



REPLY TO  
ATTENTION OF:

CEMVR-PM-M

**DEPARTMENT OF THE ARMY  
ROCK ISLAND DISTRICT, CORPS OF ENGINEERS  
CLOCK TOWER BUILDING - P.O. BOX 2004  
ROCK ISLAND, ILLINOIS 61204-2004**

April 7, 2000

**GENERAL INVESTIGATION RECONNAISSANCE STUDY  
ROCK RIVER BASIN, ECOSYSTEM RESTORATION**

**Section 905(b) Reconnaissance Analysis**

**1. STUDY AUTHORITY.** The Rock River Basin Ecosystem Restoration Study is being carried out under the Corps of Engineers General Investigations (GI) Program in partnership with the Wisconsin Department of Natural Resources and the Illinois Department of Natural Resources. The study was initiated pursuant to the provision of funds in the Energy & Water Development Appropriations Act, 1990. The study was authorized by House Resolution 2353, which reads:

“Resolved by the Committee on Public Works and Transportation of the United States House of Representatives, That the Board of Rivers and Harbors is hereby requested to review the reports of the Chief of Engineers on Rock River, Illinois and Wisconsin, published as House Document 112, Eightieth Congress, First Session, and other pertinent reports, with a view to determine the advisability of modifications of the recommendations contained therein in the interest of flood control and related water resources purposes with particular emphasis on Freeport, Illinois.”

The Rock Island District of the U.S. Army Corps of Engineers received \$100,000 in Federal Fiscal Year 1999 funds to conduct the reconnaissance phase of study and develop a Project Study Plan for the feasibility phase.

**2. STUDY PURPOSE.** The purposes of this reconnaissance study are to: (1) determine if there is a Federal interest consistent with Army policies, costs, benefits and environmental impacts in restoring fish and wildlife habitat; reducing sedimentation impacts to the fish and wildlife habitat in the Rock River Basin and providing opportunities in water and related land resources projects and planning services within the Rock River watershed; (2) prepare a Project Study Plan; and (3) assess the level of interest and support from non-Federal entities in cost-sharing for the feasibility phase and project construction. This report addresses items 1 and 3. The Project Study Plan will be developed separately. Specific attention was 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 condition. If proposed restoration activities would significantly reduce flood profiles or provide flood protection, flood damage reduction benefits will be analyzed.

**3. LOCATION OF STUDY AREA/CONGRESSIONAL DISTRICT.**

a. The Rock River originates in the lake region of southeastern Wisconsin and flows southward to the Wisconsin-Illinois state line, from which point it swings in a wide arc to the southwest, joining the Mississippi River just below the city of Rock Island, Illinois, 479.1 miles above the mouth of the Ohio River (Attachment 1). The watershed includes all or parts of 13 counties in Wisconsin and 15 in Illinois. The total area of the Rock River watershed is 10,850 square miles. The main stream of the system is 318 miles in length from its source in Fond du Lac County, Wisconsin, to its mouth. Major tributaries of the Rock River are the Green River, Rock Creek, Elkhorn Creek, Kishwaukee River, Pecatonica River, Sugar River, Turtle Creek, Yahara River, and the Crawfish River.

b. The Rock River Basin lies within Illinois and Wisconsin Congressional Districts. The Wisconsin Congressional Districts are 1<sup>st</sup> (Paul Ryan - R), 2<sup>nd</sup> (Tammy Baldwin - D), 6<sup>th</sup> (Thomas Petri - R), and

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9<sup>th</sup> (James Sensenbrenner Jr. - R). The Illinois Congressional Districts are the 14<sup>th</sup> (Dennis Hastert - R), 16<sup>th</sup> (Donald Manzullo - R), and 17<sup>th</sup> (Lane Evans - D).

#### 4. DISCUSSION OF PRIOR STUDIES, REPORTS AND EXISTING WATER PROJECTS.

a. **Prior Studies and Reports.** In conducting this analysis, a number of documents were consulted that were prepared by the U.S. Army Corps of Engineers, the Wisconsin Department of Natural Resources (DNR), the Illinois DNR, the U.S. Fish and Wildlife Service, and the University of Wisconsin. Some of the most notable studies and actions are:

(1) **Lower Rock River Basin Water Quality Management Plan**, October 1998, Wisconsin Department of Natural Resources. This report outlines actions that the Wisconsin DNR, industries, communities, counties, and other agencies need to take to protect and improve the waters of the basin and is required by Section 208 of the Federal Clean Water Act.

