illinois lands to the United States in 1818 (Temple 1977:40-56; Tanner 1987:40, 93).

As the La Salle confederacy deteriorated, hostility grew between the Miami and Illini, and the Miami eventually moved to the region around the Wabash River. The Miami (including the Wea, Piankashaw, Atchatchakangouen, Kilatika, Pepicokia, and Menagakonkia) were similar in language and culture to the Illini. When the French first heard of them, the Miami were beginning to move eastward from Sioux territory into what is now Wisconsin. Subject to Iroquois attacks throughout the 1670s, the Miami agreed to join the confederacy at Le Rocher in 1683. According to Charlevoix (cited in Temple 1977:59), some of the Miami built their own fort on Buffalo Rock. They left Le Rocher in 1688 and eventually settled in the regions around Chicago and the Wabash River.

About 1700 the Miami villages ranged from the St. Joseph to the Mississippi, with Chicago as their central town. A village of about 100 families was situated at the junction of the Des Plaines and Kankakee Rivers. Temple (1977:60) mentions that this village, which would be in the vicinity of the Dresden Island Lock and Dam, was known to exist in 1700, 1702 and 1705. By 1710 the Miami became friendly with the British and began to move eastward and down the Wabash. For the most part, the Miami had left Illinois, although during the War of 1812 a group including 120 to 150

warriors settled near the Kickapoo about one half mile from Peoria (Temple 1977:63). The Wea and Piankashaw established council fires separate from the Miami in 1818, and were eventually absorbed by the Peoria (Valley and Lembke 1991:3, 8, 11).
The Mascouten have proved elusive to historians and ethnographers due to their tendency to live with other tribes. During the time they lived in the Illinois Country, they often dwelt with the Miami, the Mesquakie, or the Kickapoo. Their language, about which little is known, was apparently mutually intelligible with Kickapoo, which is similar to the language of the Sauk and Mesquakie.

The Kickapoo and Mascouten lived in what is now Wisconsin when the French first encountered them in the 1630s. Warfare and hunting lured them into the Illinois Country by 1680. In the fall of that year Jesuit priest Father Gabriel was killed by Kickapoo below the confluence of the Kankakee and Des Plaines, and La Salle found that about 200 Kickapoo had rebuilt the Illini village at Le Rocher. Iroquois had destroyed this village in September and by December the Kickapoo had built houses of their own style on the site. Also in 1680, the Mascouten were reported to be living along the Chicago River. Throughout the 1680s the Kickapoo and Mascouten continued to migrate into the Illinois Country, possibly in order to elude the Iroquois (Temple 1977:158-159). As the Illini moved southward in the early 1700s, the Kickapoo and Mascouten moved into the Illinois River Valley. Temple (1977:159) suggests that Wisconsin remained their permanent residence in these years and that their villages in the Illinois Country were hunting encampments.

In 1720 the Kickapoo and Mascouten lands lay between the Fox and Illinois Rivers, although by that time some Kickapoo and Mascouten lived near the Potawatomi on the St. Joseph River, saying they could no longer live in peace with the Mesquakie. By 1730 the Kickapoo and Mascouten lived between the Rock and Illinois Rivers, but by mid-decade another split sent some to the Wabash River. These Wabash Kickapoo and Mascouten began to come back into the Illinois Country in the years following the American Revolution. By the 1790s the Kickapoo were on the Des Plaines, Sangamon and Vermilion Rivers (Temple 1977:160, 163-164).

About half of the Kickapoo supported Tecumseh and the Shawnee Prophet. After the Battle of Tippecanoe in 1811, the Sangamon Kickapoo moved to a village 24 miles north of Peoria, and the remainder stayed with the Prophet. Trouble erupted between the Lake Peoria Kickapoo and the American settlers in the area, and in the fall of 1812, the Americans attacked and burned the Kickapoo towns on Lake Peoria. The survivors fled to the Rock River (Temple 1977:165; Tanner 1987:105-110).

By the end of the War of 1812, the Mascoutens had apparently been absorbed by the Kickapoo and they do not appear again in the literature as a distinct tribe. Throughout the mid-1810s, the Kickapoo drifted back into the Illinois Country, settling by themselves or with the Potawatomi along the Sangamon, Illinois, and Vermilion Rivers. They ceded these lands in 1819, but some Kickapoo remained in Illinois into the 1830s.

Like the other Native American groups who occupied Illinois in historic times, the Potawatomi were an Algonquian-speaking people. Closely related to the Ottawa and Chippewa (Ojibwa), they had lived east of Lake Michigan until the Iroquois pushed them westward in the 17th century. The Potawatomi, with a few Ottawa and Chippewa, appeared in the Chicago area in the early 1740s. By the 1760s their hunting lands encompassed the Illinois, Kankakee and Des Plaines Rivers. As they encroached on Illini lands, hostilities increased, escalating after the murder of the Ottawa leader Pontiac by a Peoria in 1769. By the 1790s, the Potawatomi had villages at the confluence of the Des Plaines and Kankakee and along Lake Peoria.

In the 1810s, Potawatomis under the leadership of Gomo, Shequenebec, Black Partridge, Pepper, and Main Poche, had numerous villages at the north end of Lake Peoria, about 20-25 miles north of Peoria, and along the Kankakee. Their population was substantial enough to muster several hundred warriors (Temple 1977:137-139; Tanner 1987:119). A series of conflicts arose between the Americans and Potawatomi up and down the Illinois River, with charges of theft and murder on both sides. These hostilities culminated in the Potawatomi attack on Fort Dearborn (Chicago) in August of 1812. The Americans burned three Potawatomi, Kickapoo and Piankeshaw villages at Peoria in 1812 and burned Gomo's deserted village in 1813. In October of 1813, the Americans built Fort Clark at Peoria to curtail Potawatomi raids (Tanner 1987:110-119).

At the close of the War of 1812, the Potawatomi began bringing their families back into the Illinois Country. Between 600 and 700 hunters passed Fort Clark (Peoria) on the way to their winter hunt in the fall of 1815. The Potawatomi continued to live around Chicago and along the Illinois River throughout the 1820s. Over 1,000 lived near Chicago. Another large village was located on the Illinois just west of the confluence of the Des Plaines and Kankakee, and a Potawatomi and Chippewa village was situated at the confluence of the Little Calumet and Grand Calumet Rivers south of Chicago. The villages around Lake Peoria continued until the end of the 1820s (Temple 1977:145-7).

For the most part, the Potawatomi sided against the Sauks in the Black Hawk War, but the Americans were suspicious of all Indians, and the Illinois and Kankakee Potawatomi were forced to cede their lands in 1832. The Prairie Band, those living on the Illinois, left immediately for Indiana to await removal further west. The Lake Michigan, Des Plaines and Kankakee Potawatomi remained until they were forced to leave in the late 1830s.

The Miami were in the region around the T. J. O'Brien Lock in the 1670s and the Iroquois attacked a Miami village in the area in 1687. The Potawatomi may have been in the area as early as 1700. They had a village at the confluence of the Little Calumet and Grand Calumet in 1793 (Tanner 1987:32, 93). The Joliet/Lockport area was home to the Miami by the mid-1680s and the Potawatomi by the mid-1700s. Tanner (1987:93) indicates a Potawatomi village at the approximate location of Joliet in 1790.

Dresden Island was probably in the eastern part of the Kaskaskia range at the time of first European contact in the 1670s. The confluence of the Des Plaines and Kankakee Rivers created a desirable area. The Miami settled there in 1683 and were known to still be there in 1705. The Potawatomi had built a village by 1768 (Tanner 1987:32, 58). The Potawatomi remained, sometimes with Ottawa, Chippewa, Kickapoo and Mascouten, until the 1830s.

Kaskaskia occupied the bank of the Illinois River opposite Starved Rock in 1673, at first European contact. The Kaskaskia fled the Iroquois in 1680 and their town was briefly inhabited by the Kickapoo (Temple 1977:158). The Kaskaskia returned to join the La Salle confederacy based at Starved Rock. La Salle also attracted the Miami and Shawnee to the area in the 1680s.

The French and Indians abandoned the area for Peoria in 1691, but by 1712 a faction of Peoria had taken up residence at Starved Rock. These Peoria engaged in warfare with the Kickapoo, Mascouten and Mesquakie throughout the 1710s and 1720s. These people would have been represented at

Starved Rock by invaders and captives. The Illini had left Starved Rock by 1780 (Tanner 1987:63). The Potawatomi reached the area by 1763 and remained until forced out by American settlement.

The archaeological remains of the Grand Village of the Kaskaskia are known as the Zimmerman Site (11Ls13) and are located east of the Starved Rock Lock and Dam. The Peoria Illini inhabited Peoria from early European contact through the 1760s or 1770s (Temple 1977:58; Tanner 1987:51). The Kaskaskia moved their central village there from Starved Rock in 1691 and remained until 1700. The French had a licensed fur trade post at Fort Pimitoui in 1720 (Tanner 1987:39).

The Kickapoo came briefly in 1812, and were probably present in Potawatomi towns after that date. Peoria was included in the Potawatomi hunting range by the late 1740s and several Potawatomi towns could be found around Lake Peoria through the end of the 1820s. The peak of Potawatomi occupation was probably the 1810s, when the southernmost Potawatomi summer villages were located at Peoria (Tanner 1987:100).

The location of the La Grange Lock and Dam would have been in the heart of Illini territory at the time of European contact, and probably remained within their hunting range at least through the 1760s. By the 1790s, La Grange was within the southernmost reaches of the Potawatomi hunting lands and on the western edge of the Kickapoo territory. Tanner (1987:93) indicates a Kickapoo and Mascouten village nearby from 1776 to 1781. The first American settlers in Brown County encountered numerous Kickapoo in the 1820s:

> This Indian camp was down on the river at the old mouth of Camp Creek where they would stay through the summer and when cold weather came or the river commenced to rise they would move back to the ravines along the bluff (Bond 1959).

On the Cass County side of the river, J. F. Snyder's 1906 map shows an " 'Old Indian Trail' that ran along the foot of the Sangamon bluffs" leading to the site of Beardstown, where he indicates a Mascouten village could be found in 1698 and a Kickapoo village from 1794-1812.

Native American tribes living in the Illinois Country in historic times, including the Illini, Miami, Kickapoo, Mascouten and Potawatomi, had similar cultures and made use of the land in similar ways. In the summer, band members lived in large, relatively permanent villages and grew a variety of crops, including maize, beans, squash, pumpkins, gourds and melons (Kinietz 1972:172). After the fall harvest, seeds and surplus food were cached and most of the inhabitants left for the winter hunt. Winter hunting camps were small and usually confined to family groups. In the spring, when food resources were again plentiful, bands reunited. Fishing and maple sugar processing were important spring activities. In late spring, groups returned to their summer villages, planted crops, and participated in summer hunts. As the French and English moved westward, hunting became important for the fur trade as well as for food (Hajic, et al. 1996:12).

Europeans arrived in the region in 1673, when Frenchmen Louis de Joliet and Father Pere Jacques Marquette explored the Illinois River Valley. The character of the landscape along the Illinois River Valley quickly changed. The French immediately began to establish several forts and missions in the valley (Hajic, et al. 1996:9). Small settlements began to spring up. By 1723, the French were extensively clearing timber and cultivating lands, particularly along the Illinois and its tributaries (M. Walker 1992:2).

As American settlers moved westward, European dominance in the Illinois River Valley began to wane. By 1778, the French and British relinquished all claim to the region (M. Walker 1992:2). Forty years later Illinois had a sufficient number of residents to apply for statehood (Larson 1979:6). Businessmen and politicians soon realized the commercial and transportation value of a canal linking Lake Michigan with the Illinois River. In the spring of 1848, the first canal linking the two bodies of water was opened (Larson 1979:6-7,185). Over the years, the waterway has been modified and improved to create the Illinois Waterway System. Today, large cargo-bearing barges, as well as fishing boats and other recreational craft, are a common site along the Illinois Waterway.

As in the past, farming continues to be an important activity across much of the floodplain adjacent to the Illinois Waterway (M. Walker 1992:2). Sand, gravel, clay and shale quarries are common along portions of the waterway. Some areas of timber are logged. Urban development, highway and railroad construction, dredging and levee construction have changed the natural landscape along much of the Illinois Waterway.

French explorers produced the earliest written documentation of the plants, animals and environment which they encountered along the Illinois River Valley (Franke 1995:56). These early accounts note the abundance of resources in the valley. As indicated by Marquette (Marquette Journal 1673) and Joutel (Joutel Journal 1684), the region had a plentitude of all things necessary to support human life:

> We have seen nothing like this river [the Illinois] ... for the fertility of the land, its prairies, woods, wild cattle, elk, deer, wildcats, bustards, swans, ducks, parrots, and even beaver; its many small lakes and rivers (Marquette Journal 1673).
>
> The country of the Illinois enjoys all advantages - not only beauty, but also a plentitude of all things needed to support human life.... The plain, which is watered by the river, is beautified by... small hills... covered with groves of oaks and walnut trees.... The fields are full of grass, growing very tall. That country is one of the most temperate in the world, so that whatever is grown there - whether herbs, roots, Indian corn or even wheat - thrives very well (Joutel Journal 1684).

The areas around Starved Rock and Lake Peoria have long been of interest to historians and archaeologists concerned with the study of the early Contact period in the Illinois Country. The Newell and Zimmerman sites in particular have produced substantial data. The Peoria region has been less yielding. The location of Fort Crèvecour has been puckishly elusive; at least seven possible sites have disappointed scholars to date (Franke 1995:76-citing unpublished report of Jelks and Unsicker, 1981). Detection of contact period sites on Lake Peoria has been hampered by the almost continuous occupation of the region since the earliest European contact.

Until recently, these two locations have been the focus of nearly all scholarly interest in the historic Illini. Attention has begun to turn now toward the lower Illinois River Valley, and, specifically toward the winter hunting villages. Walthall, Norris, and Stafford (1992:149) report that the Naples site in Scott County, long known for its Middle Woodland component, includes an historic component dating to the late 17th century. They further suggest that this was the village of "the woman chief" visited by French priest Jean-Francois Buisson de St. Cosme and his companions in late November of 1698 (Walthall, et al. 1992:146-147). St. Cosme estimated the village as having about 20 cabins and reported that a woman chief led it with many sons and sons-in-law. Also living in the village was a French soldier and his "savage" wife (148).

Esarey (M. 1997:188) points out that "Woman Chief's Village" is not specifically identified as Kaskaskia by St. Cosme, and generally finds the association of the Naples site to Woman Chief's Village to be tenuous. Nevertheless, he presents a compelling case for further investigation of the lower Illinois River Valley and of winter hunting villages. Esarey provides an extensive list of early references to Illini villages along the Illinois River and its tributaries. Most of these are typically elusive when an exact location is attempted. Four villages appear to have enough information to merit further investigation, and certainly to merit closer scrutiny by archaeologists. They are Pierre a' la Fleche, the Peorias' winter hunting grounds, Mauvaise Terre, and Grand Pass. Esarey suggests that these villages were probably located, respectively, near Flint Creek, La Moine River, Mauvaise Terre or McKee Creek, and Apple Creek (M. Esarey 1997:180-181).

The first American settlers along the Illinois River frequently encountered villages of Kickapoo and Potawatomi. Occasionally, the immigrants used recently vacated Native American houses for their first dwellings. Several river towns are located on the sites of prehistoric and historic villages. Reference is made to these simultaneous habitations in the following portions of this report which discuss early American settlement of the Illinois River Valley.

F. Early European Presence (1673-1826). The French occupation of the Illinois River Valley has been outlined previously in the context of the Historic Native American occupation. It is difficult to distinguish the history of the French in Illinois from that of the Native Americans of the period. The same may often be said of the culture and life ways of the two. Once the French came, the lives of the Indians and the course of their history changed. Conversely, the presence of Native Americans along the Illinois drew the French to the region. The French came to trade for furs and to convert "savages" to Christianity. Both endeavors required close association with the indigenous people.

French trader Louis Jolliet and Jesuit priest Jacques Marquette left St. Ignace in the spring of 1673 to explore the Mississippi. They ventured far enough down the river to know that it led, not to the Pacific and the riches of the East, but to the Gulf of Mexico and the regions claimed by Spain. On their return trip, they paddled up the Illinois and Des Plaines Rivers to Lake Michigan. This was the first recorded European exploration of the Illinois Country.

Marquette returned briefly to Le Rocher in 1675. He established the Jesuit mission of the Immaculate Conception, but left almost immediately and died before he reached Mackinac. Father Claude Jean Allouez took Marquette's place at the Kaskaskia village in the spring of 1677 (Temple 1977:19-20). For the next thirty years the focus of European and aboriginal interaction in the Illinois Country would shift between Le Rocher and the shores of Lake Peoria.

René Robert Cavalier, Sieur de La Salle, came down the Illinois River late in 1679. When he reached the Grand Village at Starved Rock, he found its inhabitants away on their winter hunt. La Salle and his party raided the Kaskaskia's corn caches and proceeded down the river. Early in January of 1680, thirty leagues below the Kaskaskia village, La Salle and his party came to a Peoria village on the southern end of Lake Peoria.

La Salle and his men stayed briefly with the Peoria and then moved across the river where they built Fort Crèvecoeur. In March La Salle left Henri Tonti in charge of the unfinished fort and returned to Canada. In La Salle's absence, the men destroyed and deserted the fort. Avery (1988:89-101) summarizes the various locations believed to be the possible site of Fort Crèvecour. None of these have produced archaeological evidence of a French occupation.

La Salle continued his explorations to their tragic end and Tonti remained at the Rock until the winter of 1691-92. By that time the French and Indian village had exhausted the game and timber surrounding the Rock. Tonti built a larger Fort St. Louis, also called Fort Pimitoui, on the west bank of the river, a mile and a half above the outlet of Lake Peoria. This was said to be the site of the Kaskaskia's favorite winter camp. The Jesuit mission to the Kaskaskia also moved to Peoria. French, métis, Shawnee, Wea, Piankashaw, Miami, Ouabona, Kilatika, Pepikokia, Kickapoo, and Mascouten gathered around Tonti's forts for trade, conversion, and protection (Burns 1968:3; Howard 1972:34; Hall 1991:14-15). The precise location of Fort Pimitoui has also eluded historians and archaeologists (Barr et al. 1988).

In the early 18th century, the population around Lake Peoria began to decline. Howard (1972:36) attributes this to the increasing strength of the Mesquakie, the instability of the Illini, and the weakening of the French. The Kaskaskia moved down river in 1700, where they were followed by the traders and missionaries. Tonti left for New Orleans, the traders settled at Cahokia, and the Kaskaskia and Jesuits founded the town of Kaskaskia (Howard 1972:36).

For most of the 18th century, Peoria was a distant outpost of the French, then British, then American frontier. It may have been completely deserted in 1722 and 1723 during the Fox (Mesquakie) Wars. By 1730 there was a French village along the lake, and in 1756 the French built a stockade to protect the settlement from the Mesquakie. The Peoria had left by 1763 and were replaced by the Potawatomi, Miami and Kickapoo. The French stockade was burned by Indians in 1773, but there were one hundred French fur traders still living at Peoria in 1800.

Trader Jean Baptiste Maillet may have instigated the removal downstream of the French village in the late 1700s. Maillet's stockaded fort burned in 1788, but it was in his village that Thomas Forsythe built an American Fur Company post in 1806 (Barr et al. 1988:97; Emerson and Mansberger 1991:152; Gray 1940:78; Howard 1972:91). Secondary sources vary wildly on the dates of all of these events. For example, Gray (1940:78) says Maillet and his followers settled at Peoria in 1761, Howard (1972:70, 91) says 1778, and Emerson and Mansberger (1991:152) give a date of 1788.

In 1812, an expedition led by Governor Edwards killed twenty or thirty fleeing Miami and Kickapoo and burned several villages at Lake Peoria. This was followed by another attack by Captain Thomas E. Craig. Craig's men looted and burned the town and captured forty of its inhabitants. Craig led his captives downstream until ordered to release them. He abandoned the prisoners at Alton. The descendants of these captives would later try to re-establish their “French claims” in Peoria. Charles Ballance, an American settler and attorney in Peoria, whose life’s work was a crusade to overturn the French claims, originally wrote much of the history of the French in Peoria. Consequently, the written histories of Peoria have tended to belittle the French and métis presence in early Peoria (Ballance 1870).

The Americans replaced the French village at Peoria with Fort Clark, which they abandoned at the end of the War of 1812. Within five years the first American settlers arrived and the town of Peoria was platted in 1826. Under the French regime, the Illinois Country was a frontier within a frontier. It lay at the farthest reaches of both New France and Louisiana. Here the French and the Native Americans established their “middle ground,” a place were the representatives of indigenous and European cultures adjusted their values, their practices, and their understanding of one another (White 1991:ix-xi).

G. American Settlement. Due to the limits of this project, the discussion of the American occupation of the Illinois Waterway has been confined to the 19th century. It should not be forgotten, however, that another century of habitation has occurred since, and that the events and human behaviors of the 20th century are as much a part of the history of the valley and the waterway as those of any previous century.

For the purpose of this study, "American" settlers are defined as those people who came from the United States, or by way of the United States, to make their homes in Illinois in the 19th century. They were not the first "white" settlers, for the French had been here since the late 17th century. They were not necessarily Caucasian, for they included slaves, indentured servants and freedmen of African descent. They were by no means all "Anglo-American," and, strictly speaking, they were not all Americans, as many had emigrated from Europe.

American settlement of the Illinois River Valley began in the late 1810s, with the close of the War of 1812, the opening of the Military Tract to veterans, and achievement of Illinois statehood. When Illinois entered the Union in 1818, nearly all of its American settlers resided in the southern quarter of the state. Most of these people had come from Kentucky and Tennessee, and were "of the hunter type, desirous of finding a home in the woods, from which they could carve out little farming plots sufficient for their household needs" (Conger 1932:129). Recognized by scholars today as backwoodsmen of the Upland South culture, they subsisted on free-ranging hogs, corn grown in fields hewn from the forest, and wild game, fruit and honey.

Prior to the invention of the self-scouring plow in the 1830s, farmers found it impossible to till the prairie soil, with its deep, gummy snarl of grass roots. They established their farms along the edge of the prairies, where they could clear and till the forest, using the wood for building and fuel. The Ohio, Mississippi and Illinois Rivers, and their tributaries, provided the easiest, quickest, and safest means of transportation until the advent of the railroads.

The first generation of American settlers came into Illinois by way of the Ohio River, and congregated around Kaskaskia and Shawneetown. The second generation began to move northward along the Illinois River and its tributaries. Along the Sangamon River in the central part of the state, the Upland Southerners began to meet New Englanders. As one scholar expressed this cultural intersection, "These two human streams of settlers . . . proved very irritating to each other in many respects" (Conger 1932:130).

With the completion of the Erie Canal in 1825, immigrants from New England and the North Atlantic states found their way into Illinois by way of the Great Lakes. In 1833 only four boats dropped anchor in Chicago harbor. The following year, there were 180, and by 1836 the number had reached 450. Some of the New Englanders came in colonies, occasionally using one large common dwelling in the first years of settlement. The Connecticut colony at Rockwell, east of La Salle, was one of these (Conger 1932:144; Baldwin 1877:375).

Not all of the Eastern immigrants were farmers. The financial depressions of 1819 and 1837 brought wage-earners westward, seeking personal and financial independence from the more rigid society of the Northeast. The construction of the Illinois and Michigan Canal provided work for untold numbers of laborers.

The agricultural and labor opportunities also attracted large numbers of Irish, English and German immigrants beginning in the 1830s and 1840s. By 1850, foreign immigrants comprised one third of the population of Chicago. Most of these people dispersed throughout the state, finding work on canals and railroads, eventually buying land and taking up farming.

The earliest settlers along the Illinois River used canoes and pirogues. Even some of the first ferries consisted of a canoe, or two canoes lashed together. The first boats of European design were flatboats. Farmers, millers, and entrepreneurs built their flatboats of native timber, loaded them with products for trade, floated them down the Illinois to St. Louis, or on down the Mississippi to New Orleans. Most carried about fifteen tons and cost about $100.00 to build. Because flatboats could not reascend the river, their owners sold them for lumber or fire wood. The dismantled boats brought from $30.00 to $200.00 in New Orleans. The boatmen who desired to return home to Illinois either walked or, in later years, booked passage on a keelboat or steamboat. Flatboating continued on the Mississippi until the Civil War (Conger 1932:147).

Keelboats had the advantage of being able, with considerable effort, to return up the river. A trip up river from New Orleans to St. Louis took four backbreaking months of poling. Only one trip a year could be made by those wishing to sell goods in the Illinois Country. Keelboats gave rise to the legendary “half-horse, half-alligator” boatmen like Mike Fink.

Steamboats appeared on the Ohio River as early as 1811, and by the late 1810s, they were common on the Mississippi. The first steamboats ascended the Illinois in 1828. That year saw nine arrivals and departures at Naples. Three steamboats ran from St. Louis to Peoria in 1833. By 1852, the number of boats passing the Peoria Bridge reached 1,800. The average tonnage of Illinois River steamboats in 1851 was 275. The early boats required one cord of wood every twenty-four hours for each twelve tons (Conger 1932:156, 160, 163).

The steamboating season lasted from eight to 10 months of the year. For at least two months each winter, the boats could not move through the ice.

Two men from St. Louis and three from Springfield organized the Naples Packet Company in 1848. Until this time, the steamboats had been individually owned. The Naples Packet boats ran weekly from St. Louis to Naples, where they connected with the Sangamon and Morgan Railroad.

The Five Day Line, organized in 1852, accelerated the competition to provide speedy service. However, the railroads eventually spelled the demise of the Five Day Line, while the Naples packets survived because of their connection with the railroad. The strongest of the steamboat companies was the Illinois River Packet Company. Organized in 1858, it “largely controlled the commerce of the Illinois until it sold out in 1867” (Conger 1932:159). The railroad and “increasing hazards of navigation” (locks and dams) also spelled the end of this company (Conger 1932:159).

Traveling by steamboat could be dangerous. Snags, fires, collisions, and explosions are responsible for most of the 48 submerged boat sites on the Illinois Waterway. Although in later years the steamboats might be luxurious, the earlier boats were often very uncomfortable. As many as 500 or 600 passengers might be crowded on to the lower deck. A steamboat plying the river in 1838 provided one candle and one towel for the use of all of the women in its four ladies’ staterooms (Conger 1932:163-164).

The 19th century keelboats and steamboats brought new residents to the country, delivered goods for sale or trade, and hauled produce to market. The inhabitants of the Illinois River Valley sent down stream corn, hogs, wheat and other grains, honey and beeswax, wool, hides, cattle, whiskey, and coal. By mid-century towns like Peoria also shipped manufactured goods, especially agricultural implements and woven woolens.

Each successive mode of transportation affected the settlements along the Illinois River. Grain dealers built warehouses at the landings. Country taverns became hotels. Pork-packing became an important industry.

The construction of the Illinois and Michigan Canal opened the upper river to trade all the way to Chicago. It also caused a frenzy of land speculation and an influx of new settlers from the East and Europe.

The appearance of the railroads brought doom for some river towns and greater prosperity for those lucky enough to provide the junction between the rail and the river. River traffic continued throughout the 20th century in the form of barges pushed by tugboats. The simple necessity of getting people, goods, and livestock across the river caused ferries to be established with the earliest settlement of the river valley. Some of the first ferries were merely canoes in which people and goods could be paddled across, while the livestock swam alongside. The more daring ferryman sometimes lashed two or more canoes together in order to get larger loads across. Something more like a flatboat soon replaced the canoe, and later in the century the better ferries would be steam-powered.

The owner of the ferry was not necessarily the operator. Often the owners purchased the land, obtained the license from the county, and proceeded to found a village around the ferry landing. A series of interesting people would serve as ferry men, while the owner kept the store, the warehouse, or the tavern.

A ferry connected the people on two sides of the river. Sometimes this meant that a town grew up on both sides. In other cases, one side grew a town, while the other had no more than a wagon track leading down to the bank. Because ferries were often the only settlement along the bank of the river, and located at good natural landings, the ferry landing nearly always became a steamboat landing as well. It was not uncommon, as the century wore on, for a bridge to be built at the site of the ferry crossing. At the close of the 20th century, a few ferries still crossed the Illinois River.

Not every cargo brought by the steamboats was beneficial to the people who lived along the Illinois Waterway. Epidemic diseases traveled up and down the river on a regular basis. The most frightening of these was Asiatic Cholera, which had only appeared in the United States in the late 1700s. Cholera was most alarming because of the speed with which it could strike, killing healthy people in less than twenty-four hours, and whole families in a few days. Other forms of dysentery, as well as smallpox, measles, and scarlet fever stepped off the steamboats from time to time.

Most of the 19th century industry along the Illinois River was related to agriculture. The first essential industry were grist, saw, and flouring mills, usually built on tributary streams. As farm production increased, millers often expanded their operations. Grist mills became breweries, saw mills added carding and fulling mills, and flouring mills expanded to include distilleries. When farmers brought their grain and livestock to the steamboat landings, they often had to wait days or weeks before the boat arrived to take their cargo to market. Grain dealers and meat-packers soon discovered a profitable business opportunity.

Many of the first American settlers in Illinois were of the Upland South culture. They based their subsistence and their economy on corn, hogs, and wild game. Hogs were "cheap to raise, easy to produce, looked after themselves, and provided the household with meat for most of the year" (Walsh 1982:18-19). In the early years of settlement, the preferred breed was the razorback, a half wild hog that could been turned loose in the woods to forage for itself on nuts and fruit. Local legends said that these hogs had been left by the French, or escaped from early settlers during the winter of the Deep Snow. As the weather grew cold, owners would either hunt their stock as any other wild game, or round them up and fatten them on corn for a few weeks before slaughter. With increased settlement and markets, farmers began to bring in pure-bred stock.

River towns like La Grange, Beardstown, Pekin and Peoria became crucial centers for packing and shipping meat from the late 1820s until the prevalence of the railroads. At first, farmers drove their hogs to the landing, loaded them on flatboats and shipped them down river to St. Louis. Merchants at the landings began to butcher and salt the meat for shipping. The market, the supply, and the means of transportation grew almost simultaneously on the Illinois River. As the St. Louis market expanded, the numbers of settlers and their livestock burgeoned, and the steamboat made its appearance on the Illinois.

The Illinois towns had an advantage over the large pork-packing towns of the Ohio River, in that their packing season was longer. There were more cool, but not bitterly cold, days suitable for slaughtering and packing. Even on the Illinois River, the business could be risky:

> A mild spell was the most frequent hazard. . . Then hogs accumulated at the pens with delay and loss to the owner, or carcasses were spoiled. Rains and floods were another seasonal hazard; occasionally the rivers would rise high enough to flood the pork houses otherwise conveniently located on the bank. A bitterly cold spell or snowstorms could also retard slaughtering by making working conditions impossible (Walsh 1982:25).

Most of the mid-19th century packers along the Illinois were merchants who engaged in the meat packing business as a sideline:

> In the early fall they advertised their willingness to put up hogs or dressed pork or to supply packing materials. Once the weather turned cold enough, they started slaughtering and packing and continued to work at high speed for about six weeks. They stored the salted and cured meat ready for shipment down river in the spring. During the rest of the year they conducted a western produce and dry goods trade (Walsh 1982:41).

By the 1840s, Chicago nearly matched the river towns as a meat-packing center. The opening of the Illinois and Michigan Canal in 1848 made it easier for farmers to ship their hogs directly to Chicago, by-passing the merchants along the river. However, it was only with the advent of the railroads, with Chicago as the hub, that meat processing shifted dramatically to the "Hog Butcher to the World." In the last quarter of the 19th century, packers continued to operate along the river, but usually only for local or specialized markets. While meat-packing became a year-round industry in the large centers like Chicago, it remained largely seasonal along the river (Walsh 1982:51, 67).

From the beginning of the American occupation of the Illinois Country, settlement has not always been what it seemed. Veterans who claimed their warrants in the Military Tract between the Illinois and Mississippi Rivers often never set foot in Illinois. They sold their rights to speculators, or allowed their claims to lapse.

In wave after wave of speculative frenzies, ambitious entrepreneurs bought vast acres of farmland that would never sell at the high prices asked for them. They laid off towns that never saw a building erected or, in some cases, never even saw a lot sold. Some of the ventures, such as the proposed canal in Calhoun County, may not have been unreasonable investments, except for the succession of panics and depressions which periodically brought all economic growth to a standstill.

People bought lots and built houses in some of the towns, only to have the ferry or steamboat landing move, the railroad reach a rival town, or the founders not live up to their bargains. When they abandoned their town, the residents occasionally took their houses with them. More often, the buildings rotted into the soil, and within a generation the town site was part of a farmer's field, and the existence of the town all but forgotten.

The heart of 19th century settlement along the Illinois River is the river landing. Here farmers brought their produce to be sold and shipped to market, and they bought their supplies, necessary and frivolous, for the coming weeks, months or year. The settlers' port of entry to Illinois was the landing, and it was their way out, whether to trade, visit, or leave. Food, tools, news, wealth, disease, entertainment, rascals, and heroes came off the boats at the landings. At the landings could be found ferryboats and bridges, warehouses, stockyards, packing houses, hotels, stores, homes, offices, smithies, mills, and factories. At the site of a former river landing, extant buildings, foundations, substantial deposits of animal bone, and assemblages of 19th century artifacts related to boating, butchering, milling, brewing, distilling, milling, blacksmiths and the manufacture of plows and other farm implements, and tavern-keeping might be found.

Back from the river, on the bottoms there may be indications of the less affluent residents of the century, those who made their way into history books only as colorful characters of the valley. Their activities as farmers, boatmen, shellers, fishermen, and hunters would be reflected in the remains of their homes.

In some parts of the valley, farmers built their farmsteads at the base of the bluffs, even at a relatively early date (the text of this section of the report was taken wholly or in part from the *Illinois River Ecosystem Restoration Feasibility Study Restoration Needs Assessment Native Ecotype and Historic Change Assessment*. (Post and Wiant 2004:55-88). These structures range from log cabins to frame houses to substantial limestone buildings, some of which are still standing. A sharp rise in population in the early part of the 19th century signaled a change in human ecology and a transformation of the Illinois River Basin landscape. The wave of human migration moved from the south to the north along the Mississippi and Illinois Rivers, inland along Illinois River tributaries, and overland across the rolling prairie landscape.

People settled in areas where there were few traces of civilization, setting off a synergism measured by increases in cultivated land, the construction and maintenance of roads and trails, farms and communities that dotted the landscape, and the development of marketplaces. Farm and community-based landscape development and management soon gave way to public works projects, the first of which perhaps was the design and construction of the Illinois and Michigan Canal. At the same time, the invention of the steel plow enabled farms to expand land under cultivation with unprecedented efficiency. The demand for timber needed for construction and fuel increased accordingly, and prairie groves shrunk at a rate far greater than their ability to regenerate. By 1840 the insatiable appetite for energy shifted to coal, which was transported by wagon and barge to communities near and far alike.

By the middle of the 19th century, farmers began to secure more land for production by draining wetlands. Using horse drawn slips, they cut ditches, but soon turned to the use of drainage tile. By 1880, 1,140 factories in the Midwest, such as White and Company's Pottery and Tile Works located on the Illinois River floodplain south of Morris, manufactured drainage tile. In the Kankakee Marsh alone, more than 500,000 acres were drained, and between 1884 and 1886, steam excavators drained approximately 50,000 acres of the North Quiver Swamp near Forest City and Delavan. By the end of the century, in a period of 50 short years, most of Illinois' prairie and much of its wetlands disappeared. Meanwhile, sediment eroded from the uplands made its way into streams and rivers. In 1852, dredging began to keep certain parts of the river open for navigation. Shortly thereafter, several low dams were constructed to manage river level ii selected locations such as Henry, Illinois (1872); Copperas Creek (1877); LaGrange (1889); and Kampsville (1893) (Thompson 2002:63).

Despite changes in the river, it remained an extraordinary fishery. In 1894, there were 1,653 active fishermen on the river, and in 1899 they harvested 241,000 pounds of catfish. In 1908, 2,500 commercial fishermen took nearly 24 million pounds of fish from the Illinois (Forbes and Richardson 1908), and in 1910, over 2,600 mussel-fishing boats plied the river. Abundant waterfowl in the fall made the valley a mecca for commercial and sport hunters. Facing over-exploitation of its resources, the river soon faced a new challenge; one which would change the fundamental character of its ecosystem.

On January 1, 1900, the Chicago Sanitary and Ship Canal opened. This canal connected the Des Plaines and Illinois Rivers to Lake Michigan and as a result gave the City of Chicago a means of flushing untreated domestic sewage and industrial wastes away from Lake Michigan into the Illinois River system. At first the diverted water enhanced the aquatic habitats of the Illinois River Valley-habitats available to fishes increased as the diverted water doubled the surface area and extended and deepened the bottomland lakes and marshes. As a result of all the water, thousands of hectares of bottomland timber were inundated and eventually died as many small lakes, sloughs and marshes were united into larger bodies of water. As late as 1940, "dead snags from this 'drowned forest' were still in evidence".

The opening of the Chicago Sanitary and Ship Canal increased the sewage load in the Illinois River, and by 1923 the oxygen content of the river from below Chicago to Peoria was negligible. Stephen Forbes (1911) noted:

> "Immediately below the mouth of the canal we have in the Des Plaines a mingling of these waters, and the Illinois River itself, below the junction of the Des Plaines and the Kankakee, the septic contributions of the former stream are largely diluted by the comparatively clean waters of the latter. Nevertheless, we had in July and August what

> may be called septic conditions for 26 miles of the course of the Illinois from its origin to the Marseilles dam. At Morris, which is on the middle part of this section, the water, July 15, was grayish and sloppy, with foul, privy odors distinguishable in hot weather."

Although levee construction had begun in the late 1890s, between 1902 and 1923, drainage districts greatly modified the landscape, removing for agricultural purposes floodplain terrestrial and aquatic habitats. By 1929, 38 organized drainage and levee districts and three private levees enclosed roughly 200,000 acres of the Illinois River Valley. Spring and Thompson Lakes, long known for their fisheries and their concentrations of waterfowl, were eliminated as were a host of smaller lakes and sloughs. These districts transformed 39 percent of the total floodplain by allowing conversion of wet and mesic floodplain prairies to crops. The levees affected the hydrology and sediment transport processes of the river. They increased floodstages by reducing the space available for water flow, storage, and sediment deposition. The levees effectively constricted the floodplain right to the edge of the river.

In 1920, construction began on the Illinois Waterway (Sackett 1921). Prior to the construction of the Waterway, river traffic between Lockport and Utica was periodically interrupted due to low water. By the end of the 1930s, a series of dams and locks at Lockport (1933); Brandon Road (1933); Dresden (1933); Marseilles (1933); Starved Rock (1933); Peoria (1939); and LaGrange (1939) ensured navigation on the Illinois River (Hajic et al. 1996).

III. SUMMARY AND CONCLUSIONS

Natural processes alone shaped the character of the Illinois River Basin from its from its formation during the waning stages of the Pleistocene until the arrival of settlers in the early 19th century. Native Americans occupied the basin throughout this period, but neither their number nor technology substantially affected the long-term character of the basin, with the possible exception of using fire to maintain prairie habitat, though the scale of this enterprise is not well known. At first they depended on hunting and gathering, a procurement economy that is subject to the vagaries of seasonal and geographic variability in resources. With the cultivation first of native plants then exotic species, Native American economy coupled procurement strategies with those of production, which naturally changed their relationship with the landscape.

First the French, then American settlers brought new means of production. Though they also relied on traditional practices such as hunting and fishing, settlers had access to distant marketplaces for goods and relied in part on livestock for food. They soon developed new means of cultivation that harnessed draft animals to steel plows that substantially increased settlers' productivity, their numbers, and their influence on the landscape.

Within little more than a century, beginning in the 1830s, forest groves had been cleared, vast expanses of prairie drained and cultivated, the rural population reached its zenith, towns were established along streams and railroads, waterways had been dammed to energize mills and ensure navigation, and the Illinois River was engineered to transport resources to Chicago and waste water away.

The heart of 19th century settlement along the Illinois River is the river landing. Here farmers brought their produce to be sold and shipped to market, and they bought their supplies, necessary and frivolous, for the coming weeks, months or year. The settlers' port of entry to Illinois was the landing, and it was their way out, whether to trade, visit, or leave. Food, tools, news, wealth, disease, entertainment, rascals, and heroes came off the boats at the landings. At the landings could be found ferryboats and bridges, warehouses, stockyards, packinghouses, hotels, stores, homes, offices, smithies, mills, and factories. At the site of a former river landing, extant buildings, foundations, substantial deposits of animal bone, and assemblages of 19th century artifacts related to boating, butchering, milling, brewing, distilling, milling, blacksmiths and the manufacture of plows and other farm implements, and tavern-keeping might be found.

Back from the river, on the bottoms there may be indications of the less affluent residents of the century, those who made their way into history books only as colorful characters of the valley. Their activities as farmers, boatmen, shellers, fishermen, and hunters would be reflected in the remains of their homes. In some parts of the valley, farmers built their farmsteads at the base of the bluffs, even at a relatively early date. These structures range from log cabins to frame houses to substantial limestone buildings, some of which are still standing.

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DIST CONSERVATIONIST
EROSION CONTROL TASK FORCE
US DEPT OF AGRICULTURE-NAT RES CONSV SRV
937 W CENTER ST
EUREKA IL 61530

ECONOMIC DEVELOPMENT ADMINISTRATION
US DEPT OF COMMERCE
111 N CANAL ST - STE 855
CHICAGO IL 60606-7204

DIRECTOR
US DEPT OF HUD - REG V
77 W JACKSON BLVD
CHICAGO IL 60604

ROBERT HOLMES
DISTRICT CHIEF
US DEPT OF INTERIOR-US GEOLOGICAL SURVEY
1201 W UNIVERSITY AVE STE 100
URBANA IL 61801

DON ROSEBOOM
US DEPT OF INTERIOR-US GEOLOGICAL SURVEY
1201 W UNIVERSITY AVE STE 100
URBANA IL 61801

PHYLLIS ELLIN
EXECUTIVE DIRECTOR
I&M CANAL NATL HERITAGE CORR COMM
US DEPT OF THE INTERIOR
201 W TENTH ST #1-SE
LOCKPORT IL 60441

RONALD BABB
BRANCH MANAGER
FEDERAL AVIATION ADMIN
US DEPT OF TRANSPORTATION
GREATER PRIA APARATMENTS 6TH FL
PEORIA IL 61607

MILO ANDERSON
US ENVIRONMENTAL PROTECTION AGENCY - REG 5
77 W JACKSON BLVD
CHICAGO IL 60604

JANICE CHENG
WQW-16J
US ENVIRONMENTAL PROTECTION AGENCY - REG 5
77 W JACKSON BLVD
CHICAGO IL 60604

AL FENEDICK
PLANNING & ASSESSMENT BR ME-19J
US ENVIRONMENTAL PROTECTION AGENCY - REG 5
77 W JACKSON BLVD
CHICAGO IL 60604

WILLIAM FRANZ
CHIEF
US ENVIRONMENTAL PROTECTION AGENCY - REG 5
77 W JACKSON BLVD
CHICAGO IL 60604-3590

TIM HENRY
ASSOCIATE DIRECTOR
WATER DIVISION
US ENVIRONMENTAL PROTECTION AGENCY - REG 5
77 W JACKSON BLVD
CHICAGO IL 60604-3590

CHRISTINE URBAN
US ENVIRONMENTAL PROTECTION AGENCY - REG 5
77 W JACKSON BLVD
CHICAGO IL 60604

JO LYNN TRAUB
DIRECTOR
WATER DIVISION
US ENVIRONMENTAL PROTECTION AGENCY - REG 5
77 W JACKSON BLVD
CHICAGO IL 60604-3590

BOB CLEVENSTINE
FWIC REPRESENTATIVE
RI ECOLOGICAL SVCS FIELD OFC
US FISH AND WILDLIFE SERVICE
4469 48TH AVE CT
ROCK ISLAND IL 61201

GWEN KOLB
PRIVATE LANDS BIOLOGIST
US FISH AND WILDLIFE SERVICE
19031 EC 2110N
HAVANA IL 62644

JEFF MENGLER
COORDINATOR/BOTANIST
CHICAGO ILLINOIS FIELD OFC
US FISH AND WILDLIFE SERVICE
1250 S GROVE AVE SUITE 103
BARRINGTON IL 60010

JOHN ROGNER
FIELD SUPERVISOR
CHICAGO ILLINOIS FIELD OFC
US FISH AND WILDLIFE SERVICE
1250 S GROVE AVE SUITE 103
BARRINGTON IL 60010

MIKE MAC MILLEN
FEDERAL ACTIVITIES PROGRAM B-19J
US ENVIRONMENTAL PROTECTION AGENCY - REG 5
77 W JACKSON BLVD
CHICAGO IL 60604-3590

KEN WESTLAKE
CHIEF
ENVIRON, PLNG, & EVALUATION BR
US ENVIRONMENTAL PROTECTION AGENCY - REG 5
77 W JACKSON BLVD
CHICAGO IL 60604