(2) **Sugar-Pecatonica Rivers Water Quality Management Plan**, March 1995, Wisconsin Department of Natural Resources. This report outlines actions that the Wisconsin DNR, industries, communities, counties, and other agencies need to take to protect and improve the waters of the basin and is required by Section 208 of the Federal Clean Water Act.

(3) **Upper Rock River Basin Water Quality Management Plan**, December 1995, Wisconsin Department of Natural Resources. This report outlines actions that the Wisconsin DNR, industries, communities, counties, and other agencies need to take to protect and improve the waters of the basin and is required by Section 208 of the Federal Clean Water Act.

(4) **Environmental Assessment of the Refuge Master Plan, Horicon National Wildlife Refuge, Wisconsin**, December 1978, U.S. Department of the Interior, Fish and Wildlife Service, Twin Cities, Minnesota.

(5) **The Removal of Small Dams: An Institutional Analysis of the Wisconsin Experience**, Extension Report 96-1, May 1996, Department of Urban and Regional Planning, University of Wisconsin-Madison/Extension. This report provides an overview of Wisconsin's experience with smaller dam removals through an in-depth review of 14 dams that have been removed. The report identifies key issues that influence the decision and describes how state and local institutions shape these decisions.

(6) **Sugar-Pecatonica Area Assessment, Volumes 1, 2, and 3**, 1998, Illinois Department of Natural Resources. These reports examine an area in north-central Illinois along the Wisconsin/Illinois border. Volume I discusses the geology, soils, and minerals in the assessment area. Volume II discusses the surface and ground water resources. Volume III describes the natural vegetation communities and the fauna of the region.

(7) **Inventory of Resource Rich Areas in Illinois, An Evaluation of Ecological Resources**, 1996, Illinois Department of Natural Resources. This report discusses certain areas in Illinois that have been declared resource rich areas based on their forest, wetland, and biologically significant stream resources and other natural areas. Four (4) of the 30 identified Resource Rich Areas in Illinois are found in the Rock River Basin. The four Resource Rich Areas include the following: (1) the Sugar River in northern Winnebago County, Illinois; (2) the Kishwaukee River in McHenry and Boone Counties, Illinois; (3) the Rock River between Rockford and Dixon; and (4) the Mississippi-Lower Rock River which includes the Rock River downstream of Sterling-Rock Falls to its confluence with the Mississippi River.

(8) **Rock River Macrosite: Stewardship and Cultural Values, Parts I, II, and III.** These reports view the geographical and cultural aspects of the Rock River and its habitats.

(9) **Rock River Area Assessment Volumes I and II**, November 1996, Illinois Department of Natural Resources. This report examines an area of the Rock River situated in northern Illinois. Volume I summarizes the physical setting of the area including its geology, soils, minerals, and surface and ground

water. Volume I also describes the terrestrial and aquatic flora and fauna of the area. Volume II discusses the demographics, infrastructure, and economy of the area as well as the ecology of the area as recorded by historical writings.

**(10) Lower Rock River Area Assessment, Volumes I, II, III, and IV**, 1998, Illinois Department of Natural Resources. These reports examine an area in northwestern Illinois formed by the Rock River and Green River systems. Volume I discusses the geology, soils, and minerals in the assessment area. Volume II discusses the surface and ground water resources. Volume III describes the natural vegetation communities and the fauna of the region. Volume IV discusses the socioeconomic profile, environmental quality, and archaeological resources of the Lower Rock River Area.

**(11) Freeport on Pecatonica River, Illinois, Reconnaissance Report for General Investigations Study**, August 1995, U.S. Army Corps of Engineers, Rock Island District. Based on preliminary engineering, economic, and environmental analyses, the reconnaissance study determined that a levee and floodwall would effectively reduce flood damages in the study area with a benefit-to-cost ratio of 1.03. As the reconnaissance report recommended, the flood damage reduction study proceeded to the feasibility phase, but was terminated early in the study based upon a finding that there was no implementable plan due to floodway impacts. Construction of a levee would have violated state floodplain regulations.

**(12) Rock River Basin, Wisconsin, The Effects of Wetlands on Flood Intensities**, September 1981, U.S. Army Corps of Engineers, Rock Island District. This report was prepared at the request of the Wisconsin Department of Natural Resources to attempt to quantify and model the impact of wetlands on flood intensities. This report is intended to provide some insight into the magnitude of the reduction in peak flows that can be expected, and why these reductions occur.