REGIONAL DIRECTOR
US FISH AND WILDLIFE SERVICE
77 W JACKSON BLVD
CHICAGO IL 60604

RON FISHER
REFUGE OPERATIONS SPECIALIST
US FISH AND WILDLIFE SERVICE
19031 EC 2110N
HAVANA IL 62644

KRAIG MC PEEK
IWW OSIT REP
US FISH AND WILDLIFE SERVICE
4469 48TH AVE CT
ROCK ISLAND IL 61201

RICHARD NELSON
FIELD SUPERVISOR
US FISH AND WILDLIFE SERVICE
4469 48TH AVE CT
ROCK ISLAND IL 61201

MATT SPRENGER
REFUGE MANAGER
US FISH AND WILDLIFE SERVICE
19031E CR 2110N
HAVANA IL 62644

DON ROSEBOOM
US GEOLOGICAL SERVEY
8709 W JOHNSON FARM RD
PEORIA IL 61607

STEPHEN J SCATES
STATE EXECUTIVE DIRECTOR
USDA - FARM SERVICE AGENCY
PO BOX 19273
SPRINGFIELD IL 62794-9273

JIM APPELL
STATE DIRECTOR
USDA - RURAL DEVELOPMENT
2118 W PARK CT
CHAMPAIGN IL 61821-2986

USDA NATURAL RES CONSERVATION SERVICE
6715 N SMITH RD
EDWARDS IL 61528-9588

USDA NATURAL RESOURCES CONSERVATION SERVICE
937 W CENTER ST
EUREKA IL 61530

JEREMY BECK
USDA NATURAL RES CONSERVATION SERVICE
685 LARRY POWER RD
BOURBONNAIS IL 60914

BOB GOTHOWSKI
USDA NATURAL RESOURCES CONSERVATION SERVICE
685 LARRY POWER RD
BOURBONNAIS IL 60914

CATHERINE HADLEY
USDA NATURAL RES CONSERVATION SERVICE
7775A ROUTE 47
YORKVILLE IL 60560

JON HUBBERT
EROSION CONTROL TASK FORCE
USDA NATURAL RESOURCES CONSERVATION SERVICE
307 HILLCREST DR
WASHINGTON IL 61571

JOSH JOSEPH
EROSION CONTROL TASK FORCE
USDA NATURAL RES CONSERVATION SERVICE
6715 N SMITH RD
EDWARDS IL 61528

JILL KEETON
USDA NATURAL RESOURCES CONSERVATION SERVICE
7775A ROUTE 47
YORKVILLE IL 60560

STEVE ZWICKER
USDA NATURAL RES CONSERVATION SERVICE
312 E BACKBONE RD STE A
PRINCETON IL 61356

THOMAS SKINNER
REG ADMIN
USEPA REGION V
77 W JACKSON BLVD
CHICAGO IL 60604

DIRECTOR
UNIVERSITY OF ILLINOIS
WATER RESOURCES CENTER
1101 W PEABODY DR
URBANA IL 61801

POSTMASTER
POST OFFICE
PO BOX 9998
MT STERLING IL 62573-9998

POSTMASTER
POST OFFICE
PO BOX 9998
SPRING VALLEY IL 61362-9998

POSTMASTER
POST OFFICE
PO BOX 9998
DALZELL IL 61320-9998

POSTMASTER
POST OFFICE
PO BOX 9998
PRINCETON IL 61356-9998

POSTMASTER
POST OFFICE
PO BOX 9998
BEARDSTOWN IL 62618-9998

POSTMASTER
POST OFFICE
PO BOX 9998
ARENZVILLE IL 62611-9998

POSTMASTER
POST OFFICE
PO BOX 9998
CHANDLERVILLE IL 62627-9998

POSTMASTER
POST OFFICE
PO BOX 9998
VIRGINIA IL 62691-9998

POSTMASTER
POST OFFICE
301 N MAIN ST
LEWISTOWN IL 61542-9998

POSTMASTER
POST OFFICE
PO BOX 9998
LOMAX IL 61454

POSTMASTER
POST OFFICE
PO BOX 9998
GRAFTON IL 62037-9998

POSTMASTER
POST OFFICE
PO BOX 9998
KANKAKEE IL 60902-9998

POSTMASTER
POST OFFICE
PO BOX 9998
OSWEGO IL 60543-9998

POSTMASTER
POST OFFICE
PO BOX 9998
YORKVILLE IL 60560-9998

POSTMASTER
POST OFFICE
PO BOX 9998
GALESBURG IL 61401-9998

POSTMASTER
POST OFFICE
PO BOX 9998
RANSON IL 60470-9998

POSTMASTER
POST OFFICE
PO BOX 9998
LA SALLE IL 61301

POSTMASTER
POST OFFICE
PO BOX 9998
OTTAWA IL 61350

POST MASTER
POST OFFICE
310 MILL ST
UTICA IL 61373

POSTMASTER
POST OFFICE
PO BOX 9998
PERU IL 61354

POSTMASTER
POST OFFICE
PO BOX 9998
DANA IL 61321-9998

POSTMASTER
POST OFFICE
221 E HICKORY ST
STREATOR IL 61364-9998

POSTMASTER
POST OFFICE
PO BOX 9998
TONICA IL 61370-9998

POSTMASTER
POST OFFICE
PO BOX 9998
TOPEKA IL 61567-9998

POSTMASTER
POST OFFICE
PO BOX 9998
GRAND RIDGE IL 61325-9998

POSTMASTER
POST OFFICE
PO BOX 9998
UTICA IL 61373-9998

POSTMASTER
POST OFFICE
PO BOX 9998
RUTLAND IL 61358-9998

POSTMASTER
POST OFFICE
PO BOX 9998
OGLESBY IL 61348-9998

POSTMASTER
POST OFFICE
PO BOX 9998
LEONORE IL 61332-9998

POSTMASTER
POST OFFICE
PO BOX 9998
SENECA IL 61360-9998

POSTMASTER
POST OFFICE
PO BOX 9998
MANITO IL 61546-9998

POSTMASTER
POST OFFICE
PO BOX 9998
BATH IL 62617-9998

POSTMASTER
POST OFFICE
PO BOX 9998
LACON IL 61540-9998

POSTMASTER
POST OFFICE
505 MAIN ST
HENRY IL 61537-1400

POSTMASTER
POST OFFICE
PO BOX 9998
SPARLAND IL 61565-9998

POSTMASTER
POST OFFICE
PO BOX 9998
HAVANA IL 62644-9998

POSTMASTER
POST OFFICE
PO BOX 9998
NORMAL IL 61761-9998

POSTMASTER
POST OFFICE
PO BOX 9998
BLOOMINGTON IL 61701-9998

POSTMASTER
POST OFFICE
PO BOX 9998
MEREDOSIA IL 62665-9998

POSTMASTER
POST OFFICE
PO BOX 9998
PEORIA IL 61601-9998

POSTMASTER
POST OFFICE
PO BOX 9998
HENNEPIN IL 62644-9998

POSTMASTER
POST OFFICE
PO BOX 9998
EAST PEORIA IL 61611-9998

POSTMASTER
POST OFFICE
401 E WASHINGTON ST
EAST PEORIA IL 61611-2663

POSTMASTER
POST OFFICE
2000 MCDONOUGH ST
JOLIET IL 60436-9998

POSTMASTER
POST OFFICE MORRIS
202 E WASHINGTON ST
MORRIS IL 60450-2275

ATTN: CELRC-TS-HH-HH
US ARMY ENGR DIST - CHICAGO
111 N CANAL ST - 6TH FL STE 600
CHICAGO IL 60606-7205

SHAMEL ABOU-El-SEOUD
CHIEF
ATTN: CELRC-TS-C
US AMRY ENGR DIST - CHICAGO
111 N CANAL ST - 6TH FL STE 600
CHICAGO IL 60606-7206

SHERRIE BARHAM
CHIEF - PROGRAMS MGMT OFC
ATTN: CELRC-PM-PM
US AMRY ENGR DIST - CHICAGO
111 N CANAL ST - 6TH FL STE 600
CHICAGO IL 60606

SUSANNE DAVIS
ATTN: CELRC-PM-PL
US AMRY ENGR DIST - CHICAGO
111 N CANAL ST - 6TH FL STE 600
CHICAGO IL 60606-7206

ROY DEDA
DEPUTY DIST ENGR FOR PROJ MGMT
ATTN: CELRC-DPM
US AMRY ENGR DIST - CHICAGO
111 N CANAL ST - 6TH FL STE 600
CHICAGO IL 60606

GENE FLEMING
ATTN: CELRC-PM-PL-E
US AMRY ENGR DIST - CHICAGO
111 N CANAL ST - 6TH FL STE 600
CHICAGO IL 60606-7206

COL GARY JOHNSTON
COMMANDER
US AMRY ENGR DIST - CHICAGO
111 N CANAL ST - 6TH FL STE 600
CHICAGO IL 60606

TIM KROLL
ATTN: CELRC-TS-C-T
US AMRY ENGR DIST - CHICAGO
111 N CANAL ST - 6TH FL STE 600
CHICAGO IL 60606-7205

KEITH RYDER
ATTN: CELRC-PL-V
US AMRY ENGR DIST - CHICAGO
111 N CANAL ST - 6TH FL STE 600
CHICAGO IL 60606

CHARLES SHEA
ATTN: CELRC-PM-PM
US AMRY ENGR DIST - CHICAGO
111 N CANAL ST - 6TH FL STE 600
CHICAGO IL 60606-7205

LINDA SORN
CHIEF - TECHNICAL SERVICES DIV
ATTN: CELRC-TS
US AMRY ENGR DIST - CHICAGO
111 N CANAL ST - 6TH FL STE 600
CHICAGO IL 60606-7205

FRANK VERALDI
ATTN: CELRC-PM-PL-E
US AMRY ENGR DIST - CHICAGO
111 N CANAL ST - 6TH FL STE 600
CHICAGO IL 60606-7205

GARY WICKBOLDT
ATTN: CELRC-PM-PL-F
US AMRY ENGR DIST - CHICAGO
111 N CANAL ST - 6TH FL STE 600
CHICAGO IL 60606-7205

TODD ERNENPUTSCH
US ARMY CORPS OF ENGINEERS - PEORIA
257 GRANT ST
PEORIA IL 61603

RICK GRANADOS
IL RIV PROJECT OFFICE
US ARMY CORPS OF ENGINEERS - PEORIA
257 GRANT ST
PEORIA IL 61603

MIKE ZERBONIA
IL RIV PROJECT OFFICE
US ARMY CORPS OF ENGINEERS - PEORIA
257 GRANT ST
PEORIA IL 61603

TAMARA ATCHLEY
COMMANDER
ATTN: CEMVS-PM-F
US ARMY CORPS OF ENGINEERS - ST LOUIS
1222 SPRUCE ST
ST LOUIS MO 63103

COMMANDER
ATTN: CELRD-DE
US ARMY CORPS OF ENGRS-GR LAKES AND OHIO
111 N CANAL ST - 6TH FL STE 600
CHICAGO IL 60606-7205

JAN MILLER
ATTN: CELRD-GL-E-EW-Q
US ARMY CORPS OF ENGRS-GR LAKES AND OHIO
111 N CANAL ST - 6TH FL STE 600
CHICAGO IL 60606-7205

DAVID MC KAY
CIVIL ENGINEER
FACILITIES TECH LAB CECER-FL-P
US ARMY ENGINEER DISTRICT
CIVIL ENGR RESEARCH LAB PO BOX 9005
CHAMPAIGN IL 61826-9005

THIXTON MILLER
ATTN: CEMVS-PM-E
US ARMY ENGR DIST - ST LOUIS
1222 SPRUCE ST
ST LOUIS MO 63103

RICHARD DICKSON
ATTN: CELRE-PM
US ARMY ENGR DIST - DETROIT
477 MICHIGAN AVE 6TH FL
DETROIT MI 48226

GARY O'KEEFE
ATTN: CELRE-PL
US ARMY ENGR DIST - DETROIT
477 MICHIGAN AVE 6TH FL
DETROIT MI 48226

CARL PLATZ
ATTN: CELRE-ET-GH
US ARMY ENGR DIST - DETROIT
477 MICHIGAN AVE 6TH FL
DETROIT MI 48226

COMMANDER
US ARMY ENGR DIST - ST LOUIS
1222 SPRUCE ST
ST LOUIS MO 63103-2833

TERRY NORRIS
ATTN: CEMVS-PM-EA
DIV
US ARMY ENGR DIST - ST LOUIS
1222 SPRUCE ST
ST LOUIS MO 63101-2833

COMMANDER
US ARMY ENGR DIV - GREAT LAKES & OHIO RIVER

PO BOX 1159
CINCINNATI OH 45201-1159

TAB BROWN
ATTN: CELRD-CMP-P
US ARMY ENGR DIV - GREAT LAKES & OHIO RIVER DIV
DIV
PO BOX 1159
CINCINNATI OH 45201-1159

RICH FURMAN
ATTN: CELRD-PDS-P
US ARMY ENGR DIV - GREAT LAKES & OHIO RIVER

PO BOX 1159
CINCINNATI OH 45201-1159

CHARLES BARTON
ATTN: CEMVD-PD-SP
US ARMY ENGR DIV - MISSISSIPPI VALLEY
PO BOX 80
VICKSBURG MS 39180

MIKE HARDEN
ATTN: CEMVD-PD-SP
US ARMY ENGR DIV - MISSISSIPPI VALLEY
PO BOX 80
VICKSBURG MS 39180

CARROLL JOHNSON
ATTN: CEMVD-RB-T
US ARMY ENGR DIV - MISSISSIPPI VALLEY
1400 WALNUT ST PO BOX 80
VICKSBURG MS 39180-0080

SUSAN SMITH
ATTN: CEMVD-PD-RP
US ARMY ENGR DIV - MISSISSIPPI VALLEY
PO BOX 80 1400 WALNUT ST
VICKSBURG MS 39181-0080

STEVE KOENIG
LOCKMASTER
BRANDON RD LOCK AND DAM
1100 BRANDON RD
JOLIET IL 60436-8538

ROY CHAPMAN
LOCKMASTER
DRESDEN ISLAND LOCK AND DAM
7521 N LOCK RD
MORRIS IL 60450-9636

TODD ERENPUTSCH
PARK RANGER
ILLINOIS WATERWAY PROJECT OFFICE
257 GRANT ST
PEORIA IL 61603

DAVE HOOD
LOCKMASTER
LAGRANGE LOCK AND DAM
RR 1 BOX 185
VERSAILLES IL 62378

PAT WHARRY
LOCKMASTER
LOCKPORT LOCK
2502 CHANNEL DR
LOCKPORT IL 60441-4199

JIM HART
LOCKMASTER
MARSEILLES LOCK AND DAM
PO BOX 117
MARSEILLES IL 61341-0117

RICHARD MOSS
LOCKMASTER
PEORIA LOCK AND DAM
1071 WESLEY RD
CREVE COEUR IL 61610-3869

FLOYD COLLINS
LOCKMASTER
STARVED ROCK LOCK AND DAM
650 N 27TH RD
OTTAWA IL 61350-9736

ROBERT BALAMUT
LOCKMASTER
T J O'BRIEN LOCK
134TH & CALUMET RIVER
CHICAGO IL 60633-9998

KEVIN EWBANK
PARK RANGER
ILLINOIS WATERWAY VISITOR CENTER
US ARMY ENGR DIST - ROCK ISLAND
950 N 27TH RD
OTTAWA IL 61350-9735

KATHERINE HIGDON
PARK RANGER
ILLINOIS WATERWAY VISITOR CENTER
US ARMY ENGR DIST - ROCK ISLAND
950 N 27TH RD
OTTAWA IL 61350-9735

ILLINOIS WATERWAY PROJECT OFFICE
FOOT OF GRANT ST
PEORIA IL 61603

REGIONAL ENGINEER
FEDERAL POWER COMMISSION
230 S DEARBORN ST - FED BLDG - 31ST FL
CHICAGO IL 60604

WILLIAM GRADLE
STATE CONSERVATIONIST
NATURAL RESOURCE CONSERVATION SERVICE
2118 W PARK CT
CHAMPAIGN IL 61821

HONORABLE ROD BLAGOJEVICH
GOVERNOR OF ILLINOIS
207 STATE CAPITOL BLDG
SPRINGFIELD IL 62706

JULIE MAIN
AREA PLANNERS
55 W TOMPKINS
GALESBURG IL 61401

ROBERT L PINKERTON
AREA PLANNERS
417 S MINNESOTA AVE
MORTON IL 61550

HONORABLE PAT QUINN
LIEUTENANT GOVERNOR
207 STATE HOUSE
SPRINGFIELD IL 62706

KRISTIN RICHARDS
OFC OF HONORABLE ROD BLAGOJEVICH
207 STATE CAPITOL BLDG
SPRINGFIELD IL 62706

CHRIS RYAN
416 MAIN ST SUITE 915
PEORIA IL 61602

MICHAEL WELSH
AREA CONSULTANTS
300 W PERSHING
MORTON IL 61550

DANIEL HYNES
LEGISLATORS
COMPTROLLER
201 STATEHOUSE
SPRINGFIELD IL 62706

JIM HELWIG
ENHANCEMENTS
2109 W BIGELOW
PEORIA IL 61604

MARY ALICE ERICKSON
GREENWAYS BOARD
6707 N GREENMONT
PEORIA IL 61614-2411

DAN MALOOF
DEVELOPER
MALOOF COMMERCIAL REAL ESTATE
2000 1ST FINANCIAL PLAZA
PEORIA IL 61602

RANDY TAYLOR
DEVELOPER
PIONEER INDUSTRIAL PARK INC.
7820 N UNIVERSITY ST
PEORIA IL 61614

MAGGIE MARTINO
DEVELOPER
PRUDENTIAL/CULLINAN PROPERTIES LTD.
7707 N KNOXVILLE
PEORIA IL 61614

WILLIAM FIELDING
PEORIA/PEKIN URBANIZED AREA TR
CENTRAL IL CENTER FOR INDEP LIVING
614 W GLEN
PEORIA IL 61614

EVERETT W CONWAY
ECONOMIC DEVEL BOARD
P O BOX 5187
PEORIA IL 61601

GEBHARD WOODS STATE PARK
PO BOX 272
MORRIS IL 60450

IL AGRI MEDIATION PROGRAM
104 LESAR LAW BLDG
CARBONDALE IL 62901

HONORABLE MITCH DANIELS
GOVERNOR OF INDIANA
OFFICE OF THE GOVERNOR
STATEHOUSE
INDIANAPOLIS IN 46204-2797

ROB MOORE
EXECUTIVE DIRECTOR
CENTRAL STATES EDUCATION CENTER
PRAIRIE RIVERS NETWORK
809 S 5TH ST
CHAMPAIGN IL 61820

JUDY BAAR TOPINKA
LEGISLATORS
TREASURER
219 STATEHOUSE
SPRINGFIELD IL 62706

MICHAEL LANDWIRTH
DEVELOPER
WALD-LAND CORPORATION
121 NE JEFFERSON AVE
PEORIA IL 61602

RUSS WALDSHMIDT
DEVELOPER
WALD-LAND CORPORATION
121 NE JEFFERSON AVE
PEORIA IL 61602

DOUG CARNEY
IL DEPT OF NATURAL RESOURCES
8450 MONT CLAIRE AVE
BRIGHTON IL 62012

LAURA DUFFORD
8957 S FITZSIMMONS RD
STOCKTON IL 61085

ALAN TUCKER
STATE'S ATTORNEY
208 N BROADWAY ST
HAVANA IL 62644

DONALD KILVER
RESOURCE COORDINATOR
AMERENCIPS
PO BOX 349 800 S WASHINGTON
MEREDOSIA IL 62665

KEITH BARR
OLD INN FARM
ARCHAEOLOGICAL & ARCHITECTURAL SURVEYS
RURAL ROUTE 1
FAIRVIEW IL 61432

HONORABLE LISA RYAN
ATTORNEY GENERAL OF IL
500 S 2ND ST
SPRINGFIELD IL 62706

DIRECTOR
CASS CO SOIL & WATER CONSERVATION DIST
15381 N STATE HWY 100
LEWISTOWN IL 61542

LEE S AUSTIN
HEARTLAND WATER RESOURCE BOARD
ESE
8901 N INDUSTRIAL RD
PEORIA IL 61615

STAFF
FORBES BIOLOGICAL STATION
PO BOX 590
HAVANA IL 62644

PAUL YOUNGSTRUM
DIST CONSERVATIONIST
GRUNDY CNTY SOIL & WATER CONSRV DIST
3585 N STATE ROUTE 47
MORRIS IL 60450-8245

DAN BELL
I&M CANAL STATE TRAIL
PO BOX 272 402 OTTAWA ST
MORRIS IL 60450

TRACY EVANS
PARTNERSHIP
IDNR CONTACT FOR ECOSYSTEM PARTNERSHIP
REGION 5 OFFICE 11731 STATE HIGHWAY 37
BENTON IL 62812

PAULA MARTEL
PARTNERSHIP
IDNR CONTACT FOR ECOSYSTEM PARTNERSHIP
REGION 3 OFFICE 2005 ROUNDBARN RD
CHAMPAIGN IL 61821

DAN NORTH
PARTNERSHIP
IDNR CONTACT FOR ECOSYSTEM PARTNERSHIP
4521 ALTON COMMERCE PARKWAY
ALTON IL 62002

LEE BUNTING
IL ASSOC OF SOIL & WATER CONSERV DIST
28542 N 2900 E RD
DWIGHT IL 60420

DIRECTOR
JAMES R THOMPSON CTR
IL CONSERVATION FOUNDATION
100 W RANDOLPH ST STE 4-300
CHICAGO IL 60601

TONY HAMILTON
IL DEPARTMENT OF AGRICULTURE
9329 162ND AVE
ORION IL 61273

MAUREEN ADDIS
ENHANCEMENTS
IL DEPARTMENT OF TRANSPORTATION DIST 4
401 MAIN ST
PEORIA IL 61602

SCOTT CARPENTER
PEORIA/PEKIN URBANIZED AREA TR
IL DEPARTMENT OF TRANSPORTATION DIST 4
401 MAIN ST
PEORIA IL 61602

SHAUN COYLE
GREENWAYS BOARD
IL DEPARTMENT OF TRANSPORTATION DIST 4
401 MAIN ST
PEORIA IL 61602

RAY ENGMAN
PEORIA/PEKIN URBANIZED AREA TR
IL DEPARTMENT OF TRANSPORTATION DIST 4
401 MAIN ST
PEORIA IL 61602

PAULA GREEN
GREENWAYS BOARD
IL DEPARTMENT OF TRANSPORTATION DIST 4
401 MAIN ST
PEORIA IL 61602

ERIC THERKILDSEN
PEORIA/PEKIN URBANIZED AREA TR
IL DEPARTMENT OF TRANSPORTATION DIST 4
401 MAIN ST
PEORIA IL 61602

J.R. THOMPSON CENTER
IL DEPT OF AGRICULTURE
100 W RANDOLPH STE 10-700
CHICAGO IL 60601

MIKE BEATY
DIV ADMINISTRATOR
DIVISION OF NATURAL RESOURCES
IL DEPT OF AGRICULTURE
STATE FAIRGROUNDS PO BOX 19281
SPRINGFIELD IL 62794-9281

STEVE CHARD
DEPUTY DIV ADMINISTRATOR
DIVISION OF NATURAL RESOURCES
IL DEPT OF AGRICULTURE
STATE FAIRGROUNDS PO BOX 19281
SPRINGFIELD IL 62794-9281

STEVE FRANK
BUREAU CHIEF
LAND & WATER RESOURCES
IL DEPT OF AGRICULTURE
STATE FAIRGROUNDS PO BOX 19281 801 SANGAMON AVE
SPRINGFIELD IL 62794-9281

WARREN GOETSCH
DIVISION ADMINISTRATOR
DIVISION OF NATURAL RESOURCES
IL DEPT OF AGRICULTURE
STATE FAIRGROUNDS PO BOX 19281
SPRINGFIELD IL 62794-9281

DENNIS MC KENNA
DIVISION OF NATURAL RESOURCES
IL DEPT OF AGRICULTURE
STATE FAIRGROUNDS PO BOX 19281
SPRINGFIELD IL 62794-9281

BOB ANSTINE
SENIOR ADVISORY FOR LOCAL GOVERNMENT
IL DEPT OF COMMERCE & COMMUNITY AFFAIRS
620 E ADAMS 6TH FLOOR
SPRINGFIELD IL 62701

TIM KELLEY
IL DEPT OF NATURAL RESOURCES - DIST HERITAGE
700 S 10TH ST
HAVANA IL 62644

CONTACT FOR ECOSYSTEM PARTNERSHIP
IL DEPT OF NATURAL RESOURCES
5931 FOX RIVER DR
PLANO IL 60545

CONTACT FOR ECOSYSTEM PARTNERSHIP
IL DEPT OF NATURAL RESOURCES
13921 W ROUTE 150 JUBILEE COLLEGE ST PRK
BRIMFIELD IL 61517

DIRECTOR
NATURAL PRESERVES COMMISSION
IL DEPT OF NATURAL RESOURCES
ONE NATURAL RESOURCES WAY
SPRINGFIELD IL 62702-1270

DOUGLAS AUSTEN
OFFICE OF RESOURCE CONSERVATION
IL DEPT OF NATURAL RESOURCES
ONE NATURAL RESOURCES WAY
SPRINGFIELD IL 62702-1271

JEFF BOEDDER
IL DEPT OF NATURAL RESOURCES
ONE NATURAL RESOURCES WAY
SPRINGFIELD IL 62702

LYNN BOERMAN
IL DEPT OF NATURAL RESOURCES
2050 STEARMS RD
BARTLETT IL 60515

DEBBIE BRUCE
WATERSHED/WETLANDS MGMT UNIT
IL DEPT OF NATURAL RESOURCES
ONE NATURAL RESOURCES WAY
SPRINGFIELD IL 62702-1271

GARY CLARK
DIRECTOR
OFFICE OF WATER RESOURCES
IL DEPT OF NATURAL RESOURCES
ONE NATURAL RESOURCE WAY
SPRINGFIELD IL 62702-1271

MAGGIE COLE
IL DEPT OF NATURAL RESOURCES
2050 W STEARNS
BARTLETT IL 60103

FRED DAVIDSON
HAVANA FIELD HQ
IL DEPT OF NATURAL RESOURCES
700 S 10TH ST
HAVANA IL 62644

SAM FLOOD
ACTING DIRECTOR
IL DEPT OF NATURAL RESOURCES
ONE NATURAL RESOURCES WAY
SPRINGFIELD IL 62702-1271

DR HAROLD HASSEN
IL DEPT OF NATURAL RESOURCES
ONE NATURAL RESOURCES WAY
SPRINGFIELD IL 62702-1271

ANDY HAWKINS
CONTACT FOR ECOSYSTEM PARTNERSHIP
IL DEPT OF NATURAL RESOURCES
PO BOX 992
BOURBONNAIS IL 60914

JIM HEMINGWAY
IL DEPT OF NATURAL RESOURCES
JUBILEE COLLEGE STATE PARK
BRIMFIELD IL 61517

ANN HOLTROP
IL DEPT OF NATURAL RESOURCES
ONE NATURAL RESOURCE WAY
SPRINGFIELD IL 62702-1271

MICHAEL JONES
IL DEPT OF NATURAL RESOURCES
PO BOX 447
PITTSFIELD IL 62363

GREG KILE
BRANCH MANAGER
ILLINOIS MICH CANAL STATE TRAIL
IL DEPT OF NATURAL RESOURCES
PO BOX 272
MORRIS IL 60450-0272

JIM LANGBEIN
SILVER SPRINGS STATE PARK
IL DEPT OF NATURAL RESOURCES
13608 FOX RD
YORKVILLE IL 60560

GARY LUTTERBIE
IL DEPT OF NATURAL RESOURCES
301 S DATE ST
GIBSON CITY IL 60936

DECK MAJOR
WILDLIFE BIOLOGIST
REGION IV OFFICE
IL DEPT OF NATURAL RESOURCES
4521 ALTON COMMERCE PARKWAY
ALTON IL 62002

DR JOHN MARLIN
WASTE MAN AND RES CTR
IL DEPT OF NATURAL RESOURCES
1 E HAZELWOOD DR
CHAMPAIGN IL 61820

RAY MARSHALLA
IL DEPT OF NATURAL RESOURCES
ONE NATURAL RESOURCES WAY
SPRINGFIELD IL 62702-1270

JIM MICK
REG 3 FISHERIES ADMINISTRATOR
HAVANA FIELD HEADQUARTERS
IL DEPT OF NATURAL RESOURCES
700 S 10TH ST
HAVANA IL 62644

RICK MOLLAHAN
ACTG MGR CORPS OF ENGRS ECOSYS PROG
OFC OF RESOURCE CONSERVATION
IL DEPT OF NATURAL RESOURCES
ONE NATURAL RESOURCES WAY
SPRINGFIELD IL 62702-1271

DICK NIEMEYER
BRANCH MANAGER
PERE MARQUETTE STATE PARK
IL DEPT OF NATURAL RESOURCES
PO BOX 158
GRAFTON IL 62037-0158

JOSEPH NYHOFF
BRANCH MANAGER
GOOSE LAKE PRAIRIE STATE PARK
IL DEPT OF NATURAL RESOURCES
5010 N JUGTOWN RD
MORRIS IL 60450-9628

STEVE PESCITELLI
IL DEPT OF NATURAL RESOURCES
5931 FOX RIVER DR
PLANO IL 60545

DAN SALLEE
WILDLIFE BIOLOGIST
REG I
IL DEPT OF NATURAL RESOURCES
2317 E LINCOLN WAY STE A
STERLING IL 61081

ROBERT SCHANZLE
PERMIT PROGRAM MANAGER
OFC OF REALTY & ENVIRONMENTAL PLNG
IL DEPT OF NATURAL RESOURCES
ONE NATURAL RESOURCES WAY
SPRINGFIELD IL 62702-1271

SCOTT STUEWE
CHIEF
FISHERIES DIVISION
IL DEPT OF NATURAL RESOURCES
ONE NATURAL RESOURCES WAY
SPRINGFIELD IL 62702-1271

TRENT THOMAS
FISHERIES
IL DEPT OF NATURAL RESOURCES
1004 W HOVEY
NORMAL IL 61761

TAMMY WATSON
C2000 COORDINATOR
OFFICE OF WATER RESOURCES
IL DEPT OF NATURAL RESOURCES
ONE NATURAL RESOURCE WAY
SPRINGFIELD IL 62702-1271

SHAWN WILCOCKSON
IL DEPT OF NATURAL RESOURCES
ONE NATURAL RESOURCES WAY
SPRINGFIELD IL 62702

LOREN WOBIG
OFFICE OF WATER RESOURCES
IL DEPT OF NATURAL RESOURCES
ONE NATURAL RESOURCE WAY
SPRINGFIELD IL 62702-1271

RANDY TIMMONS
AVCC E CAMPUS BLDG
IL DEPT OF NATURAL RESOURCES - FORESTY
11 815 N ORLANDO SMITH AVE
OGLESBY IL 61348

DAN INJERD
OFC OF WATER RESOURCES
IL DEPT OF NATURAL RESOURCES - OWR RM 1606
36 S WABASH RM 1415
CHICAGO IL 60603

NEIL BOOTH
IL DEPT OF NATURAL RESOURCES - WILDLIFE
MISSISSIPPI RIVER AREA OFC
GRAFTON IL 62037

JON HANDEL
IL DEPT OF NATURAL RESOURCES - WILDLIFE
PERE MARQUETTE STATE PARK PO BOX 158
GRAFTON IL 62037

NANCY WILLIAMSON
ECOSYSTEM PROJ GRANT ADMIN
IL DEPT OF NATURAL RESOURCES REG 2 HDQRS
2050 W STEARNS RD
BARTLETT IL 60103

PAUL MARTEL
ECOSYSTEM ADMIN
IL DEPT OF NATURAL RESOURCES REG 3 OFC
1556 STATE RT 54 E
CLINTON IL 61727

KEVIN LYONS
BRANCH MANAGER
CHILD SUPPORT DIVISION
IL DEPT OF PUBLIC AID
324 MAIN ST
PEORIA IL 61602-1319

EDWIN SILVERMAN
BRANCH MANAGER
REFUGEE SERVICES
IL DEPT OF PUBLIC AID
401 S CLINTON ST, #3 FL
CHICAGO IL 60607-3800

ENVIRONMENTAL UNIT
IL DEPT OF TRANSPORTATION
700 E NORRIS DR
OTTAWA IL 61350-0697

IL DEPT OF TRANSPORTATION
401 MAIN ST
PEORIA IL 61602

JOSEPH CROWE
DEPUTY DIRECTOR REGION 3 ENGINEER
IL DEPT OF TRANSPORTATION
401 MAIN ST
PEORIA IL 61602-1111

DAN EDWARDS
IL DEPT OF TRANSPORTATION
401 MAIN ST
PEORIA IL 61602-1267

ED EVANS
IL DEPT OF TRANSPORTATION
401 MAIN ST
PEORIA IL 61602

STEVE FERGUSON
BRIDGE & HYDRAULICS ENGINEER
IL DEPT OF TRANSPORTATION
700 E NORRIS DR
OTTAWA IL 61350

DALE FITSCHEN
PEORIA/PEKIN URBANIZED AREA TR
IL DEPT OF TRANSPORTATION
310 S MICHIGAN AVE
CHICAGO IL 60610

PETE FRANTZ
CHIEF OF ENVIRONMENT
HARRY R. HANELY BUILD RM 330
IL DEPT OF TRANSPORTATION
2300 S DIRKSEN PKWY
SPRINGFIELD IL 62764

JAMES JEREB
DISTRICT ENGINEER
DIV OF HIGHWAYS - DIST 3
IL DEPT OF TRANSPORTATION
700 E NORRIS DR
OTTAWA IL 61350-0697

JAMES A. JOHNSON
IL DEPT OF TRANSPORTATION
310 S MICHIGAN AVE RM 1606
CHICAGO IL 60604

STEPHEN LEE
IL DEPT OF TRANSPORTATION
401 MAIN ST
PEORIA IL 61602

TIMOTHY MARTIN
SECRETARY
IL DEPT OF TRANSPORTATION
2300 S DIRKSEN PKWY RM 300
SPRINGFIELD IL 62764

JOSEPH CROWE PE
DIST ENGINEER
IL DEPT OF TRANSPORTATION DIST 4
401 MAIN ST
PEORIA IL 61602

DIRECTOR
CHIEF-BUR OF RES REG
IL DIVISION OF WATER RESOURCES
310 S MICHIGAN AVE - RM 1606
CHICAGO IL 60604

NEIL FULTON
IL DIVISION OF WATER RESOURCES
310 S MICHIGAN AVE RM 1606
CHICAGO IL 60604

IL ENVIRONMENTAL PROTECTION AGENCY
PO BOX 19276
SPRINGFIELD IL 62794-9276

CHRISTINE DAVIS
IL ENVIRONMENTAL PROTECTION AGENCY
1021 N GRAND AVE E
SPRINGFIELD IL 62794-9276

JIM KAMMUELLER
MANAGER
DWPC
IL ENVIRONMENTAL PROTECTION AGENCY
5415 N UNIVERSITY AVE
PEORIA IL 61614

RICH LANGE
IL ENVIRONMENTAL PROTECTION AGENCY
BOX 1515
LA SALLE IL 61301

JIM PARK
CHIEF
BUREAU OF WATER
IL ENVIRONMENTAL PROTECTION AGENCY
1021 N GRAND AVE, PO BOX 19276
SPRINGFIELD IL 62794-9276

DOUGLAS SCOTT
DIRECTOR
IL ENVIRONMENTAL PROTECTION AGENCY
1021 N GRAND AVE E
SPRINGFIELD IL 62794-9276

AMY WALKENBACK
IL ENVIRONMENTAL PROTECTION AGENCY
1021 N GRAND AVE E
SPRINGFIELD IL 62794-9276

BRUCE YURDIN
MANAGER
WATERSHED MANAGEMENT SECTION
IL ENVIRONMENTAL PROTECTION AGENCY
1021 N GRAND AVE E
SPRINGFIELD IL 62794-9276

TEENA PITMAN
BRANCH MANAGER
IL INDUSTRIAL COMMISSION
202 NE MADISON AVE STE 201
PEORIA IL 61602

TEAM LEADER
IL NATURAL HISTORY SURVEY
704 N SCHRADER AVE PO BOX 590
HAVANA IL 62644

DR STEVE HAVERA
FORBES BIOLOGICAL STATION
IL NATURAL HISTORY SURVEY
PO BOX 590 17500 E CR 1950 N
HAVANA IL 62644

DR KEVIN IRONS
LTRM HAVANA FIELD STATION
IL NATURAL HISTORY SURVEY
704 N SCHRADER
HAVANA IL 62644

TOM LERCZAK
IL NATURAL HISTORY SURVEY
704 N SCHRADER AVE PO BOX 590
HAVANA IL 62644

MATT O'HARA
LONG TERM RES MONITORING STATION
IL NATURAL HISTORY SURVEY
704 N SCHRADER AVE PO BOX 590
HAVANA IL 62644

DR MARK PEGG
LTRM HAVANA FIELD STATION
IL NATURAL HISTORY SURVEY
704 N SCHRADER
HAVANA IL 62644

JOSH STAFFORD
IL NATURAL HISTORY SURVEY
704 N SCHRADER AVE PO BOX 590
HAVANA IL 62644

AARON YETTER
IL NATURAL HISTORY SURVEY
704 N SCHRADER AVE PO BOX 590
HAVANA IL 62644

CLARE MANNING
IL POLLUTION CONTROL BOARD
100 W RANDOLPH STE 11-500
CHICAGO IL 60601

DON CONDIT
HEARTLAND WATER RESOURCE BOARD
IL RIV CONSERV TASK FORCE
RR 1 BOX 16
PUTNAM IL 61560

JEANETT BUHLIG
BRANCH MANAGER
DEPT OF MOTOR VEHICLES
IL SECRETARY OF STATE
110 W 15TH ST
BEARDSTOWN IL 62618-1701

DR EDWARD ARMBRST
ACTING CHIEF
IL STATE NATURAL HIST SURVEY
607 E PEABODY
CHAMPAIGN IL 61820

DR NANI BHOWMIK
IL STATE WATER SURVEY
2204 GRIFFITH DR
CHAMPAIGN IL 61820-7495

THOMAS BUTTS
IL STATE WATER SURVEY
PO BOX 697
PEORIA IL 61652

DR MICHAEL DEMISSIE
PRINCIPAL SCIENTIST
IL STATE WATER SURVEY
2204 GRIFFITH DR
CHAMPAIGN IL 61820

JON RODSATER
IL STATE WATER SURVEY
PO BOX 697
PEORIA IL 61652

DANA B SHACKLEFORD
IL STATE WATER SURVEY
PO BOX 697
PEORIA IL 61652

JIM SLOWKOWSKI
IL STATE WATER SURVEY
2204 GRIFFITH DR
CHAMPAIGN IL 61820-7495

MELINDA TIDRICK
IL STATE WATER SURVEY
2204 GRIFFITH DR
CHAMPAIGN IL 61820

RICK TWAIT
IL STATE WATER SURVEY
PO BOX 697
PEORIA IL 61652

BILL WHITE
IL STATE WATER SURVEY
PO BOX 697
PEORIA IL 61652-0697

DR DEREK WINSTANLEY
CHIEF
IL STATE WATER SURVEY
2204 GRIFFITH DR
CHAMPAIGN IL 61820

ROLLIE MOORE
VICE PRESIDENT
ILLINOIS FARM BUREAU
662 KNOX RD 2600 N
ONEIDA IL 61467

ANNE HAAKER
DEPUTY STATE HIST PRESERVATION OFCR
ILLINOIS HISTORIC PRESERVATION AGENCY
1 OLD STATE CAPITOL PLAZA
SPRINGFIELD IL 62701

DAVID L THOMAS
CHIEF
ILLINOIS NATURAL HISTORY SURVEY
172 NAT RESOURCES BLDG 607 E PEABODY DR
CHAMPAIGN IL 61820

RICH CAHILL
ILLINOIS STATE GEOLOGICAL SURVEY
615 E PEABODY DR
CHAMPAIGN IL 61820

DAVID GROSS
ILLINOIS STATE GEOLOGICAL SURVEY
615 E PEABODY DR
CHAMPAIGN IL 61820

BEV HERZOG
ILLINOIS STATE GEOLOGICAL SURVEY
615 E PEABODY DR
CHAMPAIGN IL 61820

JOHN MASTERS
ILLINOIS STATE GEOLOGICAL SURVEY
615 E PEABODY DR
CHAMPAIGN IL 61821

DREW PHILLIPS
FLUVIAL SEDIMENTATION-GEOMORPHOLOGY
ILLINOIS STATE GEOLOGICAL SURVEY
615 E PEABODY DR
CHAMPAIGN IL 61820

C BRIAN TRASH
NATURAL RESOURCES BUILDING
ILLINOIS STATE GEOLOGICAL SURVEY
615 E PEABODY DR
CHAMPAIGN IL 61820-6964

JUDIE WELCH
BRANCH MANAGER
DIVISION OF FORENSIC SRVCS
ILLINOIS STATE POLICE
515 WOODRUFF RD
JOLIET IL 60432-1260

KIP STEVENSON
ILLINOIS STATE WATER SURVEY
BOX 697
PEORIA IL 61652

TERRI CURLEE PRICE
WATER RESOURCE PLANNER
DIVISION OF WATER
IN DEPT OF NATURAL RESOURCES
402 W WASHINGTON RM W264
INDIANAPOLIS IN 46204-2748

JON EGGEN
ENVIRONMENTAL SUPERVISOR
DIVISION OF FISH AND WILDLIFE
IN DEPT OF NATURAL RESOURCES
402 W WASHINGTON ST RM W264
INDIANAPOLIS IN 46204-2748

TERRI PRICE
DIVISION OF FISH AND WILDLIFE
IN DEPT OF NATURAL RESOURCES
402 W WASHINGTON ST RM W264
INDIANAPOLIS IN 46204-2748

GLEN SALMON
DIRECTOR
DIVISION OF FISH AND WILDLIFE
IN DEPT OF NATURAL RESOURCES
402 W WASHINGTON ST RM W273
INDIANAPOLIS IN 46204

DAVID NOLAN
ITARP WESTERN ILLINOIS SURVEY DIV
604 EAST VANDALIA
JACKSONVILLE IL 62650

JONATHAN BLOOM
JONATHAN A BLOOM CONSULTING
527 DUNDEE RD
NORTHBROOK IL 60062

KANKAKEE COUNTY REG PLANNING COMMISS
189 E CT ST
KANKAKEE IL 60901

STAFF
LONG TERM RES MONITORING STATION
704 N SCHRADER
HAVANA IL 62644

RALPH SCHOBERT
MINERAL AND LAND RESOURCES
222 N LASALLE ST
CHICAGO IL 60601

SITE MANAGER
MISS RIVER FISH & WILDLIFE MGMT AREA
RR 182
GRAFTON IL 62037

SARAH NERENBERG
NE IL PLANNING COMMISSION
222 S RIVERSIDE PLAZA STE 1800
CHICAGO IL 60606

TOBIAS MILLER
STARVED ROCK STATE PARK
PO BOX 116
UTICA IL 61373-0116

CATHERINE BENDOWITZ
THE NATURE CONSERVANCY
8 S MICHIGAN AVE
CHICAGO IL 60603

ELIZABETH MC CANCE
THE NATURE CONSERVANCY
8 S MICHIGAN AVE
CHICAGO IL 60603

KAREN BILLE
THE NATURE CONSERVANCY TAZEWELL CO
1201 S MAIN ST
EUREKA IL 61530

ROBERT SPERLING
USCG SANGAMON (WLR 65506)
FOOT OF WASHINGTON ST
EAST PEORIA IL 61611

MATT STAFFORD
USDA NATURAL RESOURCES CONSERVATION SERVICE
SERVICE
1691 N 31ST RD
OTTAWA IL 61350

PAUL YOUNSTRUM
USDA NATURAL RESOURCES CONSERVATION

1691 N 31ST RD
OTTAWA IL 61350

RUTHE BADGER
DIRECTOR
SOUTH CENTRAL REGION
WI DEPT OF NATURAL RESOURCES
3911 FISH HATCHERY RD
FITCHBURG WI 53711-5397

JIM D'ANTUONO
WI DNR REP TO FOX RIVER BASIN COMM
SOUTHEASTERN REGION
WI DEPT OF NATURAL RESOURCES
141 NW BARSTOW ST RM 180
WAUKESHA WI 53188

CHIP KROHN
REGIONAL WATER LEADER
SOUTHEASTERN REGION
WI DEPT OF NATURAL RESOURCES
2300 N DR MARTIN LUTHER KING JR DR
MILWAUKEE WI 53212-3128

HONORABLE WILLIAM BRADY
ILLINOIS STATE SENATOR
2203 EASTLAND DR STE 3
BLOOMINGTON IL 61704

HONORABLE JOHN CULLERTON
IL STATE SENATOR
1051 W BELMONT
CHICAGO IL 60657

HONORABLE JOHN PHILLIP NOVAK
REPRESENTATIVE IN CONGRESS
135 S SCHUYLER AVE
KANKAKEE IL 60901

HONORABLE DONALD L. SALTSMAN
REPRESENTATIVE IN CONGRESS
815 N WESTERN
PEORIA IL 61604

HONORABLE EDWARD MALONEY
IL SENATOR-18TH DIST
IL HOUSE OF REPRESENTATIVES
10444 S WESTERN AVE
CHICAGO IL 60643

HONORABLE JUDY MYERS
IL SENATOR
IL SENATE
119 1/2 GILBERT ST
DANVILLE IL 61832

HONORABLE LARRY WALSH
IL SENATOR
IL SENATE
1100 PLAINFIELD RD
JOLIET IL 60435

HONORABLE FRANK WATSON
IL SENATOR - 51ST DIST
IL SENATE
101 S MAIN ST STE LL2
DECATUR IL 62523

HONORABLE PATRICK WELCH
IL SENATOR
IL SENATE
PO BOX 341
PERU IL 61354-0341

HONORABLE
ILLINOIS STATE SENATOR
LEGISLATORS
IL STATE SENATE
613 CAPITOL BLDG
SPRINGFIELD IL 62706

HONORABLE DALE RISINGER
UNITED STATES SENATOR
IL STATE SENATE DIST 37
3700 W CHARTWELL
PEORIA IL 61614

HONORABLE DALE RISINGER
UNITED STATES SENATOR
LEGISLATORS
IL STATE SENATE DIST 37
M103F STRATTON BLDG
SPRINGFIELD IL 62706

HONORABLE CAROL HALLOCK
GREENWAYS BOARD
PIMITEOUI TRAIL ASSOCIATION
3016 N WESTERN
PEORIA IL 61604

HONORABLE LISA DUGAN
STATE REP 79TH
1355 SCHUYLER
KANKAKEE IL 60901

HONORABLE DAVID LEITCH
REPRESENTATIVE IN CONGRESS
3114 N UNIVERSITY
PEORIA IL 61604

HONORABLE TOM P WALSH
REPRESENTATIVE IN CONGRESS
PO BOX 21
OTTAWA IL 61350

HONORABLE BILL BLACK
IL CONGRESSMAN
IL CONGRESS
7 E FAIRCHILD ST
DANVILLE IL 61832

HONORABLE PHIL NOVAK
IL CONGRESSMAN
IL CONGRESS
135 S SCHUYLER
KANKAKEE IL 60901

HONORABLE MARY KAY O'BRIEN
IL CONGRESSWOMAN
IL CONGRESS
760 E DIVISION ST
COAL CITY IL 60461

HONORABLE DAVID R LEITCH
LEGISLATORS
IL HOUSE OF REPRESENTATIVES
220 STRATTON BUILDING
SPRINGFIELD IL 62706

HONORABLE FRANK MAUTINO
REPRESENTATIVE IN CONGRESS 76TH DIST
IL HOUSE OF REPRESENTATIVES
108 W SAINT PAUL ST
SPRING VALLEY IL 61362-1951

HONORABLE MICHAEL K SMITH
IL REPRESENTATIVE - 91ST DIST
LEGISLATORS
IL HOUSE OF REPRESENTATIVES
45 E SIDE SQ #301
CANTON IL 61520-2673

HONORABLE KEITH SOMMER
LEGISLATORS
IL HOUSE OF REPRESENTATIVES
205 W JEFFERSON
MORTON IL 61550

HONORABLE JOHN C (JACK) MCGUIRE
REPRESENTATIVE IN CONGRESS
US HOUSE OF REPRESENTATIVES
1510 GLENWOOD AVE
JOLIET IL 60435

EDWARD WEISS
Batavia Plan Commission
100 N. Island Ave.
BATAVIA IL 60510

CARL BIBBS
REG MGR FOR NORTHERN IL MKTG PROG
DEPT OF COMMERCE & COMMUNITY AFFAIRS
100 W RANDOLPH STE 3-400
CHICAGO IL 60601

ROBERT BRUCE
FOREIGN DIRECT INVESTMENT MANAGER
DEPT OF COMMERCE & COMMUNITY AFFAIRS
100 W RANDOLPH STE 3-400
CHICAGO IL 60601

IL NATURE PRESERVES COMMISSION
ONE NATURAL RESOURCES WAY
SPRINGFIELD IL 62702-1271

SEAN WIEDEL
WATERSHED PLANNER
LAKE CO STORM MGMT COMMISSION
333 PETERSON RD
LIBERTYVILLE IL 60048

SANDI RADTKE
NORTHEASTERN IL PLANNING COMMISSION
222 S RIVERSIDE PLAZA STE 1800
CHICAGO IL 60606

BESS CHILDS
AURORA AREA CONVENTION & VISITORS BUREAU
PO BOX 907
AURORA IL 60507-0907

SUE VOS
AURORA AREA CONVENTION & VISITORS BUREAU
PO BOX 907
AURORA IL 60507-0907

JIM WASSER
BUILDING TRADES COUNCIL
5896 ROSE CIRCLE
ST ANNE IL 60964

BOB CURRY
CES
6407 N 1600E RD
MOMENCE IL 60954

FOX VALLEY LAND FOUNDATION
PO BOX 1036
ELGIN IL 60121

EDMUND THORNTON
CHAIRMAN
I&M CANAL COMMISSION
1461 W LAFAYETTE ST
OTTAWA IL 61350

PAM GIBSON
IL COUNCIL OF WATERSHEDS
866 DOOLIN
JACKSONVILLE IL 62650

JANE JOHNSON
PRESIDENT
ILLINOIS COUNCIL OF WATERSHEDS
RR 2 BOX 50
GILSON IL 61436

MARY JO ADAMS
MACKINAW RIVER WATERSHED PARTNERSHIP
RR 1 BOX 228 2015 ELKINS LANE
CARLOCK IL 61725

HARRY MEHL
MILLS BLUFF NATURE PRESERVE
RR1 BOX 14
STANFORD IL 61774

GREG EDWARDS
PEORIA AREA CONVENTION & VISITORS BUREAU
456 FULTON ST STE 300
PEORIA IL 61602

COUNTY SHERIFF
BROWN CO COURT HOUSE
MT STERLING IL 62353

COUNTY ATTORNEY
BROWN CO COURT HOUSE
MT STERLING IL 62353

COUNTY ENGINEER
BROWN CO COURT HOUSE
MT STERLING IL 62353

COUNTY ENGINEER
FULTON COUNTY COURT HOUSE
LEWISTOWN IL 61542

COUNTY ATTORNEY
FULTON COUNTY COURT HOUSE
LEWISTOWN IL 61542

COUNTY CLERK
FULTON COUNTY COURT HOUSE
LEWISTOWN IL 61542

COUNTY SHERIFF
FULTON COUNTY COURT HOUSE
LEWISTOWN IL 61542

COUNTY SHERIFF
GRUNDY COUNTY COURT HOUSE
MORRIS IL 60450

COUNTY ATTORNEY
GRUNDY COUNTY COURT HOUSE
MORRIS IL 60450

COUNTY ENGINEER
KENDALL COUNTY COURT HOUSE
YORKVILLE IL 60560

COUNTY ATTORNEY
KENDALL COUNTY COURT HOUSE
YORKVILLE IL 60560

COUNTY SHERIFF
KENDALL COUNTY COURT HOUSE
YORKVILLE IL 60560

COUNTY SHERIFF
` LASALLE COUNTY COURT HOUSE
707 E ETNA RD
OTTAWA IL 61350

COUNTY ENGINEER

707 E ETNA RD
OTTAWA IL 61350

COUNTY CLERK
MARSHALL COUNTY COURT HOUSE
LACON IL 61540

COUNTY SHERIFF
MASON COUNTY COURT HOUSE
HAVANA IL 62644

COUNTY SHERIFF
MORGAN COUNTY COURT HOUSE
JACKSONVILLE IL 62650

COUNTY SHERIFF
PEORIA COUNTY COURT HOUSE
PEORIA IL 61602

COUNTY ATTORNEY
PEORIA COUNTY COURT HOUSE
PEORIA IL 61602

COUNTY ENGINEER
PEORIA COUNTY COURT HOUSE
PEORIA IL 61602

COUNTY CLERK - STARK COUNTY
108 E WILLIAMS ST
WYOMING IL 61491-1455

COUNTY SHERIFF
WILL COUNTY COURT HOUSE
JOLIET IL 60434

COUNTY ATTORNEY
WILL COUNTY COURT HOUSE
JOLIET IL 60434

COUNTY ENGINEER
WILL COUNTY COURT HOUSE
JOLIET IL 60434

COUNTY CLERK
WILL COUNTY COURT HOUSE
JOLIET IL 60434

JUDGE THOMAS BROWNFIELD
COURT HOUSE
HAVANA IL 62644

MARC HESS
COMMISSIONER
BOX 64
BRYANT IL 61519

LAWRENCE KINZER
COUNTY ENGINEER
1400 N 27TH RD PO BOX 128
OTTAWA IL 61350-0128

VERNON C THOMSON
100 N MAIN COUNTY COURT HOUSE
LEWISTOWN IL 61542

RICHARD WALKER
SHERIFF
COURT HOUSE
HAVANA IL 62644

ROBERT WIDMAN
SUPERVISOR-BROOKFIELD TWP
RFD 1
RANSOM IL 60470

ADAMS COUNTY FARM SERVICE AGENCY
PO BOX 3006
QUIINCY IL 62305

DR GERALD HENRIKSEN
PRESIDENT
ASSN OF PEO COUNTY VET
3310 N PROSPECT RD
PEORIA IL 61603-1550

BOARD OF SUPERVISORS
BROWN CO COURT HOUSE
MT STERLING IL 62353

CASS COUNTY ENGINEER
BOARD OF SUPERVISORS
100 E SPRINGFIELD ST
VIRGINIA IL 62691

BOARD OF SUPERVISORS
CASS COUNTY COURT HOUSE
VIRGINIA IL 62691

CHAIRMAN
BOARD OF SUPERVISORS
COUNTY COURTHOUSE
OTTAWA IL 61350

MASON CO COURTHOUSE
BOARD OF SUPERVISORS
118 W MARKET ST
HAVANA IL 62644

BOARD OF SUPERVISORS
MASON COUNTY COURT HOUSE
HAVANA IL 62644

MASON COUNTY ENGINEER
BOARD OF SUPERVISORS
125 N PLUM ST
HAVANA IL 62644

MORGAN COUNTY ENGINEER
BOARD OF SUPERVISORS
300 W STATE ST
JACKSONVILLE IL 62651

STARK COUNTY
BOARD OF SUPERVISORS
108 E WILLIAMS ST
WYOMING IL 61491-1455

COUNTY CLERK
BROWN CO COURT HOUSE
200 W COURT ST
MT STERLING IL 62353

COUNTY CLERK
BROWN CO COURT HOUSE
200 W COURT ST
MT STERLING IL 62353

GLENNA DORMICE
BROWN CO FARM BUREAU
109 W N ST
MT STERLING IL 62353

COUNTY ATTORNEY
BROWN COUNTY COURT HOUSE
200 W COURT ST
MT STERLING IL 62353

COUNTY ENGINEER
BROWN COUNTY COURT HOUSE
200 W COURT ST
MT STERLING IL 62353

COUNTY CLERK
BROWN COUNTY COURT HOUSE
200 W COURT ST
MT STERLING IL 62353

COUNTY CLERK
BROWN COUNTY COURTHOUSE
200 W COURT ST
MT STERLING IL 62353

BROWN COUNTY FARM SERVICE AGENCY
PO BOX 111
MT STERLING IL 62353

COUNTY CLERK
BUREAU COUNTY COURT HOUSE
700 S MAIN ST
PRINCETON IL 61356

CARROLL COUNTY FARM SERVICE AGENCY
807A S CLAY ST
MOUNT CARROLL IL 61503

COUNTY CLERK
CASS COUNTY COURT HOUSE
100 E SPRINGFIELD ST
VIRGINIA IL 62691

CASS COUNTY FARM SERVICE AGENCY
652 S MAIN ST
VIRGINIA IL 62691

CHAMPAIGN COUNTY FARM SERVICE AGENCY
PO BOX 3007
CHAMPAIGN IL 61826-3007

BRIAN RUCH
CLERK
CITY OF BEARDSTOWN
105 W 3RD PO BOX 467
BEARDSTOWN IL 62618

RICK JEREMIAH
CITY OF EAST PEORIA DPW
2232 E WASHINGTON ST
EAST PEORIA IL 61611

DAVID ORR
COUNTY CLERK
COOK COUNTY
69 W WASHINGTON ST
CHICAGO IL 60602

JOHN STROGER JR
PRESIDENT
COOK COUNTY BD OF COMMISSIONERS
118 N CLARK ST RM 537
CHICAGO IL 60602

JACQUELYN HARDER
ECONOMIC DEVELOPMENT DIRECTOR
OFFICE OF ECONOMIC DEVELOPMENT
COOK COUNTY DEPT OF PLANNING
69 W WASHINGTON ST STE 290
CHICAGO IL 60602

STANLEY JAMES
COUNTY BOARD
5981 MURIEL LN
ST ANNE IL 60964

COUNTY BOARD OF SUPERVISORS
KENDALL COUNTY COURT HOUSE
YORKVILLE IL 60560

CHAIRMAN
LASALLE COUNTY COURT HOUSE
COUNTY BOARD OF SUPERVISORS
707 E ETNA RD
OTTAWA IL 61350

CHAIRMAN
COUNTY BOARD OF SUPERVISORS
LIVINGSTON COUNTY COURT HOUSE
PONTIAC IL 61764

CHAIRMAN
COUNTY BOARD OF SUPERVISORS
MACON COUNTY COURT HOUSE
DECATUR IL 62526

CHAIRMAN
COUNTY BOARD OF SUPERVISORS
MCLEAN COUNTY COURT HOUSE
MC LEAN IL 61701

CHAIRMAN
COUNTY BOARD OF SUPERVISORS
WILL COUNTY COURT HOUSE
JOLIET IL 60434

CHAIRMAN
COUNTY BOARD OF SUPERVISORS
COURT HOUSE - WOODFORD COUNTY
EUREKA IL 61530

RON HAPPACH
CHAIRMAN
BUREAU COUNTY COURT HOUSE
COUNTY BOARD OF SUPERVISORS
700 S MAIN ST
PRINCETON IL 61356

COUNTY CLERK
COURT HOUSE
MACON COUNTY
DECATUR IL 62526

COUNTY CLERK
COURT HOUSE
MCLEAN COUNTY
BLOOMINGTON IL 61701

BOARD OF SUPERVISORS
COURTHOUSE
100 N MAIN
LEWISTOWN IL 61542

SHELLY FINFROCK
ECSYTM PRTNSHP-UPR SALT CRK SANGAMON
DEWITT COUNTY SWCD
RR 4 BOX 344A
CLINTON IL 61727

STEVE BALISTERI
PEORIA CO ECON DEVELOPMENT DIRECTOR
EDC INC FOR THE PEORIA AREA
124 S W ADAMS STE 300
PEORIA IL 61602-1388

RANDY BELSLEY
TAZEWELL COUNTY DEVELOPMENT DIRECTOR
EDC INC FOR THE PEORIA AREA
124 S W ADAMS STE 300
PEORIA IL 61602-1388

GRUNDY COUNTY ADMINISTRATION CENTER
ENVIRONMENTAL COMMITTEE OF GRUNDY CO BD
1320 UNION ST
MORRIS IL 60450

DOUG SHORT
FOREST PRESERVE DIST OF WILL CNTY
PO BOX 1069
JOLIET IL 60433

RICHARD PHELAN
PRESIDENT
FOREST PRESERVE DISTRICT OF COOK COUNTY
536 N HARLEM AVE
RIVER FOREST IL 60305-1932

COUNTY CLERK
COURTHOUSE
FULTON COUNTY
100 N MAIN
LEWISTOWN IL 61542

BARBARA SINCLAIR
FULTON COUNTY
100 N MAIN PO BOX 283
LEWISTOWN IL 61542

BOARD OF SUPERVISORS
FULTON COUNTY COURT HOUSE
PO BOX 226
LEWISTOWN IL 61542-0226

JIM LUTZ
DIRECTOR
OFFICE OF EMERGENCY MANAGEMENT
GRUNDY CO EMER SERVICES
1320 UNION ST RM E-01
MORRIS IL 60450-2426

COUNTY CLERK
GRUNDY COUNTY
COURT HOUSE
MORRIS IL 60450

MATT MORRIS
PLANNING DIRECTOR
DEPT OF PLANNING, ZONING, & BUILDING
GRUNDY COUNTY
1320 UNION ST
MORRIS IL 60450

LARRY PACHEL
ASSISTANT PLANNING DIRECTOR
DEPT OF PLANNING, ZONING, & BUILDING
GRUNDY COUNTY
1320 UNION ST
MORRIS IL 60450

PAUL NELSON
CHAIRMAN
GRUNDY COUNTY BOARD OF SUPERVISORS
1320 UNION ST
MORRIS IL 60450

COUNTY BOARD OF SUPERVISORS
GRUNDY COUNTY COURT HOUSE
1320 UNION ST
MORRIS IL 60450

HENDERSON COUNTY FARM SERVICE AGENCY
PO BOX 510
STRONGHURST IL 61480

CATHY OLSON
DISTRICT CONSERVATIONIST
HENDERSON COUNTY SWCD
323 E MAIN PO BOX 485
STRONGHURST IL 61480

COUNTY CLERK
HENRY COUNTY COURT HOUSE
307 W CENTER ST
CAMBRIDGE IL 61238-1232

THE BOARD OF SUPERVISORS
HENRY COUNTY COURT HOUSE
307 W CENTER ST
CAMBRIDGE IL 61238-1232

CRAIG CASSEM
GRUNDY CO ENGINEER
HWY DEPT
310 E DUPONT RD
MORRIS IL 60450

L ROBERT DEAN
ASST STATE CONSERVATIONIST
DIST 4
IL NATURAL RESOURCES CONSERVATION SERVICE
233 S SOANGETAHA RD
GALESBURG IL 61401

DICK YOUNG
KANE CO FOREST PRESERVE
5118A ROUTE 34
OSWEGO IL 60543

MARY RICHARDS
KANE COUNTY BOARD
551 W. DOWNER PLACE
AURORA IL 60506

CO ENGINEER JIM PIEKARCVYK
COUNTY ENGINEER
KANKAKEE COUNTY
750 SE AVE PO BOX 825
KANKAKEE IL 60901

LEONARD MARTIN
KANKAKEE COUNTY BOARD
411 HILLTOP
BRADLEY IL 60915

LEO WHITTEN
KANKAKEE COUNTY BOARD
524 E JUNIPER LN
BRADLEY IL 60915-1102

DAN DEVALK
KANKAKEE COUNTY PLANNING
189 E COURT ST
KANKAKEE IL 60901

JIM GREENST
KANKAKEE COUNTY PLNG DEPT
189 E CT ST
KANKAKEE IL 60901

COUNTY CLERK
KENDALL COUNTY
COURT HOUSE
YORKVILLE IL 60560

SAM HALDIMAN
KENDALL COUNTY
111 W FOX
YORKVILLE IL 60560

FRANCIS KLAAS
CO ENGINEER
KENDALL COUNTY
6780 RT 47
YORKVILLE IL 60560

JOHN CHURCH
KENDALL COUNTY BOARD
5232 ROUTE34
OSWEGO IL 60543

MICHAEL GUITING
LA SALLE CO HWY
PO BOX 128
OTTAWA IL 61350

LARRY KINZER
LA SALLE COUNTY HWY DEPT
PO BOX 128
OTTAWA IL 61350

DOUG WILLIT
LA SALLE COUNTY HWY DEPT
PO BOX 128
OTTAWA IL 61350

COUNTY CLERK
LASALLE COUNTY
PO BOX 430
OTTAWA IL 61350

GLEN DOUGHERTY
CO BOARD CHAIRMAN
LASALLE COUNTY
707 E ETNA RD
OTTAWA IL 61350

COUNTY ATTORNEY
LASALLE COUNTY COURT HOUSE
707 E ETNA RD
OTTAWA IL 61350

VICTOR J WASHELESKY
ASSISTANT COUNTY ENGINEER
LASALLE COUNTY HIGHWAY DEPT
1400 N 27TH RD PO BOX 128
OTTAWA IL 61350

MENRY IMIG
MASON COUNTY BOARD
COURT HOUSE
HAVANA IL 62644

BOARD OF SUPERVISORS
MASON COUNTY COURT HOUSE
125 N PLUM ST
HAVANA IL 62644

COUNTY SHERIFF
MASON COUNTY COURT HOUSE
125 N PLUM ST
HAVANA IL 62644

WILLIAM BLESSMAN
COUNTY CLERK
MASON COUNTY COURT HOUSE
PO BOX 77
HAVANA IL 62644

JAMES GRIFFIN
COUNTY BOARD SUPERVISOR
MASON COUNTY COURT HOUSE
PO BOX 77
HAVANA IL 62644

ROBERT PEDIGO
COUNTY ENGINEER
MASON COUNTY COURT HOUSE
PO BOX 77
HAVANA IL 62644

ALLEN TUCKER
COUNTY ATTORNEY
MASON COUNTY COURT HOUSE
208 N BROADWAY
HAVANA IL 62644

DARREL HILST
MAYOR'S OFFICE
227 W MAIN ST
HAVANA IL 62644

CHARLES GINOLI
TRANSPORTATION COORDINATION CO
PEORIA CHAMBER TRANS COMMITTEE
205 W COVENTRY LANE
PEORIA IL 61614

AARON MC LEAN
PEORIA CO PLANNING AND ZONING
324 MAIN ST ROOM 301
PEORIA IL 61602

PEORIA COUNTY BOARD
324 MAIN ST
PEORIA IL 61602

ROBERT BAIETTO
PEORIA COUNTY BOARD
2815 BACON DR
PEORIA IL 61614

JAMES CHRISTOPHER
PEORIA COUNTY BOARD
618 W SINGING WOODS
EDELSTEIN IL 61526

BRIAN ELSASSER
PEORIA COUNTY BOARD
330 S KENNEDY
PRINCEVILLE IL 61559

JEFFREY D JOYCE
PEORIA COUNTY BOARD
1208 E MAYWOOD AVE
PEORIA IL 61603

SHARON K KENNEDY
PEORIA COUNTY BOARD
606 IRIS COURT
WEST PEORIA IL 61604

JEFF LICKISS
PEORIA COUNTY BOARD
907 W STRATFORD DR
PEORIA IL 61614-7042

TERRY LINDBERG
ADMINISTRATOR
PEORIA/PEKIN URBANIZED AREA TR
PEORIA COUNTY BOARD
324 MAIN ST
PEORIA IL 61602

MICHAEL MASON
PEORIA COUNTY BOARD
3419 W SHOFF AVE
PEORIA IL 61604

ROGER G MONROE
PEORIA COUNTY BOARD
2708 W OVERBROOK DR
PEORIA IL 61604

THOMAS O'NEILL
PEORIA COUNTY BOARD
4908 WANDA
BARTONVILLE IL 61607

LYNN SCOTT PEARSON
PEORIA COUNTY BOARD
1201 N E MADISON
PEORIA IL 61603

MICHAEL PHELAN
PEORIA COUNTY BOARD
1513 E MONETA AVE
PEORIA HEIGHTS IL 61603

WILLIAM R PRATHER
PEORIA COUNTY BOARD
1732 N 4TH
CHILLICOTHE IL 61523

ALEXANDRA L RANSBURG
PEORIA COUNTY BOARD
509 E HIGH POINT RD
PEORIA IL 61614

JAMES W THOMAS
PEORIA COUNTY BOARD
1629 W BRADLEY AVE
PEORIA IL 61606

CAROL TRUMPA
PEORIA COUNTY BOARD
6904 W CHALLACOMBE
EDWARDS IL 61528

CAROL TRUMPE
PEORIA COUNTY BOARD
6904 W CHALLACOMBE
EDWARDS IL 61528

JUNIOR WATKINS
PEORIA COUNTY BOARD
P O BOX 6125
PEORIA IL 61601

DAVID T WILLIAMS SR
PEORIA COUNTY BOARD
2513 W FREMONT
PEORIA IL 61605

COUNTY CLERK
PEORIA COUNTY COURT HOUSE
324 MAIN ST
PEORIA IL 61602

AMY BENECKE-MCLOREN
PEORIA CO HWY DEPT
PEORIA COUNTY HIGHWAY DEPARTMENT
6915 W PLANK RD
PEORIA IL 61604

THOMAS MC FARLAND
PEORIA/PEKIN URBANIZED AREA TR
PEORIA COUNTY HIGHWAY DEPARTMENT
6915 W PLANK RD
PEORIA IL 61604

R DALE PAGE
COUNTY ENGINEER
GREENWAYS BOARD
PEORIA COUNTY HIGHWAY DEPARTMENT
6915 W PLANK RD
PEORIA IL 61604

ANDREW WERNER
PEORIA CO HWY DEPT
PEORIA COUNTY HIGHWAY DEPARTMENT
6915 W PLANK RD
PEORIA IL 61604

ERLE F CURRIE
PEORIA/PEKIN URBANIZED AREA TR
PEORIA COUNTY HIGHWAY DEPT
6915 W PLANK RD
PEORIA IL 61604

SCOTT SORREL
LAND USE ADVISORY COMMITTEE L
PEORIA COUNTY PLANNING & ZONING
324 MAIN ST
PEORIA IL 61602

MATT WAHL
GREENWAYS BOARD
PEORIA COUNTY PLANNING & ZONING
324 MAIN RM 301
PEORIA IL 61602

KELLY MCINTYRE
GREENWAYS BOARD
PEORIA COUNTY PLANNING AND ZONING
324 MAIN ST ROOM 301
PEORIA IL 61602

W LOUIS SIDELL JR
PEORIA COUNTY ZONING
R 504 COURT HOUSE
PEORIA IL 61602

DAN BELL
HEARTLAND WATER RESOURCE BOARD
PEORIA LAKES STUDY
1900 ENGLISH OAK
WASHINGTON IL 61571-3433

JACK M FULLER
PEORIA PARK DIST
2218 N PROSPECT RD
PEORIA IL 61603

COUNTY CLERK
PUTNAM COUNTY
COURT HOUSE
HENNEPIN IL 61327

COUNTY CLERK
SANGAMON CO COURT HOUSE
800 E MONROE
SPRINGFIELD IL 62701

BOARD OF SUPERVISORS
SANGAMON CO COURT HOUSE
200 S 9TH ST
SPRINGFIELD IL 62701

ROBERT FAIRCHILD
DISTRICT #4 REPRESENTATIVE
SANGAMON COUNTY BOARD
200 S 9TH ST
SPRINGFIELD IL 62701-1629

SANGAMON COUNTY FARM SERVICE AGENCY
40 ADLOFF LANE STE 4
SPRINGFIELD IL 62703

KURT EHNLE
HEARTLAND WATER RESOURCE BOARD
SWCD BOARDS
3420 AKRON RD
EDELSTEIN IL 61526

CLIFF SCHROCK
GREENWAYS BOARD
TAZEWELL CO PARK & FOREST PRESERVE
COUNTY COURT HOUSE
PEKIN IL 61554

COUNTY CLERK
TAZEWELL COUNTY
COURT HOUSE
PEKIN IL 61554

DALE CLAUS
PEORIA/PEKIN URBANIZED AREA TR
TAZEWELL COUNTY ADMINISTRATOR
334 ELIZABETH ST STE 50
PEKIN IL 61554

JOYCE ANTONINI
TAZEWELL COUNTY BOARD
2107 BROOKVIEW TER #1
PEKIN IL 61554-5207

JOSEPH BERARDI
TAZEWELL COUNTY BOARD
1610 CAROLINE ST
PEKIN IL 61550

JAMES CARIUS
TAZEWELL COUNTY BOARD
83 FORESTVIEW AVE
MORTON IL 61550

TIMOTHY CHURCH
TAZEWELL COUNTY BOARD
802 FONDULAC DR
EAST PEORIA IL 61611

JAN DONOHUE
TAZEWELL COUNTY BOARD
506 COUNTRY CLUB DR
PEKIN IL 61554

KENNETH EUBANKS
TAZEWELL COUNTY BOARD
414 MANOR ST
PEKIN IL 61554

MICHAEL GODAR
TAZEWELL COUNTY BOARD
1004 LAWNDALE LANE
WASHINGTON IL 61571

PAUL GRETHEY
TAZEWELL COUNTY BOARD
22340 OAKLANE ACRES
MORTON IL 61550

DEAN GRIMM
TAZEWELL COUNTY BOARD
320 S MAIN
MORTON IL 61550

MICHAEL HARRIS
TAZEWELL COUNTY BOARD
P O BOX 245
MACKINAW IL 61755

BRIAN J HELLER
TAZEWELL COUNTY BOARD
109 N PINE ST BOX 213
WASHINGTON IL 61571

CARROLL IMIG
TAZEWELL COUNTY BOARD
8863 KESSINGER RD
TREMONT IL 61568

KEN KLOPFENSTEIN
TAZEWELL COUNTY BOARD
100 ARBOR CT
EAST PEORIA IL 61611-1901

CARLA KLOPFENSTEIN
TAZEWELL COUNTY BOARD
1600 E JEFFERSON
MORTON IL 61550

LARRY KOCH
TAZEWELL COUNTY BOARD
1100 FONDULAC DR
EAST PEORIA IL 61611

PEGGY MEISINGER
DIST OFFICE
TAZEWELL COUNTY BOARD
410 COURT ST
PEKIN IL 61554

JAMES NEWMAN
TAZEWELL COUNTY BOARD
616 WILSHIRE DR
WASHINGTON IL 61571

LARRY NOREUIL
TAZEWELL COUNTY BOARD
709 HILLYER ST
PEKIN IL 61554

JERRIANN ROSENAK
CHIEF CLERK
TAZEWELL COUNTY BOARD
1824 VALLE VISTA
PEKIN IL 61550

STEVEN SAAL
TAZEWELL COUNTY BOARD
608 S 5TH ST
PEKIN IL 61554

GREG SINN
TAZEWELL COUNTY BOARD
607 S LOCUST
TREMONT IL 61568

JAMES UNSICKER
CHAIRMAN
TAZEWELL COUNTY BOARD
334 ELIZABETH ST SUITE 50
PEKIN IL 61554

JAMES VONBOECKMAN
TAZEWELL COUNTY BOARD
334 ELIZABETH ST
PEKIN IL 61554-4176

NORMAN JOHANSEN
PEORIA/PEKIN URBANIZED AREA TR
TAZEWELL COUNTY HIGHWAY DEPT
21308 IL ROUTE 9
TREMONT IL 61568

DENNIS TRESENRITER
PEORIA/PEKIN URBANIZED AREA TR
TAZEWELL COUNTY HIGHWAY DEPT
21308 IL ROUTE 9
TREMONT IL 61568

KRISTAL DEININGER
LAND USE ADVISORY COMMITTEE
TAZEWELL COUNTY PLANNING & ZONING
MCKENZIE BUILDING 11 S 4TH
PEKIN IL 61554

JIM NACHEL
THE FOREST PRESERVE DIST OF WILL COUNTY
17540 W LARAWAY RD
JOLIET IL 60433

THOMAS GEREND
TRI COUNTY REG PLAN
411 N HAMILTON STE 2001
PEORIA IL 61602

ROBERT PINTARTIN
TRI COUNTY RIVERFRONT FORUM
417 S MINNESOTA AVE
MORTON IL 61550

BOB HAYES
TRI-COUNTY DUCK & GOOSE ASSOC
392 W HICKORY HILLS DR
HAVANA IL 62644

KEVIN GREEN
ECOSYSTEM PRTNRSHP-VERMILION RIVER
VERMILION COUNTY SWCD
1905-A US ROUTE 150
DANVILLE IL 61832

NANCY SCHULTZ VOOTS
COUNTY CLERK
WILL COUNTY
302 N CHICAGO ST
CHICAGO IL 60432

JAY KESSEN
WILL COUNTY LAND USE DEPARTMENT
58 E CLINTON STE 500
JOLIET IL 60432

AMY MUNRO
PLANNING DIV
WILL COUNTY LAND USE DEPARTMENT
58 E CLINTON ST STE 500
JOLIET IL 60432

COUNTY CLERK
WOODFORD COUNTY
COURT HOUSE
EUREKA IL 61530

ARDEN BALDWIN
WOODFORD COUNTY BOARD
19 SKYVIEW DR
EAST PEORIA IL 61611

JAMES L BOOTH
WOODFORD COUNTY BOARD
704 SOMERSET DR
METAMORA IL 61548

BERNARD BUCHER
WOODFORD COUNTY BOARD
RR 2 BOX 185
EUREKA IL 61530

ELLEN BURTON
WOODFORD COUNTY BOARD
RR 1 BOX 72
CONGERVILLE IL 61729

WILLIAM A CHRIST
WOODFORD COUNTY BOARD
RR 1
METAMORA IL 61548

JOHN A GAUGER
WOODFORD COUNTY BOARD
COURT HOUSE
EUREKA IL 61530

ROBERT HUSCHEN
WOODFORD COUNTY BOARD
706 RANDOLPH
ROANOKE IL 61561

THOMAS JANSSEN
CHAIRMAN
WOODFORD COUNTY BOARD
910 MARY ST
MINONK IL 61760

K C JONES
WOODFORD COUNTY BOARD
1918D CANTERBURY DR
WASHINGTON IL 61571-3416

PETER LAMBIE
WOODFORD COUNTY BOARD
1346 VALLEYVIEW
EAST PEORIA IL 61611

RODNEY RUESTMAN
WOODFORD COUNTY BOARD
404 LINCOLN ST
MINONK IL 61760

CHARLES TANTON
WOODFORD COUNTY BOARD
121 KNOLLAIRE
METAMORA IL 61548

KENNETH M UPHOFF
WOODFORD COUNTY BOARD
RR 1 BOX 66A
HUDSON IL 61748

LARRY WHITAKER
WOODFORD COUNTY BOARD
BOX 301 TIMBERLINE RD
GOODFIELD IL 61742

WOODFORD COUNTY FARM SERVICE AGENCY
939 W CENTER ST
EUREKA IL 61530

DENNIS BACHMAN
PEORIA/PEKIN URBANIZED AREA TR
WOODFORD COUNTY HIGHWAY DEPT
301 S MAIN BOX 467
ROANOKE IL 61561

DIANE FREEMAN
WOODFORD COUNTY SWCD
937 W CENTER ST
EUREKA IL 61530

ROBERT WEERS
ZONING ADMINISTRATOR
GREENWAYS BOARD
WOODFORD COUNTY ZONING
ROOM 104 115 N MAIN
EUREKA IL 61530

DIRECTOR OF PUBLIC WORKS
1101 EDWARDS
BEARDSTOWN IL 62618

CITY ADMINISTRATOR
115 W HOWARD ST
CITY HALL
PONTIAC IL 61764

CITY ATTORNEY
115 W HOWARD ST
CITY HALL
PONTIAC IL 61764

CITY MANAGER
CITY HALL
419 FULTON ST RM 207
PEORIA IL 61602

EXE DIRECTOR OF RIVERFRONT DEV
CITY HALL
419 FULTON ST RM 302
PEORIA IL 61602

FINANCE DIRECTOR/COMPTROLLER
CITY HALL
419 FULTON ST RM 106
PEORIA IL 61602

JUDY BATUSICH
TOWNSHIP SUPERVISOR
222 E 9TH ST RM 3110
LOCKPORT IL 60441

WAYNE EICHELKRAUT
802 W MCKINLEY RD
OTTAWA IL 61350

ANTON GRAFF
CITY ADMINISTRATOR
800 GAME FARM RD
YORKVILLE IL 60560-9999

VALERIE JARRETT
COMMISSIONER
121 N LASALLE ST RM 1000
CHICAGO IL 60602

DWIGHT JARVIS
425 E MAIN ST
HAVANA IL 62644-1435

DANIEL KRAMER
CITY ATTORNEY
800 GAME FARM RD
YORKVILLE IL 60560-9999

BILL KRAUSE
CITY ENGINEER
301 W MADISON
OTTAWA IL 61350

ARLEN PETERSON
FORREST RESTORATION CONSULTANT
1231 SUPERIOR ST
AURORA IL 60505

ARTHUR PROCHASKA
MAYOR
800 GAME FARM RD
YORKVILLE IL 60560-9999

JOSEPH WYWROT
MUNICIPAL ENGINEER
800 GAME FARM RD
YORKVILLE IL 60560-9999

SUPERVISOR
AURORA TWNSP KANE CO
80 N. BROADWAY
AURORA IL 60504

ANDREW MANION
DEAN
COLLEGE ARTS & SCIENCES
AURORA UNIVERSITY
347 GLADSTONE AVE
AURORA IL 60506

CHUCK BETSON
BARTONVILLE CITY COUNCIL
4434 S BAKER LANE
BARTONVILLE IL 61607

W DON GARSKE
BARTONVILLE CITY COUNCIL
4615 SANDRON
BARTONVILLE IL 61607

LARRY A JOHNSON
BARTONVILLE CITY COUNCIL
4100 S BAKER LANE
BARTONVILLE IL 61607

TERRY L PYATT
BARTONVILLE CITY COUNCIL
6105 S MADISON
BARTONVILLE IL 61607

CYNTHIA STAFFORD
BARTONVILLE CITY COUNCIL
3524 DOROTHY
BARTONVILLE IL 61607

GLEN STALLINGS
BARTONVILLE CITY COUNCIL
3902 S AIRPORT RD
BARTONVILLE IL 61607

EXECUTIVE DIRECTOR
BATAVIA CHAMBER OF COMMERCE
101 N ISLAND AVE
BATAVIA IL 60510

MICAHEL CLARK
EXECUTIVE DIRECTOR
BATAVIA PARK DISTRICT
327 W WILSON
BATAVIA IL 60510

SUPERVISOR
BATAVIA TOWNSHIP KANE CO
100 N ISLAND AVE
BATAVIA IL 60510

BEARDSTOWN CHAMBER OF COMMERCE
101 W 3RD
BEARDSTOWN IL 62618

BEARDSTOWN SANITARY DIST
W 6TH ST
BEARDSTOWN IL 62618

BEARDSTOWN WATER WORKS
1101 EDWARDS ST
BEARDSTOWN IL 62618

BOARD OF SUPERVISORS
119 S ADAMS ST FULTON COUNTY COURTHOUSE
LEWISTOWN IL 61542

MARK KEINICKE
BOURBONNAIS TOWNSHIP PARK DIST
459 N KENNEDY
BOURBONNAIS IL 60914

BARBARA KOCH
EXECUTIVE DIRECTOR - IL VALLEY AREA
CHAM OF COMMERCE & ECON DEVELOPMENT
300 BUCKLIN PO BOX 446
LA SALLE IL 61301-0446

CHAMBER OF COMMERCE
320 WAUPONSEE ST
MORRIS IL 60450

CHAMBER OF COMMERCE
100 W LAFAYETTE ST
OTTAWA IL 61350

CHAMBER OF COMMERCE
135 WASHINGTON ST
MARSEILLES IL 61341

CHAMBER OF COMMERCE
3 S OLD STATE CAPITOL PLZ
SPRINGFIELD IL 62701

CHAMBER OF COMMERCE
100 N CHICAGO ST
JOLIET IL 60434

CHAMBER OF COMMERCE
603 OTIS AVE
ROCKDALE IL 60436

DENICE RAY
EXECUTIVE DIRECTOR
CHAMBER OF COMMERCE
PO BOX 116
HAVANA IL 62644

LYNN SMITH
CHAMBER OF COMMERCE
R 2 BOX 30
RUSHVILLE IL 62081

DEPT OF RESEARCH & PLANNING
CHICAGO PARK DIST
401 S LA SALLE ST
CHICAGO IL 60605

KEN MALURE
CHICAGO PARK DIST
7032 W FARREGUT
CHICAGO IL 60686

PATRICIA HEIDEN
CHILLICOTHE CHAMBER OF COMMERCE
1007 N 2ND STE 1 BOX 106
CHILLICOTHE IL 61523

TARA CAPOCCI-KILMER
CHILLICOTHE CITY COUNCIL
1017 N HISHAW AVE
CHILLICOTHE IL 61523-1438

SHARON CRABEL
CHILLICOTHE CITY COUNCIL
108 WILLIAMS DR
CHILLICOTHE IL 61523

JAMES DENNISON
ALDERMAN
CHILLICOTHE CITY COUNCIL
1722 BENEDICT ST
CHILLICOTHE IL 61523

RICHARD ECKSTEIN
ALDERMAN
CHILLICOTHE CITY COUNCIL
1127 ELM ST
CHILLICOTHE IL 61523

R PAUL GOLLNITZ
ALDERMAN
CHILLICOTHE CITY COUNCIL
1521 N SANTA FE
CHILLICOTHE IL 61523

IRVIN LATTA
TREASURER
CHILLICOTHE CITY COUNCIL
311 2ND ST
CHILLICOTHE IL 61523

CARL A SPENCER JR
ALDERMAN
CHILLICOTHE CITY COUNCIL
224 CLOVERFIELD DR
CHILLICOTHE IL 61523

NEIL YOUNG
ALDERMAN
CHILLICOTHE CITY COUNCIL
810 N SANTA FE
CHILLICOTHE IL 61523

MAYOR
CITY HALL
145 W MAIN ST
MT STERLING IL 62353

MAYOR
CITY HALL
109 3RD ST
GRAFTON IL 62037

MAYOR
CITY HALL
385 E OAK ST
KANKAKEE IL 60901

MAYOR
CITY HALL
203 E THOMAS
RANSOM IL 60470

MAYOR
CITY HALL
204 S BLOOMINGTON ST
STREATOR IL 61364

MAYOR
CITY HALL
213 S FRONT ST
ODELL IL 60460

MAYOR
CITY HALL
602 E MAIN ST
CORNELL IL 61319

MAYOR
CITY HALL
PO BOX 166
CULLOM IL 60929

MAYOR
CITY HALL
GENERAL DELIVERY
SAUNEMIN IL 61769

MAYOR
CITY HALL
115 W HOWARD ST
PONTIAC IL 61764

MAYOR
CITY HALL
201 E LOCUST ST
FAIRBURY IL 61739

MAYOR
CITY HALL
GENERAL DELIVERY
CHATSWORTH IL 60921

MAYOR
CITY HALL
GENERAL DELIVERY
EMINGTON IL 60934

MAYOR
CITY HALL
209 S PRAIRIE AVE
DWIGHT IL 60420

MAYOR
CITY HALL
202 N CENTER ST
FORREST IL 61741

MAYOR
CITY HALL
1 GARY K ANDERSON PLAZA
DECATUR IL 62520

MAYOR
CITY HALL
329 W MAIN ST
LEXINGTON IL 61753

MAYOR
CITY HALL
307 N HARRISON
COLFAX IL 61728

MAYOR
CITY HALL
109 E OLIVE ST
BLOOMINGTON IL 61701

MAYOR
CITY HALL
313 E JEFFERSON ST
RIVERTON IL 62561

MAYOR
CITY HALL
101 SE MAIN ST
HOPEDALE IL 61747

CITY MANAGER
CITY HALL
111 S CAPITOL ST
PEKIN IL 61544

MAYOR
CITY HALL
207 E FAST ST
MACKINAW IL 61755

HONORABLE JOE COOK
VILLAGE PRESIDENT
CITY HALL
24555 S NAVAJO DR
CHANNAHON IL 60410-3334

HONORABLE C. RICHARD ELLIS
VILLAGE PRESIDENT
CITY HALL
121 E MCVILLY RD
MINOOKA IL 60447-9420

HONORABLE ROBERT ESCHBACH
MAYOR
CITY HALL
301 W MADISON ST
OTTAWA IL 61350-2820

HONORABLE FRED ESMOND
MAYOR
CITY HALL
PO BOX 188
UTICA IL 61373

HONORABLE KAREN HASARA
MAYOR
CITY HALL
406 E MONROE ST
SPRINGFIELD IL 62706

HONORABLE JIM JENNINGS
MAYOR
CITY HALL
145 W MAIN ST
MT STERLING IL 62353-1223

HONORABLE RICHARD KOPCZICK
MAYOR
CITY HALL
320 WAUPONSEE ST
MORRIS IL 60450-2125

HONORABLE ARTHUR SCHULTZ
MAYOR OF JOLIET
CITY HALL
150 W JEFFERSON ST
JOLIET IL 60432-1148

HONORABLE DAVID SINCLAIR
MAYOR
CITY HALL
153 S FRONT ST
VIRGINIA IL 62691-9999

HONORABLE ROBERT WALTERS
MAYOR
CITY HALL
105 W 3RD PO BOX 467
BEARDSTOWN IL 62618

HONORABLE ART WASHKOWIAK
MAYOR
CITY HALL
745 2ND ST
LA SALLE IL 61301-2501

HONORABLE DAVID YECK
MAYOR
CITY HALL
116 W WILLIAMS ST PO BOX 27
SENECA IL 61360-0027

HONORABLE JEFFREY ZIRCHER
VILLAGE PRESIDENT
CITY HALL
5912 S ADAMS ST
BARTONVILLE IL 61607-1997

HONORABLE RICHARD M DALEY
MAYOR
CITY HALL RM 507
121 N LASALLE ST
CHICAGO IL 60602

STEVE ANDRAS
CITY OF AURORA
44 E DOWNER PLACE
AURORA IL 60507

RICHARD TODAS
CHIEF OF STAFF
CITY OF AURORA
44 EAST DOWNER PL
AURORA IL 60507

HONORABLE TOM WEISNER
MAYOR
CITY OF AURORA
44 E DOWNER PLACE
AURORA IL 60507

SUPERINTENDENT
ELECTRIC UTILITIES
CITY OF BATAVIA
100 N ISLAND AVE
BATAVIA IL 60510

LINNEA MILLER
ALDERMAN
CITY OF BATAVIA
100 N ISLAND AVE
BATAVIA IL 60510

JEFFERY SCHIELKE
MAYOR
CITY OF BATAVIA
101 N ISLAND AVE
BATAVIA IL 60510

HONORABLE JOANN CONWAY
VILLAGE PRESIDENT
CITY OF BATH
PO BOX 140
BATH IL 62617-9999

HONORABLE HOWARD MAYFIELD
VILLAGE PRESIDENT
CITY OF BAY VIEW GARDENS
300 GARBER LN# 8
EAST PEORIA IL 61611-9668

HONORABLE JESSE SMART
MAYOR
CITY OF BLOOMINGTON
P O BOX 3157
BLOOMINGTON IL 61702

HONORABLE DANNY FISHEL
VILLAGE PRESIDENT
CITY OF BRIMFIELD
PO BOX 451
BRIMFIELD IL 61517-0451

HONORABLE MAX MAYBERRY
VILLAGE PRESIDENT
CITY OF BRYANT
PO BOX 13
BRYANT IL 61519-0013

HONORABLE DWIANE VAN MEENEN
VILLAGE PRESIDENT
CITY OF CAMBRIDGE
123 W EXCHANGE ST
CAMBRIDGE IL 61238

HONORABLE ROD HEINZE
MAYOR
CITY OF CANTON
2 N MAIN
CANTON IL 61520

HENRY HENDERSON
DEPT OF ENVIRONMENT
CITY OF CHICAGO
30 N LASALLE ST 25TH FLOOR
CHICAGO IL 60602

HONORABLE BURTON NATARUS
ALDERMAN
CITY OF CHICAGO
121 N LA SALLE ST RM 306
CHICAGO IL 60602

LISA BURNETT
ECONOMIC DEVELOPMENT DIRECTOR
GREENWAYS BOARD
CITY OF CHILLICOTHE ECONOMIC DEVELOPMENT
908 N 2ND ST
CHILLICOTHE IL 61523

HONORABLE GLORIA ORLANDI
VILLAGE PRESIDENT
CITY OF DALZELL
119 SCOTT ST PO BOX 255
DALZELL IL 61320-0255

HONORABLE JOSEPH CENTENO
VILLAGE PRESIDENT
CITY OF DANA
VILLAGE HALL
DANA IL 61321-9999

WILLIAM SANDS
DIRECTOR OF PUBLIC WORKS
CITY OF DECATUR
ONE CIVIC CENTER PLAZA
DECATUR IL 62523

HONORABLE CHARLES DENMAN
MAYOR
CITY OF DELAVAN
PO BOX 590
DELAVAN IL 61734-0590

HONORABLE HELEN WILLIAMS
VILLAGE PRESIDENT
CITY OF DUNFERMLINE
129 FULTON ST PO BOX 121
DUNFERMLINE IL 61524-0121

HONORABLE RICHARD CALHOUN
VILLAGE PRESIDENT
CITY OF DUNLAP
104 N 2ND ST PO BOX 116
DUNLAP IL 61525-0121

CITY CLERK
CITY OF EAST PEORIA
100 S MAIN ST
EAST PEORIA IL 61611

ANTHONY BARRETT
PEORIA/PEKIN URBANIZED AREA TR
CITY OF EAST PEORIA
100 S MAIN ST
EAST PEORIA IL 61611

TOM BRIMBERRY
LAND USE ADVISORY COMMITTEE L
CITY OF EAST PEORIA
100 S MAIN
EAST PEORIA IL 61611

HONORABLE CHARLES DOBBELAIRE
MAYOR
CITY OF EAST PEORIA
100 S MAIN ST
EAST PEORIA IL 61611-2457

JOHN ESKLE
CITY OF EAST PEORIA
701 MARINER WAY
EAST PEORIA IL 61611

JEFF GIEBELHAUSEN
PEORIA/PEKIN URBANIZED AREA TR
CITY OF EAST PEORIA
100 S MAIN ST
EAST PEORIA IL 61611

JEFF GIEBELHOUSEN
MAYOR
CITY OF EAST PEORIA
100 S MAIN ST
PEORIA IL 61611-2457

HONORABLE EDWARD COSBY JR
MAYOR
CITY OF ELMWOOD
201 W MAIN ST PO BOX 439
ELMWOOD IL 61529-0439

HONORABLE LAURA SISCOE
MAYOR
CITY OF EUREKA
128 N MAIN ST
EUREKA IL 61530-1157

HONORABLE SCOTT KNIGHT
VILLAGE OF FLANAGAN
CITY OF FLANAGAN
PO BOX 597
FLANAGAN IL 61740-0597

LYMAN JENSEN
DIRECTOR OF PUBLIC WORKS
CITY OF GALESBURG
PO BOX 1387
GALESBURG IL 61402-1387

HONORABLE ROBERT SHEEHAN
MAYOR
CITY OF GALESBURG
55 W TOMPKINS
GALESBURG IL 61402-9999

HONORABLE MARVIN JOHNSON
VILLAGE PRESIDENT
CITY OF GERMANTOWN HILLS
216 HOLLAND RD
METAMORA IL 61548-9999

HONORABLE SHIRLEY GLELOW
MAYOR
CITY OF GRAND RIDGE
PO BOX 745
GRAND RIDGE IL 61325-0745

HONORABLE ROBERTA BUCHER
VILLAGE PRESIDENT
CITY OF GREEN VALLEY
P O BOX 111
GREEN VALLEY IL 61534-0111

HONORABLE PHIL MC ALEARNEY
VILLAGE PRESIDENT
CITY OF HANNA CITY
313 N 1ST ST PO BOX 492
HANNA CITY IL 61536-0492

PORTIA BROWN
CITY OF HAVANA
617 N BROADWAY ST
HAVANA IL 62644-1003

HONORABLE DALE ROBERTS
MAYOR
CITY OF HAVANA
227 W MAIN ST
HAVANA IL 62644-1137

HONORABLE KEVIN COLEMAN
VILLAGE PRESIDENT
CITY OF HENNEPIN
VILLAGE HALL
HENNEPIN IL 61327-9999

HONORABLE DARYL FOUNTAIN
MAYOR
CITY OF HENRY
426 E PARK ROW ST PO BOX 196
HENRY IL 61537-0196

HONORABLE AUGUST CILTS
VILLAGE PRESIDENT
CITY OF HOPEDALE
PO BOX 387
HOPEDALE IL 61747-0387

HONORABLE CHARLETTE HANCOCK
VILLAGE PRESIDENT
CITY OF KINGSTON MINES
201 WASHINGTON PO BOX 17
KINGSTON MINES IL 61539-0017

TIMOTHY R. HANSEN
VILLAGE PRESIDENT
CITY OF LA GRANGE
53 S LA GRANGE RD
LA GRANGE IL 60525

PAM BROVIAK
CITY OF LA SALLE
745 2ND
LA SALLE IL 61301

HONORABLE MICHAEL HIELL
MAYOR
CITY OF LACON
406 5TH ST
LACON IL 61540-1295

HONORABLE RONALD BARNHART
MAYOR
CITY OF LEONORE
VILLAGE HALL
LEONORE IL 61332-9999

HONORABLE BARRY BLACKWELL
MAYOR
CITY OF LEWISTOWN
119 S ADAMS ST
LEWISTOWN IL 61542-1443

HONORABLE RANDY MAY
VILLAGE PRESIDENT
CITY OF LOMAX
PO BOX 116
LOMAX IL 61454-0116

HONORABLE RICHARD LEFLER
VILLAGE PRESIDENT
CITY OF LONG POINT
PO BOX 38
LONG POINT IL 61333-0038

HONORABLE PHILLIP THAMES
VILLAGE PRESIDENT
CITY OF MACKINAW
100 E FAST AVE PO BOX 542
MACKINAW IL 61755-0542

HONORABLE TIMOTHY SONDAG
VILLAGE PRESIDENT
CITY OF MANITO
204 N BROADWAY ST PO BOX 618
MANITO IL 61546-0618

HONORABLE KEN OEDEWALDT
VILLAGE PRESIDENT
CITY OF MAPLETON
P O BOX 101
MAPLETON IL 61547-0101

HONORABLE DAVID REDFIELD
MAYOR
CITY OF MARQUETTE HEIGHTS
715 LINCOLN RD
MARQUETTE HEIGHTS IL 61554-1313

HONORABLE NEILL KENEIPP
VILLAGE PRESIDENT
CITY OF MINIER
PO BOX 350
MINIER IL 61759-0350

HONORABLE MARK SPENCER
MAYOR
CITY OF MINONK
670 N CHESTNUT ST
MINONK IL 61760-1272

HONORABLE DON ROTH
MAYOR
CITY OF MORTON
120 N MAIN ST
MORTON IL 61550

HONORABLE JO HAMLET
MAYOR
CITY OF MOUNT STERLING
104 ELM
MT STERLING IA 52573-7700

SUPERINTENDENT
ELECTRIC UTILITIES
CITY OF NAPERVILLE
139 WATER ST
NAPERVILLE IL 60540

HONORABLE KENT KARRAKER
MAYOR
CITY OF NORMAL
100 E PHOENIX
NORMAL IL 61761

HONORABLE WILLIAM CLUTTS
VILLAGE PRESIDENT
CITY OF NORTH PEKIN
318 N MAIN ST
NORTH PEKIN IL 61554-1066

HONORABLE ROBERT EGBERT
VILLAGE PRESIDENT
CITY OF NORWOOD
1515 N NORWOOD BLVD
NORWOOD IL 61604-4355

HONORABLE JERRY SCOTT
MAYOR
CITY OF OGLESBY
128 W WALNUT ST PO BOX 10
OGLESBY IL 61348-0010

RANDY CONSTANTINE
CITY OF OTTAWA
301 W MADISON ST
OTTAWA IL 61350

WAYNE EICHELKRAUT JR
COMMISSIONER OF PUBLIC PROPERTY
CITY OF OTTAWA
301 W MADISON ST
OTTAWA IL 61350

DAPHNE MITCHELL
CITY OF OTTAWA
301 W MADISON ST
OTTAWA IL 61350

GARY PIKE
CITY OF OTTAWA
301 W MADISON ST
OTTAWA IL 61350

ELIZABETH TAYLOR
CITY OF OTTAWA
301 W MADISON ST
OTTAWA IL 61350

EDWARD WHITNEY
CITY OF OTTAWA
301 W MADISON ST
OTTAWA IL 61350

HONORABLE LYNDELL HOWARD
MAYOR
CITY OF PEKIN
111 S CAPITAL ST
PEKIN IL 61554-3260

RICHARD JOST
LAND USE ADVISORY COMMITTEE L
CITY OF PEKIN
1416 W SHORE DR
PEKIN IL 61554

DENNIS KIEF
PEORIA/PEKIN URBANIZED AREA TR
CITY OF PEKIN
111 S CAPITOL ST
PEKIN IL 61554

GREG RANNEY
MUNICIPAL BUS DEPT
CITY OF PEKIN
1130 KOCH ST
PEKIN IL 61554

CITY CLERK
CITY OF PEORIA
419 FULTON ST #401
PEORIA IL 61602

PEORIA/PEKIN URBANIZED AREA TR
CITY OF PEORIA
419 FULTON ST ROOM 307
PEORIA IL 61602

ENHANCEMENTS
CITY OF PEORIA
419 FULTON
PEORIA IL 61602

WAYNE ANTHONY
PEORIA/PEKIN URBANIZED AREA TR
CITY OF PEORIA
4 FULTON ST TWIN TOWERS #402
PEORIA IL 61602

ROSS BLACK
AREA PLANNERS
CITY OF PEORIA
419 FULTON ROOM 402
PEORIA IL 61602

GENE HEWITT
PEORIA/PEKIN URBANIZED AREA TR
CITY OF PEORIA
419 FULTON ST
PEORIA IL 61602

ELLIE HOGAN
RIVERFRONT BUSINESS DIST COMM
CITY OF PEORIA
419 FULTON ST ROOM 106
PEORIA IL 61602

JOHN KUNSKI
419 FULTON ST #401
CITY OF PEORIA
PEORIA CITY HALL ROOM 300 419 FULTON
PEORIA IL 61602

MICHAEL MC KNIGHT
PEORIA/PEKIN URBANIZED AREA TR
CITY OF PEORIA
419 FULTON SUITE 207
PEORIA IL 61602

BRIAN NICHOLSON
EROSION CONTROL TASK FORCE
CITY OF PEORIA
419 FULTON ROOM 307
PEORIA IL 61602

HONORABLE DAVID RANSBURG
MAYOR
CITY OF PEORIA
419 FULTON ST RM 401
PEORIA IL 61602-1217

STEVEN VAN WINKLE
DIRECTOR OF PUBLIC WORKS
PEORIA/PEKIN URBANIZED AREA TR
CITY OF PEORIA
419 FULTON ST #307
PEORIA IL 61602