**(13) Phase I: General Design Memorandum, Flood Damage Reduction Rock River, Illinois, Agricultural Levees, Stage 3 Report**, August 1984, District Engineer, U.S. Army Engineer District, Rock Island. This report evaluates structural and nonstructural alternatives to flood damage reduction in five agricultural areas along the lower Rock River in Rock Island, Henry, and Whiteside Counties, Illinois, including the communities of Hillsdale, Erie, Joslin, and Barstow. A number of economically justified plans in the Erie-Hillsdale area were identified, but these plans were not acceptable. Plans that involved raising the levee along its existing alignment were unacceptable because these plans would violate State of Illinois stage and discharge criteria and induce flood damages downstream. The setback plans were unacceptable to the Village of Erie because they left too much land unprotected. The report concludes that further work was not warranted at this time due to the lack of economic justification for an implementable project.

**(14) Rock River, Rockford and Vicinity, Illinois (Loves Park Interim)**, October 19, 1983, Chief of Engineers, Department of the Army. This study was made to develop and analyze alternative programs designed to reduce flood damage and urban drainage problems in the Large and Small Unnamed Creek Basins in the vicinity of Loves Park, Illinois.

**(15) Lower Rock River Flood Protection Feasibility Study**, November 1979, U.S. Army Corps of Engineers, Rock Island District. This study is directed at developing and analyzing alternative programs to reduce flood damages and to enhance water and related land resources within the floodplains of the lower Rock River.

**(16) Rock River, Rockford, Illinois and Vicinity Final Report, Main Report**, July 1981, U.S. Army Corps of Engineers, Rock Island District. This study is directed toward evaluating alternative programs to reduce flood damages and to enhance water and related land resources within Rockford and vicinity.

**(17) Operation and Maintenance Manual for Completed Local Flood Protection Works, Penny Slough Levee Project, Henry and Whiteside Counties, Illinois**, September 1946, Rock Island Engineer District.

**(18) Lower Rock River Feasibility Study for Flood Damage Reduction**, September 1981, U.S. Army Corps of Engineers, Rock Island District. This report evaluates several alternative programs for reducing flood damages along the lower 14 miles of the Rock River from Green Rock, Illinois, to the confluence with the Mississippi River. No structural or nonstructural alternatives were economically feasible.

**(19) Survey Review of Reports for Flood Control on Lower Rock River and Green River, Illinois, Main Report**, January 17, 1956, Rock Island District Corps of Engineers, U.S. Army. This report was printed as House Document No. 173, Eighty-fifth Congress, First Session. As a result of this report, Congress in 1958 authorized five local protection projects along the lower Rock River in Illinois.

**(20) Comprehensive Report on Reservoirs in Mississippi River Basin**, August 2, 1935, Chief of Engineers, United States Army. This report contains data on possible flood control reservoirs on the Rock River at Barstow, Illinois, and on the Pecatonica River near Rockton, Illinois.

**b. Existing Water Projects in the Basin.** Several ongoing actions call for a collaborative effort between local, state, and Federal agencies to address water and related land resources within the Rock River Basin. Significant actions include:

**(1) Section 206 Activities in the Rock River Basin.**

**Token Creek, Dane County, Wisconsin.** Stream restoration on Token Creek, which flows into the Yahara River, a tributary to the Rock River. This project is located immediately northeast of Madison, Wisconsin. The Wisconsin DNR and the Town of Windsor are the cost-share sponsors. Project has been approved by MVD and is in the Ecosystem Restoration Report (ERR) phase. Project cost is estimated at \$4.7 million.

**Lake Belle View, Dane County, Wisconsin.** Stream and lake restoration at Lake Belle View on the Sugar River, a tributary to the Rock River. This project is located southwest of Madison, Wisconsin. The Village of Belleville, Wisconsin, is the cost-share sponsor. Project has been approved by MVD and is in the feasibility phase. Project cost is estimated at \$5.8 million.

**Jefferson Dam, Jefferson County, Wisconsin: Fish Bypass at the Jefferson Dam on the Rock River, east of Madison, Wisconsin.** The City of Jefferson is the cost-share sponsor. The Project Restoration Plan has been submitted to MVD for approval in February 2000. The total project cost is estimated at \$774,000, with an estimated construction cost of \$584,000.

**Brodhead Dam, Sugar River in Green County, Wisconsin.** Fish bypass at the Brodhead Dam on the Sugar River. The City of Brodhead is the cost-share sponsor. The Preliminary Restoration Plan was initiated in September 1999, but was delayed pending the outcome of a community referendum regarding dam removal. Finalization of the Preliminary Restoration Plan is dependent on city council acceptance of the proposed fish bypass.