VILLAGE CLERK
CITY OF PEORIA HEIGHTS
4901 N PROSPECT RD
PEORIA HEIGHTS IL 61616

HONORABLE EARL CARTER
VILLAGE PRESIDENT
CITY OF PEORIA HEIGHTS
4901 N PROSPECT RD
PEORIA HEIGHTS IL 61616-5397

DAVID EVANCOE
AREA PLANNERS
CITY OF PEORIA PLANNING & ZONING
419 FULTON ROOM 404
PEORIA IL 61602

OLAJIDE GIWA
AREA PLANNERS
CITY OF PEORIA PLANNING & ZONING
456 FULTON ST #402
PEORIA IL 61602

PATRICIA LANDES
AREA PLANNERS
CITY OF PEORIA PLANNING & ZONING
419 FULTON ROOM 404
PEORIA IL 61602

MIKE SALATA
TRANSPORTATION COORDINATION CO
CITY OF PEORIA PUBLIC WORKS
3505 N DRIES LANE
PEORIA IL 61604

HONORABLE DONALD BAKER
MAYOR
CITY OF PERU
PO BOX 299
PERU IL 61354-0299

HONORABLE KEITH CAIN
MAYOR
CITY OF PRINCETON
2 S MAIN ST
PRINCETON IL 61356-1708

HONORABLE SIDNEY R STAHL
VILLAGE PRESIDENT
CITY OF PRINCEVILLE
206 N WALNUT
PRINCEVILLE IL 61559-9999

HONORABLE KEITH KLEIN
VILLAGE PRESIDENT
CITY OF ROANOKE
PO BOX 1098
ROANOKE IL 61561-1098

HONORABLE CHARLOTTE RUPE
VILLAGE PRESIDENT
CITY OF RUTLAND
101 N W FRONT ST
RUTLAND IL 61358-0395

HONORABLE MIKE LAFRAMBOISE
VILLAGE PRESIDENT
MAYOR
CITY OF SECOR
VILLAGE HALL
SECOR IL 61771-9999

HONORABLE RICHARD HUSE
VILLAGE PRESIDENT
CITY OF SOUTH PEKIN
309 W MAIN ST PO BOX 10
SOUTH PEKIN IL 61564-0010

HONORABLE PHILLIP MURPHY
VILLAGE PRESIDENT
CITY OF SPARLAND
PO BOX 278
SPARLAND IL 61565-0278

HONORABLE JAMES NARCZEWSKI
MAYOR
CITY OF SPRING VALLEY
215 N GREENWOOD ST
SPRING VALLEY IL 61362-2003

HONORABLE ROGER THOMPSON
VILLAGE PRESIDENT
CITY OF TONICA
PO BOX 268
TONICA IL 61370-0268

HONORABLE DAVE MASON
TOWN PRESIDENT
CITY OF TOPEKA
TOWN HALL
TOPEKA IL 61567-9999

HONORABLE TODD BONG
VILLAGE PRESIDENT
CITY OF TREMONT
211 S SAMPSON ST
TREMONT IL 61568-9999

HONORABLE MARWOOD KIDD
VILLAGE PRESIDENT
CITY OF TROY GROVE
PO BOX 2
TROY GROVE IL 61372-0002

HONORABLE CHARLES ELDRED
MAYOR
CITY OF URBANA
400 S VINE ST
URBANA IL 61801

HONORABLE STEVE FORMEY
VILLAGE PRESIDENT
CITY OF WASHBURN
136 JEFFERSON
WASHBURN IL 61570-9999

DALE CLAUS
CITY ADMINISTRATOR
CITY OF WASHINGTON
115 W JEFFERSON
WASHINGTON IL 61571

JAMES GEE
CITY OF WASHINGTON
810 HILLDALE AVE
WASHINGTON IL 61571

JAY GETZ
AREA PLANNERS
CITY OF WASHINGTON
115 W JEFFERSON
WASHINGTON IL 61570

HONORABLE GARY MANIER
MAYOR
CITY OF WASHINGTON
115 W JEFFERSON
WASHINGTON IL 61571-9999

DAVID PLYMAN
CITY OF WASHINGTON
115 W JEFFERSON
WASHINGTON IL 61571

HONORABLE JAMES R DILLON
MAYOR
CITY OF WEST PEORIA
2506 W ROHMANN
WEST PEORIA IL 61604-1377

JEFF ROBINSON
PEORIA/PEKIN URBANIZED AREA TR
CITY OF WEST PEORIA
2506 W ROHMANN
WEST PEORIA IL 61604

DAVID STROHL
PEORIA/PEKIN URBANIZED AREA TR
CITY OF WEST PEORIA
2506 W ROHMANN
WEST PEORIA IL 61604

DALE SMITH
CITY RECREATION BOARD
301 W MADISON
OTTAWA IL 61350

RICK SEMONSKI
PEORIA/PEKIN URBANIZED AREA TR
DEPARTMENT OF PUBLIC WORKS
2232 E WASHINGTON ST
EAST PEORIA IL 61611

STEVE CARR
DIRECTOR
DEPT OF PUBLIC WORKS
2232 E WASHINGTON ST
EAST PEORIA IL 61611

DICK DODSON
E PEORIA CHAMBER OF COMMERCE
111 W WASHINGTON ST
EAST PEORIA IL 61611

CHARLES DOBBELAIRE
E PEORIA CITY COUNCIL
232 COVENTRY LANE
EAST PEORIA IL 61611

HAROLD FOGELMARK
E PEORIA CITY COUNCIL
126 W FAULKNER RD
EAST PEORIA IL 61611

TOM ROTH
EL PASO CHAMBER OF COMMERCE
1 W FRONT ST
EL PASO IL 61738

FONDULAC PARK DIST
201 VETERANS DR #2
EAST PEORIA IL 61611

WILLIAM RUTHERFORD
GREENWAYS BOARD
FOREST PARK FOUNDATION
5823 N FOREST PARK DR
PEORIA HEIGHTS IL 61614

LOUISE MC ENTIRE
ENHANCEMENTS
FORT CREVE COEUR PARK
301 LAWNRIDGE DR
CREVE COEUR IL 61610

BOB VAUGHAN
FOX VALLEY PARK DIST
P.O. Box 818
AURORA IL 60507

STEVEN HATCHER
GREATER AURORA AREA CHAMBER OF COMMERCE
40 W DOWNER PL
AURORA IL 60506

DAVID BRAUN
PEORIA/PEKIN URBANIZED AREA TR
GREATER PEORIA MASS TRANSIT
2105 NE JEFFERSON ST
PEORIA IL 61603

JOHN STOKOWSKI
PEORIA/PEKIN URBANIZED AREA TR
GREATER PEORIA MASS TRANSIT
2105 NE JEFFERSON ST
PEORIA IL 61603

MICHAEL P BOER
GRTR SPGFLD CHAMBER OF COMMERCE
3 S OLD STATE CAPITOL PLAZA
SPRINGFIELD IL 62701

SUPERINTENDENT OF HIGHWAYS
GRUNDY COUNTY
310 E DUPONT RD
MORRIS IL 60450

HAVANA CHAMBER OF COMMERCE
112 S ORANGE ST
HAVANA IL 62644

HAVANA PARK DIST
227 W MAIN ST
HAVANA IL 62644

ROBERTA PARKS
CHAMBER OF COMMERCE
HEARTLAND PARTNERSHIP
124 SW ADAMS ST SUITE 300
PEORIA IL 61602

HENRY CHAMBER OF COMMERCE
426 E PARK ROW
HENRY IL 61537

COUNTY CLERK
KANKAKEE COUNTY
189 E CT ST
KANKAKEE IL 60901

ED SMITH
COUNTY ATTORNEY
KANKAKEE COUNTY
450 E CT ST
KANKAKEE IL 60901

JEAN HURRLE
KANKAKEE FOREST PRESERVE
605 1/2 S 5TH AVE
KANKAKEE IL 60901

CHUCK SMEAD
KANKAKEE FOREST PRESERVE
1221 E 5000 S RD
ST ANNE IL 60904

JOSEPH CANTWELL
KANKAKEE RIVER CONSERVANCY DIST
207 E RIVER ST
MOMENCE IL 60954

STEVE ENGELKING
KANKAKEE RIVER CONSERVANCY DIST
11861 E GREGG BLVD
MOMENCE IL 60954

J R BLACK
KANKAKEE RIVER PARTNERSHIP
9 NORTHVIEW
KANKAKEE IL 60901

DAVE MOGLE
KANKAKEE VALLEY PARK DIST
175 S WALL
KANKAKEE IL 60901

ROBERT PADDOCK
GLADYS FOX MUSEUM
LOCKPORT TOWNSHIP PARK DIST
1911 S LAWRENCE
LOCKPORT IL 60441-4498

GEORGE WHITLATCH
CHAIRMAN
GREENWAYS BOARD
MACKINAW RECREATION PROGRAM
100 E FAST AVE
MACKINAW IL 61755

PAUL MARIEN
ECOSYSTEM PRTNRSHP-HEART SANGAMON R
MACON COUNTY CONSERVATION DISTRICT
3939 NEARING LANE
DECATUR IL 62521

RICK CRUM
GREENWAYS BOARD
MARQUETTE HEIGHTS STS AND PARKS
715 LINCOLN RD
MARQUETTE HEIGHTS IL 61554

THEODORE J BAKALAR
MAYOR
204 S BLOOMINGTON ST
STREATOR IL 61364

GENERAL SUPERINTENDENT
METR SANITARY DIST - GREATER CHICAG0
100 E ERIE ST
CHICAGO IL 60511

BYRON MILLER
MOMENCE CHAMBER OF COMMERCE
PO BOX 34 28 N DIXIE HWY
MOMENCE IL 60954

MIKE BADGEROW
MORTON CHAMBER OF COMMERCE
415 W JEFFERSON ST
MORTON IL 61550

DONALD BIGGER
MORTON CITY COUNCIL
77 MAPLE RIDGE DR
MORTON IL 61550

MARK HUTCHISON
MORTON CITY COUNCIL
309 E BIRCHWOOD
MORTON IL 61550

JEFF KAUFMAN
MORTON CITY COUNCIL
525 S MAIN
MORTON IL 61550

CRAIG SCHWARZENTRAUB
MORTON CITY COUNCIL
317 S MINNESOTA
MORTON IL 61550

GENE SHRADER
MORTON CITY COUNCIL
9 HOLLY RIDGE SPUR
MORTON IL 61550

MAYOR
OSWEGO
113 MAIN
OSWEGO IL 60543

PAT DUNN
OSWEGO CHAMBER OF COMMERCE
44 MONROE ST PO BOX 863
OSWEGO IL 60543

SUPERVISOR
OSWEGO TWNSP, KENDALL CO
4100 Rt. 71
OSWEGO IL 60543

JERRY GALAS
OTTAWA AREA CHAMBER
301 W MADISON ST
OTTAWA IL 61350

BOYD PALMER
CHAIRMAN OF THE BOARD
OTTAWA AREA CHAMBER OF COMMERCE & INDUST
110 W LAFAYETTE ST PO BOX 888
OTTAWA IL 61350

CURT SESTO
PRESIDENT
OTTAWA CHAMBER AMBASSADORS
PO BOX 888
OTTAWA IL 61350

PEKIN CHAMBER OF COMMERCE
402 COURT ST
PEKIN IL 61554-3201

CAROL SHIELDS
PEKIN CHAMBER OF COMMERCE
402 COURT ST
PEKIN IL 61554-3201

LAURIE BARRA
PEKIN CITY COUNCIL
#9 RAINBOW DR
PEKIN IL 61554

JIM JONES
PEKIN CITY COUNCIL
1806 VALENCIA DR
PEKIN IL 61554

LLOYD ORRICK
PEKIN CITY COUNCIL
699 OXFORD
PEKIN IL 61554

HARVEY RICHMOND
PEKIN CITY COUNCIL
33 ROSEWOOD LANE
PEKIN IL 61554

CELIUS ANDERSON
PEKIN PLANNING COMMISSION
1015 MATILDA
PEKIN IL 61554

RICHARD BOLAM
PEKIN PLANNING COMMISSION
1014 PRINCE ST
PEKIN IL 61554

RALPH BROWER
PEKIN PLANNING COMMISSION
1832 HIGHWOOD
PEKIN IL 61554

SCOTT EWING
PEKIN PLANNING COMMISSION
2206 SCENIC VIEW COURT
PEKIN IL 61554

WOODY GOOD
PEKIN PLANNING COMMISSION
711 WASHINGTON ST
PEKIN IL 61554

EMIL MONGE
PEKIN PLANNING COMMISSION
1418 N 9TH ST
PEKIN IL 61554

J DOUGLAS PAYNE
PEKIN PLANNING COMMISSION
2306 COURT ST
PEKIN IL 61554

MARGE SEVIER
PEKIN PLANNING COMMISSION
1700 ST CLAIR DR
PEKIN IL 61554

CHAIRMAN
PEORIA AREA CHAMBER OF COMMERCE
124 SW ADAMS ST #300
PEORIA IL 61602

PEORIA CITY COUNCIL
419 FULTON ST RM 207
PEORIA IL 61605

CAMILLE M GIBSON
PEORIA CITY COUNCIL
1627 W COLUMBIA TERRACE
PEORIA IL 61606

EDWARD P GLOVER
PEORIA CITY COUNCIL
3711 N SHERIDAN RD
PEORIA IL 61614

CHARLES V GRAYEB
PEORIA CITY COUNCIL
510 W HIGH ST
PEORIA IL 61606

PATRICK NICHTING
PEORIA CITY COUNCIL
10507 N SLEEPY HOLLOW RD
PEORIA IL 61615-1119

GARY V SANDBERG
PEORIA CITY COUNCIL
2807 N LINN
PEORIA IL 61604

WILLIAM R SPEARS
PEORIA CITY COUNCIL
2225 W OVERHILL RD
PEORIA IL 61615

GALE S THETFORD
PEORIA CITY COUNCIL
1126 E FAIROAKS AVE
PEORIA IL 61603

W ERIC TURNER
PEORIA CITY COUNCIL
6212 N TEALWOOD CIRCLE
PEORIA IL 61615

LEONARD A UNES
PEORIA CITY COUNCIL
1216 W TETON DR
PEORIA IL 61614

PEORIA ECONOMIC DEVELOPMENT
419 FULTON ST #303
PEORIA IL 61602

ROBERT F FAVORITE
PEORIA HEIGHTS CITY COUNCIL
5121 N MONTCLAIR
PEORIA HEIGHTS IL 61614

RICK GRIFFITH
PEORIA HEIGHTS CITY COUNCIL
820 E COX AVE
PEORIA HEIGHTS IL 61614

PATRICIA HONEY
PEORIA HEIGHTS CITY COUNCIL
1708 E ST JUDE COURT
PEORIA HEIGHTS IL 61614

WILLIAM KELLEY SR
PEORIA HEIGHTS CITY COUNCIL
1111 E EUCLID AVE
PEORIA HEIGHTS IL 61614

ANDREA PENDLETON
PEORIA HEIGHTS CITY COUNCIL
1200 E DURYEA AVE
PEORIA HEIGHTS IL 61614

ROSS TARR
PEORIA HEIGHTS CITY COUNCIL
215 W SAM J STONE AVE APT 501
PEORIA IL 61605-2569

PEORIA PARK DIST
GLEN OAK PAVILION-2218 N PROSPECOURT RD
PEORIA IL 61603

JERRY OLSON
DIRECTOR
JOLIET PARK DIST
PILCHER PARK NATURE CENTER
RTE 30 & COUGAR RD- 3000 W JEFFERSON
JOLIET IL 60435

SUSAN SCHANLABER
THE LANDMARK GROUP
P.O. Box 5155
AURORA IL 60507

TOWNSHIP OF OSWEGO
PO BOX 792 4100 RT 71
OSWEGO IL 60543

DOUGLAS TUCKER
GREENWAYS BOARD
TREMONT PARK BOARD
312 E JEFFERSON
TREMONT IL 61615

JOHN WEBB
GREENWAYS BOARD
TREMONT PARK BOARD
309 N SAMPSON
TREMONT IL 61568

JACK WEST
GREENWAYS BOARD
TREMONT PARK BOARD
115 RIPLEY
TREMONT IL 61568

JEFF RANDOLPH
TRI COUNTY RIVERFRONT ACTION FORUM
911 N PIONEER PKWY
PEORIA IL 61615

UTICA CITY OFFICE
255 MILL ST
UTICA IL 61373

MARVIN DEAN
SUPERVISOR
UTICA TOWNSHIP
PO BOX 472
UTICA IL 61373

UTICA TOWNSHIP SUPERVISOR
200 MILL ST
UTICA IL 61373

RICHARD MYERS
VALLEY CITY LEVEE AND DRAINAGE DIST
RR 2 BOX 21
GRIGGSVILLE IL 62340

PRESIDENT
VILLAGE BOARD
CHANDLERVILLE IL 62627

HONORABLE ROBERT HORNER
MAYOR
VILLAGE OF ARMINGTON
P O BOX 31
ARMINGTON IL 61721

DON GARSKE
PEORIA/PEKIN URBANIZED AREA TR
VILLAGE OF BARTONVILLE
4615 SANDRON LANE
BARTONVILLE IL 61607

HONORABLE STEVE MEYER
MAYOR
VILLAGE OF BAYVIEW GARDENS
325 GARDEN RD RR 8
EAST PEORIA IL 61611

HONORABLE RALPH WILSON
MAYOR
VILLAGE OF BELLEVUE
622 S BYRON AVE
PEORIA IL 61604

HONORABLE ARTHUR BROOKS
MAYOR
VILLAGE OF BENSON
412 FRONT ST PO BOX 107
BENSON IL 61516-0107

LISA ARMOUR
INTERIM VILLAGE ADMIN
VILLAGE OF CHANNAHON
24555 S NAVAJO DR
CHANNAHON IL 60410-3334

EILEEN CLARK
VILLAGE CLERK
VILLAGE OF CHANNAHON
24555 S NAVAJO DR
CHANNAHON IL 60410-3334

HONORABLE TROY CHILDERS
MAYOR
VILLAGE OF CHILLICOTHE
908 N 2ND ST
CHILLICOTHE IL 61523

HONORABLE STEVEN SCHROCK
VILLAGE PRESIDENT
VILLAGE OF CONGERVILLE
PO BOX 118
CONGERVILLE IL 61729-0118

HONORABLE EUGENE TALBOT
VILLAGE PRESIDENT
VILLAGE OF CREVE COEUR
101 N THORNCREST AVE
CREVE COEUR IL 61611-3959

HONORABLE RONALD B MOOL
MAYOR
VILLAGE OF EL PASO
475 W FRONT
EL PASO IL 61738

HONORABLE JACK RUDD
VILLAGE PRESIDENT
VILLAGE OF GLASFORD
PO BOX 47
GLASFORD IL 61533-0047

HONORABLE DEAN HUDSON
VILLAGE PRESIDENT
VILLAGE OF GOODFIELD
114 S EUREKA ST
GOODFIELD IL 61742-0121

HONORABLE MARK HAWKINS
MAYOR
VILLAGE OF KAPPA
RR1 BOX 142
EL PASO IL 61738

HONORABLE GEORGE EMERY
MAYOR
VILLAGE OF KINGSTON MINES
209 WASHINGTON ST
KINSTON MINES IL 61539

HONORABLE GARY LITTLE
MAYOR
VILLAGE OF MARQUETTE HEIGHTS
715 LINCOLN RD
MARQUETTE HEIGHTS IL 61554

BOB WRAIGHT
PEORIA/PEKIN URBANIZED AREA TR
VILLAGE OF MORTON
120 N MAIN ST PO BOX 28
MORTON IL 61550

CLAUDE STONE
LAND USE ADVISORY COMMITTEE L
VILLAGE OF MORTON PLANNING
1109 BRENTWOOD RD
MORTON IL 61550

TOM SURACE
BRANCH MANAGER
TRANSPORATION DEPT
VILLAGE OF NILES
6859 W TOUHY AVE
NILES IL 60714-4519

CARRIE HANSEN
VILLAGE ADMINISTRATOR
VILLAGE OF OSWEGO
113 MAIN ST
OSWEGO IL 60543

HONORABLE ROGER BOGNER
MAYOR
VILLAGE OF PANOLA
RR 2
EL PASO IL 61738

KENTON D MANNING
VILLAGE PRESIDENT
VILLAGE OF PAWNEE
617 9TH ST PO BOX 560
PAWNEE IL 62558

RICK WILLIAMS
PEORIA/PEKIN URBANIZED AREA TR
VILLAGE OF PEORIA HEIGHTS
4901 N PROSPECT HEIGTHS
PEORIA HEIGHTS IL 61614

HONORABLE HENRY BERRY
PRESIDENT
VILLAGE OF ROCKDALE
603 OTIS ST
ROCKDALE IL 60436

HONORABLE RICK CHAPMAN
PRESIDENT
VILLAGE OF SHOREWOOD
903 W JEFFERSON ST
SHOREWOOD IL 60431

PRESIDENT
VILLAGE OF SPRING BAY
EAST PEORIA IL 61611

HONORABLE RALPH ATHERTON
MAYOR
VILLAGE OF SPRING BAY
111 TAZEWELL
SPPRING BAY IL 61611

TARRY LANCE
WASHINGTON CHAMBER OF COMMERCE
112 WASHINGTON SQUARE
WASHINGTON IL 61571

DON BRUBAKER
WASHINGTON CITY COUNCIL
502 N MAIN APT M
WASHINGTON IL 61571

DELMAR CUNNINGHAM
WASHINGTON CITY COUNCIL
616 PARR HUE LANE
WASHINGTON IL 61571

JIM GEE
WASHINGTON CITY COUNCIL
9 BROWNING CT
WASHINGTON IL 61571-9551

ROBERT GORDON
WASHINGTON CITY COUNCIL
604 YORKSHIRE
WASHINGTON IL 61571

TERRY HILLEGONDS
WASHINGTON CITY COUNCIL
1300 OAK LEAF LN
WASHINGTON IL 61571-9711

CAROL K MOSS
WASHINGTON CITY COUNCIL
204 N SPRUCE
WASHINGTON IL 61571

STEVE HARENBERG
WASTE MANAGEMENT OF PEORIA
3550 E WASHINGTON ST
EAST PEORIA IL 61611

ANA KOVAL
EXE DIR
CANAL CORRIDOR ASSOC
25 E WASHINGTON STE 1650
CHICAGO IL 60602

EUGENE KURDA PHD
SENIOR ECONOMIST-AGRIC MARKETS GROUP
MARKET AND PRODUCT DEVELOPMENT DEPT
CHICAGO BOARD OF TRADE
141 W JACKSON BLVD #1
CHICAGO IL 60604-2994

CHRIS MANHEIM
EXECUTIVE DIRECTOR
GRUNDY ECONOMIC DEVELOPMENT COUNCIL
112 E WASHINGTON ST
MORRIS IL 60450

JACK BERNHARDT
ILLINOIS CHAMBER
311 S WACKER DR
CHICAGO IL 60606

ED SLININGER
LAND USE ADVISORY COMMITTEE
RR 5 1004 HICHORY CREEK CT
METAMORA IL 61548

DONNA WOODROW
MACKINAW VALLEY IMPROVEMENT ASSN
RR #1 BOX 274
GREEN VALLEY IL 61534

GEORGE CLARK
MID AMERICA PORT COMMISSION
RR 3 BOX 23
MT STERLING IL 62665

MAX EDLEN
COMMISSIONER
MID AMERICA PORT COMMISSION
213 N BLUFF ST
BLUFFS IL 62621

NORTHEASTERN IL PLANNING COMMISSION
222 S RIVERSIDE PLAZA SUITE 1800
CHICAGO IL 60606

TOM PRICE
NORTHEASTERN IL PLANNING COMMISSION
222 S RIVERSIDE PLAZA SUITE 1800
CHICAGO IL 60606

MIKE VAN MILL
REGIONAL PLANNING COMMISSION
189 E COURT ST
KANKAKEE IL 60901

THOMAS A WOBBE
EXECUTIVE DIRECTOR
SOUTHWEST ILLINOIS
SOUTHWEST ILLINOIS METRO PLANNING COMM
203 W MAIN ST
COLLINSVILLE IL 62234-3002

OUTDOOR SPACE & RECR COMMITTEE
TRI COUNTY REG PLANNING COMMISSION
411 HAMILTON BLVD
PEORIA IL 61602-1144

HALA AHMED
TRI COUNTY REG PLANNING COMMISSION
411 HAMIILTON BLVD STE 2001
PEORIA IL 61602

MELISSA EATON
TRI COUNTY REG PLANNING COMMISSION
411 HAMILTON BLVD STE 2001
PEORIA IL 61604

TERRY KOHLBUSS
EXECUTIVE DIRECTOR
TRI COUNTY REG PLANNING COMMISSION
411 HAMILTON BLVD STE 2001
PEORIA IL 61602-1104

MARY DICKSON
TRI COUNTY RIVERFRONT ACTION FORUM
6916 N BROOKSTONE DR
PEORIA IL 61615-8600

DONALD MEINEN
REGIONAL DIRECTOR
TRI COUNTY RIVERFRONT ACTION FORUM
PO BOX 131
PEKIN IL 61555-0131

DON PETERSON
TRI COUNTY RIVERFRONT ACTION FORUM
500 S MENARD
METAMORA IL 61548-9707

WILLIAM TANTON
TRI COUNTY RIVERFRONT ACTION FORUM
612 TIMBER RIDGE CT
EUREKA IL 61530-9205

RANDY J. BELSLEY
TAZWELL COUNTY DEVELOPMENT DIRECTOR
EDC INC FOR PEORIA AREA
124 SW ADAMS ST STE 300
PEORIA IL 61602

ROBERT RICH
ATTORNEY AT LAW
25 N OTTAWA ST
JOLIET IL 60431

DAVID A STJERN
ATTORNEY AT LAW
3116 VICTORIA DR
SPRINGFIELD IL 62704

DICK L WILLIAMS ESQ
ATTORNEY AT LAW
139 E WASHINGTON ST
EAST PEORIA IL 61611

LONNIE DOAN
1ST FARM CREDIT SERVICE OF N IL
1689 N 31ST RD
OTTAWA IL 61350

A F M MESSENGER SERVICE INC
7420 N WESTERN AVE #1
CHICAGO IL 60645-1707

AARON BROS MOVING SYSTEM INC
4034 S MICHIGAN AVE
CHICAGO IL 60653-2116

BOB JACOBS
ADM
PO BOX 175
PEORIA IL 61650

RICHARD BLAUDOW
ECONOMIC DEVEL BOARD
ADVANCE TECHNOLOGY SERVICES
8201 N UNIVERSITY
PEORIA IL 61615

ADVANCED MESSENGER SERVICE
485 N MILWAUKEE AVE
CHICAGO IL 60610-3922

DAVID WARD
ADWELL CORP
102 N WESTGATE AVE
JACKSONVILLE IL 62650-1718

AFFETTO LEWIS A CARTAGE INC
2143 N NARRAGANSETT AVE
CHICAGO IL 60639-2633

TONY DOWIATT
AREA CONSULTANTS
AJ DOWIATT INC
121 W CENTER
EUREKA IL 61530

ALEXANDERS MOVERS INC
6535 S COTTAGE GROVE AVE
CHICAGO IL 60637-4209

ALL SEASONS MOVERS
6059 N ALBANY AVE
CHICAGO IL 60659-2402

DOUGLAS KULLEN
ALLIED ARCHEOLOGY
239 S CALUMET AVENUE
AURORA IL 60506

LOCAL 235
AMALGAMATED PLANT
446 CASS ST
EAST PEORIA IL 61611

AMER THEOLOGICAL LIBRARY ASSOCIATION
250 S WACKER
CHICAGO IL 60606

BOB ANDERSON
AREA CONSULTANTS
AMERICAN ENGINEERS ASSOCIATED
1750 FOSTER RD
WASHINGTON IL 61571

GARY F STELLA
ECONOMIC DEVEL BOARD
AMERICAN FAMILY INS/PEORIA CO BRD
4229 N PROSPECT RD
PEORIA HEIGHTS IL 61614

AMERICAN HOECHST CORP
501 BRUNNER ST
PERU IL 61354

RON WUNDERLICH
AMERICAN RIVER TRANSPORTATION
PO BOX 50
LA SALLE IL 61301

PATTI STERLING
PEORIA AREA CONVENTION & VISITOR BUR
AMERITECH
324 FULTON ST FLOOR 2
PEORIA IL 61602

ANCHOR MARINE - SENECA HARBOR SERVICE
1 EAST DUPONT RD
SENECA IL 61360

ANDERSON BROS STORAGE & MOVING COMPANY
3141 N SHEFFIELD AVE
CHICAGO LA 60657-4434

MARY ARDAPPLE
PEORIA AREA CONVENTION & VISITOR BUR
APPLE'S BAKERY
8412 N KNOXVILLE AVE
PEORIA IL 61615

AREA DISPOSAL SERVICE INC
PO BOX 9071
PEORIA IL 61612-9071

JACK BEAUPRE
ARK
12 BRIARCLIFF PROFESSIONAL CTR
BOURBONNAIS IL 60914

ARROW EXPRESS INC
505 N LAKE SHORE DR APT 6409
CHICAGO IL 60611-6455

ARROW MESSENGER SERVICES INC
1322 W WALTON ST
CHICAGO IL 60622-5340

MATHEW FRENCH
ARTCO
PO BOX 50
LA SALLE IL 61301

EDWARD HASKELL
ARTCO
PO BOX 1470
DECATUR IL 62525

GEORGE M BURRIER
GREENWAYS BOARD
ATTORNEY AT LAW
257-259 E WASHINGTON
EAST PEORIA IL 61611

REX LINDER
PEORIA AREA CONVENTION & VISITOR BUR
ATTORNEY AT LAW
124 S W ADAMS ST
PEORIA IL 61602

AURORA AREA EXPRESS INC (DEL)
1036 5TH AVE
AURORA IL 60505-5061

AURORA BANK TRUST 19310
2 S BROADWAY
AURORA IL 60507

RIC CREASY
PEORIA/PEKIN URBANIZED AREA TR
AUSTIN ENGINEERING COMPANY
8100 N UNIVERSITY ST
PEORIA IL 61614

AREA CONSULTANTS
AUSTIN ENGINEERING INC
8100 N UNIVERSITY
PEORIA IL 61614

AREA CONSULTANTS
AUTOMATED ANALYSIS CORP
423 SW WASHINGTON
PEORIA IL 61602

DON ANDERSON
AUTOMOTIVE TRADES
1499 W RTE 102
BOURBONNAIS IL 60914

AVAILABLE DISPOSAL SERVICE
7246 S EBERHART AVE
CHICAGO IL 60619-1713

RAY ADAMS
AXIS
2201 W TOWNLINE RD
PEORIA IL 61615

AREA CONSULTANTS
AXIS INC
2201 W TOWNLINE RD
PEORIA IL 61615

B F CARTAGE COMPANY
3627 W HARRISON ST
CHICAGO IL 60624-3621

BRUCE HALVERSON
BAIRD & ASSOCIATES
2981 YARMOUTH GREENWAY
MADISON WI 53711

MARK HOSKINS
BAKER ENGINEERING
801 W ADAMS ST
CHICAGO IL 60607

JAMES M CORKERY
CHAIRMAN
BANK ONE
124 SW ADAMS ST
PEORIA IL 61602

JAMES M CORKERY
RIVERFRONT BUSINESS DIST COMM
BANK ONE
124 SW ADAMS ST
PEORIA IL 61602

DEAN HEINZMANN
ECONOMIC DEVEL BOARD
BANK ONE
124 SW ADAMS ST
PEORIA IL 61602

BARR & MILES INC
5448 W 47TH ST
CHICAGO IL 60638-1807

KAI TARUM
BATVAIA
100 N. Island Ave.
BATAVIA IL 60510

BCW CONSTRUCTION COMPANY
8145 S EUCLID AVE
CHICAGO IL 60617-1036

BEARDSTOWN CLINIC II
8460 ST LUKE DR
BEARDSTOWN IL 62618

LOREN BECKER
BECKER & RANSON BULLDOZING
RR 2
JACKSONVILLE IL 62650-9802

ROBERT REGINA
HILLCREST SHOPPING CENTER
BELING CONSULTANTS
N LARKIN AVE AT PLAINFIELD RD
JOLIET IL 60435

DALE STEPHENSON
VICE PRESIDENT
BELL CO S H
10218 S AVE O
CHICAGO IL 60617

BEN LEE MOTOR SERVICE COMPANY INC
3314-44 S LAWNDALE AVE
CHICAGO IL 60623

DAVID BIELFELDT
ECONOMIC DEVEL BOARD
BIELFELDT & COMPANY
4700 N PROSPECT RD
PEORIA HEIGHTS IL 61614

BIGANE VESSEL FUELING CO
10540 S WESTERN AVE
CHICAGO IL 60643-2536

WILLIAM BLANK
BLANK, WESWELINK, COOK & ASSOC INC
2623 E PERSHING RD PO BOX 2910
DECATUR IL 62524

CAPT ROBERT ANTON
BOATWORKS
606 E ILLINOIS
PEORIA IL 61603

BRODERICK TEAMING COMPANY
3927 S HALSTED ST
CHICAGO IL 60609-2610

BOB KINNEY
AREA CONSULTANTS
BROWN ENGINEERING COMPANY
2407 WASHINGTON RD
WASHINGTON IL 61571

BROWNS RELIABLE MOVERS
30 SHERWICK DR
OSWEGO IL 60543-9406

BRUNT BROS TRANSFER INC
1220 E 75TH ST
CHICAGO IL 60619-2012

BURROWS MOVING COMPANY INC
6542 N CLARK ST
CHICAGO IL 60626-4002

C & D MOVING & STORAGE INC
PO BOX 410565
CHICAGO IL 60641

C R DAVIDSON LTD
114 E NORTH ST
MORRIS IL 60450-1814

BILL RIEBEL
PEORIA AREA CONVENTION & VISITOR BUR
C/O MARK TWAIN HOTEL
225 NE ADAMS ST
PEORIA IL 61602

CAHAKA PROPERTIES INC
1215 N SHERIDAN
PEORIA IL 61606

LOUISE TIMMERMAN
CAMP FARM MANAGEMENT INC
PO BOX 707
CHAMPAIGN IL 61824-0707

CANNONBALL INC
PO BOX 806167
CHICAGO IL 60680-4123

BRIAN HARRELL
CARPENTERS LOCAL 904
121 ELDEN
JACKSONVILLE IL 62650

JACOB PETERSON
CARPENTERS LOCAL 904
406 REID ST
JACKSONVILLE IL 62650

EARL BIMM
CARPENTERS UNION
1119 S DIAMOND ST
JACKSONVILLE IL 62650

JOEL MC NEELY
CARPENTERS UNION
1145 S EAST ST
JACKSONVILLE IL 62650

ANDREA DAWN PARKER
RIVERFRONT BUSINESS DIST COMM
CARVER FAMILY HEALTH CTR
711 W JOHN GWYNN AVE
PEORIA IL 61605

TIM CASSIDY
RIVERFRONT BUSINESS DIST COMM
CASSIDY & MUELLER
323 COMMERCE BANK BLDG 416 MAIN
PEORIA IL 61602

DON MAHANNAH
CATERPILLAR
901 W WASHINGTON ST SS6400
EAST PEORIA IL 61630-6400

CHAIRMAN
CATERPILLAR INC
100 NE ADAMS ST 9210
PEORIA IL 61629-1899

CRAIG BENNETT
CATERPILLAR INC
100 NE ADAMS ST
PEORIA IL 61629

JIM HANNEMAN
CATERPILLAR INC
100 NE ADAMS ST
PEORIA IL 61629

MARILYN LEYLAND
CATERPILLAR INC
7501 S ADAM ST
BARTONVILLE IL 61607-2732

DEREK PASCHAL
CATERPILLAR INC
100 NE ADAMS ST
PEORIA IL 61629

DICK POWELL
CATERPILLAR INC
100 NE ADAMS ST
PEORIA IL 61629

JOHN SLYMAN
PEORIA AREA CONVENTION & VISITOR BUR
CATERPILLAR INC
100 N E ADAMS
PEORIA IL 61629

JOE SPARKS
CATERPILLAR INC
100 N E ADAMS ST
PEORIA IL 61602

ORRIN STEMLER
CATERPILLAR INC
100 NE ADAMS ST
PEORIA IL 61629

TERRY THORSTENSON
PEORIA CHAMBER BOARD
CATERPILLAR INC
100 NE ADAMS ST - 1465
PEORIA IL 61629

GARY KRAMER
CATERPILLAR PROVING GROUNDS
136 STAR RIM DR
EAST PEORIA IL 61611

CATERPILLAR TRACTOR CO.
100 N E ADAMS ST
EAST PEORIA IL 61611

MICHAEL CLINE
CATERPILLER INC
23 WOODFORD WAY
METAMORA IL 61548

RON SATYLE
CATERPILLER INC
16615 W STREITMATTER
PRINCEVILLE IL 61559

CEE-BEE CARTAGE INC
14 W S WATER MARKET
CHICAGO IL 60608-2210

ELDON R ARNOLD
ECONOMIC DEVEL BOARD
CEFCU
PO BOX 1715
PEORIA IL 61656

PHIL LOZIUK
CEMCON LTD
2280 WHITE OAK CIRCLE
AURORA IL 60504-9675

CENTER FOR RESEARCH LIBRARIES
6046 S KENWOOD AVE
CHICAGO IL 60637-2804

DAVID LOUDENBURG
CENTRAL IL CENTER FOR INDEP LIVING
614 W GLEN
PEORIA IL 61614

AREA CONSULTANTS
CENTRAL IL CONTROLS
345 CENTER
EAST PEORIA IL 61611

CALVIN G BUTLER
PEORIA CHAMBER BOARD
CENTRAL IL LIGHT COMPANY
300 LIBERTY ST
PEORIA IL 61602

JIM STEIN
CENTRAL STATE BANK
301 IOWA AVE
MUSCATINE IA 52761

AREA CONSULTANTS
CH2MHILL
8501 W HIGGINS RD SUITE 300
CHICAGO IL 60631

JERRY YENDRO
CHAMLIN & ASSOCIATES, INC.
3017 5TH ST
PERU IL 61354

CHARLES ROCK
DEVELOPER
CHARLES ROCK & ASSOCIATES
230 SW ADAMS
PEORIA IL 61602

CHICAGO DISTRIBUTION COMPANY L P
140 S DEARBORN ST STE 320
CHICAGO IL 60603-5202

CHICAGO MESSENGER SERVICE INC
1600 S ASHLAND AVE
CHICAGO IL 60608-2013

CHICAGO SUBURBAN EXPRESS INC
PO BOX 388568
CHICAGO IL 60638-8568

KARYE F SETTERLUND
ECONOMIC DEVEL BOARD
CHILLICOTHE METAL CO
4507 E ROME RD
CHILLICOTHE IL 61523-9071

STEVE KERR
AREA CONSULTANTS
CHRISTOPHER B BURKE ENGINEERING
410 FAYETTE
PEORIA IL 61602

GREENWAYS BOARD
CILCO
300 LIBERTY ST
PEORIA IL 61602-1400

S L BURNS
CILCO
300 LIBERTY ST
PEORIA IL 61602

JAMES VERGON
ECONOMIC DEVEL BOARD
CILCO
300 LIBERTY ST
PEORIA IL 61601

JOHN SAHN
PEORIA CHAMBER BOARD
CILCORP
300 LIBERTY ST
PEORIA IL 61602-1400

WILLIAM M SHAY
EXEC VP
RIVERFRONT BUSINESS DIST COMM
CILCORP
300 LIBERTY ST
PEORIA IL 61602

CITGO
3737 S CICERO AVE
CHICAGO IL 60650

FEDERAL CREDIT UNION
CITIZEN'S EQUITY
PO BOX 1715
PEORIA IL 61656

CITY HAUL INC
4101 S MORGAN ST
CHICAGO IL 60609-2516

BILL MC GRATH
CITY MANAGER
CITY OF BATAVIA
100 NORTH ISLAND AVE
BATAVIA IL 60510-1930

BOB POPECK
CITY OF BATAVIA
100 N ISLAND AVE
BATAVIA IL 60510

BYRON RITCHASON
WASTEWATER TREATMENT
CITY OF BATAVIA
100 N ISLAND AVE
BATAVIA IL 60510

RYAN PALM
LANDSCAPE ARCHITECT
GREENWAYS BOARD
CLARK ENGINEERS
111 NE JEFFERSON ST
PEORIA IL 61602

AREA CONSULTANTS
CLARK ENGINEERS INC
111 N E JEFFERSON AVE
PEORIA IL 61602

JAMES ASH
GREENWAYS BOARD
CLARK ENGINEERS MIDWEST INC
111 N E JEFFERSON AVE
PEORIA IL 61602

KAREN DVORSKY
EROSION CONTROL TASK FORCE
CLARK ENGINEERS MW INC
111 NE JEFFERSON
PEORIA IL 61602

EARL S MOLDOVAN
ECONOMIC DEVEL BOARD
CLARK ENGINEERS MW INC
111 N E JEFFERSON AVE
PEORIA IL 61602

CLER INC
6445 S STATE ST
CHICAGO IL 60637

WILLIAM R BARRICK
ECONOMIC DEVEL BOARD
CLIFTON GUNDERSON & COMPANY
301 SW ADAMS SUITE 800
PEORIA IL 61602

CMT TRANSPORT INC
4056 W 54TH ST
CHICAGO IL 60632-4248

BOB COHEN
DEVELOPER
COHEN DEVELOPMENT COMPANY
406 SW WASHINGTON
PEORIA IL 61602

LES COHEN
DEVELOPER
COHEN DEVELOPMENT COMPANY
406 SW WASHINGTON
PEORIA IL 61602

DALE JORGENSON
DEVELOPER
COLDWELL BANKER-JORGENSON NHS
8500 N KNOXVILLE
PEORIA IL 61614

C. G. COLBURN
COLLBURN LAW OFFICE
5 AARON DR
JACKSONVILLE IL 62650-1728

COLLINS CARTAGE INC
6850 W 63RD ST
CHICAGO IL 60638-4026

COMET MESSENGER SERVICE INC
1316 S MICHIGAN AVE
CHICAGO IL 60605-2602

JOSEPH T HENDERSON
PEORIA CHAMBER BOARD
COMMERCE BANK N A
416 MAIN ST
PEORIA IL 61602

GREG SCHULER
COMMONWEALTH EDISON
PO BOX 767
CHICAGO IL 60690

BOB SCHMELTER
COMMUNITY HOSPITAL OF OTTAWA
1100 E NORRIS DR
OTTAWA IL 61350

DAVID HANDWERK
CONSOER TOWNSEND ENVIRODYNE ENGINEERS
303 E WASCKER DR STE 600
CHICAGO IL 60601

CONTRACT DISTRIBUTION INC
1506 W DETWEILLER DR
PEORIA IL 61615-1601

CORTESE MOTOR SERVICE COMPANY
7821 W CARMEN AVE
CHICAGO IL 60656-3207

RICHARD BADEUSZ
TRANSPORTATION MANAGER
COZZI IRON & METAL INC
2231 S BLUE ISLAND AVE
CHICAGO IL 60608

ERIC HANSEN
AREA CONSULTANTS
CRAWFORD MURPHY & TILLY
5701 W SMITHVILLE RD SUITE 600
PEORIA IL 61607

WILLIAM KNOWLES
AREA CONSULTANTS
CRAWFORD MURPHY & TILLY
2750 W WASHINGTON
SPRINGFIELD IL 62702

THERESA O GRADY
CRAWFORD, MURPHY & TILLY
600 N COMMONS DR STE 107
AURORA IL 60504

CONSULTING ENGINEERS
CRAWFORD, MURPHY AND TILLY
2750 W WASHINGTON ST
SPRINGFIELD IL 62702

CROSSTOWNS INC
4359 S WOOD ST
CHICAGO IL 60609-3138

DAVID JOSEPH
DEVELOPER
D JOSEPH SONS & ASSOCIATES
5001 N UNIVERSITY ST.
PEORIA IL 61614

WILLIAM DUNLOP
DAILY & ASSOC ENGINEERS INC
1610 BROADMOOR DR
CHAMPAIGN IL 61821

JUDY GAGNON
DAILY & ASSOC ENGINEERS
7500 N HARKER DR
PEORIA IL 61615

G RICHARD SPENCER
DAILY & ASSOCIATES
7500 N HARKER
PEORIA IL 61615

PATRICK G SLOAN
DAILY & ASSOCIATES ENGINEERS
7500 N HARKEY DR
PEORIA IL 61615

MARION MC GREW
PEORIA/PEKIN URBANIZED AREA TR
DAILY AND ASSOCIATES
7500 N HARKER DR
PEORIA IL 61615

STANLEY BERSIN
AREA CONSULTANTS
DAILY AND ASSOCIATES INC
7500 N HARKER DR
PEORIA IL 61615

STEPHEN DORF
PRESIDENT
DAMEN-LAWERENCE CURRENCY EXCHANGE INC
4753 N DAMEN AVE
CHICAGO IL 60625-1442

WILLIAM DAUB
DAUB TV SERVICE
30 WESTFAIR DRIVE
JACKSONVILLE IL 626501760

TODD R DAVIS
PEORIA CHAMBER BOARD
DAVIS AGENCY INSURANCE
1105 N NORTH ST
PEORIA IL 61606

DAWSON MOTOR SERVICE INC
2025 N PULASKI RD
CHICAGO IL 60639-3733

LEGISLATORS
DCCA
620 E ADAMS
SPRINGFIELD IL 62701

DENNISON PROPERTIES
PO BOX 120055
PEORIA IL 61614

DEVON CARTAGE & WAREHOUSE INC
1017 W 48TH ST
CHICAGO IL 60609-4305

DIETZS INC
1822 W 23RD ST
CHICAGO IL 60608-4312

AREA CONSULTANTS
DL MARKLEY & ASSOCIATES INC
2104 W MOSS AVE
WEST PEORIA IL 61604

DUKE FAKLARIS
ECONOMIC DEVEL BOARD
DMI INC
RT 150 E BOX 65
GOODFIELD IL 61742

DOLPHIN CARTAGE INC
5274 S ARCHER AVE
CHICAGO IL 60632-4756

DONALD Z WHITE
PEORIA CHAMBER BOARD
DONALD Z WHITE PLANNING CONSLT
302 N 2ND
CHILLICOTHE IL 61523

DOUG LAVERY LIMITED
12200 S SHIRLEY LN
CHICAGO IL 60658-2422

CHRIS DOUGLAS
DOUGLAS CRANE
15 MARQUETTE LN
KANKAKEE IL 60901

ROBERT DOUGLAS
DOUGLAS CRANE
15 MARQUETTE LN
KANKAKEE IL 60901

LORI NELSON
MANAGER
DYNAMIC DIME
PO BOX 10712
PEORIA IL 61652-0712

E GATES COMPANY
2055 W WALNUT ST
CHICAGO IL 60612-2317

EAST BALT INC
1801 W 31ST PL
CHICAGO IL 60608-6102

DR DAVID SCHAEFFER
ECO HEALTH RESEARCH INC
701 DEVONSHIRE DR STE 209
CHAMPAIGN IL 61820

ECONOMY INC
3850 W CORTLAND ST
CHICAGO IL 60647-4636

ECONOMY MOVING & TRANSFER COMPANY
5875 N ROGERS AVE
CHICAGO IL 60646-5953

EDENS EXPRESS INC
837 N MILWAUKEE AVE, #104
CHICAGO IL 60622-4152

NEAL NINMANN
PEORIA CHAMBER BOARD
ENTERPRISE RENT-A-CAR
1130 W PIONEER PARKWAY
PEORIA IL 61614

GREG ASBURY
ECONOMIC DEVEL BOARD
ESE
8901 N INDUSTRIAL RD
PEORIA IL 61615

EVERGREEN PLACE
8570 ST LUKE DR
BEARDSTOWN IL 62618

MERRILL PARSONS
ECONOMIC DEVEL BOARD
EXCEL FOUNDRY
RR 3 BOX 400
PEKIN IL 61554

LYNN FINLEN
FARNSWORTH & WYLIE
2709 MCGRAW DR
BLOOMINGTON IL 61704

JEFF GASTEL
PEORIA/PEKIN URBANIZED AREA TR
FARNSWORTH & WYLIE
4600 BRANDYWINE DR SUITE 105
PEORIA IL 61614

AREA CONSULTANTS
FARNSWORTH & WYLIE PC
4600 N BRADNYWINE DR
PEORIA IL 61614

RICHARD HELM
FARNSWORTH GROUP INC
7707 N KNOXVILLE STE 200
PEORIA IL 61614

R BRANDON LOTT
FARNSWORTH GROUP INC
7707 N KNOXVILLE STE 200
PEORIA IL 61614

ED SCHOMBERG
FARNSWORTH GROUP INC
2909 MCGRAW DR
BLOOMINGTON IL 61704

FAUCHER BROS CARTAGE INC
PO BOX 94934
CHICAGO IL 60690-4934

DR JOHN F GILLIGAN
PEORIA CHAMBER BOARD
FAYETTE COMPANIES
P O BOX 1346
PEORIA IL 61654

FEDERAL WAREHOUSE COMPANY
PO BOX 1329
PEORIA IL 61654-1329

WAYNE FIELDMAN
FIELDMAN REALTY INC
1304 GEMINI CIR
OTTAWA IL 61350

DANIEL DALY
ECONOMIC DEVEL BOARD
FIRST CAPITAL BANK
6699 N SHERIDAN RD
PEORIA IL 61614-2934

DON HARRIS
FIRST NATIONAL BANK
PO BOX 657
OTTAWA IL 61350

DAVID R LEITCH
VICE PRESIDENT
FIRST OF AMERICA BANK
301 SW ADAMS ST 4TH FLOOR
PEORIA IL 61602

DOUGLAS S STEWART
PEORIA CHAMBER BOARD
FIRST OF AMERICA BANK-IL NA
301 SW ADAMS ST
PEORIA IL 61652

LEON MC NAIR
FOX BEND GOLF COURSE
RT 34
OSWEGO IL 60543

LINDA RICKMAN
FOX WATERWAY AGENCY
45 S PISTAKEE LAKE RD
FOX LAKE IL 60020

FRANK J SIBR & SONS INC
5240 W 123RD PL
CHICAGO IL 60658-3201

FREDS MOVERS
1301 TOWNE AVE
BATAVIA IL 60510-4521

G M RANDA INC
123 CHESTERFIELD DR
OSWEGO IL 60543-8946

G Z ENTERPRISES INC
840 W 34TH PL
CHICAGO IL 60608-6716

GALAXY TRANSPORT INC
4950 W 39TH ST
CHICAGO IL 60650

TED SUMMERS
GARVEY PROCESSING INC
PO BOX 546
OTTAWA IL 61350

AREA CONSULTANTS
GIOVANETTO CONSULTING SERVICES
RR2
TREMONT IL 61568

GOLDEN EAGLE MOVERS
2719 W BARRY AVE
CHICAGO IL 60618-7103

SCOTT POTTER
GORDON ELECTRIC
PO BOX 231
KANKAKEE IL 60901

TOM MEYER
AREA CONSULTANTS
GPSD
2322 S DARSH ST
PEORIA IL 61607

GRAND SERVICES INC
4630-34 W ARMITAGE AVE
CHICAGO IL 60639

TOTE GRAY
HEARTLAND WATER RESOURCE BOARD
GRAYBOY KAWASAKI
4426 N PROSPECT RAOD
PEORIA HEIGHTS IL 61614

FRED TRAUB
PEORIA/PEKIN URBANIZED AREA TR
GREATER PEORIA AIRPORT AUTHORITY
6100 W DIRKSEN PARKWAY
PEORIA IL 61607

GREG LEE
EROSION CONTROL TASK FORCE
GREG LEE CONSTRUCTION
4635 MINIER RD
ARMINGTON IL 61721-9371

GRRH INC
12600 S HAMLIN CT
CHICAGO IL 60658-1525

TED - BONNIE GUDAT
GUDAT'S CHAUTAUQUA LAKE BAR & GRILL
21464 N DR
HAVANA IL 61644

GUS MOTOR SERVICE INC
5921 W 65TH ST
CHICAGO IL 60638-5405

NICK OWENS
RIVERFRONT BUSINESS DIST COMM
HAGERTY BROTHERS COMPANY
601 N MAIN ST
EAST PEORIA IL 61611

CHARLES J POPARAD
ECONOMIC DEVEL BOARD
HAGERTY BROTHERS COMPANY
601 N MAIN PO BOX 1500
EAST PEORIA IL 61655

JACK HEALY
HANSON PROFESSIONAL SERVICES INC
1525 S 6TH ST
SPRINGFIELD IL 62703

TIM LEACH
AREA CONSULTANTS
HANSON PROFESSIONAL SERVICES INC
2900 W WILLOWKNOLLS DR
PEORIA IL 61614

CHRIS EVERTS
HARDING ESE
8901 N INDUSTRIAL RD
PEORIA IL 61614

CHRIS EVERTS
HARDING ESE
2721 N KINGSTON DR
PEORIA IL 61604

WAYNE INGRAM
HARDING ESE
8901 N INDUSTRIAL RD
PEORIA IL 61614

HAROLD TURLEY
HAROLD D TURLEY & ASSOCIATES
6824 N FROSTWOOD PKWY
PEORIA IL 61615-2417

D H WHITE
HARRISON WHITE & SONS
RR 1
LEWISTOWN IL 61542-9801

GREGORY HILLEBRENNER
HARZA ENGINEERING CO
SEARS TOWER - 233 S WACKER DR
CHICAGO IL 60606

CAROL WASKO
HARZA ENGINEERING COMPANY
175 W JACKSON BLVD #18
CHICAGO IL 60604-2615

PETE CONROY
HARZA ENGINEERING CORP
175 W JACKSON BLVD #18
CHICAGO IL 60604-2615

RAYMOND HAYES
HAYES TRENCHING
RR 5 BOX 28
JACKSONVILLE IL 62650-9212

DOUGLAS W FEHR
HEARTLAND WATER RESOURCE BOARD
HEARTLAND FARM BUREAU
1806 W KINSWAY
PEORIA IL 61614

CHARLES BLYE
LAND USE ADVISORY COMMITTEE
HEARTLAND WATER RESOURCE BOARD
112 VONACHEN CT
EAST PEORIA IL 61611

HEBARD-PORTER STORAGE & MOVING COMPANY
6331 N BROADWAY ST
CHICAGO IL 60660-1401

HELDERS MOTOR SERVICE COMPANY
3201 S KOSTNER AVE
CHICAGO IL 60623-4845

AREA CONSULTANTS
HENNEMAN RAUFEISEN & ASSOCIATES
1605 S STATE
CHAMPAIGN IL 61821

HENNEPIN BOAT MARKET INC
PO BOX 487
HENNEPIN IL 61327-0380

ARNOLD SOBEL
HENRY CROWN & CO
222 N LASALLE ST
CHICAGO IL 60601

HERITAGE MANOR
8306 ST LUKE DR
BEARDSTOWN IL 62618

KENNETH HESS
HESS BROS
1531 BASE LINE RD
JACKSONVILLE IL 62650-6032

JOHN TANDARICH
HEY AND ASSOCIATES
53 W JACKSON BLVD STE 1015
CHICAGO IL 60604

MIKE LUFTON
HOFMMAN PAN RIVER RATS
141 GAGE
RIVERSIDE IL 60546

JOHN MACH
HOFMMAN PAN RIVER RATS
6141 W 26TH ST
CICERO IL 60804

DARRYL SCHULTE
PEORIA AREA CONVENTION & VISITOR BUR
HOLIDAY INN/BRANDYWINE
4400 N BRANDYWINE DR
PEORIA IL 61614

PATT MEDCHILL
HOLLYWOOD-CASINO-AURORA
49 W. Galena Blvd.
AURORA IL 60506

HOLTON CARTAGE INC
7837 S RIDGELAND AVE
CHICAGO IL 60649-4905

SCOTT BOSECKER
EROSION CONTROL TASK FORCE
HOME BUILDERS ASSOCIATION OF GREATER PEO
4024 S DANBAR POINT
MAPLETON IL 61547

GREGG FOLTZ
HOMER L CHASTAIN & ASSOC LLP
5 N CNTY CLUB RD - PO BOX 25587
DECATUR IL 62525

BILL CARTER
PEORIA AREA CONVENTION & VISITOR BUR
HOTEL PERE MARQUETTE
501 MAIN ST
PEORIA IL 61602

JAMES TWYFORD
VICE PRESIDENT
HUTCHISON ENGINEERING INC
1801 W LAFAYETTE AVE PO BOX 820
JACKSONVILLE IL 62651-0820

RICHARD C SCHWARZ
ECONOMIC DEVEL BOARD
IL AMERICAN WATER CO
123 SW WASHINGTON ST
PEORIA IL 61602

JOSEPH F. BOYLE, JR.
COMMISSIONER
IL DEPT OF TRANSPORTATION
310 S MICHIGAN AVE
CHICAGO IL 60601

MICHEL MC CORD
ECONOMIC DEVEL BOARD
IL MUTUAL INSURANCE COMPANY
300 SW ADAMS ST
PEORIA IL 61634

JAMES D BROADWAY
CHAIRMAN
WESTERVELT JOHNSON NICOLL & KELLER
IL RIVERFRONT DEV CORP
411 HAMILTON BLVD 14TH FLOOR
PEORIA IL 61602-1114

GREENWAYS BOARD
IL VALLEY STRIDERS
700 W MAIN ST
PEORIA IL 61606

KEN BECKLER
ENHANCEMENTS
IL VALLEY WHEELM'N
1022 NORTH INSTITUTE
PEORIA IL 61604

SAMUEL JOSLIN
ENHANCEMENTS
IL VALLEY WHEELM'N
119 W SANTA FE RD
CHILLICOTHE IL 61523-9316

STEVE SHAFFER
ENHANCEMENTS
IL VALLEY WHEELM'N
1009 W RIDGE RD
PEORIA IL 61614

ELWIN BASQUIN
PRESIDENT
WTVP-CHANNEL 47
IL VLY PUB TELECOM CORP
PO BOX 1347
PEORIA IL 61654-1347

CHARLES BAREIS
UNIVERSITY OF ILLINOIS
ILLINOIS ARCHELOGICAL SURVEY
396B DAVENPORT HALL 607 S MATTHEWS AVE
URBANA IL 61801

ANTHONY IANELLO
EXECUTIVE DIRECTOR
ILLINOIS INTERNATIONAL PORT DIST
3600 E 95TH ST
CHICAGO IL 60617-5100

FRANK ALBERT
DIRECTOR
ILLINOIS INTNL PORT OF CHICAGO
BUTLER DR & LAKE CALUMET
CHICAGO IL 60633

PHILLIP ROGERS
ILLINOIS POWER CO
500 S 27TH ST
DECATUR IL 62525

JIM DARNELL
IT CORP
16406 US RTE 224 E
FINDLAY OH 45840

J & J MOTOR SERVICE INC
2338 S INDIANA AVE
CHICAGO IL 60616-2402

J & S AIR FREIGHT INC
1740 HUBBARD AVE
BATAVIA IL 60510-1424

JACK VENTURINI
5319 N NEWCASTLE AVE
CHICAGO IL 60656-2019

STEVE KRUEGER
JAKE WOLF FISH HATCHERY
25410 N FISH HATCHERY RD
TOPEKA IL 61567

JIMS CARTAGE & GARAGE INC
9040 S HALSTED ST
CHICAGO IL 60620-2611

GARY E JAKOBY
AREA CONSULTANTS
JOKOBY G E ENGINEERING INC
12025 N KNOWVILLE
DUNLAP IL 61525

JRED ENTERPRISES INC
449 N UNION AVE
CHICAGO IL 60610-3927

MICHELLE PEARSON
PEORIA AREA CONVENTION & VISITOR BUR
JUMER'S CASTLE LODGE
117 N WESTERN AVE
PEORIA IL 61604

JANICE HARTMAN
KANKAKEE CNTY REALTORS
PO BOX 373
AROMA PARK IL 60910

HAROLD JOHNSON
KANKAKEE RIVER AG CONCERNS
16081 E 5000N RD
MOMENCE IL 60964

KEITH KELLOGG
7 STONE HILL RD
OSWEGO IL 60543-9449

DOUG DRAEAR
ECONOMIC DEVEL BOARD
KIRBY-RISK ELECTRICAL SUPPLIES
316 SW WASHINGTON
PEORIA IL 61602

KNAPPEN MOLASSES CO
13550 S INDIANA AVE
CHICAGO IL 60627

KNICKERBOCKER CORP
PO BOX 2065
EAST PEORIA IL 61611-0065

KRESS CORP
227 W ILLINOIS ST
BRIMFIELD IL 61517

JIM SUTOR
KRESS CORP
227 ILLINOIS ST
BRIMFIELD IL 61517

DENNIS THOMAS
KRESS CORP
227 ILLINOIS ST
BRIMFIELD IL 61517

STEVE KUHN
KUHN CONSTRUCTION
321 KAIN ST
OTTAWA IL 61350-1160

L R MILLER INC
PO BOX 277707
CHICAGO IL 60627-7707

L U TRANSPORT INC
2648 W 50TH ST
CHICAGO IL 60632

CURTIS JORSTAD
LA SALLE COMPANY SOIL
RTE 23 & DAYTON RD
OTTAWA IL 61350

JON J VRABEL
TRANSPORTATION COORDINATION CO
LAFARGE CORPORATION
6033 WICKWOOD
PEORIA IL 61614

LAVERDIERE CONSTRUCTION INC
4055 W JACKSON ST
MACOMB IL 61455

LAVERDIERE CONSTRUCTION INC
4055 W JACKSON ST
MACOMB IL 61455

MARY A CORRIGAN
PEORIA CHAMBER BOARD
LAW OFFICE OF MARY CORRIGAN PC
456 FULTON ST #425
PEORIA IL 61602-1250

WILLIAM PAPE
PEORIA CHAMBER BOARD
LINCOLN OFFICE
7707 N KNOXVILLE #100
PEORIA IL 61614

MICHAEL R WIESEHAN
RIVERFRONT BUSINESS DIST COMM
LIPPMANN'S FURNITURE & INTERIORS
2514 N SHERIDAN RD
PEORIA IL 61604

TROY LOGSDON
CO-OWNER
LOGSDON SAND & GRAVEL CO
300 W MAIN ST
BEARDSTOWN IL 62618

BRUCE DAVEY
ECONOMIC DEVEL BOARD
LONZA INC
P O BOX 105
MAPLETON IL 61547

LOOP EXPRESS INC
2608 S DAMEN AVE
CHICAGO IL 60608-5209

JACK GITTINGER
LTZ ASSOCIATES INC
124 SW ADAMS
PEORIA IL 61602

MARTIN H COLLIER
AREA PLANNERS
LZT ASSOCIATION INC
124 SW ADAMS ST
PEORIA IL 61602

M & G TRANSPORT INC
2934 N LONG AVE
CHICAGO IL 60641-4921

M & S TRANSPORT INC
3738 S CICERO AVE
CHICAGO IL 60650-4536

M H K INC
7615 N PAULINA ST
CHICAGO IL 60626-1017

M J SEIWERT CARTAGE COMPANY
140 S DEARBORN ST STE 820
CHICAGO IL 60603-5224

GREENWAYS BOARD
MACKINAW CANOE CLUB
701 E POLK ST
MORTON IL 61550

PAUL J TENAVITZ
ECONOMIC DEVEL BOARD
MAGNA BANK NA
107 SW JEFFERSON ST
PEORIA IL 61602

MARIAN K KRAMER TRUST
32 N MAIN ST
OSWEGO IL 60543

CHRISTY BLEZ
MARINA COMMITTEE
107 W 7TH ST
BEARDSTOWN IL 62218

MARK MARQUIS
MARQUIS INC
602 POPLET HOLLOW RD
PEORIA IL 61614

DAN PARTRIDGE
MARSEILLES MARINE & FLEETING
PO BOX 249
OTTAWA IL 61350

DAVE HORVATH
MASON STATE NURSERY
17855 N CR 2400E
TOPEKA IL 61567

DON HALLORIN
MATERIAL SERVICE CORP
PO BOX 232
MORRIS IL 60450

DAN SCHWIND
MATERIAL SERVICE CORP
4226 LAWNDALE
LYONS IL 60534

JURIS AND LIBBY LAZDINS
MATTHEWS & LAZDINS
247 W JEFFERY
KANKAKEE IL 60901

JOE STUTZ
AREA CONSULTANTS
MAURER-STUTZ ENGINEERS INC
7615 N HARKER
PEORIA IL 61615

KEN MURATA
MBL USA CORPORATION
601 DAYTON RD
OTTAWA IL 61350

MILTON MC CLURE
MCCLURE BRANNAN & HARDWICK
113 STATE ST
BEARDSTOWN IL 62618

AREA CONSULTANTS
MCCLURE ENGINEERING ASSOCIATES
1138 COLUMBUS ST
OTTAWA IL 61350-2107

HENRY ALLOVIO JR
ECONOMIC DEVELOPMENT BOARD
MCGLADREY & PULLEN LLP
401 MAIN ST #1200
PEORIA IL 61602

DONALD GORMAN
MCIRCC
4914 N LONGVIEW PL
PEORIA HEIGHTS IL 61616-5135

MEDLEYS MOVING AND STORAGE
251 E 95TH ST
CHICAGO IL 60619-7207

STEVE SHAW
PEORIA AREA CONVENTION & VISITOR BUR
MERCEDES RESTAURANTS
2402 W NEBRASKA ST
PEORIA IL 61604

JIM KEISTLER
INLAND WATERWAYS USERS BOARD
MERCHANDISING MANAGER - TWOMEY CO
2031 58TH
MONMOUTH IL 61462

MERCHANTS NATIONAL BANK OF AURORA
84 S BROADWAY
AURORA IL 60148

MEREDOSIA TERMINAL
PO BOX 246
MEREDOSIA IL 62665

MERRILL ASSOCIATES LTD
2317 E 71ST ST
CHICAGO IL 60649-2505

TONY MERTEL
MERTEL GRAVEL CO
W END OF WATER ST
PERU IL 61354

DEBORAH SIMON
PEORIA CHAMBER BOARD
METHODIST MEDICAL CENTER
221 NE GLEN OAK
PEORIA IL 61636

METRO CHICAGO FLOOR DELIVERY COOP
1760 N MILWAUKEE AVE
CHICAGO IL 60647-5453

RICHARD WORTHEN
METRO EAST STORMWATER OFFICE
PO BOX 1366
GRANITE CITY IL 62040-1366

METROPOLITAN CHICAGO INC
2500 W ROOSEVELT RD
CHICAGO IL 60608-1006

MGM COMPANY INC
1800 W 43RD ST
CHICAGO IL 60609-3111

MICHAELS LEASING INC
4208 S WESTERN AVE
CHICAGO IL 60609-2224

MIDWAY MOVING AND STORAGE INC
4100 W FERDINAND ST
CHICAGO IL 60624-1027

MIDWEST CARGO SYSTEMS INC
1050 W PERSHING RD
CHICAGO IL 60609-1462

DAN DOUGHERTY
MIDWEST CORRESPONDANT
1949 W LUNT AVE
CHICAGO IL 60626

JAMES P CATHEY
AREA CONSULTANTS
MIDWEST ENGINEERING PROFESSIONALS
1 LAUREL CT
WASHINGTON IL 61571

MERLE KALKWARF
ECONOMIC DEVEL BOARD
MINONK STATE BANK
137 W 5TH ST
MINONK IL 61760

MOBIL OIL CO
3801 S CICERO AVE
CHICAGO IL 60650

MORDUE MOVING & STORAGE INC
9011 N UNIVERSITY ST
PEORIA IL 61615-1646

MR BULTS INC
2658 E 139TH ST
CHICAGO IL 60633-2131

LARRY CLORE
PEORIA CHAMBER BOARD
MULTI-AD SERVICES
1720 W SETWEILLER DR
PEORIA IL 61615

EUGENE DAUGHERITY
MYERS, DAUGHERITY, BERRY, O'CONOR & KUZM
130 E MADISON ST
OTTAWA IL 61350

N D LEASING COMPANY
200 N DEARBORN ST APT 701
CHICAGO IL 60601-1617

BRUCE ALKIRE
PEORIA CHAMBER BOARD
N E FINCH COMPANY
P O BOX 5187
PEORIA IL 61601

N E FINCH COMPANY
PO BOX 5187
PEORIA IL 61601-5187

DALE BURKLAND
CHAIRMAN OF THE BOARD
NATL MARINE SALES INC
5406 N GALENA RD
PEORIA IL 61614-5445

NEW WORLD VAN LINES OF CAL CAL
5875 N ROGERS AVE
CHICAGO IL 60646-5953

J W FARMER
NORFOLK SOUTHERN CORP
1735 E CONDIT
DECATUR IL 62521

NORMANS MOVING & STORAGE
3517 W MONTROSE AVE
CHICAGO IL 60618-1118

NORTHERN CROSS DOCK OPERATION
2000 WIESBROOK RD #D
OSWEGO IL 60543-8308

NORTHERN PETROCHEMICALS COMPANY
8805 TABLER RD
MORRIS IL 60450

MANAGER
OBSERVER
1616 W PIONEER PKWY
PEORIA IL 61615-1945

SUE O'CONNOR
O'CONNOR CONCEPTS
6649 W RTE 115
HERSCHER IL 60941

OIL-DRI CORP AMERICA
410 N MICHIGAN AVE
CHICAGO IL 60611-4211

OL THOMPSON TRANSPORT SERVICE
1351 BRANDON RD
JOLIET IL 60436-8529

TRUST 587
OLD SECOND NATIONAL BANK OF AURORA
37 S RIVER ST
AURORA IL 60507

SULFURIC ACID TERMINAL
OLIN CORP
PO BOX 2219 1945 PATTERSON RD
JOLIET IL 60436

OLYMPIC FREIGHTWAYS INC
1801 W 31ST PL
CHICAGO IL 60608-6102

OMEGA CARTAGE INC
7601 S WENTWORTH AVE
CHICAGO IL 60620-1058

OROURKE CARTAGE COMPANY INC
13518 S HOXIE AVE
CHICAGO IL 60633-1808

RICHARD RICHMAN
CORPORATE DIRECTOR OF ENGINEERING
OSF HEALTH CARE SYSTEM
800 NE GLEN OAD AVE
PEORIA IL 61603

JON KRANOV
OTTAWA SAVINGS BANK
925 LASALLE ST
OTTAWA IL 61350

PAL AUTOMOTIVE PARTS
1016 E MARIETTA AVE
PEORIA IL 61614-6320

CHRIS HEINTZELMAN
PEORIA AREA CONVENTION & VISITOR BUR
PAR A DICE HOTEL
7 BLACKJACK BOULEVARD
EAST PEORIA IL 61611

BOB PARSONS
ECONOMIC DEVELOPMENT BOARD
PARSONS COMPANY
JCT OF ROUTE 116 & 117
ROANOKE IL 61561

AREA CONSULTANTS
PDC TECHNICAL SERVICES INC
4349 SOUTHPORT RD
PEORIA IL 61615

PECKLER MOTOR SERVICE INC
4601 W 47TH ST
CHICAGO IL 60632-4801

ROBERT MOORE
ECONOMIC DEVELOPMENT BOARD
PEKIN HOSPITAL
600 S 13TH ST
PEKIN IL 61554

TRANSPORTATION COORDINATION CO
PEORIA & PEKIN UNION RAILWAY
101 WESLEY RD
CREVE COEUR IL 61610

GARY JAMESON
DIRECTOR
PEORIA ART GUILD
203 HARRISON ST
PEORIA IL 61602

ROGER WINKLER
TRANSPORTATION COORDINATION CO
PEORIA CHARTER COACH COMPANY
2600 NE ADAMS ST
PEORIA IL 61603

RALPH WOOLARD
TRANSPORTATION COORDINATION CO
PEORIA CHARTER COACH COMPANY
2600 NE ADAMS ST
PEORIA IL 61603

DON WELCH
PEORIA AREA CONVENTION & VISITOR BUR
PEORIA CIVIC CENTER
201 S W JEFFERSON ST
PEORIA IL 61602

GARY ROCKOW
AREA CONSULTANTS
PHILLIPS SWAGER AND ASSOCIATES
401 SW WATER ST STE 702
PEORIA IL 61602-1530

PHOENIX OIL COMPANY
1434 W 76TH ST
CHICAGO IL 60620-4153

MERCHANDISE MART
PHOTO DELIVERY SERVICE INC
PO BOX 4114
CHICAGO IL 60654

PICKENS-KANE MOVING & STORAGE COMPANY
410 N MILWAUKEE AVE
CHICAGO IL 60610-3935

PIONEER RAILCORP
1318 S JOHANSON RD
PEORIA IL 61607-1130

THERESA KOEHLER
AREA PLANNERS
PLANNING & GROWTH MGMT
419 FULTON ST STE 404
PEORIA IL 61602

DAVID PANZERA
PRESIDENT
PML INC- PANZERA MARINE TRANSP INC
2455 GLENWOOD AVE STE #204
JOLIET IL 60435

DENNIS HUFF
ECONOMIC DEVELOPMENT BOARD
PMP FERMENTATION PRODUCTS INC
121 WAYNE ST
PEORIA IL 61603

PAUL FELTENSTEIN
ECONOMIC DEVELOPMENT BOARD
PP&U RAILWAY CO
301 WESLEY RD
CREVE COEUR IL 61610

KIM ST JOHN
PRAIRIE RIVER RC & D
400 EDWARDS ST
HENRY IL 61537

PRATT LUMBER & HOME CENTER
311 E AVE E
LEWISTOWN IL 61542

IL RIALTO SQUARE
PREITZEL & STOUFFER, CHARTERED
116 N CHICAGO STE 500
JOLIET IL 60432

PREMIER CARTAGE INC
3217 W 48TH PL
CHICAGO IL 60632-3022

GARY MUELLER
PRETZEL & STOUFFER CHARTERED
116 N CHICAGO STE 500
JOLIET IL 60432

NORMAN H LACONTE
ECONOMIC DEVELOPMENT BOARD
PROCTOR HOSPITAL
5409 N KNOXVILLE
PEORIA IL 61614

PRODUCE HAULERS INC
2038 N CLARK ST #151
CHICAGO IL 60614-4713

SANDRA J BIRDSALL
PEORIA CHAMBER BOARD
PRUDENTIAL/CULLINAN PROPERTIES
7707 N KNOXVILLE AVE
PEORIA IL 61614

HENRY HOLLING
HEARTLAND WATER RESOURCE BOARD
PUBLIC AFFAIRS CATERPILLAR
100 N E ADAMS
PEORIA IL 61629

QUICK TRIP EXPRESS INC
3004 N WILSON
PEORIA IL 61605

R & S GROUP SERVICES INC
5500 W 47TH ST
CHICAGO IL 60638-1890

MICHAEL CULLINAN
ECONOMIC DEVELOPMENT BOARD
R A CULLINAN & SONS
P O BOX 166
TREMONT IL 61568

ROBERT C MILLER
PEORIA CHAMBER BOARD
R C MILLER CO INC
1406 W QUEENS CT RD
PEORIA IL 61614

MEREDOSIA TERMINAL, INC
R WM DAVIDSMEYER
HWY 104 W PO BOX 268
MEREDOSIA IL 62665

HARRY SCHOLL
RACKOFF-EADS
118 N CLINTON-SUITE 303
CHICAGO IL 60606

PATRICK MEYER
PEORIA/PEKIN URBANIZED AREA TR
RANDOLPH & ASSOCIATES INC
911 W PIONEER PARKWAY
PEORIA IL 61615

REEBIE STORAGE & MOVING COMPANY
2325-33 N CLARK ST
CHICAGO IL 60614

JIM REED
REEDS CANOE RENTAL
907 N INDIANA
KANKAKEE IL 60901

REILLEY EXCAVATING & WRECKING
4844 N LAMON AVE
CHICAGO IL 60630-2414

RELIANCE SPECIAL DELIVERY SERVICE
1722 W CARROLL AVE
CHICAGO IL 60612-2504

REO MOVERS & VAN LINES INC
7000 S CHICAGO AVE
CHICAGO IL 60637-4143

REPUBLIC STEEL CORP
941 LEHIGH CIR
NAPERVILLE IL 60565-3456

RAYMOND HOPKINS
ARTCO
RIAC
PO BOX 2889 4528 S BROADWAY
ST LOUIS MO 63111

RICHARD MC CURRIE TEAMING COMPANY
1443 W 41ST ST UNIT 1
CHICAGO IL 60609-2496

RIDOL INC
6801 W 66TH PL
CHICAGO IL 60638-4805

RJN ENVIRONMENTAL ASSOCIATES INC
247 W JEFFERSON
KANKAKEE IL 60901

MICHAEL E QUINE
PEORIA CHAMBER BOARD
RLI COPORATION
9025 N LINDBERGH DR
PEORIA IL 61615

TIM KRUEGER
ECONOMIC DEVELOPMENT BOARD
RLI CORPORATION
9025 N LINDBERGH DR
PEORIA IL 61615

AREA CONSULTANTS
RMR CONSULTING
3128 N BILTMORE
PEORIA IL 61604

ROGERS TRANSFER INC
1040 5TH AVE
AURORA IL 60505-5061

ROTRANSCO INC
6516 W 74TH ST
CHICAGO IL 60638-6011

RYANS EXPRESS INC
7035 W 65TH ST
CHICAGO IL 60638-4603

S T SERVICES - SUNMARK SMITH OIL
PO BOX 5
PERU IL 61354

ESTHER C. ABERNATHY
BRANCH MANAGER
SAMMONS COMMUNICATIONS INC
PO BOX 607
JACKSONVILLE IL 62651-0607

SAMMY SUTTON
7500 S ASHLAND AVE
CHICAGO IL 60620-4245

SCHACHTRUP FARMS INC
4515 GRANDVIEW
PEORIA IL 61614

SCHADTS INC
3611 S NORMAL AVE
CHICAGO IL 60609-1723

SCHIEK MOTOR EXPRESS COMPANY INC
90 CASSEDAY AVE
JOLIET IL 60432-2909

AREA CONSULTANTS
SCHWARTZ ENGINEERING INC
602 DERBY
PEKIN IL 61554

GLIDDEN DURKEE DIVISION
SCM CORP
PO BOX 796
JOLIET IL 60434

SEAYS DELIVERY SERVICE INC
920 N GARFIELD AVE
PEORIA IL 61606-1828

DALE ROEDL
SHADY HAVEN
212 E 6TH ST
MENDOTA IL 61342

MARY CAY WESTPHAL
PEORIA CHAMBER BOARD
SHAMROCK PLASTICS INC
PO BOX 3530
PEORIA IL 61612

LAURA ROSS-STUART
SHRADER ASSOC.
2S648 DEERPATH RD
BATAVIA IL 60510

SILICA SAND TRANSPORT INC
1521 WAREHOUSE DR
OTTAWA IL 61350-9004

SMITH MOVERS INC
7150 S HALSTED ST
CHICAGO IL 60621-1728

SNAP TRANSPORT INC
9410 S LEAVITT ST
CHICAGO IL 60620-5621

SOUTH END CARTAGE CORP DEL
4222 S KNOX AVE
CHICAGO IL 60632-3934

SPECIAL SERVICE COMPANY INC
681 N GREEN ST
CHICAGO IL 60622-5966

DAVE VAN HISE
FARM MANAGER
SPRING LAKE FARMS CORPORATION
4541 N PROSPECT RD - STE 303
PEORIA HEIGHTS IL 61614

TERRY GALLE
SPURGEONS MERCANTILE CO
822 W WASHINGTON BLVD
CHICAGO IL 60607

STARKS BROTHERS MOVING & HAULING
PO BOX 24191
CHICAGO IL 60624-0191

TERRY CROSS
STARVED ROCK LODGE & CONFERENCE CENTER
PO BOX 570 HWY 178 AND 71
UTICA IL 61373

STATLAND CARTAGE COMPANY INC
443 N RACINE AVE
CHICAGO IL 60622-5841

WILLIAM STEVENSON
STEVENSON TRANSFER
300 W STEVENSON RD
OTTAWA IL 61350

DUANE HAMILTON
STEVERS SAND AND GRAVEL
2423 W FARMINGTON RD
WEST PEORIA IL 61604

JR NEDZA
STOLT HAVEN INC
12200 S STONEY ISLAND AVE
CHICAGO IL 60633

SUN BRITE SERVICES INC
6825 S HERMITAGE AVE
CHICAGO IL 60636-3330

DARRYL ANDERSON
SUPER 8 MOTEL
500 E ETNA RD
OTTAWA IL 61350

SUPERB MOTOR SERVICE INC
6214 N ALBANY AVE
CHICAGO IL 60659-1402

TOM SVENDSEN
EROSION CONTROL TASK FORCE
SVENDSEN CONSTRUCTION
1302 HOWARD CT
PEKIN IL 61554

T & T TRANSFER INC
140 S DEARBORN ST STE 320
CHICAGO IL 60603-5236

T M DOYLE TEAMING INC
4232 W 81ST ST
CHICAGO IL 60652-2243

JOHN TALBERT
TALBERTS GARAGE
PO BOX 464
BEARDSTOWN IL 62618-0065

TERRY DOWD INC
2501 W ARMITAGE AVE
CHICAGO IL 60647-4324

THE BELT RAILWAY COMPANY OF CHICAGO
6900 S CENTRAL AVE
CHICAGO IL 60638-6312

ALLEN M CAMERON
THE CAMERON GROUP
444 INTERSTATE RD
ADDISON IL 60101

JAMES SHERMAN
PEORIA CHAMBER BOARD
THE CHILDREN'S HOME ASSOCIATION
2130 N KNOXVILLE AVE
PEORIA IL 61603

WILLIAM O BROWNING
PEORIA CHAMBER BOARD
THE HEARTLAND PARTNERSHIP
124 SW ADAMS - #300
PEORIA IL 61602

THE LEWISTON BANK
120 E WASHINGTON
LEWISTOWN IL 61542

TERRANCE HOLM
THE NARRAGANSETT
1640 E 50TH ST - 9C
CHICAGO IL 60615

THE VALLEY LINE CO
529 N CHICAGO ST
JOLIET IL 60432

THE VALLEY LINE COMPANY
529 N CHICAGO ST
JOLIET IL 60432

ED WYSS
TRANSPORTATION COORDINATION CO
TP & W
1990 E WASHINGTON ST
EAST PEORIA IL 61611

TRANS AMERICAN STORAGE DEL
7540 S WESTERN AVE
CHICAGO IL 60620-5816

DICK CRIDLEBAUGH
TRANSPORTATION COORDINATION CO
116 FLORENCE ST
EAST PEORIA IL 61611

TREYS MOVERS INC
9122 S MICHIGAN AVE
CHICAGO IL 60619-6619

DANA LOGSDON
PRESIDENT
TUG LOGSDON SERVICE
PO BOX 27
BEARDSTOWN IL 62618-1134

TURKS MOTOR EXPRESS INC
1017 W 48TH ST
CHICAGO IL 60609-4305

TWOMEY CO
PO BOX 158
SMITHSHIRE IL 61478

U HAUL
1700 N CICERO AVE
CHICAGO IL 60639-4504

THOMAS CLARK
BRANCH MANAGER
U A CABLE SYSTEM
UACC MIDWEST INC
3517 N DRIES LN
PEORIA IL 61604-1210

VAN JACKSON
OTTAWA BANKING CTR
UNION BANK
122 W MADISON ST
OTTAWA IL 61350

UNION CARTAGE COMPANY INC
5401 W 65TH ST
CHICAGO IL 60638-5637

UNION EXPRESS DES SERVICE
PO BOX 180047
CHICAGO IL 60618-0524

UNION FREIGHTWAYS INC
1001 S LARAMIE AVE
CHICAGO IL 60644-5506

UNITED EXPRESS SYSTEM INC
PO BOX 1628
AURORA IL 60507-1628

UNITED LOGISTICS INC
PO BOX 559
PEORIA IL 61651-0559

WILLIAM C MANIKA
TRANSPORTATION COORDINATION CO
UNITED PARCEL SERVICE
2600 WARRENVILLE RD SUITE 210
DOWNERS GROVE IL 60515

MICHAEL J TRURAN
TRANSPORTATION COORDINATION CO
UNITED PARCEL SERVICE
2349 HUBBARB AVE
DECATUR IL 62526

JAMES OLIVER
ECONOMIC DEVELOPMENT BOARD
UNIVERSITY FORD OF PEORIA INC
2100 W PIONEER PARKWAY
PEORIA IL 61615

CORNELL OLIVER
PEORIA CHAMBER BOARD
UNIVERSITY FORD OF PEORIA INC
2100 W PIONEER PARKWAY
PEORIA IL 61615

VAN OHARE LINES INC
5000 W ROOSEVELT RD
CHICAGO IL 60650-1368

MATT J VONACHEN
PEORIA CHAMBER BOARD
VONACHEN SERVICE & SUPPLY
PO BOX 3156
PEORIA IL 61612

ED LAURENT
PRESIDENT
WATER AND OIL TECHNOLOGIES INC
52 EASTFIELD RD
MONTGOMERY IL 61538

WATKINS TRUST
5 OAKWOOD DR
OSWEGO IL 60543

JIM SUSIN
PEORIA AREA CONVENTION & VISITOR BUR
WAUGH FROZEN FOODS COMPANY
8903 N HALE AVE
PEORIA IL 61615

DAN SILVERTHORN
ECONOMIC DEVELOPMENT BOARD
WEST CENTRAL IL BLDG & CONST
400 N E JEFFERSON ST STE 403
PEORIA IL 61603

JAMES BROADWAY
RIVERFRONT BUSINESS DIST COMM
WESTERVELT JOHNSON NICOLL & KELLER
411 HAMILTON BLVD 14TH FLOOR
PEORIA IL 61602

CAROLINE NEIL
PRESIDENT
WHITECAP DRIFTERS BOAT CLUB
6802 SANKOTY DR
PEORIA IL 61614-3118

AREA CONSULTANTS
WILLETT HOFMANN & ASSOCIATES INC
512 1/2 COURT ST
PEKIN IL 61554

WILLIAM CUNNINGHAM MOVERS
5862 N NW HWY
CHICAGO IL 60631-2641

WINKLER DISTRIBUTING INC
PO BOX 698
PEORIA IL 61652-0698

WIRTZ CARTAGE COMPANY
4116 W PETERSON AVE
CHICAGO IL 60646-6017

MIKE J WISDOM
PEORIA CHAMBER BOARD
WISDOM DEVELOPMENT GROUP
405 SW COMMERCIAL ALY
PEORIA IL 61602-1550

STEVEN WOODRUM
WOODRUM MANUFACTURING
RR 4
JACKSONVILLE IL 62650-9804

WORLD PAPER STORAGE
4545 W PALMER ST
CHICAGO IL 60639-3421

YACKLEY ALL WEATHER SERVICE LTD
435 RANCE RD
OSWEGO IL 60543-9766

RICHARD LINDEMEIR
AMERICAN RIVER TRANS
PO BOX 1470
DECATUR IL 62525

FRANK CASTLEMAN
AMERICAN RIVER TRANSPORTATION
PO BOX 1470
DECATUR IL 62525

BARGE TERMINAL TRUCKING INC
PO BOX 636
OSWEGO IL 60543-0636

CBSL TRANSPORTATION SERVICES INC
4750 S MERRIMAC AVE
CHICAGO IL 60638-1439

FULL TRANSPORTATION SERVICE
2300 S THROOP ST
CHICAGO IL 60608-5012

BILL KINZELER II
DIRECTOR
ILLINOIS RIVER CARRIERS ASSOC
PO BOX 610
JEFFERSONVILLE IN 47130

DANIEL HOUGHTON
JACK TANNER TOWING CO
801 S 11TH ST
HAVANA IL 62644

LLOYD COLE
PRESIDENT
JACK TANNER TOWING COMPANY INC
801 11TH ST
HAVANA IL 62644-1613

MARK CARR
MEMCO BARGE LINE INC
16090 SWINGLEY RIDGE RD #600
CHESTERFIELD MO 63017

DON HUFFMAN
MARC 2000
MEMCO BARGE LINE INC
16090 SWINGLEY RIDGE RD STE 600
CHESTERFIELD MO 63017

OHIO BARGE LINE, INC.
927 COLLINS ST
JOLIET IL 60432

DAN WIESBROCK
OTTAWA BARGE TERMINAL INC
PO BOX 197
LEONORE IL 61332

PEM TRANSPORTATION
5757 W OGDEN AVE
CHICAGO IL 60650-3807

JAMES R MEHLENBECH
PEORIA BARGE TERMINAL
1925 DARST ST PO BOX 5187
PEORIA IL 61605

JAMES R MEHLENBECK
TRANSPORTATION COORDINATION CO
PEORIA BARGE TERMINAL
P O BOX 5187
PEORIA IL 61601

THOMAS FINCH
PRESIDENT
PEORIA BARGE TERMINAL INC
PO BOX 5187
PEORIA IL 61601-5187

PIER TRANSPORTATION INC
2901 W 31ST ST
CHICAGO IL 60623-5104

PYRAMID TRANSPORTATION COMPANY
3103 E 79TH ST
CHICAGO IL 60649-5311

ROADLINK USA MIDWEST
4201 W 36TH ST FL 4
CHICAGO IL 60632-3828

STAR TRUCK DRIVING SCHOOL
PO BOX 1039
MONTGOMERY IL 60538-7039

PETE COFER
TABOR MARINE
PO BOX 175
PEORIA IL 61650

THE VALLEY LINE CO
529 N CHICAGO ST
JOLIET IL 60432

JOHN ZICK
SENIOR VICE PRESIDENT
1421 W FLETCHER ST
CHICAGO IL 60657-2112

ADM-GROWMARK, INC
PO BOX 560
HAVANA IL 62644-1364

APEX MARINE TERMINAL
3301 S KEDZIE AVE
CHICAGO IL 60623

TOM KRAMER
CALUMET TERMINAL
3259 E 100TH ST
CHICAGO IL 60617

BEN MILLER
CARGILL GRAIN
310 S WATER ST
HAVANA IL 62644

CARGILL INC
PO BOX 232
SPRING VALLEY IL 61362

OIL TAD DEPT
CARGILL INC
122ND & TORRENCE AVE
CHICAGO IL 60617

OIL TAD DEPT
CARGILL INC
122ND & TORRENCE AVE
CHICAGO IL 60617

CARGILL INC
310 S WATER ST
HAVANA IL 62644-1360

MARK BIEBER
GRAIN DIVISION
CARGILL INC
PO BOX 260
MEREDOSIA IL 62665

ROBERT LAURISCH
LAKES AREA SUPERINTENDENT
CARGILL INC
122ND & TORRENCE AVE
CHICAGO IL 60617

ED MC QUEEN
CARGILL INC
300 BOARD OF TRADE BLDG
PEORIA IL 61602

CERES TERMINALS
9301 S KREITER AVE
CHICAGO IL 60617

JAMES FARLEY
CONTI CARRIERS & TERMINALS
3647 173RD CT APT 9C
LANSING IL 60438-1450

GARVEY INTERNATIONAL INC
P O BOX 546
OTTAWA IL 61350

KOCH MARINE OIL TERMINAL
4100 S CICERO AVE
CHICAGO IL 60650

LAKE RIVER TERMINALS INC
6800 W 68TH ST
CHICAGO IL 60638-4838

R WM DAVIDSMEYER
MEREDOSIA TERMINAL INC
HWY 104 W PO BOX 268
MEREDOSIA IL 62665

NORMAN LITTLE
MEREDOSIA TERMINAL INC
HWY 104 W PO BOX 268
MEREDOSIA IL 62665

FRAN KASTEN
QUANTUM CHEMICAL CO
8805 N TABLER RD
MORRIS IL 60450

RESERVE MARINE TERMINALS
11401 S GREEN BAY AVE
CHICAGO IL 60617-7100

S H BELL CO
10218 S AVE O
CHICAGO IL 60617

TIM BERENS
STOLTHAVEN CHICAGO INC
12200 S STONY ISLAND AVE
CHICAGO IL 60633

BURLINGTON NORTHERN - GALESBURG DIV
1670 S HENDERSON
GALESBURG IL 61401

ELMER BERGQUIST
MANAGER
PUBLIC PROJECTS
BURLINGTON NORTHERN & SANTA FE RAILROAD
1670 S HENDERSON ST
GALESBURG IL 61401

DIRECTOR OF PUBLIC WORKS
BURLINGTON NORTHERN INC.
547 W JACKSON BLVD
CHICAGO IL 60606

RUTH MC CULLUM
BURLINGTON RAILROAD
5601 W 26TH ST
CHICAGO IL 60650

CHICAGO RAIL LINK
2728 E 104TH ST
CHICAGO IL 60617-5766

CHICAGO W PULLMAN SOUTHERN RR COMPANY
2728 E 104TH ST FL 1
CHICAGO IL 60617-5766

J. T. HENSCHEL
ASSET MANAGEMENT DEPARTMENT
ELGIN JOLIET & EASTRN RAILWAY COMPANY
1141 MAPLE RD
JOLIET IL 60432-1981

DAVE BLACKMON
ACTING REGIONAL ADMINISTRATOR
FEDERAL RAILROAD ADMINISTRATION-REG 4
111 ST CANAL ST SUITE 655
CHICAGO IL 60606

MICHAEL K. MOHAN
ILLINOIS CENTRAL RAILROAD
455 NORTH CITY FRONT PLAZA DR
CHICAGO IL 60611-5504

NORTHEAST IL REG COMMUTER RR CORP (METRA)
547 W JACKSON BLVD
CHICAGO IL 60661-5717

ANTHONY OGNIBENE
REAL ESTATE & CONTRACT MGMT
NORTHEAST IL REG COMMUTER RR CORP (METRA)
547 W JACKSON BLVD
CHICAGO IL 60661-5717

RICK HART
ENGINEER
AMEREN CIPS
104 E 3RD ST
BEARDSTOWN IL 62618

CENTRAL IL LIGHT CO.
300 LIBERTY ST
PEORIA IL 61602

KEVIN CULVER
LABORATORY DIRECTOR
CONSUMERS ILLINOIS WATER COMPANY
1100 COBB BLVD
KANKAKEE IL 60901

GEORGE LEVI
DIRECTOR - ECONOMIC DEVELOPMENT
ILLINOIS POWER CO
500 S 27TH ST
DECATUR IL 62525

RICH SCHULTZ
KANKAKEE MUNICIPAL UTILITY
199 S EAST AVE #2
KANKAKEE IL 60901

NORTHERN ILLINOIS GAS CO
2704 FESTIVAL DR
KANKAKEE IL 60901

JOSEPH PRZEN
PERU POWER CO
1415 WATER ST
PERU IL 61354

PRINCETON MUNICIPAL UTILITIES
2 S MAIN ST
PRINCETON IL 61356

THOMAS BRIGGS
WEBSTER ILLINOIS POWER COOP
PO BOX 609
JACKSONVILLE IL 62651

MARK LAMBERT
IL CORN GROWERS ASSOCIATION
102 S BONE DR
NORMAL IL 61761

DALE KNAPP
ADM/GROWMARK
PO BOX 352
MORRIS IL 60450

JAMES L WHALEN
ADM/GROWMARK
PO BOX 560
HAVANA IL 62644-0560

JOHN SKORBURG
SENIOR ECONOMIST
AMERICAN FARM BUREAU
1501 E WOODFIELD RD STE 300W
SCHAUMBURG IL 60173-5422

G ALLEN AND MARTIN ANDREAS
PRESIDENT & CEO
ARCHER DANIELS MIDLAND CO
PO BOX 1470
DECATUR IL 62525

LEW BATCHELDER
ARCHER DANIELS MIDLAND CO
4666 FARIES PKWY
DECATUR IL 62525

NANCY HAMILL WINTER
NATURE CONSERVANCY
BIG SKY FARM
5229 S MASSBACH RD
STOCKTON IL 61085

BRIAN INGRAM
BROWN CO FARM BUREAU
RR 3
MT STERLING IL 62353

LEN WIESE
BROWN CO FARM BUREAU
RR 1 BOX 86
VERSAILLES IL 62378

MANAGER
BUREAU COUNTY FARM BUREAU
PO BOX 190
PRINCETON IL 61356

ROGER BRUYN
MANAGER
BUREAU COUNTY FARM BUREAU
627 DOWNEY DR
PRINCETON IL 61356

DALE HADDEN
CASSMORGAN FARM BUREAU
1291 HWY 78 W
JACKSONVILLE IL 62650

JAMES CARLETON
CASS-MORGAN FARM BUREAU
1152 TENDICK
JACKSONVILLE IL 62650

CANDY ANDERSON
CITIZENS AGAINST FACTORY FARMS INC
RT 3 BOX 235
MT STERLING IL 62353

LYLE & SHARI LEWIS
CITIZENS AGAINST FACTORY FARMS INC
RR 3 BOX 239
MT STERLING IL 62353

JIM HAMACKER
CONSOLIDATED GRAIN & BARGE CO
RR 4 BOX 167
PRINCETON IL 61356

ROBERT W HALE
ASST VICE PRESIDENT
CHICAGO REGION
CONTINENTAL GRAIN & BARGE CO
PO BOX 408
BEARDSTOWN IL 62618

CONTINENTAL GRAIN CO
101 N WATER ST PO BOX 117
LACON IL 61540

CONTINENTAL GRAIN CO-BEARDSTOWN TMNL
814 W MAIN ST PO BOX 408
BEARDSTOWN IL 62618

TED HARDING
FARM BUREAU
208 S TRIVOLI RD
TRIVOLI IL 61569

ROBERT JOHNSON
FARM BUREAU
10625 N RT 47
MORRIS IL 60450

GEORGE FLAGEOLE
FLAGEOLE FARMS INC
1656 W 2000S RD
KANKAKEE IL 60901

ELAINE STONE
MANAGER
FULTON CO FARM BUREAU
15411-A N IL 100 HWY
LEWISTOWN IL 61542-9500

MANAGER
FULTON COUNTY FARM BUREAU
RR2 BOX 37A5
LEWISTOWN IL 61542-9500

GOFFLAND FARMS
26880 ACORN
HOPEDALE IL 61747

WILLIAM LEMMON
EXECUTIVE VICE PRESIDENT
GRAIN AND FEED ASSOC OF IL
3521 HOLLIS DR
SPRINGFIELD IL 62707

GROWMARK INC
PO BOX 352
MORRIS IL 60450

JAYNE KITTELL
GRUNDY CNTY FARM BUREAU
4000 N DIVISION
MORRIS IL 60450

ROGER HARDY
HARDY FARMS
RR 1 BOX 35A
JACKSONVILLE IL 62650-9801

CHARLES HUNT
HUNT FAMILY FARMS
RR 1
GRAFTON IL 62037-9801

ROSS PAULI
ICGA
9919 N FORD RD
EDWARDS IL 61528

RODNEY WEINZIEL
IL CORN GROWERS
3617 N 1300 E RD
STANFORD IL 61774

DENNY BOGNER
IL CORN GROWERS ASSOCIATION
898 CAMP GROVE RD
SPARLAND IL 61565

NANCY ANDERSON
IROQUOIS CNTY FARM BUREAU
RTE 1 BOX 30
DANFORTH IL 60930

BILL OLTHOFF
KANKAKEE COUNTY FARM BUREAU
4503-A E 3000N RD
BOURBONNAIS IL 60914

KANKAKEE COUNTY FARM SERVICE AGENCY
685 LARRY POWERS RD
BOURBONNAIS IL 60914

ROBERT KENNELL
KENNELL ROBERT FERTILIZER
RR 2 BOX 24
ROANOKE IL 61561-9802

HAROLD KUHLMANN
KUHLMANN & KUHLMANN FARMS
RR 1 BOX 73
BEARDSTOWN IL 62618-9505

MACON COUNTY FARM SERVICE AGENCY
PO BOX 3458
DECATUR IL 62524

MASON COUNTY FARM SERVICE AGENCY
PO BOX 107
HAVANA IL 62644

KEITH SWIGART
MINIER COOP GRAIN
PO BOX 650
MINIER IL 61759-0650

LEW KORSMEYER
PRESIDENT
KORSMEYER N FARMS
N KORSMEYER INC
RR 3 BOX 358
BEARDSTOWN IL 62618-9577

MIKE COCHRAN
NIGHT HAWK FARMS
RR 1 BOX 149C
TIMEWELL IL 62375

GREENWAYS BOARD
PEORIA COUNTY FARM BUREAU
1716 NORTH UNIVERSITY
PEORIA IL 61604

PATRICK KIRCHHOFER
PEORIA COUNTY FARM BUREAU
1716 N UNIVERSITY
PEORIA IL 61604

PEORIA COUNTY FARM SERVICE AGENCY
2412 W NEBRASKA AVE
PEORIA IL 61604

BLAKE RODERICK
MANAGER
PIKE.SCOTT COUNTY FARM BUREAU
629 E WASHINGTON
PITTSFIELD IL 62363

JAMES RAY
RAY BROTHERS FARM PARTNERSHIP
PO BOX 149
MT STERLING IL 62353-0149

BOBBY G. HARDWICK, JR.
PRESIDENT
S W HARDWICK FARMS INC
1401 GRAND AVE
BEARDSTOWN IL 62618

FRANCIS B. SCHACHTRUP
PRESIDENT
SCHACHTRUP FARMS INC
4515 N GRANDVIEW DR
PEORIA IL 61614-6629

F. M. SCHACHTRUP
VICE-PRESIDENT
SCHACHTRUP FARMS INC
105 FAIRHAVEN LN
PEORIA HEIGHTS IL 61614-6611

KENT PRATHER
SCHUYLER CO FARM BUREAU
415 N CAPITOL
MT STERLING IL 62353

KENT PRATTEN
SCHUYLER COUNTY FARM BUREAU
114 E LAFAYETTE
RUSHVILLE IL 62681

WARREN WOLF
SISTER CREEK FARMING
20798 E USHWY 24
LEWISTOWN IL 61542

ALISON WOLF
SISTER CREEK GRAIN
20798 E US RT 24
LEWISTOWN IL 61542

TODD HUDSON
TABOR GRAIN CO
PO BOX 447
LA SALLE IL 61301

GREENWAYS BOARD
TAZEWELL COUNTY FARM BUREAU
1505 VALLE VISTA
PEKIN IL 61554

TAZEWELL COUNTY FARM SERVICE AGENCY
1440 VALLE VISTA BLVD
PEKIN IL 61554-6224

JOAN FRENCH
TRENCHARD FARMS
4531 N MILLER
PEORIA HEIGHTS IL 61616

WAYNE UNSIKER
TRIPLE U FARMS
8611 N RADNOR RD
PEORIA IL 61615-9641

WILL COUNTY FARM SERVICE AGENCY
1201 GOUGAR RD
NEW LENOX IL 60451

GREENWAYS BOARD
WOODFORD COUNTY FARM BUREAU
117 W CENTER
EUREKA IL 61530

STAN GREBNER
LAND USE ADVISORY COMMITTEE
WOODFORD COUNTY FARM BUREAU
RR 1 BOX 191
WASHBURN IL 61570

GORDON A TINGLEY
SENIOR TRANSMISSION ENGINEER
AmerenCIPS
104 E 3rd ST
BEARDSTOWN IL 62618

C F INDUSTRIES
PO BOX 492
PERU IL 61354

DONALD DAVIS
CATERPILLAR INDUSTRIAL PRODUCTS
100 N E ADAMS
PEORIA IL 61629-9310

DAVID ASBRIDGE
AGRI-BUSINESS ANALYSIS DEPT
AGRI-BUSINESS ANALYSIS DEPT
CF INDUSTRIES INC
ONE SALEM LAKE DR
LONG GROVE IL 60047-8401

TIM MINOR
DIRECTOR, STATE GOV RELATIONS
CF INDUSTRIES INC
ONE SALEM LAKE DR
LONG GROVE IL 60047

MARGARET VAN WISSINK
STATE GOVERNMENT RELATIONS
CF INDUSTRIES INC
ONE SALEM LAKE DR
LONG GROVE IL 60047-8402

INDUSTRIAL WASTE MANAGEMENT INC
2515 S WABASH AVE
CHICAGO IL 60616-2308

KIM LOGSDON
LOGSDON TUG SERVICE
400 1/2 W MAIN ST
BEARDSTOWN IL 62618

PRECAST/PRESTRESSED CONCRETE INSTITUTE
209 W JACKSON BLVD
CHICAGO IL 60606

GEORGE R LAMB
SHIPYARD TERMINAL & INDUSTRIAL PARK
520 SHIPYARD RD
SERVICE
SENECA IL 612360-921

WILLIAM LEWIS JR
AGRICULTURAL ECONOMIST
USDA NATURAL RESOURCES CONSERVATION

2118 W PARK CT
CHAMPAIGN IL 61821-2986

A & R TRANSPORT INC
2223 BUSH RD
JOLIET IL 60436-8557

ALL TRUCK TRANSPORTATION COMPANY
4924 S AUSTIN AVE
CHICAGO IL 60638-1412

AURORA FAST FREIGHT INC
1859 PLAIN AVE
AURORA IL 60505-3250

BECK TRUCKING COMPANY INC
1149 W GRAND AVE
CHICAGO IL 60622-5808

C & C TRUCKING COMPANY
300 MAPLE ST
JOLIET IL 60432-2545

C&K TRUCKING INC
6850 W 63RD ST
CHICAGO IL 60638-4026

CHICAGO FREIGHT SYSTEM INC
3333 W 36TH ST
CHICAGO IL 60632-2702

CITY WIDE WAREHOUSE & TRUCKING
3850 W CORTLAND ST
CHICAGO IL 60647-4636

CUSHING TRUCKING INC
3756 S CICERO AVE
CHICAGO IL 60650-4536

EWG TRUCKING CORP
12 E 112TH PL
CHICAGO IL 60628-4914

FARQUHAR TRUCKING COMPANY
2200 S LOOMIS ST
CHICAGO IL 60608-5007

FULLERTON MOTOR TRUCK SERVICE INC
181763 W 33RD PL
CHICAGO IL 60608

HOYT BROTHERS TRUCKING INC
1665 TERRY DR
JOLIET IL 60436-8542

J AND V TRUCKING INC
5308 W GRAND AVE
CHICAGO IL 60639-3010

J D GRIGGS TRUCKING COMPANY INC
4950 N ELSTON AVE
CHICAGO IL 60630-1730

JACK FREEMAN TRUCKING COMPANY
4948 S WESTERN BLVD
CHICAGO IL 60609-4742

JAYDEE TRUCK SERVICE INC
PO BOX 2302
PEORIA IL 61611-0302

JOHN RYAN TRUCKING INC
2704 W MELROSE ST
CHICAGO IL 60618-5908

JOMAR TRUCK LINES INC
13803 S SAGINAW AVE
CHICAGO IL 60633-2105

DAVE VAN HISE
LINCOLN FARM CORP
1314 E MARIETTA AVE
PEORIA IL 61614-6530

MC DOWELL TRUCKING COMPANY
4622 S BISHOP ST
CHICAGO IL 60609-3240

MELKAS TRUCKING INC
910 SAK DR
JOLIET IL 60435-2478

MILLER TRUCKING INC
8800 S FRANCISCO AVE
CHICAGO IL 60642-1248

NAGEL TRUCKING & MATERIALS
1043 PARAMOUNT PKWY
BATAVIA IL 60510-1454

PROSPERITY TRUCKING COMPANY
4654 W ERIE ST
CHICAGO IL 60644-1713

RELIANCE TRUCKING INC
PO BOX 803
MORRIS IL 60450-0803

SPIRIT TRUCKING COMPANY
5400 W 47TH ST
CHICAGO IL 60638-1807

STALL TRUCK AND EQUIPMENT INC
13735 S JEFFERY AVE
CHICAGO IL 60633-2343

STOKES TRUCKING
35W160 BUTTERFIELD RD
BATAVIA IL 60510-9338

SUNSHINE MOVERS TRUCK RENTAL INC
2309 N DAMEN AVE
CHICAGO IL 60647-3321

TEXS TRUCKING INC
PO BOX 8324
CHICAGO IL 60680-8324

THRIFT TRUCKING INC
4420 ENTEC DR
PEORIA IL 61607-2779

VANEK BROS TRUCKING COMPANY
3920 S LOOMIS ST
CHICAGO IL 60609-2401

W & D TRUCK LINES INC
6019 SO PERRY
CHICAGO IL 60621

WILLETT TRUCKING COMPANY LP
140 S DEARBORN ST STE 320
CHICAGO IL 60603-5202

ASSOC GEN CONTRACTORS OF IL
3219 EXECUTIVE PARK DR
SPRINGFIELD IL 62708

TOM CASSON
CASSON CONSTRUCTION
RR 5
JACKSONVILLE IL 62650-9805

KERRY RICE
ECONOMIC DEVELOPMENT BOARD
GP CONTRACTORS & SUPPLIERS ASSOC
1811 W ALTORFER DR
PEORIA IL 61615

RICHARD DAVIDSMEYER
BRANCH MANAGER
IL ROAD CONTRACTORS
HWY 104 W PO BOX 268
MEREDOSIA IL 62665

CHRISTOPHER KLUG
ILLINOIS VALLEY MARINE
720 LINCOLN CT
LA SALLE IL 61301

JOHN SIMPSON
JOHN D SIMPSON CONSTRUCTION CO
512 MACK ST
JOLIET IL 60435-5922

TROY LOGSDON
LOGSDON SAND & GRAVEL
PO BOX 319
BEARDSTOWN IL 62618-0319

GARY PRUDEN
PRUDEN CONSTRUCTION
PO BOX 167
MT STERLING IL 62353-1208

HOLLY FULTON
EAST PEORIA MARINA
701 MARINER WAY
EAST PEORIA IL 61611

FOUR STAR MARINA
BOX 249
OTTAWA IL 61350

R. SCOTT OWEN
GALENA MARINE
4817 N GALENA RD
PEORIA IL 61614-5432

KEVIN JUDD
HENNEPIN BOAT STORE
118 FRONT ST
HENNEPIN IL 61327

NICK NEKNOSIUS
IL VALLEY MARINE
748 7TH ST
LA SALLE IL 61301

MARINA CARTAGE INC
4450 MORGAN ST
CHICAGO IL 60609-3336

ROBERT T. KELLER
PRESIDENT
PEORIA HARBOR & FLEETING SERVICE
619 WESLEY RD
PEORIA IL 61611-3118

ROBERT MOONEY
OWNER
RAINBOW COVE MARINA
202 DISTRICT CT
EAST PEORIA IL 61611-1411

STARVED ROCK MARINA
PO BOX 2460
OTTAWA IL 61350

STARVED ROCK YACHT CLUB
DEE BENNETT RD
OTTAWA IL 61350

WHARF HARBOR MARINA
FOOT OF ALEXANDER
PEORIA IL 61603

JOHN J. SULKA, JR.
PRESIDENT
WHARF HARBOR SALES INC
FOOT OF ALEXANDER ST
PEORIA IL 61603

TERRY GUILINDRI
BOOKKEEPER
EAST PEORIA SANITARY DIST
802 E WASHINGTON ST
EAST PEORIA IL 61611

HOWARD HIGHT
SECRETARY-TREASURER
EAST PEORIA SANITARY DIST
802 E WASHINGTON ST
EAST PEORIA IL 61611

DAVE MC CARTY
SUPERINTENDENT
EAST PEORIA SANITARY DIST
802 E WASHINGTON ST
EAST PEORIA IL 61611

EMERY SARY
PRESIDENT-COMMISSIONER
EAST PEORIA SANITARY DIST
802 E WASHINGTON ST
EAST PEORIA IL 61611

DICK WILLIAMS
ATTORNEY
EAST PEORIA SANITARY DIST
802 E WASHINGTON ST
EAST PEORIA IL 61611

BOB LAWLESS
ECSYTM PTNSHP-VERMILION WTRSHD TASK
22855 E 1123 N RD
FAIRBURY IL 61739

PRESIDENT
FOX METRO WATER RECLAMATION DIST
682 Route 31
OSWEGO IL 60543-9417

GREGG BUCHNER
FOX METRO WATER RECLAMATION DISTRICT
682 STATE ROUTE 31
OSWEGO IL 60543-8500

STAN BROWNING
GREATER PEORIA SANITARY DISTRICT
2322 S DARST ST
PEORIA IL 61607

STEVE JURGENS
ECOSYSTEM PRTNRSHP-UPPER KASKASKIA
LAKE SHELBYVILLE WATERSHED MGMT. COMMITT
1102 W JACKSON
SULLIVAN IL 61951

MARK DRESSEL
METROPOLITAN WATER RECLAMATION DIST
100 E ERIE ST
CHICAGO IL 60611-2803

JACK FARNAN
GENERAL SUPERINTENDENT
DIST OF GREATER CHICAGO
METROPOLITAN WATER RECLAMATION DIST
100 E ERIE ST
CHICAGO IL 60611-2803

RONALD HILL
PRINCIPAL ASSISTANT ATTORNEY
DIST OF GREATER CHICAGO
METROPOLITAN WATER RECLAMATION DIST
100 E ERIE ST
CHICAGO IL 60611-2003

RICHARD LANYON
DIRECTOR
RESEARCH AND DEVELOPMENT
METROPOLITAN WATER RECLAMATION DIST
100 E ERIE ST
CHICAGO IL 60611

HUGH MC MILLAN
GENERAL SUPERINTENDENT
METROPOLITAN WATER RECLAMATION DIST
100 E ERIE ST
CHICAGO IL 60611

TERRENCE O'BRIEN
PRESIDENT
DIST OF GREATER CHICAGO
METROPOLITAN WATER RECLAMATION DIST
100 E ERIE ST
CHICAGO IL 60611

MICHAEL ROSENBERG
ATTORNEY
METROPOLITIAN WATER RECLAMATION DIST
111 E ERIE
CHICAGO IL 60441

DAVID RAMSAY
ECOSYSTEM PRTNRSHP-N BRNCH CHICAGO R
NORTH BRANCH WATERSHED PROJECT
407 S DEARBORN SUITE 1580
CHICAGO IL 60605

COMISSIONER-SECRETARY
RT 1 BOX 47
ARENZVILLE IL 62611

CHAIRPERSON
BD OF COMMISSIONERS
1906 MOUND AVE
JACKSONVILLE IL 62650

PRESIDENT
BOARD OF COMMISSIONERS
BROWN CO COURT HOUSE COURT ST
MT STERLING IL 62353

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CHAIRMAN-COMMISSIONER
TAYLOR GRAIN & LIVESTOCK FARM
CLEAR LAKE SPECIAL DRAINAGE DIST
19466 CHANDLERVILLE RD
VIRGINIA IL 62691-8670

CHESTER ESTHER JR
COMMISSIONER
COAL CREEK DRAINAGE & LEVEE DIST
RR2 BOX 186
BEARDSTOWN IL 62618

PRESIDENT-BD OF COMMISSIONERS
COON RUN DRAIN DIST
222 N PUTNAM
MEREDOSIA IL 62665

LELAND LITTIG
COON RUN DRAIN DIST
RT 1 BOX 174 D
MEREDOSIA IL 62655

ROBERT MEYER
COMMISSIONER
CRANE CREEK DR & LEVEE DIST
15 TAYLOR CT
BEARDSTOWN IL 62618

HOMER BRINEY
% MIKE MEYER CHAIRMAN
CRANE CREEK DRAINAGE & LEVEE DIST
515 W 8TH ST
BEARDSTOWN IL 62618

MIKE MEYER
CHAIRMAN-COMMISSIONER
CRANE CREEK DRAINAGE & LEVEE DIST
515 W 8TH ST
BEARDSTOWN IL 62618

JAMES BULL
CHAIRMAN-COMMISSIONER
EAST LIVERPOOL DRAINAGE & LEVEE DIST
21583 E US HWY 24
LEWISTOWN IL 61542

JOHN GRAHAM
COMMISSIONER
EAST PEORIA SANITARY DIST
802 E WASHINGTON ST
EAST PEORIA IL 61611

KENNETH EFFLAND
EFFLAND DRAINAGE & LEVEE DIST
RR1 BOX 86
AVON IL 61415

OAKLEIGH ADKINS JR
PRESIDENT-COMMISSIONER
FARMERS LEVEE & DRAINAGE DIST
RR 2 BOX 19
CHANDLERVILLE IL 62627

DAVID SANDIDIGE
HAGER SLOUGH DRAINAGE & LEVEE DIST
RR 1 BOX 27
BEARDSTOWN IL 62618

MARTY TURNER
CHAIRMAN-COMMISSIONER
HAGER SLOUGH DRAINAGE & LEVEE DIST
RR 1 BOX 27
BEARDSTOWN IL 62618

LANE WEISE
HAGER SLOUGH DRAINAGE & LEVEE DIST
RR 1 BOX 27
BEARDSTOWN IL 62618

MARTIN TURNER
CHAIRMAN
HAGER SLOUGH DRAINAGE AND LEVEE DIST
RR 1 BOX 27
BEARDSTOWN IL 62618

WILLIAM RICHTER
CHAIRMAN
HAGER SLOUGH SPECIAL DRAINAGE DIST
CLEAR LAKE RD RR1 BOX 82
BEARDSTOWN IL 62618

WILLIAM STEVENSON
CHAIRMAN
HENDERSON COUNTY DRAINAGE DIST NO 2
RR 1 BOX 15
GLADSTONE IL 61437

JOHN ROBB
COMMISSIONER
HENDERSON COUNTY DRAINAGE DIST NO 3
624 WOODLAND KNOLLS RD
METAMORA IL 61548-9429

GUDMUND JESSEN
CHAIRMAN-COMMISSIONER
HENNEPIN DRAINAGE & LEVEE DIST
WETLANDS
PO BOX 236
HENNEPIN IL 61327

ALBERT PYOTT
COMMISSIONER/PRESIDENT
HENNEPIN DRAINAGE AND LEVEE DIST (THE
INITIATIVE)
SUITE 1015 53 W JACKSON BLVD
CHICAGO IL 60604-3703

DUKE LYTER
CHAIRMAN
INDIAN GRAVE DRAINAGE DIST
RR 2 BOX 109
QUINCY IL 62301

DAVID SHAFFER
COMMISSIONER
INDIAN GRAVE DRAINAGE DIST
411 SHAFFER LN
URSA IL 62376

MIKE RAUSCH
KEACH DRAINAGE & LEVEE DIST
102 N WESTGATE AVE
JACKSONVILLE IL 62650

LYNN MASON
SOLE COMMISSIONER
KERTON VALLEY DRAINAGE & LEVEE DIST
4030 STONEYARD RD
HAVANA IL 62644

STEPHEN SPECKETER
CHAIRMAN-COMMISSIONER
LACEY DRAINAGE & LEVEE DIST
18214 QUIVER BEACH RD
HAVANA IL 61644

DONALD SPECKETER
COMMISSIONER
LACEY DRAINAGE & LEVEE DIST
620 E MAIN
HAVANA IL 62644

WARREN WOLF
CHAIRMAN-COMMISSIONER
LIVERPOOL DRAINAGE & LEVEE DIST
20544 E US RTE 24
LEWISTOWN IL 61542

EDWIN HOBROCK
CHAIRMAN-COMMISSIONER
LOST CREEK DRAINAGE & LEVEE DIST
9024 CHANDLERVILLE RD
BEARDSTOWN IL 62618

MARTY TURNER
COMMISSIONER
LOST CREEK DRAINAGE & LEVEE DIST
CHANDLERVILLE RD
BEARDSTOWN IL 62618

ROBERT TALBOTT
PRESIDENT-COMMISSIONER
MACKINAW RIVER LEVEE & DRAINAGE DIST
10413 SKY RANCH RD
MANITO IL 61546

JOSEPH POWLEY
PRESIDENT-COMMISSIONER
MASON & MENARD DRAINAGE & LEVEE DIST
26266 E COUNTY RD
EASTON IL 62633

LOREN WIESE
PRESIDENT
MC GEE CREEK DRAINAGE & LEVEE DIST
RR 1 BOX 82
VERSAILLES IL 62378

BRENT HOERR
COMMISSIONER
MO FARM BUREAU FED/MARION CO DRAINAGE DIST
7265 CO RD 336
PALMYRA MO 63461

MICK CLICH
SUPERINTENDENT
OTTAWA LEVEE & DRAINAGE DISTRICT
211 E MAIN ST
OTTAWA IL 61350

RICHARD WHITNEY
PEKIN & LAMARSH DRAINAGE & LEVEEE DIST
2406 N NEBRASKA
PEORIA IL 61604

WILLLIAM MUELLER
PRESIDENT-COMMISSIONER
SANITARY DIST OF BEARDSTOWN
114 W 17TH ST
BEARDSTOWN IL 62618

ROBERT TURK
COMMISSIONER
SEAHORN DRAINAGE & LEVEE DIST
BOX 108
TOPEKA IL 61567

DAVID SAGER
SPOON RIVER ECO-SYSTEM PARTNERSHIP
RR 1 BOX 5
SPEAR IL 61479

RICHARD SPANGLER
SPOON RIVER LEVEE VIST #1
26668 N RIVER BOTTOM RD
SMITHFIELD IL 61477

OWEN MILLER
SPOON RIVER RANCH & RODDIS D&L DIST
12012 E COUNTY HIGHWAY 14
LEWISTOWN IL 61542

RALPH GUENGERICH
CHAIRMAN-COMMISSIONER
SPRING LAKE DRAINAGE & LEVEE DIST
7360 SKY RANCH RD
MANITO IL 61546

STEVE THOMAS
COMMISSIONER
SPRING LAKE DRAINAGE & LEVEE DIST
6336 SKY RANCH RD
MANITO IL 61546

DIANNE BARNETT
UMIMRA
102 N WESTGATE
JACKSONVILLE IL 62650

NORMAN KORSMEYER
CHAIRMAN AND COMMISSIONER
VALLEY DR & LEVEE DIST
RR 2 BOX 146A
BEARDSTOWN IL 62618

LEW KORSMEYER
CHAIRMAN-COMMISSIONER
VALLEY DRAINAGE & LEVEE DIST
RR3 BOX 358
BEARDSTOWN IL 62618

W A MORRISON
VALLEY DRAINAGE & LEVEE DIST
RFD 1 BOX 290
BEARDSTOWN IL 62618

WAYNE NELSON
% DAVID PRATT
VILLAGE OF CHANDLERVILLE LEVEE DIST
PO BOX 205
CHANDLERVILLE IL 62627

KEN CAPPS
BEARDSTOWN SANITARY DIST
1016 W 6TH ST
BEARDSTOWN IL 62618

EARL JOHN CODERS
IL ASSOCIATION DRAINAGE DISTRICTS
27637 ARROW RD
DEER GROVE IL 61243

COULTER MASON
KERTAS VALLEY DRAINAGE DIST
RR 2
HAVANA IL 62644

RALPH PFISTER
EXEC DIR
SANITARY DISTRICT
PO BOX 27 305 RIVER ST
YORKVILLE IL 60560

BERNARD MC CANCE
FULTON CO SOIL & WATER CONSERVATION DIST
15381 N STATE HWY 100
LEWISTOWN IL 61542

HAVANA SERVICE CENTER
930 E LAUREL AVE
HAVANA IL 62644-6977

JIM GIGL
IROQUOIS COUNTY SWCD
1367 E 3200N RD
CHEBANSE IL 60922

KEN BLANCK
IROQUOIS RIVER 2020
BOX 164
CRESCENT CITY IL 60928

JOHN LAUBSCHER
IROQUOIS RIVER 2020
BOX 327
CISSNA PARK IL 60924

RICHARD RYAN
IROQUOIS RIVER 2020
2780 E TWP RD 121
SHELDON IL 60966

ALLEN CARLEY
IROQUOIS SOIL AND WATER
1991E 1630 N RD
WATSEKA IL 60970

THAD ESHLEMAN
IROQUOIS SWCD
1001 E GRANT ST STE A
WATSEKA IL 60970

JACKSONVILLE SERVICE CENTER
1904 W LAYFAYETTE AVE
JACKSONVILLE IL 62650-1011

RICH HOWELL
KANKAKEE CNTY SWCD
658 LARRY POWER RD
BOURBONNAIS IL 60914

DON LAMBERT
KANKAKEE RIVER CONSERVATION DIST
207 E RIVER ST
MOMENCE IL 60954-1609

LARRY KUCLINE
KANKAKEE SOIL AND WATER CONSERVATION SERVICE
5108 N 9000W RD
BONFIELD IL 60913

KENDALL COUNTY S&WCD
7775 A ROUTE 47
YORKVILLE IL 60560

CONSERVATION DISTRICT
LASALLE COUNTY SOIL & WATER
ROUTE 23 & DAYTON RD
OTTAWA IL 61350

LEWISTOWN SERVICE CENTER
15381 N STATE 100 HWY
LEWISTOWN IL 61542-9456

CHAIRMAN
MACON COUNTY S&WCD
4004 COLLEGE PARK RD
DECATUR IL 62521-6207

MARSHALL-PUTNAM COUNTY S&WCD
509 FRONT ST
HENRY IL 61537-1573

VAN BITNER
MASON CO SOIL & WATER CONSERVATION DIST
930 E LAUREL
HAVANA IL 62644

ERIC GOLDEN
MENDARD CO S&WCD
9521-2 W RR 3 BOX 16
PETERSBURG IL 62675

MORRIS SERVICE CENTER
3585 N STATE RT 47
MORRIS IL 60450-8245

MT STERLING SERVICE CENTER
511 E MAIN ST
MT STERLING IL 62353-1378

OTTAWA SERVICE CENTER
1691 N 31ST RD
OTTAWA IL 61350-9640

JENNIFER HAMMER
DIRECTOR OF WATERSHED PROTECTION
THE CONSERVATION FOUNDATION
10 S 404 KNOCH KNOLLS RD
NAPERVILLE IL 60565

TRACI GOLDIE
WILL COUNTY SWCD
1201 S GOUAR RD
NEW LENOX IL 60451

ROBERT BO WINDY
135 JUNEWAY DR
UTICA IL 61373

JENNIFER MAKASEAH
TRIBAL SECRETARY
ABSENTEE-SHAWNEEE TRIBE OF INDIANS OF OK
2025 S GORDON COOPER DIRVE
SHAWNEE OK 74801-9381

ART ASSOC OF JACKSONVILLE
331 W COLLEGE AVE PO BOX 213
JACKSONVILLE IL 62651

JOHN ROSS
CHIEF
UNITED KEETOOWAH BAND
CHEROKEE INDIANS OF OKLAHOMA
PO BOX 746
TAHLEQUAH OK 74465-0746

RICHARD L ALLEN
CHEROKEE NATION OF OKLAHOMA
PO BOX 948
TAHLEQUAH OK 74465

GARY WHITE DEER
DIRECTOR OF CULTURAL AFFAIRS
CHICKASAW NATION
PO BOX 1548
ADA OK 74820

TERRY D COLE
NAGPRA COORDINATOR
CHOCTAW NATION OF OKLAHOMA
PO DRAWER 1210 16TH & LOCUST ST
DURANT OK 74701

JOHN BARRETT
TRIBAL CHAIRPERSON
OKLAHOMA BUSINESS COMMITTEE
CITIZEN BAND POTAWATOMI INDIAN TRIBE
1601 S GORDON COOPER DR
SHAWNEE OK 74801

JEREMY FINCH
CULTURAL RESOURCES MANAGEMENT CONSUL
OF OKLAHOMA BUSINESS COMMITTEE
CITIZEN BAND POTAWATOMI INDIAN TRIBE
1601 S GORDON COOPER DR
SHAWNEE OK 74801

CHARLES CLARK
DIRECTOR OF NAGPRA
CITIZEN POTAWATOMI NATION
1601 GORDON COOPER DR
SHAWNEE OK 74801

LISA KRAFT
CULTURAL RESOURCES MGMT CONSULTANT
CITIZEN POTAWATOMI NATION
1901 S GORDON COOPER DR
SHAWNEE OK 74801

REBECCA WARE
ENVIRONMENTAL PROGRAM DIRECTOR
DELAWARE NATION OF OKLAHOMA
PO BOX 825
ANADARKO OK 73005
121

DR BRUCE OBERMEYER
EMPORIA STATE UNIV
DEPT OF SOC & ANTHROPOLOGY
DELAWARE TRIBE OF INDIANS
1200 COMMERCIAL BOX 4022 ROOSEVELT HALL RM

EMPORIA KS 66801

CURTIS ZUNIGA
CHIEF
DELAWARE TRIBE OF INDIANS
170 N BARBARA
BARTLESVILLE OK 74006-2746

KATHY MC COY
KAGPRA REPRESENTATIVE
EASTERN BAND OF CHEROKEE INDIANS
PO BOX 455
CHEROKEE NC 28719

GEORGE BUCK J CAPTAIN
CHIEF
EASTERN SHAWNEE TRIBE OF OKLAHOMA
MUSEUM
PO BOX 350
SENECA MO 64865

MIKE ALLOWAY
DIRECTOR
FOREST CO POTAWATOMI CULTURAL CTR &

PO BOX 340
CRANDON WI 54520

HAROLD "GUS" FRANK
CHAIRMAN
FOREST COUNTY POTAWATOMI EXE COUNCIL
PO BOX 340
CRANDON WI 54520

AL MILHAM
VICE-CHAIRMAN
FOREST COUNTY POTAWATOMI EXE COUNCIL
PO BOX 340
CRANDON WI 54520

HARTFORD SHEGONEE
CHAIRMAN
FOREST COUNTY POTAWATOMI EXE COUNCIL
RES
RR 1
CRANDON WI 54520

MARCUS GUTHRIE
ALT REPATRIATION REP & MUSEUM CURATO
GEORGE W BROWN JR OJIBWE MUSEUM & CULT

603 PEACE PIPE RD PO BOX 804
LAC DU FLAMBEAU WI 54814

CHARLES THURMOND
DEPUTY CHIEF
GEORGIA TRIBE OF EASTERN CHEROKEE
TEMBROOK RT 2
CLARKESVILLE GA 35023

GOVERNOR DUNCAN MANSION
4 DUNCAN PL
JACKSONVILLE IL 62650

KENNETH MESHIGUAD
CHAIRMAN
HANNAHVILLE INDIAN COMMUNITY COUNCIL
N14911 HANNAHVILLE B1 RD
WILSON MI 49896-9728

GEORGE LEWIS
TRIBAL PRESIDENT
HO-CHUNK NATION OF WI
PO BOX 667
BLACK RIVER FALLS WI 54615

TERRY CHIVIS
CHAIRMAN
HURON POTAWATOMI NATION
2221 1 1/2 MILE RD
FULTON MI 49052

LEON CAMPBELL
CHAIRMAN
IA OF KS-NB EXE COMMITTEE
RTE 1 BOX 58A
WHITE CLOUD KS 66094-9624

SUZETTE MCCORD-RODGERS
NATIVE AMERICAN HERITAGE MUSEUM
IA TRIBE OF KANSAS & NEBRASKA
RR1 BOX 152C
HIGHLAND KS 66035

JIM RHODD
NAGPRA REPRESENTATIVE
IA TRIBE OF KS AND NB
R 1 BOX 58 A
WHITE CLOUD KS 66094

DONALD L ROUBIDOUX
NAGPRA COORDINATOR
IA TRIBE OF NB AND KS
RTE 1 BOX 210
HIAWATHA KS 66434

LAWRENCE MURRAY
CHAIRMAN
IA TRIBE OF OKLAHOMA
RR1 PO BOX 721
PERKINS OK 74059

MARIANNE LONG
CULTURAL PRESERVATIONIST
IOWA TRIBE OF OKLAHOMA
RR 1 BOX 721
PERKINS OK 74059

JACKSONVILLE HERITAGE CULTURAL CENTER
200 W DOUGLAS
JACKSONVILLE IL 62650

JERRY JACKSON
JENA BAND OF CHOCTAW INDIANS
PO BOX 14
JENA LA 71342

JUNE FIXICO
TOWN KING
KIALEGEE TRIBAL TOWN OF CREEK NATION OK
PO BOX 332
WETUMKA OK 74883-0332

TRIBAL CHAIRPERSON
KICKAPOO OF KANSAS TRIBAL COUNCIL
ROUTE 1 BOX 157
HORTON KS 66349

CAROL ANSKE
CHAIRPERSON
KICKAPOO OF KANSAS TRIBAL COUNCIL
ROUTE 1 PO BOX 271
HORTON KS 66349

NANCY BEAR
CHAIR
KICKAPOO OF KANSAS TRIBAL COUNCIL
RTE 1 BOX 157
HORTON KS 66439

TRIBAL CHAIRPERSON
KICKAPOO OF OKLAHOMA BUS COUNCIL
BOX 70
MC CLOUD OK 74851

RICHARD SALAZAR
CHAIRMAN
KICKAPOO OF OKLAHOMA BUSINESS COUNCIL
PO BOX 70
MC CLOUD OK 74851

TRIBAL CHAIRPERSON
KICKAPOO TRADITIONAL TRIBE OF TEXAS
HC 1 PO BOX 9700
EAGLE PASS TX 78853

RAUL GARZA
CHAIRMAN
KICKAPOO TRADITIONAL TRIBE OF TEXAS
HC 1 BOX 9700
EAGLE PASS TX 78853

TRIBAL CHAIRPERSON
KICKAPOO TRIBE OF INDIANS OF THE KICKAPOO
PO BOX 270
HORTON KS 66439

CURTIS SIMON
NAGPRA DIRECTOR
KICKAPOO RESERVATION IN KANSAS
KICKAPOO TRIBE OF INDIANS OF THE KICKAPOO
PO BOX 270
HORTON KS 66439

EMERY NEGONSOTT
CHAIRMAN
KICKAPOO TRIBE OF KANSAS
PO BOX 271
HORTON KS 66439

KATHY SCHUETZ
DELEGATE
KICKAPOO TRIBE OF KANSAS
RR 1 BOX 225
HORTON KS 66439

FRED THOMAS
KICKAPOO TRIBE OF KANSAS
RR 1 BOX 157A
HORTON KS 66439

JANICE HOMESKY
REPARTIATION REPRESENTATIVE
LAKE SUPERIOR CHIPPEWA INDIANS
LAC COURTE OREILLE BAND
ROUTE 2 BOX 2700
HAYWARD WI 54543

ROXANNE BAIN
NAGPRA COORDINATOR
LAC VIEUX DESERT BAND
LAKE SUPERIOR CHIPPEWA INDIANS
PO BOX 249
WATERSMEET MI 49969

GEORGE BECK
TRIBAL HISTORIC PRESERVATION OFFICER
LAC VIEUX DESERT BAND
LAKE SUPERIOR CHIPPEWA INDIANS
PO BOX 249
WATERSMEET MI 49969

KELLY JACKSON
HISTORIC PRESERVATION OFFICER
WI INTER-TRIBAL REPATRIATION COM
LK SPR CHIPPEWA INDIANS-LAC DU FLAMBEAU
PO BOX 67
LAC DU FLAMBEAU WI 54538

JOSEPH GOODTHUNDER
PRESIDENT
LOWER SIOUX INDIAN COMMUNITY COUNCIL
PO BOX 308
MORTON MN 56270

CHAD WAUKECHON
CULTURAL PLANNER
MENOMINEE INDIAN TRIBE OF WISCONSIN
PO BOX 910
KESHENA WI 54135-0910

JULIE OLDS
CULTURAL PRESERVATION OFFICER
MIAMI TRIBE OF OKLAHOMA
PO BOX 1326
MIAMI OK 74355

TRAVIS R ANNETTE
SPECIAL PROJECTS COORDINATOR
MINNESOTA CHIPPEWA TRIBE
PO BOX 217
CASS LAKE MN 56633

JIM JONES
MINNESOTA INDIAN AFFAIRS COUNCIL
3801 BEMIDJI AVE N STE 5
BEMIDJI MN 56601-4236

KENNETH H CARLETON
TRIBAL ARCHAEOLOGIST
CHOCTAW BRANCH
MISSISSIPPI BAND OF CHOCTAW INDIANS
PO BOX 6005 - CHOCTAW BRANCH
PHILADELPHIA MN 39350

HONORABLE AUDREY KOHNEN
TRIBAL CHAIRMAN
PRAIRIE ISLAND INDIAN COMMUNITY
MN MDWAKANTON SIOUX
1158 ISLAND BLVD
WELCH MN 55089-9540

PERRY BEAVER
PRINCIPAL CHIEF
MUSCOGEECREEK NATION OF OKLAHOMA
PO BOX 580
OKMULGEE OK 74447

RON HARRIS JR
COMMITTEE MEMBER
SAC & FOX NATION OF OKLAHOMA
NAGRAPA CONTACT REPRESENTATIVE
ROUTE 2 BOX 246
STROUD OK 74079

DR CAROL CORNELIUS
HISTORIC PRESERVATION OFFICER
ONEIDA TRIBE OF INDIANS OF WISCONSIN
PO BOX 365
ONEIDA WI 54155

EVERETT M WALLER
NAGRPA REPRESENTATIVE
OSAGE NATION
813 GRANDVIEW AVE
PAWHUSKA OK 74056

MILDRED HUDSON
NAGPRA REPRESENTATIVE
OTOE-MISSOURIA TRIBE
8151 HWY 177
RED ROCK OK 74651

NAGPRA COORDINATOR
OTOE-MISSOURIA TRIBAL OFFICE
OTOE-MISSOURIA TRIBE OF OKLAHOMA
RT 1 BOX 62
RED ROCK OK 74651

BUD ELLIS
REPARTIATION/NAGPRA REPRESENTATIVE
PEORIA TRIBE OF INDIANS OF OKLAHOMA
118 S EIGHT TRIBES TRAIL PO BOX 1527
MIAMI OK 74355

JOHN MILLER
CHAIRMAN
POKAGON BAND OF POTAWATOMI INDIANS
PO BOX 180
DOWAGIAC MI 49047

JOSEPH B WINCHESTER
CHAIRMAN
POKAGON BAND OF POTAWATOMI INDIANS
53237 TOWN HALL RD
DOWAGIAC MI 49047

LUTHER WAHWASUCK
DELEGATE
PRAIRIE BAND OF POTAWATOMI
16281 Q RD PO BOX 97
MAYETTA KS 66509

ZACHARIAH PAHMAHMIE
TRIBAL CHAIRPERSON
NATIVE AMERICAN GRAVES PROTECTION
PRAIRIE BAND POTAWATOMI TRIBAL COUNCIL
16281 Q RD PO BOX 97
MAYETTA KS 66509

CURTUS CAMPBELL SR
PRESIDENT
PRAIRIE ISLAND COMMUNITY COUNCIL
1158 ISLAND BLVD
WELCH MN 55089

ROSE GURNOE
CHAIRMAN OF THE BOARD
RED CLIFF TRIBAL COUNCIL
RED CLIFF CHIPPEWA TRIBAL FUND
37960 BISHOP LN
BAYFIELD WI 54814

DEANNE BAHR
NAGPRA COORDINATOR
SAC & FOX NATION OF MO IN KS & NB
305 N MAIN
RESERVE KS 66434-9723

CURTIS GILFILLAN
SAC & FOX OF MISSOURI
305 N MAIN
RESERVE KS 66434

SANDRA KEO
DELEGATE
SAC & FOX OF MISSOURI
305 N MAIN RR 1 BOX 60
RESERVE KS 66434

JOAN REBAR
TRIBAL CHAIRPERSON
SAC & FOX OF MISSOURI
305 N MAIN
RESERVE KS 66434

YVONNE SCHEKAHOSE
SAC & FOX OF MISSOURI
RT 1 BOX 60
RESERVE KS 66434-9723

GAILEY WANATEE
ACTING CHIEF
SAC & FOX TRIBAL COUNCIL
349 MESKWAKI RD
TAMA IA 52339

HOMER BEAR JR
TRIBAL CHAIRPERSON
SAC & FOX TRIBE OF THE MISSISSIPPI IN IA
349 MESKWAKI RD
TAMA IA 52339-9629

CHAIRMAN JOHNATHAN BUFFALO
HISTORIC PRESERVATION OFFICER
SAC & FOX TRIBE OF THE MISSISSIPPI IN IA
349 MESKWAKI RD
TAMA IA 52339-9629

TALBERT DAVENPORT
SAC & FOX TRIBE OF THE MISSISSIPPI IN IA
349 MESKWAKI RD
TAMA IA 52339-9629

CHAR THOMPSON
SAC & FOX TRIBE OF THE MISSISSIPPI IN IA
349 MESKWAKI RD
TAMA IA 52339-9629

SANDRA MASSEY
NAGPRA COORDINATOR
CULTURAL RESOURCES
SAC AND FOX NATION
RT 2 BOX 246
STROUD OK 74079

KAY RHOADS
PRINCIPAL CHIEF
SAC AND FOX OF OK BUSINESS COUNCIL
RTE 2 BOX 246
STROUD OK 74079

TRIBAL CHAIRPERSON
SAC AND FOX OF OKLAHOMA BUSINESS COUNCIL
ROUTE 2 BOX 246
STROUD OK 74079

JERRY HANEY
PRINCIPAL CHIEF
SEMINOLE NATION OF OKLAHOMA
PO BOX 1498
WEWOKA OK 74884

JAMES BILLIE
CHAIRMAN
SEMINOLE TRIBE OF FLORDIA
6073 STIRLING RD
HOLLYWOOD FL 33024

STANLEY CROOKS
TRIBAL CHAIRPERSON
SHAKOPEE SIOUX COMMUNITY COUNCIL
2330 SIOUX TRAIL NW
PRIOR LAKE MN 55372

ROBERT VAN ZILE
REPARTIATION REPRESENTATIVE
SOKOAGON CHIPPEWA COMMUNITY MOLE LAKE INDIANS
3140 STATE HWY 55 RT1 BOX 625
CRANDON WI 54520

TED NELSON
TRIBAL HISTORIC PRESERVATION OFFICER
ST CROIX BAND OF LAKE SUPERIOR CHIPPEWA

PO BOX 287
HERTEL WI 54845

DOROTHY DAVIDS
REPATRIATION REPRESENTATIVE
OF MOHICAN INDIANS
CHIPPEWA INDIANS
STOCKBRIDGE-MUNSEE BAND
8476 MOKECONUCK RD
BOWLER WI 54416

SHARON LEMIEUX
THPO
THE BAD RIVER BAND OF LAKE SUPERIOR

PO BOX 39
ODANAH WI 54861

WILLIAM QUACKENBUSH
TRIBAL HISTORIC PRESERVATION OFFICER
THE HO-CHUNK NATION
PO BOX 667
BLACK RIVER FALLS WI 54615-0667

JOHN FROMAN
CHIEF
THE PEORIA TRIBE OF OKLAHOMA
PO BOX 1527
MIAMI OK 74355

LORRAINE CAVENDER-GOUGE
TRIBAL CHAIRPERSON
UPPER SIOUX TRIBE
PO BOX 147
GRANITE FALLS MN 56241

DAVID LEE SMITH
CULTURAL PRESERVATION OFFICER
WINNEBAGO TRIBE OF NB TRIBAL COUNCIL
PO BOX 687
WINNEBAGO NE 68071

STEPHEN PARRISH
ARCHAEOLOGICAL RESEARCH
1735 NORTH PAULINA ST SUITE 113
CHICAGO IL 60622

EDUCATIONAL SERVICE REGION
500 N RUSH ST
STOCKTON IL 61085-1033

JOE BYBEE
SOCIAL SCIENCE RESEARCH INSTITUTE
NORTHERN IL UNIVERSITY
DE KALB IL 60115

LAWRENCE CONRAD
ARCHEOLOGICAL RESEARCH LAB
WESTERN ILLINOIS UNVERSITY
201 TILLMAN HALL
MACOMB IL 61455

JAY GLATZ
435 E HIGH POINT LN
PEORIA IL 61614-3006

JOHN BLACKHAWK
TRIBAL CHAIRPERSON
WINNEBAGO TRIBAL COUNCIL
PO BOX 687
WINNEBAGO NE 68071

MONA ELK SHOULDER
DELEGATE
WINNEBAGO TRIBE OF NEBRASKA
PO BOX AE
SLOAN IA 51055

HENRY DRAWVE
DRAWVE NURSERY SCHOOL
900 W 6TH ST APT B13
BEARDSTOWN IL 62618-1460

DR KEVIN MC GOWAN
CHICAGOLAND OFFICE (UI-UC)
PUBLIC SERVICE ARCHAEOLOGY PRGM
PO BOX 7085
GRAYSLAKE IL 60030

FATHER ALLEN MATTINGLY
ST BEDE ACADEMY
RT 6
PERU IL 61354

RON FERGUSON
800 W MEADOWS PL
PEORIA IL 61604-3450

CHARLES WARTHEN
VICE PRESIDENT
BLACK HAWK EAST CAMPUS
1501 STATE HIGHWAY 78
KEWANEE IL 61443

BLUE ISLAND PUBLIC LIBRARY
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BLUE ISLAND IL 600406

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BRADLEY UNIVERSITY
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PEORIA IL 61625

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HEARTLAND WATER RESOURCE BOARD
BRADLEY UNIVERSITY
1501 W BRADLEY AVE
PEORIA IL 61625

DR SHARON M MURPHY
PROVOST & VP - ACADEMIC AFFAIRS
RIVERFRONT BUSINESS DIST COMM
BRADLEY UNIVERSITY
1501 W BRADLEY AVE #205
PEORIA IL 61625

ROBERT WEINSTEIN
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PEORIA IL 61625

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CARTHAGE IL 62321

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CHICAGO IL 60617

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CHICAGO STATE UNIVERSITY
9501 S KING DR
CHICAGO IL 60628-1598

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GOVERNORS STATE UNIVERSITY
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PARK FOREST IL 60466

THOMAS K THOMAS
ECONOMIC DEVELOPMENT BOARD
IL CENTRAL COLLEGE
ONE COLLEGE DR
EAST PEORIA IL 61635

PAUL ANDERSON
IL INSTITUTE OF TECHNOLOGY
10 W 33RD ST
CHICAGO IL 60616

IL STATE LIBRARY
300 S 2ND ST
SPRINGFIELD IL 62701

DR CHARLES ORSER
DIRECTOR
MIDWEWESTERN ARCHAEOLOGICAL RES CTR
IL STATE UNIV
111 EDWARDS HALL
NORMAL IL 61761-6901

MIDWEST ARCH RESEARCH CTR
IL STATE UNIVERSITY
MARC 4641
NORMAL IL 61761

ANGELO CAPPARELLA
DEPT OF BIOLOGICAL SCIENCES
IL STATE UNIVERSITY
NORMAL IL 61790-4120

DAVID PFEIFER
ILL RIVER COOR COUNCIL
PO BOX 9
ELSAH IL 62028-9799

JOHN THOMPSON
ILLINOIS MATH & SCIENCE COMMITTEE
1500 SULLIVAN RD
AURORA IL 60506

DR CHARLES ROHRBAUGH
MW ARCHEOLOGICAL RESEARCH CENTER
ILLINOIS STATE UNIVERSITY
EDWARDS HALL - 320 ROBERT DR
NORMAL IL 61761

JOLIET JUNIOR COLLEGE INFORMATION TDD
1216 HOUBOLT AVE
Joliet IL 60435

DIRECTOR
KENNEDY PARK LIBRARY
11320 S WESTERN AVE
CHICAGO IL 60655

ANNE GRAUER
LAKE SHORE CAMPUS
LOLOYA UNIVERSITY OF CHICAGO
6525 N SHERIDAN RD
CHICAGO IL 60626

DR RICHARD SPARKS
DIRECTOR OF RESEARCH
NATIONAL GREAT RIVERS RESEARCH AND EDUCATION CENTER
110 OLIN SCIENCE BLDG 5800 GODFREY RD
GODFREY IL 62035-2466

RACHELLE DAVIS
PRINCIPIA COLLEGE
1 MAYBECK PLACE
ELSAH IL 62028

LAURON WARBUY
PRINCIPIA COLLEGE
1 MAYBECK PLACE
ELSAH IL 62028

DIRECTOR
QUINCY UNIVERSITY-BRENNER LIBRARY
1800 COLLEGE AVE
QUINCY IL 62301

DR BRIAN BUTLER
SOUTHERN ILLINOIS UNIVERSITY
CENTER FOR ARCHAEOLOGICAL INVEST
CARBONDALE IL 61455

DR PHOEBE HELM
PRESIDENT
TRUMAN COLLEGE
1145 W WILSON AVE
CHICAGO IL 60640

DR ROBERT HALL
DEPT OF ANTHROPOLOGY
UNIV OF IL-CHICAGO BRANCH
601 S MORGAN ST
CHICAGO IL 60680

BOB FRAZEE
EAST PEORIA EXTENSION CENTER
UNIV OF ILLINOIS COOP EXTENSION SVC
727 SABRINA DR
EAST PEORIA IL 61611

DALE MC ELRATH
RESOURCE INVESTIGATION PROGRAM
UNIVERSITY OF IL - ANTHROPOLOGY DEPT
109 DAVENPORT HALL
URBANA IL 61801

DR PAUL KREISA
PUBLIC SERVICE ARCHAEOLOGY PROGRAM
UNIVERSITY OF IL - ANTHROPOLOGY PROGRAM
109 DAVENPORT HALL - 607 S MATTHEWS AVE
URBANA IL 61801

ROBERT EASTER
DEAN
COLLEGE OF AG CONSUMER & ENVIRON SCI
UNIVERSITY OF IL AT URBANA-CHAMPAIGN
122 MUMFORD HALL MC710 1301 W GREGORY DR
URBANA IL 61801-9015

PAM JACOBS
ECSYSTM PRTNRSHP-SINKHOLE PLAN AREA
UNIVERSITY OF IL COOPERATIVE EXT SERVICE
901 B ILLINOIS AVE
WATERLOO IL 62298-1140

DIRECTOR
WATER RESOURCES CENTER
UNIVERSITY OF ILLINOIS
1101 W PEABODY DR
URBANA IL 61801

DR JOHN BRADEN
DIRECTOR - WATER RESOURCES CENTER
278 ENVIRONMENTAL & AG SCIENCES BLDG
UNIVERSITY OF ILLINOIS
1101 W PEABODY DR
URBANA IL 61801

BRUCE HANNON
UNIVERSITY OF ILLINOIS
1208 W UNION ST
CHAMPAIGN IL 61821

DR THOMAS RILEY
ASSOCIATE DEAN - ANTHROPOLOGY
UNIVERSITY OF ILLINOIS
107 COBLE HALL 801 S WRIGHT
CHAMPAIGN IL 61820

DR WILLIAM SCHOWALTER
DEAN - COLLEGE OF ENGINEERING
UNIVERSITY OF ILLINOIS
1308 W GREEN ST MC 266
URBANA IL 61801

GERALD NEWTON
INST FOR REGL RURAL & COMM STUDIES
WESTERN ILLINOIS UNIV
1 UNIVERSITY CIR
MACOMB IL 61455

LEE ANN BRAMMEIER
WESTERN ILLINOIS UNIVERSITY
13587 N STATE 78 HWY
LEWISTOWN IL 61542-8721

SHAWN MEAGHER
BIOLOGICAL SCIENCE
WESTERN ILLINOIS UNIVERSITY
1 UNIVERSITY CIR
MACOMB IL 61455

DIRECTOR
BRADLEY UNIVERSITY LIBRARY REFERENCE
1511 W BRADLEY AVE
PEORIA IL 61606-1047

JOHN MENDELSON
PROFESSOR
ECYSTM PRTNRSHP-THRON CREEK MACROSIT
ENVIRONMENTAL BIOLOGY
GOVERNOR'S STATE UNIVERSITY
UNIVERSITY PARK IL 60466

DIRECTOR
ILLINOIS CENTRAL COLLEGE LIBRARY & AUDIO
#1 COLLEGE DR
EAST PEORIA IL 61635

ILLINOIS CENTRAL COLLEGE LIBRARY HEALTH
201 SW ADAMS ST
PEORIA IL 61602-1407

DAVE CATTRON
LIVING EDUCATION HISTORY MUSEUM
JOLIET JUNIOR COLLEGE
1216 HOUBOLT AVE
JOLIET IL 60436-9352

JIM SHINN
LIVING EDUCATION HISTORY MUSEUM
JOLIET JUNIOR COLLEGE
1216 HOUBOLT AVE
JOLIET IL 60436-9352

JOE MILOSEVICH
JOLIET JUNIOR COLLEGE
LAURA A SPRAGUE ART GALLERY
1216 HOUBOLT AVE
JOLIET IL 60436-9352

SUE MERCHANT
ECSYSTM PRTNRSHP-SUGAR PECATONICA RV
NATURAL LAND INSTITUTE
320 S THRID ST
ROCKFORD IL 61104

NEWS DIRECTOR
UNIVERSITY OF ILLINOIS SPRINGFIELD
WUIS
STATE HOUSE PRESS ROOM
SPRINGFIELD IL 62706

DIRECTOR
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810 N DEARBORN ST
CHICAGO IL 60610-3317

DIRECTOR
ANTONIA SPITZER JEWISH LIBRARY
6331 N CALIFORNIA AVE
CHICAGO IL 60659-1701

DIRECTOR
ASHER LIBRARY OF SPERTUS COLLE
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CHICAGO IL 60605-1900

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AURORA IL 60505

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BELLEVILLE IL 62220

DIRECTOR
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205 E OLIVE ST PO BOX 3308
BLOOMINGTON IL 61702

DIRECTOR
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7840 W 79TH ST
BRIDGEVIEW IL 60455-1496

DIRECTOR
CHRISTIAN CNTY HIST MUSEUM
C/O TAYLORVILLE PUBLIC LIBRARY
PO BOX 28
TAYLORVILLE IL 62568

DIRECTOR
CAIRO PUBLIC LIBRARY
1609 WASHINGTON AVE PO BOX 151
CAIRO IL 62914

DIRECTOR
COLLEGE OF ST FRANCIS LIBRARY
500 WILCOX ST
JOLIET IL 60435-6169

DIRECTOR
DECATUR PUBLIC LIBRARY
247 E N ST
DECATUR IL 62523

DIRECTOR
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140 E WASHINGTON ST
EAST PEORIA IL 61611-2526

DIRECTOR
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GALESBURG IL 61401-4515

DIRECTOR
HAROLD WASHINGTON LIBRARY CENTER
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DIRECTOR
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201 W ADAMS ST
HAVANA IL 62644-1321

DIRECTOR
HENDERSON COUNTY PUBLIC LIBRARY DISTRICT
110 HILL CREST DR
BIGGSVILLE IL 61418-1418

DIRECTOR
HENRY PUBLIC LIBRARY
328 EDWARD ST
HENRY IL 61537

DIRECTOR
ILLINOIS VALLEY LIBRARY SYSTEM
600 HIGH POINT LN STE 2
EAST PEORIA IL 61611-9397

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JACKSONVILLE PUBLIC LIBRARY
201 W COLLEGE
JACKSONVILLE IL 62650-2497

DIRECTOR
JERSEYVILLE PUBLIC LIBRARY
105 N LIBERTY ST
JERSEYVILLE IL 62052-1512

DIRECTOR
JOLIET PUBLIC LIBRARY
3395 BLACK RD
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DIRECTOR
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201 E MERCHANT ST
KANKAKEE IL 60901-3864

DIRECTOR
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LACON PUBLIC LIBRARY
205 6TH ST
LACON IL 61540-1244

DIRECTOR
LEWISTOWN CARNEGIE LIBRARY
321 W LINCOLN AVE
LEWISTOWN IL 61542-1304

DIRECTOR
LINCOLN PUBLIC LIBRARY
326 S SEVENTH ST
SPRINGFIELD IL 62701-1621

DIRECTOR
MACOMB PUBLIC LIBRARY DISTRICT
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MACOMB IL 61455-2231

DIRECTOR
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15 PARK AVE W
PRINCETON IL 61356

DIRECTOR
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604 LIBERTY ST
MORRIS IL 60450

DIRECTOR
MOUNT STERLING PUBLIC LIBRARY
143 W MAIN ST
MOUNT STERLING IL 62353

DIRECTOR
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NAPERVILLE IL 60540

DIRECTOR
NORMAL PUBLIC LIBRARY
206 W COLLEGE AVE
NORMAL IL 61761

DIRECTOR
OGLESBY PUBLIC LIBRARY
128 W WALNUT ST
OGLESBY IL 61348

DIRECTOR
OSWEGO PUBLIC LIBRARY
32 W JEFFERSON ST
OSWEGO IL 60543

DIRECTOR
PEORIA HEIGHTS PUBLIC LIBRARY
816 E GLEN AVE
PEORIA IL 61614-5206

DIRECTOR
PEORIA PUBLIC LIBRARY
107 NE MONROE ST
PEORIA IL 61602-1021

DIRECTOR
PERU PUBLIC LIBRARY
1409 11TH ST
PERU IL 61354

DIRECTOR
PONTIAC PUBLIC LIBRARY
211 E MADISON ST
PONTIAC IL 61764-2088

DIRECTOR
REDDICK PUBLIC LIBRARY
1010 CANAL ST
OTTAWA IL 61350

DIRECTOR
SENECA PUBLIC LIBRARY
210 N MAIN ST
SENECA IL 61360

DIRECTOR
SPRING BAY LIBRARY
406 ILLINOIS ST
EAST PEORIA IL 61611-4213

DIRECTOR
SPRING VALLEY PUBLIC LIBRARY
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SPRING VALLEY IL 61362

DIRECTOR
STREATOR PUBLIC LIBRARY
130 S PARK ST
STREATOR IL 61364

DIRECTOR
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MILL & GROVE STS PO BOX 367
UTICA IL 61373-0367

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200 N MAIN ST
VIRGINIA IL 62691

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201 S 4TH ST
WATSEKA IL 60970

DIRECTOR
WAUBONSEE COMMUNITY COLLEGE LIBRARY
RT 47 WAUBONSEE DR
SUGAR GROVE IL 60554

DIRECTOR
WESTERN ILLINOIS LIBRARY SYSTEM
1518 S HENDERSON ST
GALESBURG IL 61401-5708

DIRECTOR
YORKVILLE PUBLIC LIBRARY
902 Game Farm Rd
Yorkville IL 60560-1135

SCIENCE DEPARTMENT CHAIR
BATAVIA HIGH SCHOOL
1200 W. WILSON ST
BATAVIA IL 60510

SCIENCE DEPARTMENT CHAIR
EAST AURORA HIGH SCHOOL
500 Tomcat Lane
AURORA IL 60505

STEVE INMAN
KANKAKEE VALLEY HIGH SCHOOL
1200 W JEFFERY ST
KANKAKEE IL 60901

SCIENCE DEPARTMENT CHAIR
OSWEGO SENIOR HIGH SCHOOL
4250 RT 71
OSWEGO IL 60543

ROBERT KASSEL
PRINCIPAL
ST JOHN LUTHERAN SCHOOL
220 E 6TH ST
BEARDSTOWN IL 62618-1868

SCIENCE DEPARTMENT CHAIR
WAUBONSIE VALLEY HIGH SCHOOL
2590 OGDEN AVE
AURORA IL 60504

SCIENCE DEPARTMETN CHAIR
WEST AURORA HIGH SCHOOL
1201 W NEW YORK
AURORA IL 60506

TOM JOBST
ADMINISTRATIVE ASSISTANT
OTTAWA TWP HIGH SCHOOL
211 E MAIN ST PO BOX 792
OTTAWA IL 61350

DIRECTOR
RUTLAND PUBLIC LIBRARY
RUTLAND IL 61358

RICK MILLER
12526 N 2700 E RD
FORREST IL 61741

TIM SULLIVAN
RR 4 41
RUSHVILLE IL 62681

INGRID WEST
32400 N HARRIS RD
GRAYSLAKE IL 60040

KEVIN WILLIAMS
CHAIR
24309 WILLIAMSON LANE
CANTON IL 61520

DIRECTOR
ALLIANCE LIBRARY SYSTEM
600 HIGH POINT LN
EAST PEORIA IL 61611-9396

BUD GANN
IL STATE GOV COORDINATOR
AMER SOC OF MECHANICAL ENGRS
3423 CHRISTINE DR
DECATUR IL 62526

DAVID KEENE
ARCHAEOLOGICAL RESEARCH INC
1735 NORTH PAULINA ST SUITE 113
CHICAGO IL 60622

PATRICK AND DANA LEWIS
AREA RIVER CLEANUP
526 E ERIE
SPRING VALLEY IL 61362

IRENE MONDHINK
AUDUBON
1830 MC CLUSKY RD
JERSEYVILLE IL 62052

TOM WALL
PRESIDENT
BETTER FISHING ASSN
1212 PEORIA ST
PERU IL 61354

JOHN KELLA
PRESIDENT
CATHEDRAL AREA PRESERVATION ASSOC
PO BOX 3662
JOLIET IL 60434-3662

ZURICH EXPOSITO
CHICAGO ARCHITECTURE FDN
224 S MICHIGAN AVE
CHICAGO IL 60604-2507

JIM S RERMON
CHILDRENS HOME
2130 N KNOXVILLE
PEORIA IL 61603

DAN LOBBES
VOLUNTEER
CONSERVATION FOUNDATION
10 S 404 KNOCH KNOLLS RD
NAPERVILLE IL 60565

BILL MEYER
GAR ANGLERS' SPORTING SOCIETY
620 ROOT ST
NEW LENOX IL 60451

PASHION GAWORSKI
ASSISTANT DIRECTOR
HEARTLAND WATER RESOURCES COUNCIL
416 MAIN ST STE 828
PEORIA IL 61602-1116

THOMAS TINCHER
EXECUTIVE DIRECTOR
HEARTLAND WATER RESOURCES COUNCIL
416 MAIN ST STE 828
PEORIA IL 61612

I V Y CLUB
5102 N GALENA RD
PEORIA HGHTS IL 61614

ELEANOR ZIMMERLEIN
IL AGRI- WOMEN
1518 BASELINE RD
LA MOILLE IL 61330-9257

HELEN WUESTERNFELD
IL AUDOBON SOC
34 OAKWOOD PL
JERSEYVILLE IL 62052

R BRYON WALTERS
IL NATURAL AREAS IMPROVEMENT
130 N2803RD RD
UTICA IL 61373

F JOHN TAYLOR
IL VALLEY FLOOD CONTROL ASSOCIATION
RR 2 BOX 152
VIRGINIA IL 62691

ILLINOIS RIVER REFUGES
19031 E COUNTY RD 2105N
HAVANA IL 62644

BECKY KEENE
JAYCEES
PO BOX 123
OTTAWA IL 61350

DENNIS HESS
KANKAKEE COUNTY CONV & VISITORS
864 ASH DR
ST ANNE IL 60964

RAY ENGLISH
KANKAKEE VALLEY BOAT CLUB
1LAWRENCE DR
KANKAKEE IL 60901

DAVID BAHLMAN
LANDMARKS PRES COUNCIL OF IL
53 W JACKSON STE 752
CHICAGO IL 60604

DARLENE J BRUCE
NATURAL RESOURCES CHAIRPERSON
GREENWAYS BOARD
LEAGUE OF WOMEN VOTERS
505 W CRESTWOOD DR
PEORIA IL 61614

CHERYL BUDZINSKI
LEAGUE OF WOMEN VOTERS
623 W STRATFORD DR
PEORIA IL 61614

MARY JANE CROWELL
GREENWAYS BOARD
LEAGUE OF WOMEN VOTERS
1630 N E GLEN OAK
PEORIA IL 61603

BETTE JOHNSON
GREENWAYS BOARD
LEAGUE OF WOMEN VOTERS
3300N ATLANTIC AVE
PEORIA IL 61603

JEAN SANGER
LEAGUE OF WOMEN VOTERS
3205 W BROOKSIDE D
PEORIA IL 61615

AL WYLLE
GREENWAYS BOARD
LEAGUE OF WOMEN VOTERS
2615 W NEBRASKA
PEORIA IL 61604

FRANKLIN JASIEK
LVR WATERSHED
462 N 2929TH RD
LA SALLE IL 61301

JIM GILLES
MIDWEST FOUNDATION
PO BOX 1207
TREMONT IL 61568

JOHN GILLESPIE
MIGRATORY WATERFOWL HUNTERS
PO BOX 8009
ALTON IL 62002

HAROLD PETERS
MIGRATORY WATERFOWL HUNTERS
1308 SEMINARY ST
ALTON IL 62002

GEORGE MURPHY
BRANCH MANAGER
MADD
MOTHERS AGAINST DRUNK DRIVING
1659 S MAIN ST
JACKSONVILLE IL 62650-3408

NATURE OF IL FOUNDATION
208 S LADALLE ST STE 1666
CHICAGO IL 60604-1003

ALICE ANDERSON
NIAA
20 DENNISON
BOURBONNAIS IL 60914

CHANNY LYONS
PEORIA ART GUILD
5856 N PROSPECT RD
PEORIA IL 61614

ALLEY RINGHAUSEN
PIASA CREEK WATERSHED PARTNERSHIP
PO BOX 821
ALTON IL 62002

POLISH NATIONAL ALLIANCE YOUTH CAMP
10701 RIVER RD
YORKVILLE IL 60560

DAVID KING
PRAIRIE HILLS RC&D
321 UNIVERSITY DR
MACOMB IL 61455

JEROME JACOBSEN
SAVE OLD SPRINGFIELD
2617 CLIFTON DR
SPRINGFIELD IL 62704

AARON ROSINSKI
SE ENVIRONMENTAL TASK FORCE
10100 S EWING AVE
CHICAGO IL 60617

MARY JO HETRICK
SPRING VALLEY PRIDE
215 N GREENWOOD ST
SPRING VALLEY IL 61362

TOM MILLER
TREES FOREVER
416 W CLYBOURN CT
PEORIA IL 61614

JAMES ELLIOTT
TWO RIVERS RESOURCES CONSERVATION & DEVELOPMENT
DEVELOPMENT
PO BOX 184
LIBERTY IL 62347-0184

MARTHA SHEPPARD
TWO RIVERS RESOURCES CONSERVATION &

110 E FAYETTE ST
PITTSFIELD IL 62363

TED STAKER
UMIMRA
27000 QUEENWOOD RD
MORTON IL 61550

RITA RENWICK
CHAIRWOMAN
UNIVERSITY OF ILLINOIS
1508 W ACRES RD
JOLIET IL 60435

LYDIA SCOTT
PRESIDENT
VILLAGE OF LINCOLNSHIRE
ONE OLDE HALF DAY RD
LINCOLNSHIRE IL 60069-3035

BOB NELSON
WESTERN ILLINOIS SPORTSMAN FOR DUCKS
694 E LOSEY
GALESBURG IL 61401

MRS WILLIAM C LIMACHER
WILL-JOLIET BICENTENNIAL PARK
201 W JEFFERSON ST
JOLIET IL 60435

MIKE CHRISMAN
WLPO
138 5TH ST
LA SALLE IL 61301

HOMEOWNERS ASSOCIATION
ALTA AREA ASSOC
P O BOX 9403
PEORIA IL 61612

NANCY LAWLESS
HOMEOWNERS ASSOCIATION
CENTER BLUFF NEIGHBORHOOD ASSOC
415 W MELBOURNE AVE
PEORIA IL 61604

LES KENYON
HOMEOWNERS ASSOCIATION
CENTRAL IL LANDMARKS FOUNDATION
PO BOX 495
PEORIA IL 61651

WAYNE NOWLAN
HOMEOWNERS ASSOCIATION
COLUMBIA TERRACE NEIGHBORHOOD ASSOC
1317 N MACHIN AVE
PEORIA IL 61606

BETTY FAGAN
HOMEOWNERS ASSOCIATION
COMMON PLACE NEIGHBORHOOD
514 S SHELLEY ST
PEORIA IL 61605

JANE GOLDSTEIN
HOMEOWNERS ASSOCIATION
CRAB ORCHARD HOMEOWNERS ASSOC
8106 CRAB ORCHARD CT
PEORIA IL 61614

JOHN AMDALL
HOMEOWNERS ASSOCIATION
DEERBROOK ESTATE HOMEOWNERS
11119 N ANTLER PLACE
PEORIA IL 61515

LAVONNE SCHLEETER
HOMEOWNERS ASSOCIATION
EDGEWILD HOMEOWNERS ASSOC
135 W COVENTRY LANE
PEORIA IL 61614

WILLIAM O'BRIEN
HOMEOWNERS ASSOCIATION
FORREST HILL HOMEOWNERS ASSOC
3321 N CHESTNUT LANE
PEORIA IL 61604

STEVEN BISHOP
HOMEOWNERS ASSOCIATION
GLENCREST HOMEOWNERS ASSOC
325 W IVY LANE
PEORIA IL 61614

MARK GUY
HOMEOWNERS ASSOCIATION
GRACE-BIGELOW NEIGHBORHOOD WATCH
605 W FLORENCE
PEORIA IL 61604

WILLIAM GRAMLEY
HOMEOWNERS ASSOCIATION
HARVARD AREA HOMEOWNERS ASSOC
4000 N HARVARD AVE
PEORIA IL 61614

MIKE HAMMER
HOMEOWNERS ASSOCIATION
HARVARD AREA HOMEOWNERS ASSOC
3803 N HARVARD AVE
PEORIA IL 61614

DAN LOSBY
HOMEOWNERS ASSOCIATION
HAWLEY HILLS HOMEOWNERS ASSOC
203 W LINDY LANE
PEORIA IL 61614

KELLY MC KINNEY
HOMEOWNERS ASSOCIATION
HAWTHORNE HILLS/TANGLEWOOD ASSOC
1501 W BUCKINGHAM DR
PEORIA IL 61614

RICHARD LENZ
HOMEOWNERS ASSOCIATION
134 N E ROCK ISLAND AVE
PEORIA IL 61603

GLORIA LURIE
HOMEOWNERS ASSOCIATION
605 E ARMSTRONG AVE
PEORIA IL 61603

RICHARD AND MARY BARTHEL
HOMEOWNERS ASSOCIATION
IDYLBROOK HOMEOWNERS ASSOC
6501 N GREENMONT RD
PEORIA IL 61614

MILDRED BRYANT
ILLINOIS RIVER VALLEY RESIDENTS
3120 N CALIFORNIA
PEORIA IL 61603

CARL HENDRICKSEN
HOMEOWNERS ASSOCIATION
KNOLLCREST HOMEOWNERS ASSOC
4013 N N ST
PEORIA IL 61614

PATRICK GALLAGHER
HOMEOWNERS ASSOCIATION
KNOLLS HOMEOWNERS ASSOC
309 W WESTWOOD DR
PEORIA IL 61614

JAMES BROWN
LAKE MATANZA HOMEOWNERS ASSOC
12528 N SR78
HAVANA IL 62644

DR ROBERT STIENAUER
LAKE MATANZA HOMEOWNERS ASSOC
312 W MAIN ST
HAVANA IL 62644

MAX SALMON
HOMEOWNERS ASSOCIATION
LAKE PARK HOMEOWNERS ASSOC
4526 DAWN DR
PEORIA IL 61614

JULIE WOZNIAK
CORPORATE EH & S GROUP
MIDWEST GENERATION
440 S LA SALLE ST STE 3500
CHICAGO IL 60605

MARY MATHEWS
HOMEOWNERS ASSOCIATION
MOSS-BRADLEY RESIDENTIAL ASSOC
1536 W MOSS AVE
PEORIA IL 61606

CINDY MC LEAN
HOMEOWNERS ASSOCIATION
MOSS-BRADLEY RESIDENTIAL ASSOC
1714 W MOSS AVE
PEORIA IL 61606

DAVID WENTWORTH II
HOMEOWNERS ASSOCIATION
MOSS-BRADLEY RESIDENTIAL ASSOC
1528 W MOSS AVE
PEORIA IL 61606

ALLEN KOHTZ
HOMEOWNERS ASSOCIATION
NEAR NORTHSIDE IMPROVEMENT ASSOC
122 N E ROCK ISLAND AVE
PEORIA IL 61603

TAMARA WHITE
HOMEOWNERS ASSOCIATION
NORTH CENTER BLUFF NEIGHBORHOOD
517 W RICHWOODS BLVD
PEORIA IL 61604

BARBARA HUNZIKER
HOMEOWNERS ASSOCIATION
NORTH PROSPECT AREA NEIGHBORHOOD
5513 MONTCLAIR AVE
PEORIA IL 61614

GENE PACYGA
HOMEOWNERS ASSOCIATION
NORTH STERLING HOMEOWNERS ASSOC
3637 W WILLOW KNOLLS CT
PEORIA IL 61603

JEFF KOLBUS
HOMEOWNERS ASSOCIATION
NORTHGATE PARK WEST HOMEOWNERS
7084 N AYCLIFFE DR
PEORIA IL 61614

BILL RYAN
HOMEOWNERS ASSOCIATION
NORTHMOOR HILLS HOMEOWNERS ASSOC
5924 N TRENTON LANE
PEORIA IL 61614

RONALD HINTON
HOMEOWNERS ASSOCIATION
NORTHMOOR KNOLLS HOMEOWNERS
6216 N KNOLL AIRE DR
PEORIA IL 61614

EDWARD NELSON
HOMEOWNERS ASSOCIATION
NORTHSIDE IMPROVEMENT ASSOC
4014 N NEW YORK AVE
PEORIA IL 61614

DAVID SAGER
HOMEOWNERS ASSOCIATION
OAK PARK HOMEOWNERS ASSOC
120 OAK PARK DR
PEORIA IL 61614

FRANK LEWIS
HOMEOWNERS ASSOCIATION
OLDE TOWNE NORTH HOMEOWNERS
712 EVONS
PEORIA IL 61603

GEORGE WISE
HOMEOWNERS ASSOCIATION
OLDE TOWNE NORTH HOMEOWNERS
504 VORIS ST
PEORIA IL 61603

BERNADINE FISHER
HOMEOWNERS ASSOCIATION
PARKVIEW NEIGHBORHOOD ASSOC
2402 N GALE AVENEUE
PEORIA IL 61604

ROBERT CAUGHEY
HOMEOWNERS ASSOCIATION
PARKWOOD HOMEOWNERS ASSOC
6811 N BOBOLINK RD
PEORIA IL 61614

MARCELLA TEPLITZ
HOMEOWNERS ASSOCIATION
RANDOLPH-ROANOKE HOMEOWNERS
240 N E RANDOLPH AVE
PEORIA IL 61606

LARRY SAVRE
HOMEOWNERS ASSOCIATION
RICHWOODS KNOLLS HOMEOWNERS
1913 W RIVIERA DR
PEORIA IL 61614

BETH SLEVIN
HOMEOWNERS ASSOCIATION
RIDGE ROAD ASSOC
911 W RIDGE
PEORIA IL 61614

RICHARD VAN NORMAN
HOMEOWNERS ASSOCIATION
SHERWOOD FORREST HOMEOWNERS
2723 W HUNTINGTON DR
PEORIA IL 61614

JOAN MONROE
HOMEOWNERS ASSOCIATION
STRATFORD AIRE HOMEOWNERS
820 STRATFORD DR
PEORIA IL 61614

HOMEOWNERS ASSOCIATION
TIMBEREDGE HOMEOWNERS ASSOC
5853 N OLD HICKORY LANE
PEORIA IL 61615

ROGER LUMAN
HOMEOWNERS ASSOCIATION
TIMBERIDGE II HOMEOWNERS ASSOC
501 E PROSPECT LN
PEORIA IL 61614-4320

JACK H SHEPLER
FRIENDS OF IL RIVERS
TRI COUNTY RIVERFRONT ACTION FORUM
1700 ST CLAIR DR
PEKIN IL 61554

THOMAS HOHN
HOMEOWNERS ASSOCIATION
UPLANDS RESIDENTIAL ASSOC
1600 W COLUMBIA TERRACE
PEORIA IL 61606

JANICE JACKSON
HOMEOWNERS ASSOCIATION
VINTON-HIGHLANDS HOMEOWNERS
3713 W VERNER DR
PEORIA IL 61615

JOHN MEEK
HOMEOWNERS ASSOCIATION
WARDCLIFFE HOMEOWNERS ASSOC
211 CROSSOVER RD
LACON IL 61540-8855

PETER DUSENBERY
HOMEOWNERS ASSOCIATION
WEST BLUFF NEIGHBORHOOD HOUSE
921 N MAPLEWOOD AVE
PEORIA IL 61606

GEORGE VOORHEES
HOMEOWNERS ASSOCIATION
WEST PARK KNOLLS HOMEOWNERS
5109 N DAWN
PEORIA IL 61614

GREGG MEHAWICH
HOMEOWNERS ASSOCIATION
WILLIAMSBURG HOMEOWNERS ASSOC
6311 JAMESTOWN RD
PEORIA IL 61615

JIM GRAVES
HOMEOWNERS ASSOCIATION
WILLOW KNOLLS HOMEOWNERS
6700 N COTTONWOOD CT
PEORIA IL 61614

HOMEOWNERS ASSOCIATION
WILLOW RIDGE TOWNHOUSE ASSOC
210 LIBERTY ST
PEORIA IL 61602

CHARITY MONROE
HOMEOWNERS ASSOCIATION
WIND CHIME CONDOMINIUM ASSOC
7102 N WIND CHIME CT
PEORIA IL 61614

P E W ROBERT IVARSON
PRACTICE DIRECTOR
WATER RESOURCES
ARCHITECTS ENGINEERS PLANNERS
111 N CANAL ST STE 1250
CHICAGO IL 60606-7252

DEBRA ROE
CHRISTOPHER B BURKE ENGINEERING
202 NE MADISON
PEORIA IL 61602

KAREN DVORSKY
CLARK ENGINEERS INC
11 NE JEFFERSON AVE
PEORIA IL 61602

ELDON AND KAREN HAGEMAN
CHAIRMAN
CROW CREEK WATER SHED
1158 CNTY RD 1300 E
HENRY IL 61537

JAMIE ZELLERS
SECRETARY
MATANZA LAKE ASSOC
12646 SR 78
HAVANA IL 62644

TERRY JOHNSON
AMERICAN RIVERS
ALLIANCE TO RESTORE THE KANKAKEE RIVER
154 E COURT ST
KANKAKEE IL 60901

MAURY BRUCKA
AUDUBON SOCIETY
6606 N ALLEN #92
PEORIA IL 61614

ENIKO YANG
AUDUBON SOCIETY
6606 N ALLEN RD #92
PEORIA IL 61614

SYLVESTER KASTIGAR
PRESIDENT
BETTER FISHING ASSN OF NORTHERN IL
BOX 46
SEATONVILLE IL 61359

DICK BLYTHE
CHAIRMAN
IN GRAND KANKAKEE MARSH REST PROJ
BLYTHE'S SPORT SHOPE INC
138 N BROAD ST
GRIFFITH IN 46319

N PARK VILLAGE
CHICAGO AUDUBON SOCIETY
5801-C N PULASKI
CHICAGO IL 60646

JULIE SMENTEK
ECOSYSTEM PRTNRSHP
CHICAGO WILDERNESS
8 S MICHIGAN #900
CHICAGO IL 60603

TOM BUNOSKY
CONSUMERS IL WATER
1000 S SCHUYLER
KANKAKEE IL 60901

GARY MECHANIC
ECOSYSTEM PRTNRSHP-LOWER DES PLAINES
DES PLAINES RIVER WATERSHED ALLIANCE
4905 N HAMLIN
CHICAGO IL 60625

HERBERT ALLEN JR
DUCKS UNLIMITED
20458 TIMBERLAND ESTATES LN
CARLINVILLE IL 62626

ERIC SCHENCK
DUCKS UNLIMITED INC
229 N 3RD AVE STE B
CANTON IL 61520

LARRY HASHEIDER
ECOSYSTEM PARTNERSHIP
6067 HERON RD
OKAWVILLE IL 62271

BRUCE OLSON
ECOSYSTEM PRTNRSHP UPPER ROCK RIVER
9544 N 2ND ST
ROSCOE IL 61073

ALBERT ETTINGER
SIERRA CLUB MEMBER & DIRECTOR
ENVIRON LAW & POLICY CTR OF THE MIDWEST
35 E WACKER DR #1300
CHICAGO IL 60601

BOBBY FRANKLIN, PE, LS
ENVIRONMENTAL SCIENCE & ENGINEERING
8901 N INDUSTRIAL RD
PEORIA IL 61615-1589

DALE GOODNER
HEARTLAND WATER RESOURCE BOARD
FOREST PARK NATURE CENTER
5809 FOREST PARK DR
PEORIA IL 61614

BECKY HOAG
FOX RIVER ECOSYSTEM PARTNERSHIP
1281 DANFORTH DRIVE
BATAVIA IL 60510

MARGARET FRISBIE
EXECUTIVE DIRECTOR
FRIENDS OF THE CHICAGO RIVER
407 S DEARBORN SUITE 1580
CHICAGO IL 60605

KATHE LACEY-ANDERSON
FRIENDS OF THE FOX RIVER
PO BOX 1314
CRYSTAL LAKE IL 60039-1314

WAYNE FREEMAN
SIERRA CLUB MEMBER
GREAT RIVERS HABITAT ALLIANCE
801 N SECOND ST STE 401
ST LOUIS MO 63102

ANNIE HOAGLAND
ECOSYSTEM PRTNRSHP-BIG RIVERS
GREAT RIVERS LAND PRESERVATION ASSOC.
3406 ROSENBERG LANE
GODFREY IL 62305

GREENWAYS BOARD
HEART OF IL SIERRA CLUB
P O BOX 3593
PEORIA IL 61614

RUDY HABBEN
HEART OF IL SIERRA CLUB
3732 N MONROE AVE
PEORIA HEIGHTS IL 61616-7632

JOYCE BLUMENSHIRE
HEART OF ILLINOIS SIERRA CLUB
2419 E RESERVOIR BLVD
PEORIA IL 61614-8029

SHIRLEY O'CONNELL
HEART OF ILLINOIS SIERRA CLUB
1609 N KNOLLWOOD CT
PEORIA IL 61604

MARIANNE HAHN
IL AUDOBON SOC
18429 GOTTSCHALK
HOMEWOOD IL 60430

LAURE ROSS
IL CHAPTER NATURE CONSERVANCY
8 S MICHIGAN AVE STE 900
CHICAGO IL 60603

IL CHAPTER OF SIERRA CLUB
200 N MICHIGAN AVE STE 505
CHICAGO IL 60601-5908

RANDY HOLBROOK
PARTNERSHIP
IL DEPT OF NATURAL RESOURCES REG 4 OFC
4521 ALTON COMMERCE PARKWAY
ALTON IL 62002

DOUG BLODGETT
CHAIRMAN/COMMISSIONER
THOMPSON LAKE DRAINAGE & LEVEE DIST
IL RIVER PROJECT DIRECTOR - THE NATURE CONSERVANCY
11304 N PRAIRIE RD
LEWISTOWN IL 61542

KEN GORTOWSKI
IL SMALLMOUTH ALLIANCE
206 W CRESCENT
ELMHURST IL 60126

PAUL TOBECK
IL SMALLMOUTH ALLIANCE
1405 E 1000 N RD
MILFORD IL 60953-6242

JOHN NELSON
IND RIVER
B0X 248
SCHNEIDER IN 46376

RICHARD EICHELKRAUT
HEARTLAND WATER RESOURCE BOARD
IZAAK WALTON LEAGUE
208 WILSHIRE DR
WASHINGTON IL 61571

BILL GRANT
DIRECTOR
MIDWEST OFFICE
IZAAK WALTON LEAGUE OF AMERICA
1619 DAYTON AVE #202
ST PAUL MN 55104

JODY MELTON
KANKAKEE RIVER BASIN COMMISSION
6100 SOUTHPORT RD
PORTAGE IN 46368

DONALD ANDERSON
KANKAKEE RIVER BASIN PARTNERSHIP
20 DENNISON DR
BOURBONNAIS IL 60914

JIM REED
KANKAKEE RIVER PARTNERSHIP - NIAA
261 W CHEBANSKE
CHEBANSE IL 60922

EXECUTIVE DIRECTOR
LAKE MICHIGAN FEDERATION
220 S STATE STE 2108
CHICAGO IL 60604

MICHAEL SANDS
ECSYSTM PRTNRSHP-UPPER DES PLAINES R
LIBERTY PRAIRIE FOUNDATION
1472 PRAIRIE TRAIL RD
GRAYSLAKE IL 60030

MARCIA DEFALCO
MARCIA SOLUTIONS
1071 DOUBLE GATE RD
DAVIDSONVILLE MD 21035-1808

JOHN THOMPSON
PRESIDENT
ECOSYSTEM PRTNRSHP-FOX RIVER
MAX MCGRAW WILDLIFE FOUNDATION
PO BOX 9
DUNDEE IL 60118

ANGELA ANDERSON
UPPER BASIN PROGRAM DIRECTOR
MISSISSIPPI RIVER BASIN ALLIANCE
1915 ALFRED AVE
ST LOUIS MO 63110

MARK BEORKREM
UPPER BASIN PROGRAM DIRECTOR
MISSISSIPPI RIVER BASIN ALLIANCE
PO BOX 370 204 N WYANDOTTE ST
MORRISONVILLE IL 62546

RICHARD HILDEBRAND
NAIA
21 BERRY LN
BOURBONNAIS IL 60914

DONALD ANDERSON
NIAA
PO BOX 188
BOURBONNAIS IL 60914

JIM RACHUY
NORTHWEST IL PRAIRIE ENTHUSIASTS
11219 E STOCKTON RD
STOCKTON IL 61085

DERS ANDERSON
ECOSYSTEM PRTNRSHP-KISHWAUKEE RIVER
OPENLANDS PROJECT
25 E WASHINGTON ST SUITE 1650
CHICAGO IL 60602-1708

JONATHON BECK
OPENLANDS PROJECT
25 E WASHINGTON STE 1605
CHICAGO IL 60602

JOYCE O'KEEFE
ECOSYSTEM PRTNRSHP-PRAIRIE PARKLANDS
OPENLANDS PROJECT
25 E WASHINGTON ST SUITE 1650
CHICAGO IL 60602

GREENWAYS BOARD
PEORIA AUDUBON SOCIETY
677 E HIGH POINT TERRACE
PEORIA IL 61614

MAURICE BRUCKER
PEORIA AUDUBON SOCIETY
6606 N ALLEN RD UNT # 92
PEORIA IL 61614

RICK & TRACY FOX
PEORIA AUDUBON SOCIETY
15215 IVY LAKE RD
CHILLICOTHE IL 61523

JEANNETTE ULRICH
GREENWAYS BOARD
PIMITEOUI TRAIL ASSOCIATION
2391 HOLLANDS GROVE RD
WASHINGTON IL 61571-9625

JOYCE BLUMENSHINE
PRAIRIE RIVERS NETWORK
2419 E RESERVOIR
PEORIA IL 61614-8029

ROBERT MOORE
EXECUTIVE DIRECTOR
PRAIRIE RIVERS NETWORK
809 S 5TH ST
CHAMPAIGN IL 61820

DON SWENSSON
CONSERVATION CHAIR
QUAD CITY CONSERVATION ALLIANCE
5301 11TH AVE C
MOLINE IL 61265

TOM EDWARDS
RIVER RESCUE
902 W MOSS AVE # I
PEORIA IL 61606-1800

FRAN CAFFEE
SIERRA CLUB
726 W DOWNER PL
AURORA IL 60506

AMY COSTA
SIERRA CLUB
330 E SPANGLE RD
STAUNTON IL 62088

BOB FREEMAN
SIERRA CLUB
223 MARKET ST
ALTON IL 62002

GEORGANNE HIGGINS
SIERRA CLUB
2904 CHIPPEWA DR
BOURBONNAIS IL 60914

JOE LASZLO
SIERRA CLUB
330 S BARNEWOLT DR
PEORIA IL 61604

DEAN REBUFFONI
MISSISSIPPI RIVER SPECIALIST
SIERRA CLUB
5421 QUEEN AVE S
MINNEAPOLIS MN 55410

MIKE BROCK
SIERRA CLUB - VALLEY OF THE FOX GROUP
726 WEST DOWNER
AURORA IL 60506

DOUG CHIEN
SIERRA CLUB ILLINOIS CHAPTER
200 N MICHIGAN AVE STE 505
CHICAGO IL 60601-5908

JACK DARIN
STATE FIELD REPRESENTATIVE
SIERRA CLUB ILLINOIS CHAPTER
200 N MICHIGAN AVE STE 505
CHICAGO IL 60601-5908

WILLIAM CROOK
CHAIR
SIERRA CLUB SANGAMON VALLEY GROUP
PO BOX 1452
SPRINGFIELD IL 62705

BOB FREEMAN
SIERRA CLUB-KASKASKIA GROUP
4313 KASKASKIA TRAIL
GODFREY IL 62035

YVETTE DULLE
ECOSYSTEM PRTNRSHP
SOUTHWESTERN IL RC 7 D
406 E MAIN
MASCOUTAH IL 62258

ED WEILBACHER
ECOSYSTEM PRTNRSHP-AMERICAN BOTTOM
SOUTHWESTERN IL RC&D
406 E MAIN
MASCOUTAH IL 62258

JOHN MC KEE
STARVED ROCK AUDUBON SOCIETY
605 9TH AVE
OTTAWA IL 61350

TED GRAY
ECO-HYDROLOGIST
TED GRAY & ASSOCIATES INC
1 SOUTH 132 SUMMIT AVE STE 304
OAKBROOK TERRACE IL 60181

BROOK MC DONALD
ECSYSTM PRTNRSHP-UPPER DUPAGE RIVER
THE CONSERVATION FOUNDATION
10 S 404 KNOCH KNOLLS RD
NAPERVILLE IL 60565

HERMAN BODEWES
THE NATURE CONSERVANCY
1 W OLD CAPITAL PLAZA #600
SPRINGFIELD IL 62704

MARY BUSWELL
CONSERVATION PROGRAMS ADMIN
THE NATURE CONSERVANCY
301 S W ADAMS ST STE 1007
PEORIA IL 61602

KEVIN COULTER
ECOSYSTEM PRTNRSHP-MACKINAW RIVER`
THE NATURE CONSERVANCY
301 SW ADAMS ST STE 1007
PEORIA IL 61602-1558

D J DAVIS
THE NATURE CONSERVANCY
301 S W ADAMS ST STE 1007
PEORIA IL 61629

CHRIST DINESEN ROGERS
CONSERVATION INFORMATION MANAGER
THE NATURE CONSERVANCY
301 S W ADAMS ST STE 1007
PEORIA IL 61602

PAUL DYE
THE NATURE CONSERVANCY
8 S MICHIGAN AVE STE 900
CHICAGO IL 60603-3310

CLAUDIA EMKEN
DIRECTOR OF GOVERNMENT RELATIONS
IL CHAPTER
THE NATURE CONSERVANCY
301 SW ADAMS ST STE 1007
PEORIA IL 61602

GUY FRAKER
THE NATURE CONSERVANCY
1312 E WASHINGTON
BLOOMINGTON IL 61701

KIRSTEN HALVORSON
THE NATURE CONSERVANCY
301 S W ADAMS ST STE 1007
PEORIA IL 61602

THARRAN HOBSON
THE NATURE CONSERVANCY
11304 N PRAIRIE RD
LEWISTOWN IL 61542

DOUG LEHR
GRAND PRAIRIE AREA ADMINISTRATOR
THE NATURE CONSERVANCY
301 SW ADAMS ST STE 1007
PEORIA IL 61602-1558

JIM MC MAHON
AREA DIRECTOR
THE NATURE CONSERVANCY
301 S W ADAMS ST STE 1007
PEORIA IL 61602-1558

SHELLY MILLER
AQUATIC ECOLOGIST
THE NATURE CONSERVANCY
301 S W ADAMS ST STE 1007
PEORIA IL 61602

CYNTHIA OLMSTEAD
THE NATURE CONSERVANCY
301 S W ADAMS ST STE 1007
PEORIA IL 61602-1528

JEFF POWERS
DIRECTOR OF LAND PROTECTION
THE NATURE CONSERVANCY
301 S W ADAMS ST STE 1007
PEORIA IL 61602

MIKE REUTER
CHIEF CONSERVATION OFFICER
ILLINOIS CHAPTER
THE NATURE CONSERVANCY
301 SW ADAMS ST STE 1007
PEORIA IL 61602

KYLE ROBESON
ROBESON'S INC
THE NATURE CONSERVANCY
1501 INTERSTATE DR
CHAMPAIGN IL 61821

DEBORAH LOESER SMALL
THE NATURE CONSERVANCY
8 S MICHIGAN AVE STE 900
CHICAGO IL 60603-3310

HANK STONE
THE NATURE CONSERVANCY
301 S W ADAMS ST STE 1007
PEORIA IL 61615

TIM TEAR
DIRECTOR OF CONSERVATION SCIENCE
THE NATURE CONSERVANCY
301 S W ADAMS ST STE 1007
PEORIA IL 61602

HOLLY VAN DYKE
OFFICE ADMINISTRATOR
THE NATURE CONSERVANCY
301 S W ADAMS ST STE 1007
PEORIA IL 61602

DONALD HEY
SENIOR VICE PRESIDENT
THE WETLANDS INITIATIVE
53 W JACKSON BLVD STE 1015
CHICAGO IL 60604-3703

JERRY PAULSON
THE WETLANDS INITIATIVE
53 W JACKSON BLVD STE 1015
CHICAGO IL 60604

NANCY PHILIPPI
THE WETLANDS INITIATIVE
53 W JACKSON BLVD
CHICAGO IL 60604

JACK HUGGINS
TNC - PEORIA LAKES BASIN ALLIANCE
1101 FONDULAC
EAST PEORIA IL 61611

DOROTHY SINCLAIR
TRI COUNTY RIVERFRONT ACTION FORUM
1019 W TETON DR
PEORIA IL 61614

LARAINE E BRYSON
PEORIA CHAMBER BOARD
TRI-COUNTY URBAN LEAGUE
317 S MACARTHUR HIGHWAY
PEORIA IL 61605

GEORGE VANDER VELDE
WMRC
1010 JORIE STE 12
OAK BROOK IL 60523

AL MC COY
AURORA ECONOMIC DEVELOPMENT COMMISSION
44 EAST DOWNER PL
AURORA IL 60507

DIRECTOR
REGIONAL OFFICE
ECONOMIC DEVELOPMENT ADMINISTRATION
111 N CANAL ST STE 855
CHICAGO IL 60606-7213

JIM MENTESTI
PRESIDENT
GREAT RIVER ECONOMIC DEVELOP FOUNDATION
300 CIVIC CENTER PLAZA STE 256
QUINCY IL 62305

WILLIAM BROWNING CED
PRESIDENT AND CEO
HARTLAND PARTNERSHIP
124 S W ADAMS STE 300
PEORIA IL 61602-1388

NORMAN WALZER
DIRECTOR
ILLINOIS INSTITUTE FOR RURAL AFFAIRS
WIU - 518 STIPES HALL
MACOMB IL 61455

RUTH FITZGERALD
PRESIDENT
JOLIET-WILL COUNTY CTR FOR ECO DEV
116 N CHICAGO ST
JOLIET IL 60431

LAWRENCE CHRISTMAS
EXECUTIVE DIRECTOR
NORTHEAST ILLINOIS PLANNING COM
400 W MADISON ST
CHICAGO IL 60606

JOSEPH SOMERSET
MGR OF COMMUNITY & ECON DEVELOPMENT
SOYLAND POWER COOPERATIVE
PO BOX 610
JACKSONVILLE IL 626510610

KEVIN WIEHARDT
WESTERN ILLINOIS REG PLANNING COUNCIL
223 S RANDOLPH
MACOMB IL 61455

J SCOTT SESSION
316 E MASON ST
HAVANA IL 62644-1821

JOHN CURRAN
DIRECTOR
ALSIP PARK DISTRICT
12521 S KOSTNER AVE
CHICAGO IL 60658-2624

JIM EBY
BATAVIA PARK DISTRICT
327 W WILSON ST
BATAVIA IL 60510

SCOTT LUKEN
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BATAVIA PARK DISTRICT
327 W WILSON ST
BATAVIA IL 60510

GREG OUTSEN
BRADLEY BOURBONNAIS SPORTSMANS CLUB
417 KRISTINA
BOURBONNAIS IL 60914

JEAN A ROBINSON
CANAL CORRIDOR ASSOC
2617 E HOLDERMAN RD
MORRIS IL 60450

CHARLES PENDLETON
BRANCH MANAGER
CHICAGO PARK DISTRICT
6312 W ROSEDALE AVE
CHICAGO IL 60646-5316

WILLIAM PENN
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HUMBOLDT PARK DISTRICT
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CHICAGO IL 60622-2738

TERRY JOHNSTON
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KANKAKEE IL 60901

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COMMODORE
EAST PEORIA BOAT & RECREATION
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AURORA IL 60506

BILL DONNELL
FOX VALLEY PARK DISTRICT
PO BOX 818
AURORA IL 60507

AMY LARSON
FOX VALLEY PARK DISTRICT
PO BOX 818
AURORA IL 60507

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FOX VALLEY PARK DISTRICT
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AURORA IL 60507

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GREENWAYS BOARD
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SPRINGFIELD IL 62701

RONALD DODD
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3000 W JEFFERSON ST
JOLIET IL 60435-5277

RICK FOLKIE
KANKAKEE AREA SPORTSMANS CLUBS
4243 N 3000W RD
BOURBONNAIS IL 60914

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KANKAKEE IL 60901

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MORTON IL 61550

MARK DE SALVO
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NORRIDGE PARK DISTRICT
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CHICAGO IL 60656-4522

J R BLACK
NORTHERN IL ANGLERS
BOX 188
BOURBONNAIS IL 60914

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313 E WASHINGTON ST
OSWEGO IL 60543

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OSWEGOLAND PARK DISTRICT
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OSWEGO IL 60543

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OSWEGOLAND PARK DISTRICT
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SUPERINTENDENT
RIVERDALE PARK DIST COMM CTR
PARK RIVERDALE
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CHICAGO IL 60627-1652

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PEKIN IL 61554

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313 E WASHINGTON ST
OSWEGO IL 60543

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WALT DAVIS
TAZEWELL GUN CLUB
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PEORIA IL 61604

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GREENWAYS BOARD
WASHINGTON PARK DISTRICT
815 LINCOLN
WASHINGTON IL 61571

THOMAS MC CULLOUCH
C/O DON KLIMA
EASTERN OFFICE OF PROJECT REVIEW
ADVISORY COUNCIL ON HISTORIC PRESERVATION
1100 PENNSYLVANIA AVE NW #809
WASHINGTON DC 20004

DON KLIMA
DIRECTOR -EASTERN OFC OF PROJ REVIEW
EASTERN OFFICE OF PROJECT REVIEW
ADVISORY COUNCIL ON HISTORIC PRESERVATION
1100 PENNSYLVANIA AVE NW #809
WASHINGTON DC 20004

IL VETERANS HOME
ALL WARS MUSEUM
1701 N 12TH ST
QUINCY IL 62301

ALTON AREA HIST SOCIETY
PO BOX 971
ALTON IL 62002

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ALTON IL 62002

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901 S MATHEWS AVE
URBANA IL 61801

ANDOVER HIST SOCIETY
PO BOX 197 - 418 LOCUST ST
ANDOVER IL 61233

ANITA PURVES NATURE CENTER
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URBANA IL 61801

ARLINGTON HEIGHTS HISTORICAL SOCIETY
110 W FREMONT ST
ARLINGTON HEIGHTS IL 6004

AURORA HISTORICAL SOCIETY
317 CEDAR ST
AURORA IL 60506

AURORA PRESERVATION COMMISSION
44 E DOWNER PL
AURORA IL 60507

AVON HISTORICAL SOCIETY
PO BOX 483
AVON IL 61415

BARLETT HISTORICAL SOCIETY
228 S MAIN ST PO BOX 8257
BARTLETT IL 60103

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212-218 W MAIN ST
BARRINGTON IL L0010

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PO BOX 14
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673 PENFIELD ST PO BOX 1469
BEECHER IL 60401

BELLFLOWER GENEALOGICAL & HISTORICAL SOC
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PO BOX 479
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109 PARK AVE W
PRINCETON IL 61356

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300 MILLER ST
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107 ELM ST
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30 RAMEY ST
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CALHOUN COUNTY HISTORICAL SOCIETY
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HARDIN IL 62047

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760 WENTWORTH AVE PO BOX 1917
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MOUNT CARROLL IL 61053

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313 E 3RD ST
GALESBURG IL 61401

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LINCOLN COURTROOM
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COLUMBIA IL 62236

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CRABTREE NATURE CENTER
RTE 3 STOVER RD
BARRINGTON IL 60010

CTR FOR AMERICAN ARCHEOLOGY
PO BOX 366
KAMPSVILLE IL 62053

CUSTOM HOUSE
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CAIRO IL 62914

DANVERS HISTORICAL SOCIETY
102 S W ST PO BOX 613
DANVERS IL 61732

DARIEN HISTORICAL SOCIETY
7422 S CASS AVE PO BOX 2178
DARIEN IL 60561

DEERFIELD AREA HISTORICAL SOCIETY
450 KIPLING PL PO BOX 520
DEERFIELD IL 60015

DES PLAINES HISTORICAL SOCIETY
789 PEARSON
DES PLAINES IL 60016-4506

DEWITT CNTY MUSEUM ASSOC
219 E WOODLAWN
CLINTON IL 61727

DUANE ESAREY
DICKSON MOUNDS MUSEUM
10956 N DICKSON MOUNDS RD RR 1 BOX 185
LEWISTOWN IL 61542

ALAN HARN
DEPT OF ANTHROPOLOGY
DICKSON MOUNDS MUSEUM
10956 N DICKSON MOUNDS RD RR 1 BOX 185
LEWISTOWN IL 61542

DOWNERS GROVE HISTORICAL SOCIETY
831 MAPLE AVE
DOWNERS GROVE IL 60515-4904

DOWNERS GROVE MUSEUM
831 MAPLE AVE
DOWNERS GROVE IL 60515-4904

DUNDEE TOWNSHIP HISTORICAL SOCIETY
426 HIGHLAND AVE
DUNDEE IL 60118

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102 E WESLEY ST
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119 W MAIN ST
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205 WINTHROP ST PO BOX 420
EARLVILLE IL 60518

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3658 E 106TH ST
CHICAGO IL 60617

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6173 N MC CLELLAN
CHICAGO IL 60646

ELBURN & COUNTY HISTORICAL SOCIETY
525 N MAIN PO BOX 115
ELBURN IL 60119

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360 PARK ST
ELGIN IL 60120

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116 N LATHAM PO BOX 225
ELKHART IL 62634

EVANSTON HISTORICAL SOCIETY
225 GREENWOOD ST
EVANSTON IL 60201

FAIRMOUNT-JAMAICA HISTORICAL SOCIETY
PO BOX 349
FAIRMOUNT IL 61841-0349

FARMER CITY GENEALOGICAL & HIST SOCIETY
224 S MAIN PO BOX 173
FARMER CITY IL 61842

FERN DELL HISTORIC ASSOC
PO BOX 254
NEWARK IL 60541

FIELD MUSEUM OF NATURAL HISTORY
1200 S LAKE SHORE DR
CHICAGO IL 60605-2496

FLAGG CREEK HISTORICAL SOCIETY
7965 BIELBY
LA GRANGE IL 60521

ANDERSON
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201 W STATE ST PO BOX 115
PAXTON IL 60957-0115

JOHN ANDERSON
FORD COUNTRY HISTORICAL SOCIETY
201 W STATE ST PO BOX 115
PAXTON IL 60957-0115

FORT KASKASKIA HIST SITE
RR 1 BOX 63
ELLIS GROVE IL 62241

FRANKFORT AREA HIST SOCIETY OF WILL CNTY
132 KANSAS ST PO BOX 546
FRANKFORT IL 60423

FRANKLIN GROVE AREA HISTORICAL SOCIETY
110 W FRONT
MT MORRIS IL 61054

FREEBURG HIST & GENE SOCIETY
PO BOX 69
FREEBURG IL 62243

VILLA KATHRINE
FRIENDS OF THE CASTLE
PO BOX 732
QUINCY IL 62306

FRIENDS OF THE DR RICHARD EELLS HOUSE
PO BOX 628 415 JERSEY ST
QUINCY IL 62306

FULTON COUNTY HISTORICAL & GEN SOCIETY
45 ASPEN DR
CANTON IL 61520

GALENA STATE HIST SITES
PO BOX 333 908 3RD ST
GALENA IL 61036

GALESBURG HISTORICAL SOCIETY
534 N BROAD ST
GALESBURG IL 61401-3646

GALVA HISTORICAL SOCIETY
906 W DIVISION ST - PO BOX 4
GALVA IL 61434-0004

GALVA HISTORICAL SOCIETY
2141 COUNTY HWY 5
GALVA IL 61434

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332 MAINE ST
QUINCY IL 62306

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PO BOX 345
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GLEN ELLYN HISTORICAL SOCIETY
557 GENEVA RD PO BOX 283
GLEN ELLYN IL 60137

GLENCOE HISTORICAL SOCIETY
377 PARK AVE
GLENCOE IL 60022

GLENVIEW AREA HISTORICAL SOCIETY
1121 WAUKEGAN RD
GLENVIEW IL 60025

GOLDEN HISTORICAL SOCIETY
PO BOX 148 902 PRAIRIE MILLS RD
GOLDEN IL 62339

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MORRIS IL 60450

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526 JERSEY
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HARVARD IL 60033

GREENE CNTY HIST & GENEALOGICAL SOCIETY
PO BOX 137 532 N MAIN ST
CARROLLTON IL 62016

LAKEVIEW MUSEUM
GREENWAYS BOARD
1125 W LAKE AVE
PEORIA IL 61614

GROVE HERITAGE ASSOC
PO BOX 484
GLENVIEW IL 60025

GRUNDY COUNTY HISTORICAL SOCIETY
PO BOX 224
MORRIS IL 60450

HENRY BARSCHDORF
PRESIDENT
GRUNDY COUNTY HISTORICAL SOCIETY
PO BOX 224
MORRIS IL 60450-2329

ARTHUR HORNSBY
GRUNDY COUNTY HISTORICAL SOCIETY
815 CHAPIN ST
MORRIS IL 60450

HANCOCK CNTY HISTORICAL SOCIETY
PO BOX 68
CARTHAGE IL 62321

HANCOCK COUNTY HISTORICAL SOCIETY
PO BOX 68
CARTHAGE IL 62321

JOHN H ALLAMAN
HENDERSON COUNTY HISTORICAL SOCIETY
RR 1 BOX 130
OQUAWKA IL 61469-9711

HENRY COMMUNITY HIST & GENE SOCIETY
610 NORTH ST
HENRY IL 61537

HENRY COMMUNITY HISTORICAL & GENEAL SOC
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HENRY IL 61537

HENRY COUNTY HISTORICAL SOCIETY
PO BOX D
BISHOP HILL IL 61419

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HIGHLAND PARK IL 60035

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HINSDALE IL 60522

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OAK PARK IL 60302

HISTORIC PRESERVATION REVIEW COMMISSION
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ORLAND PARK IL 60462

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UTICA IL 61373

HISTORICAL ASSOC OF PRINCEVILLE
325 N OSTROM AVE
PRINCEVILLE IL 61559-9538

HISTORICAL SOCIETY OF CICERO
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CICERO IL 60650

HISTORICAL SOCIETY OF ELMWOOD PARK
2823 N 77TH AVE
ELMWOOD PARK IL 60635-1408

HISTORICAL SOCIETY OF FOREST PARK
519 JACKSON BLVD
FOREST PARK IL 60130

HISTORICAL SOCIETY OF FORT HIL CNTY
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MUNDELEIN IL 60060

HISTORICAL SOCIETY OF MONTGOMERY CNTY
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HISTORICAL SOCIETY OF OAK PARK & RIV FOREST
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QUINCY IL 62301

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HOMER IL 61849

HOMEWOOD HISTORICAL SOCIETY
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HOMEWOOD IL 60430

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PARKDIST
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HOOPESTON IL 60942

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STREAMWOOD IL 60107

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CHICAGO IL 60637

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LOCKPORT IL 60441

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IL CANAL SOCIETY
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IL GREAT RIVERS CONFERENCE HIST SOCIETY
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BLOOMINGTON IL 61702

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CHAMPAIGN IL 61820

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SPRING AND EDWARDS STS
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MUSEUM DIRECTOR
IL STATE MUSEUM
SPRING AND EDWARDS STS
SPRINGFIELD IL 62706-5000

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JACKSONVILLE IL 62650

JACKSON CNTY HISTORICAL SOCIETY
1616 EDITH ST
MURPHYSBORO IL 62966-2543

JACKSON CNTY HISTORICAL SOCIETY
HISTORICAL SOCIETY
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416 S MAIN ST
JACKSONVILLE IL 62650

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JERSEYVILLE IL 62052

JERSEY COUNTY HISTORICAL SOCIETY
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KENILWORTH IL 60043

KEWANEE HISTORICAL SOCIETY
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KEWANEE IL 61443

KEWANEE HISTORICAL SOCIETY
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KNOXVILLE IL 61448

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WILMETTE IL 60091

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LYNDON IL 61261

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MIDLOTHIAN IL 60445

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MORRISION IL 61270

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MORRISONVILLE IL 62546

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CHICAGO IL 60655

MT PROSPECT HISTORICAL SOCIETY
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CHICAGO IL 60631

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OAK PARK IL 60304

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PARK RIDGE IL 60068

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BUFFALO GROVE IL 60089

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CHICAGO IL 60625

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BATAVIA IL 60510

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DE KALB IL 60115

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CHICAGO IL 60643

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NORTHBROOK IL 60062

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SHEFFIELD HISTORICAL SOCIETY
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ROSEVILLE IL 61473

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401 MAIN ST
WARSAW IL 62379

WASHBURNE HOUSE STATE HIST SITE
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GALENA IL 61036

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LEROY EED
2661 RIVER RD
KANKAKEE IL 60901

DAVID EGAN
23368
TOPEKA IL 61567

THOMAS EHLESS
1295 S LINCOLN
KANKAKEE IL 60901

WILLIAM EICHELKRAUT
1432 OTTAWA AVE
OTTAWA IL 61350

RUBERT EUBANKS
239 CHICAGO ST
EAST PEORIA IL 61611

STANLEY FAULKNER
12415 N DAVIS RD
DAVIS IL 61019

PETER FERRACUTI
110 E MAIN ST
OTTAWA IL 61350

JAMES FESTER
PO BOX 2474
EAST PEORIA IL 61611

LARRY - LOIS FIDLER
1002 COPPER CREEK RD
MANITO IL 61546

WILLIAM FIESTER
5779 WAGONSELLER RD
GREEN VALLEY IL 61534

RAYMOND FILIPIAK
40 TWILIGHT LANE
SPRINGFIELD IL 62707

HARRY FITZGERALD
PO BOX 99
BOURBONNAIS IL 60914

JOSEPH FITZGERALD
2455 GLENWOOD AVE
JOLIET IL 60435-5495

JOHN M FLOYD
110 CENTER ST
EAST PEORIA IL 61611

TOM FORBURGER
6629 N 16000 ERD
MOMENCE IL 60954

DON AND DONNA FORBURGER
16780 E 5000 N RD
MOMENEE IL 60954

JOHN J FORNERIS
2236 S SPRING
SPRINGFIELD IL 61704

RANDALL FORNOFF
PO BOX 583
HAVANA IL 62644-9801

BILL FRAUSE
1425 DAIRY LANE
OTTAWA IL 61350

JOHN FRERICH
1615 Millview Dr.
BATAVIA IL 60510

RON FRIEND
11582 PETERVILLE RD
HAVANA IL 62644

WESLEY & BARB FRISCH
3 OAKWOOD CT
OSWEGO IL 60543

ADRIAN GALE
217 CHICAGO ST
EAST PEORIA IL 61611

PAT & JERRY GALLIGAR
3515 WOLF CROSSING
OSWEGO IL 60543

JAMES & MARTHA GARBE
12 OAKWOOD DR
OSWEGO IL 60543

GARY & PHILLIS GATES
309 W MAIN
YORKVILLE IA 60560

HENRY GAUWITZ
7407 N PATTON LN
PEORIA IL 61614-1804

BRIDGET GAVAGHAN
920 N FRANKLIN ST #301
CHICAGO IL 60610

NANCY GENDRON
545 CHICAGO ST
EAST PEORIA IL 61611

PAUL GERDING
725 CONGRESS ST
OTTAWA IL 61350

EARL GERDING
101 W ALLEN ST
OTTAWA IL 61350

WILLIAM GESSNER
1004 W HAWKINS ST
KANKAKEE IL 60901

CLARENCE GETTINGS
305 SCENIC PARK DR
CREVE COEUR IL 61610-3168

PAUL GEWARTOWSKI
3 TOPHILL LANE
SPRINGFIELD IL 62704

RON GILKERSON
1314 S BATAVIA AVE
BATAVIA IL 60510

CECIL GILSON
635 S BROADWAY
HAVANA IL 62644

GARY GLEESPEN
105 E VIRGINA AVE
PEORIA IL 61603

JOSEPH GLOSSICK
2816 S HILTON LANE
PEORIA IL 61607

ALAN G GOODFIELD
504 OLD TIPPECANOE DR
SPRINGFIELD IL 62707

JULIE GOWEN
18301 WILKINSONN RD
DEER CREEK IL 61733

GARRY GRAHAM
316 CHICAGO RD
OSWEGO IL 60543

DAVID GRANT
1 BRIARCLIFF CT
BOURBONNAIS IL 60914

BETTY E GREEN
216 ASTORIA RD
SPRINGFIELD IL 62704-1285

DR DONALD W "BILL" GRIFFIN
140 E WESTVIEW DR
MACOMB IL 61455

DALE HAGEN
HC82 BOX 90
BRUSSELS IL 62013-9724

GILFORD HAGEY
105 MARY PLACE
EAST PEORIA IL 61611

LAVERNE HAGEY
419 EDMUND ST
EAST PEORIA IL 61611

GAINES AND SHARON HALL
12 ELMWOOD DR
KANKAKEE IL 60901

DR MAX D HAMMER
501 N 1ST ST - PO BOX 19248
SPRINGFIELD IL 62694-9248

HAL HAMMOND
143 STATE ST
EAST PEORIA IL 61611

WALTER E HANSON
15 TURNBERRY PLACE
SPRINGFIELD IL 62704-3174

MILDRED HARDWICK
212 CASS ST
EAST PEORIA IL 61611

DUANE HARRING
34738 RT 122
MINIER IL 61759

MIKE HARTMAN
16590 E RT 114
MOMENCE IL 60954

RONALD HASTINGS
1400 E CRUGER RD
WASHINGTON IL 61571-9696

BILLY HATCHER
111 EDMUND ST
EAST PEORIA IL 61611

KATE HAWKES
65 MEADOWLARK LANE
SPRINGFIELD IL 62702

JERRY HAYES
2664 300TH AVE
EMDEN IL 62635

JOHN M HEALY
3112 KEMPER DR
SPRINGFIELD IL 62704

ED HEASLEY
4 TRA-LIN RIDGE
ALTON IL 62002

SHAWN HEINRICH
6 RIDGE RD
STREATER IL 61364-1428

MARK & VICKI HEIZLER
320 CHICAGO RD
OSWEGO IL 60543

ALVIN HELFERICH
100 MAPLE ST
EAST PEORIA IL 61611

DR BOB & ALICE HENRY
24 GRANDVIEW DR
MACOMB IL 61455

DENNIS HENSON
334 CENTER ST
EAST PEORIA IL 61611

LARRY HESTED
426 CHURCHILL CT
BATAVIA IL 60510

CHARLOTTE HIATT
418 TERMINAL RD
EAST PEORIA IL 61611

ROBERT HIATT
119 HIATTS LANE BOX 33-B
EAST PEORIA IL 61611

ERNEST HICKMAN
143 FISHER
EAST PEORIA IL 61611

MELVIN HICKS
BOX 7
GLADSTONE IL 61437

EDWIN HODROCK
RT 1 BOX 27
BEARDSTOWN IL 62618

MARGARET HOLLOWELL
908 ARLENE AVE
BLOOMINGTON IL 61701

GENE HOOD
139 CHICAGO ST
EAST PEORIA IL 61611

CAROL HOOVER
12 MARQUETTE
KANKAKEE IL 60901

GENE HOWELL
2 SPRUCE CT
BLOOMINGTON IL 61704-2782

JIM HULTS
22 LAWRENCE DR
KANKAKEE IL 60901

DEBORAH HUMBAUGH
430 MONSON ST
EAST PEORIA IL 61611

GARY HUME
15260 NORTH S.R. 78
HAVANA IL 62644

FRANK HUMMEL
101 S ILLINOIS ST
LEWISTOWN IL 61542-1507

DAVID HURST
7813 S HURST DR
PEORIA IL 61607

JOANN HUSTIS
110 W JEFFERSON ST
OTTAWA IL 61350

JACK HUTCHINSON
517 EDMUND ST
EAST PEORIA IL 61611

JACQUELINE JACKSON
816 N 5TH ST
SPRINGFIELD IL 62702

GERALD JACKSON
403 MONSON ST
EAST PEORIA IL 61611-2345

MIKE JACOCKS
440 E HIGH POINT DR
PEORIA IL 61614

BOB JAMESON
1042 STATE ST
OTTAWA IL 61350

KIM JANSSEN
PO BOX 19281
SPRINGFIELD IL 62794-9281

ABEL JAZONBECK
8 BEDNARCIK CT
OSWEGO IL 60533

DAVE AND PEARLE JEFFRIES
2762 N 2050 E
FAIRBURY IL 61734

DEAN JENSEN
24911 SHEPLEY RD
SHOREWOOD IL 60431

KAY JEVITZ
2 VALLEY VIEW LANE
OTTAWA IL 61350

ALAN JIRANEK
9065 VAN EMMON RD
YORKVILLE IL 60560

DEL JOHNSON
2992 DCOUNTY RD 1900 E
RANTOUL IL 61866

JAMES JOHNSON
159 N PRAIRIE
BRADLEY IL 60915

VIRGIL & DIXIE JOHNSON
112 CHICAGO RD
OSWEGO IL 60543

JANE JOHNSON
1776 KNOX HWY 11
GILSON IL 61436-9433

ANNIE JOHNSON
521 EDMUND ST
EAST PEORIA IL 61611

GEORGE JOHNSON
557 CHICAGO ST
EAST PEORIA IL 61611

DOROTHY JOLLEY
200 CASS ST
EAST PEORIA IL 61611

GEORGE JONES
109 MALLARD LANE
EAST PEORIA IL 61611

BOB JORDON
821 OAKWOOD RD
EAST PEORIA IL 61611

MARILYN KALB
407 W KIMBLE
SPRINGFIELD IL 62703

JOHN & SHARON KECK
19 PARKWAY DR
YORKVILLE IL 60560

KA KEIGHIN
19652 N 800 E RD
CARLOCK IL 61725-9559

THOMAS KELLY
302 MAIN ST
YORKVILLE IL 60560

RODGER - DIANNA KEMP
1011 HOWARD
NORMAL IL 61761

WILL - VELMA KERBER
1011 HOWARD
NORMAL IL 61761

GARY KIRKPATRICK
621 SHABBONA ST
OTTAWA IL 61350

DAVE AND SHEILA KLAMECKI
3233 SERPENTINE
MOMENCE IL 60954

ALAN KOCH
RR 1 BOX 136
MT STERLING IL 62353

DON KOCHEVAR
PO BOX 272
MORRIS IL 60450

EARL KOEHLER
1322 N RIVERSIDE DR
MOMENCE IL 60954

ORAL C KOST
ATTORNEY
200 MAIN ST
LEWISTOWN IL 61542

DONALD KRANOV DDS
150 FOREST PARK RD
OTTAWA IL 61350

W KRAUSE
1425 DAIRY LN
OTTAWA IL 61350

KEN KROS
117 GRIFFIN ST
GRANT PARK IL 60940

PAUL E LARSON
730 W MADISON ST
OTTAWA IL 61350

CURT LAWSON
2340 CHARLES CT
OTTAWA IL 61350

JAMES - CYNTHIA LAWSON
BOX 435
MANITO IL 61546

DALE LAWSON
3198 SPRING LAKE RD
MANITO IL 61546

ROBERT LEAS
291 E WHITE OAK CT
EAST PEORIA IL 61611

HOWARD LEE
403 CARLOCK CT
WASHINGTON IL 61571-1008

HOWARD LEE
1124 PEKIN AVE
CREVE COEUR IL 61610

JOHNNIE LEEMON
307 PARK AVE
EAST PEORIA IL 61611-3355

MAURICE LEGATE
RR 1 BOX 204
GRAFTON IL 62037-9746

JEANNE LINDBERT
18 MARQUETTE LN
KANKAKEE IL 60901

LOUIS LOOK
2224 N UNIVERSITY AVE
PEORIA IL 61604

DONALD LOREE
138 CHICAGO ST
EAST PEORIA IL 61611

EVELYN LOVE
541 EDMUND ST
EAST PEORIA IL 61611

JIM LOWE
233 CHICAGO ST
EAST PEORIA IL 61611

DOUG OR LARRY MACKIN
1068 S WILDWOOD
KANKAKEE IL 60901

SAM F MADONIA
2416 SILVER MILL CT
SPRINGFIELD IL 62704-6548

RAFAEL MAGANA
454 CHICAGO ST
EAST PEORIA IL 61611

JERRY - CHERYL MAJORS
129 LINCOLN PARKWAY
EAST PEORIA IL 61611

THOMAS MALPASS
630 E VAN BUREN ST
OTTAWA IL 61350

JEFFERY MANN
312 EDMUND ST
EAST PEORIA IL 61611

DR RONALD MARINO
542 CHAPEL ST
OTTAWA IL 61350

LARRY MARION
814 PLEANT HILL RD
EAST PEORIA IL 61611

KELLI MARKS
104 STONEGATE DR
OSWEGO IL 60543

JOHN MARLIN
2203 BOUDREAU CIRCLE
URBANA IL 61801-6601

DAVID & RAE MARTIN
6 PENN CT
OSWEGO IL 60543

THOMAS MARTIN
300 CHICAGO ST
EAST PEORIA IL 61611

GREG MASLOWSKI
622 YORK ST
OTTAWA IL 61350

GARY MASON
RR 2 BOX 171
BEARDSTOWN IL 62618-9755

ART MASON
1460 N 2401 RD
OTTAWA IL 61350

NANCY MASON
3419 W SHOFF AVE
PEORIA IL 61604

DONALD MC CARROLL
221 STATE ST
EAST PEORIA IL 61611

RAY MC CAUSLAND
16235 CR 1800 B
HAVANA IL 62644

TIMOTHY MC GREE
70 E CEDR ST
CHICAGO IL 60611

JOHN MC GREW
721 E ADAMS
HAVANA IL 62644

PAUL MC GREW
117 FISHER ST
EAST PEORIA IL 61611

JOHN MC MURRAY
3820 N DONNA LANE
PEORIA IL 61615

ARTHUR MEIER
307 DAKOTA RD
RIDOTT IL 61067

MARLI MEISS
2412 W IMPERIAL
PEORIA IL 61614

AL MELLOTT
2719 DEER CT
OTTAWA IL 61350

LARRY MICHAUD
40 BAY RIDGE
SPRINGFIELD IL 62707

LOUIS MIKRUT
71-5 W US HWY 150
EDWARDS IL 61528

LEO MILLER
4767 E 1950 N RD
DANVERS IL 61732-9208

ROBERT MILLER
222 FRANKLIN ST
EAST PEORIA IL 61611

ROBERT MILLER
101 JOLIET CT
EAST PEORIA IL 61611-1842

HOWARD MILLER
500 CENTENNIAL DR APT 6348
EAST PEORIA IL 61611-4976

ALMA K MILLER
443 MONSON ST
EAST PEORIA IL 61611

C E MITSULES
332 CASS ST
EAST PEORIA IL 61611

JERRY MITZELFELT
7672 WARNER RD
MANITO IL 61546

JIM MOLL
2914 S PARK
SPRINGFIELD IL 62704

KENNETH AND DONNA MOODY
1800 STATE HWY 78N
JACKSONVILLE IL 62650

DARRELL MOODY
12 COUNTRY LN
EAST PEORIA IL 61611

LEE & BETTY MOOREHEAD
700 W. FABYAN, 27A
BATAVIA IL 60510

ANGELLA MOOREHOUSE
20381 E 1100 ST
GOOD HOPE IL 61438

NELSON MORALES
24 SQUIRES
SPRINGFIELD IL 62704

GARY MORRISON
RT 1 BOX 248A
FIELDON IL 62031

GILBERT - EVA MORTON
1006 COPPER CREEK RD
MANITO IL 61546

JULIE MOSBY-ZIMMERMAN
101 E WATER ST PO BOX 47
GRAFTON IL 62037

MIKE MURPHY
2301 W WAGNER LN
PEORIA IL 61615

DAVID & SHERYL MUSSER
238 CHICAGO RD
OSWEGO IL 60543

AVON NABORS
336 CENTER ST
EAST PEORIA IL 61611

CLIFTON - JANET NANNIE
523 EDMUND ST
EAST PEORIA IL 61611

STEVEN NEAL
BUSINESS MANAGER
6408 W PLANK RD
PEORIA IL 61604

MIKE NELSON
3515 AN 17340 E RD
MOMENCE IL 60954

NICK NELSON
3584 N 18000 E RD
MOMENCE IL 60954

MARK AND NATHAN NELSON
R1
MOMENCE IL 60954

GARY NEUHAUS
6420 N CAMELOT RD
PEORIA IL 61615-2712

JOHN M NICHOLS
2300 S DIRKSEN PKWY
SPRINGFIELD IL 62764

UKEN NORMAN
2419 COUNTY RD 1800 E
URBANA IL 61802

ROBERT NORTHCUTT
7005 E 875 ST
MACOMB IL 61455

ROY E NOTTINGHAM
1916 S COLLEGE
SPRINGFIELD IL 62704-3923

DENNIS O'CONNELL
528 W ALLEN
SPRINGFIELD IL 62704

GARRY OEST
20545 CR 1950E
HAVANA IL 62644

DOYLE O'KEEFE
26 FOX MILL LANE
SPRINGFIELD IL 62707

RANDALL & LISA OLAH
2 PENN CT
OSWEGO IL 60543

JACK OLLER
404 MEADOW LANE
OTTAWA IL 61350

RICHARD OOST
1415 RANDALL CT
AURORA IL 60507

E Z OSTERHUBER
40 FORESTERS LANE
SPRINGFIELD IL 61704

STEVE OVERRIGHT
2518 N OSAGE DR
BOURBONNAIS IL 60914

RANDY PARKS
8240 E 2350TH ST
ADAIR IL 61411

OWEN PARN
RR 1
MT STERLING IL 62353-9801

ED PARNHAM
2305 SPRINGFIELD RD
EAST PEORIA IL 61611

MARY PATTON
1607 N AUTUMN LN
PEORIA IL 61604

MARTHA PATTON
231 FISHER ST
EAST PEORIA IL 61611

JERRY PAYNE
308 N ORANGE
HAVANA IL 62644

RAYMOND PELELAS
15 RED HAW LANE
LAKE ZURICK IL 60047

JAMES PENCE
45 MARIAN
SPRINGFIELD IL 61704

CHARLES H PERINO
900 W LAKE DR
SPRINGFIELD IL 62707

JEFFREY PETERSON
6513 N POST OAK RD
PEORIA IL 61615-2738

C K PETERSON
209 RACILL CT
EAST PEORIA IL 61611

LOLA PINE
317 PINE ST
MORRIS IL 60450

MIKE PLATT
RT 1
YATES CITY IL 61572-9801

MICHAEL D PLATT
2034 KNOX RD 700 N
LOTIS CITY IL 61572

DONALD PLAUCK
256 CHICAGO RD BOX 468
OSWEGO IL 60543

JOHN & MARY PLAYER
128 STONEGATE DR
OSWEGO IL 60543

BARNEY AND SHIRLEY POTTS
727 SABRINA DR
EAST PEORIA IL 61611

HAROLD POWERS
405 W CRESTWOOD DR
PEORIA IL 61614-7227

MARILYN PROPP
505 W CORRINGTON
PEORIA IL 61604

WILLIAM PURDY
PO BOX 371
WILMINGTON IL 60481

WALLACE PUTNEY
323 CHICAGO ST
EAST PEORIA IL 61611

RICKIE & JIM RACHEY
11219 E STOCKTON RD
STOCKTON IL 61085

AL RAE
2480 AMY LN
AURORA IL 60507-0907

ANDREW RAGAN
528 BLOOMINGTON RD
EAST PEORIA IL 61611

STANLEY RANSON
522 SANFORD ST
EAST PEORIA IL 61611

JOYCE RAY
704 N MAPLE ST
MT STERLING IL 62353-1136

WILLIAM J REAGAN
546 E MAIN ST
OTTAWA IL 61350

LAURIE REEVE
17372 ECR1600N
HAVANA IL 62644

KENNETH REGENTZ, SR.
446 CHICAGO ST
EAST PEORIA IL 61611

ROSE MARIE REPKA
1018 LINCOLN AVE
OTTAWA IL 61350

DON RHODES
RR #8 BOX 100 - TEN MILE CREEK RD
EAST PEORIA IL 61611

ROBERT RICE
1800 FISHER RD
CREVE COEUR IL 61610

HELEN RIMKUS
1139 N WALNUT ST
SPRINGFIELD IL 62702

JAMES RINEHART
100 MONSON ST
EAST PEORIA IL 61611

CHRIS RING
143 FRANKLIN ST
EAST PEORIA IL 61611

JOHN ROAT
RR 2
HAVANA IL 62644-9802

CHUCK ROBERTS
305 E. MAIN ST.
YORKVILLE IL 60560

PATRICIA ROBERTS
112 GLOBE ST
EAST PEORIA IL 61611

JOSEPH P ROCK
2404 CAHOKIA DR
SPRINGFIELD IL 62702

JOHN ROESCH
2445 W DOWNER PLACE
AURORA IL 60506

CHAU ROGER
106 TURNRON PL
EAST PEORIA IL 61611

ROY ROHN
532 CHICAGO ST
EAST PEORIA IL 61611

STEVE RONE
8481 MARKET ST
AKIN IL 62805

GIL & BETH RONE
1277 HILLPOINT RD
EAST PEORIA IL 61611

TOM ROWEN
223 COUNTY RD 1225E
DEER CREEK IL 61733

KSENIA RUDENSIVK
111 W FOX
YORKVILLE IL 60560

BUD RUFF
6800 RUFF LN
PEORIA IL 61614

JAY R & JOHN M SAMUEL
132 OAKLAWN AVE
OSWEGO IL 60543

SHARON SANDERSON
932 E MAIN
HAVANA IL 62644

GENE SARVER
ENGINEERING CONSULTANT
218 W LAFAYETTE
OTTAWA IL 61350

JOHN SASS
3001 N 15920 E RD
MOMENCE IL 60954-3019

CALRA SAVAGE
918 GRAND AVE
BEARDSTOWN IL 62618

MILTON SCHAIBLE
203 HAWTHORNE LANE
OTTAWA IL 61350

DONALD SCHIELEIN
914 EVERGREEN
CHILLICOTHE IL 61523

R G SCHLADEN
1113 W BRADLEY AVE PO BOX 6105
PEORIA IL 61606

TOM SCHRADER
75411 Midfield Drive
AURORA IL 60506

ROBERT SCHROEDER
2511 KEN MAR TER
QUINCY IL 62301

BOB SCHUESSLER
1719 N MOHAWK ST #E
CHICAGO IL 60614-5625

BOB SCOTT
126 STATE ST
EAST PEORIA IL 61611

RICHARD SCOVIL
300 W DETWEILLER
PEORIA IL 61615

DEBBIE SEARLE
12875 E 11670N
GRANT PARK IL 60940

DARRELL SEIGLER
434 PEARL ST
OTTAWA IL 61350

LEDGER SENTINEL
64 N MAIN
OSWEGO IL 60543

JOHN SEROVY
4107 W 82 PLACE
CHICAGO IL 60652

REGINA F SERRA
2580 LINDBERGH
SPRINGFIELD IL 62704

TOM SHANNON
901 ARLON RD
AURORA IL 60506

DAVID SHOMAN
3363 ADAM
MOMENCE IL 60954

GENE SHOSTRUM
300 E CONGRESS ST
OTTAWA IL 61350

RUSSELL SHRIVER
726 N 2353 RD LN
URSA IL 62376-2021

LEWIS SHRUM
247 CHICAGO ST
EAST PEORIA IL 61611

LESLIE SHUTTS
530 CASS ST
EAST PEORIA IL 61611

MARY ALICE SIEBERT
249 EDMUND ST
EAST PEORIA IL 61611

ANDREW SIEDLER
1001 N E MADISON AVE
PEORIA IL 61603

CECIL SIMMONS
2437 COLE ST
EAST PEORIA IL 61611

RICHARD SINKS
532 CASS ST
EAST PEORIA IL 61611

DONALD SKAGGS
326 CHICAGO ST
EAST PEORIA IL 61611

DAVID A SKELLY
453 W WATER ST
KANKAKEE IL 60901

JEAN SKELLY
850 W RIVER ST
KANKAKEE IL 60901

BOB SKOGLUND
708 N SCHRADER
HAVANA IL 62644

CLYDE DONALD SMITH
12 VILLA GROVE
SPRINGFIELD IL 62707

THEODORE J SMITH
406 S LIVINGSTON
SPRINGFIELD IL 62703

LASTON SMITH
405 CHICAGO ST
EAST PEORIA IL 61611

LARRY SMITH
324 EDMUND ST
EAST PEORIA IL 61611

GENE SOLOMON
505 CHICAGO ST
EAST PEORIA IL 61611

TIM SOUTHER
2224 S SPRING
SPRINGFIELD IL 61704

RICHARD SPECKMAN
203 KING ST
YORKVILLE IL 60560

FRANCIS G SPRINKEL
1648 W MONROE
SPRINGFIELD IL 62704

HENRY STAUFFER
2654 W CARMEN AVE
CHICAGO IL 60625

DAVID STELL
814 E MACARTHUR
LEWISTOWN IL 61542-1254

JAMES E STERN
1104 STEEPLECHASE LANE
SPRINGFIELD IL 62707

VERA STIDHAM
448 MONSON ST
EAST PEORIA IL 61611

BONDELYN LOU STIEFBOLD
124 CHICAGO RD BOX 406
OSWEGO IL 60543

SIGNEY STIEFEL
808 PEARL ST
OTTAWA IL 61350

DR ROBERT STINAVER
506 N PROMENADE
HAVANA IL 62644

ANNE STOSICH
341 CHICAGO ST
EAST PEORIA IL 61611

DON STOVALL
12273 SPRING LANE
MANITO IL 61546

NORM STRASMA
2 ISLAND VIEW
KANKAKEE IL 60901

WILLIAM STRONG
PO BOX 2123
OTTAWA IL 61350-6723

DON STUEDEMANN
590 LOGUE CIRCLE
SENECA IL 61360-9671

GARY SULLIVAN
3017 BENNINGTON
SPRINGFIELD IL 61704

LARRY SWIECK
6642 S KOSTNER
CHICAGO IL 60629

EDWOOD SYRJALA
PO BOX 149
CENTERVILLE MA 02632

WILLIAM C TANSKY
2746 LOWELL
SPRINGFIELD IL 61704

JIM TARLING
1871 CHARLES LN
AURORA IL 60505-1260

JACK E TAYLOR
RR 1
LEWISTOWN IL 61542-9801

L J TAYLOR
128 FRANKLIN ST
EAST PEORIA IL 61611

LOIS TEDFORD
317 PINE ST
MORRIS IL 60450

LYNNE TERRELL
3963 ROUTE 34
OSWEGO IL 60543

VERNON C THOMSON
BOX 283
LEWISTOWN IL 61542

GREGG TICHACEK
#5 VILLAGE GREEN DR
PETERSBURG IL 62675

SHELDON TOELKE
8824 W RANGE RD
LENA IL 61048

PAMELA TOLER
2414 GRANDVIEW AVE
PEORIA IL 61614

MAX TOLLEY
141 CHICAGO ST
EAST PEORIA IL 61611

MARK TOMM
610 E WARREN ST
LE ROY IL 61752-1266

S TOMMINELLO
1320 CROSS ST
PERU IL 61354

ED TONJES
200 CLARK ST
EAST PEORIA IL 61611

GEORGE & MARY TOSCANO
18 PENN CT
OSWEGO IL 60543

R L TOWNSEND
2028 S PARK AVE
SPRINGFIELD IL 62704-3404

DONALD R TRACY
700 MERCANTILE BANK BLDG - 205 S 5TH ST
SPRINGFIELD IL 62701-1489

JEFFERY TUPPER
6210 ST MARY LN
PEORIA IL 61614

MILO TURBETT JR
147 FRANKLIN ST
EAST PEORIA IL 61611

HAROLD TURNER
510 CHICAGO ST
EAST PEORIA IL 61611

GARY UPPOLE
109 RACILL CT
EAST PEORIA IL 61611

THO VAN BUI
4023 W COURTLAND
PEORIA IL 61615

LAWRENCE - RAY VINSON
114 RAYNOR
EAST PEORIA IL 61611

ROBERT VOLK
RR 1
MT STERLING IL 62353

MIRANDA VOLK
15522 RIVERBEACH
CHILLICOTHE IL 61523

RICHARD WACHENHEIM
503 AMHERST AVE
ROMEOVILLE IL 60446-1301

TESS WACKERLIN
44 E. Downer Place
AURORA IL 60507

RON WAGNER
3007 RIVER RD
KANKAKEE IL 60901

THEODORE WAGNER
7 OAKWOOD DR
OSWEGO IL 60543

DOUGLAS P WAGNER
900 AIRPORT DR
SPRINGFIELD IL 62707

DANA ROY WALKER
315 N MADISON
MACOMB IL 61455

PAUL E WALKER
1712 N 23RD ST
SPRINGFIELD IL 62702

HAROLD WALKER
125 DEVRON CIRCLE
EAST PEORIA IL 61611

HAROLD WALKER
441 SANFORD ST
EAST PEORIA IL 61611

BILL - MARLA WALLS
311 N BROADWAY
HAVANA IL 62644

JOSEPH - MARY WALSH
103-105 PFUND AVE
OSWEGO IL 60543

WILLIAM WALSH
1839 COLUMBUS ST
OTTAWA IL 61350

JOHN WALTON
160 CENTER ST
EAST PEORIA IL 61611

DAVID R WANKEL
7245 US HWY 67
BEARDSTOWN IL 62618

FLORENCE WARD
2509 HOWETT ST
PEORIA IL 61605

JEANNE B WARD
1915 HAMILTON CT
SPRINGFIELD IL 61704

JOHN WARNOCK
804 W CARROLL ST
MCOMB IL 61455

JOHN WARSAW
BOX 2302
EAST PEORIA IL 61611

J ELTON WATERS
724 RAILRD ST
JOLIET IL 60436

ROBERT WATKINS
5 OAKWOOD DR
OSWEGO IL 60543

VAL WATT
808 E LAKESHORE
SPRINGFIELD IL 62707

GARY WEBER
4101 W CHARTER OAK RD
PEORIA IL 61615

DALE WEBER
5026 N FAWVER RD
DAKOTA IL 61018

JERALD & PAT WEINER
9 BEDNARCIK CT
OSWEGO IL 60543

MIKEL WEISSER
200 S 11TH ST
SPRINGFIELD IL 62703

BOB WELKER
20391 CR 1950E
HAVANA IL 62644

CELIA WESLE
74 TRAILRIDGE LANE
SPRINGFIELD IL 62704

MARY JEAN WESTERN
13 WILDWOOD
SPRINGFIELD IL 62704

DON WHALEN
616 OAK ST
GLEN ELLYN IL 60137

CHARLES WHITMORE
16 WOOD DUCK LANE
OTTAWA IL 61350-9685

BILL WIET
44 E. Downer Place
AURORA IL 60507

RACHEL WILLIS
17740 ECR1600N
HAVANA IL 62644

DON - MARVIN WILSON
201 SUNSET ST
MANITO IL 61546

JOHN WILSON
301 N NORMAL ST
MACOMB IL 61455

MARY WINE
123 SW JEFFERSON STE 113
PEORIA IL 61602

BARBARA WINSLOW
PO BOX 305
GRAFTON IL 62037-0305

ROBERT WIRE
15 FOREST RIDGE
SPRINGFIELD IL 62707

LELAND WISER
125 CHICAGO ST
EAST PEORIA IL 61611

WILL - ROSLYN WOLFRAM
1103 E VIRGINIA AVE
PEORIA IL 61603

DON WOLLAND
1314 W TOBI LANE
PEORIA IL 61614

ARTHUR WOLLARD
238 FRANKLIN ST
EAST PEORIA IL 61611

BUDD WORMLEY
13 S. ADAMS, P.O. BOX 765
OSWEGO IL 60543

MARILYN WORTH
6 OLD ORCHARD
KANKAKEE IL 60901

RICHARD WRIGHT
1075 JUSTINE DR
KANKAKEE IL 60901

LAURI - BARRY WRIGHT
19 MARQUETTE
SPRINGFIELD IL 62707

MARY - RON WRIGHT
113 MONSON ST
EAST PEORIA IL 61611

RAWLEIGH YOUNG
251 CHICAGO ST
EAST PEORIA IL 61611

ERNIE ZAHNER
140 FRANKLIN ST
EAST PEORIA IL 61611

ROBERT ZENK
317 INDIAN
EAST PEORIA IL 61611

ANGELO ZERBONIA
514 JUSTA RD
METAMORA IL 61548

ARTHUR ZWEMKE
1351 DAVEY DRIVE
BATAVIA IL 60510

MELVIN MEIN
C-O SHERMAN BURRUS
109 E WASHINGTON ST
EAST PEORIA IL 61611