**Koshkonong Creek, Dane County, Wisconsin.** Aquatic ecosystem restoration; enhance 89 hectares (220 acres) of wetlands and re-meander/restore creek channel. The City of Sun Prairie is the cost share sponsor. Project cost is estimated at \$2.8 million. The project has been approved by MVD; awaiting funding.

**Lake Koshkonong, Rock, Jefferson, and Dane Counties, Wisconsin.** Aquatic ecosystem restoration at Lake Koshkonong on the Rock River; wetland restoration and shoreline protection. The Rock-Koshkonong Lake District is the cost share sponsor. The Preliminary Restoration Plan was initiated in February 2000.

**(2) Partnerships and Ongoing Water Resource Projects and Programs.**

**Conservation 2000, Illinois.** Conservation 2000 (C2000) is a 6-year, State of Illinois program designed to reverse the decline of the state's ecosystems identified by Critical Trends Assessment Project Phase I. C2000 will fund nine new programs in three State of Illinois agencies with a total of \$100 million.

**C2000 Ecosystem Partnerships, Illinois.** Ecosystems Partnership Program is a C2000 program to support cooperative public-private partnerships that merge natural resource stewardship with compatible economic and recreational development. The Ecosystems Program (1) provides technical assistance to the Ecosystems Partnerships, (2) assesses resources in the area encompassed by each Ecosystem Partnership, and (3) funds site-specific ecosystem projects recommended by each partnership. Ecosystem projects may involve habitat protection and improvement, technical assistance, research, and education. Four Ecosystems Partnerships operate within the Rock River boundaries—Sugar-Pecatonica, Upper Rock River, Kishwaukee River, and Lower Rock River. The partnerships are coalitions of local stakeholders—private landowners, business people, natural scientists, recreation enthusiasts, local policy makers, etc.—united by a common interest in the natural resources of their area’s watershed. Grants are provided to the partnerships for projects that preserve and enhance the region’s resources, while addressing local economic and recreational concerns. Between fiscal years 1996 and 2000, the Illinois DNR awarded C2000 funds to 46 projects in the Rock River Basin. A total of \$3.5 million was spent on these projects, with \$1.1 million coming from C2000 and \$2.4 million coming from local matching funds.

**State of Illinois Natural Resources Coordinating Council (NRCC).** In 1994, Governor Jim Edgar’s administration created the NRCC to address and coordinate issues between the state’s natural resource and environmental agencies. The NRCC consists of the directors of eight Illinois state agencies, including the Environmental Protection Agency; The Pollution Control Board; and the Departments of Natural Resources, Agriculture, Public Health, Commerce and Community Affairs, Transportation, and Nuclear Safety.

**The Rock River Watershed Partnership, Wisconsin.** The Rock River Watershed Partnership is a stakeholder group committed to addressing nutrient and other water quality management issues within the Rock River Watershed in an integrated, holistic manner using the tools of watershed-based planning/decision making. The partnership group includes municipal and industrial wastewater treatment plants, county land conservation commissions, lake and conservation organizations, industries, agriculture, and private citizens. This partnership is evaluating a market-based mechanism for phosphorus point to nonpoint pollution credit trading to improve water quality in the Rock River Basin in Wisconsin. This group has voted to merge with the Rock River Coalition.

**The Rock River Coalition (RRC), Wisconsin.** The Rock River Coalition is a basin-wide non-profit volunteer organization founded in 1994. Its 65 members are private citizens, conservation organizations, private industries, and local and state agency staffs. The purpose of the RRC is to make the Rock River more useful, beautiful, and enjoyable by increasing cooperation among communities, organizations, and individuals to preserve and promote our shared cultural, economic, and environmental resources. The Rock River Coalition is the official partnership group for the Wisconsin DNR for the Upper and Lower Rock River Basin geographical management units in Wisconsin. Seven issue teams are developing and implementing basin-wide actions in the areas of ground water, surface water, wetlands, shorelands, recreation, hunting and fishing, and land use.

**The Rock River Basin Forum.** The forum, Partnerships for the Future, is a major project sponsored by the Rock River Coalition, Rock River Partnership, UW Extension, and the Wisconsin DNR to develop a stakeholder initiative, bringing together individuals from business, government agencies, and civic, conservation, and community organizations to work on resolving issues throughout the basin. Seven issues teams were developed from the forum. Liaisons were chosen for each issue, and action plans are being developed.

**State of Wisconsin Unified Watershed Assessment and Watershed Priorities Workgroup.** In conjunction with the Clean Water Action Plan, the Natural Resources Conservation Service and the Wisconsin DNR jointly developed consistent nonpoint source project selection processes. Federal Environmental Quality Incentives Program (EQIP), 319 nonpoint source funds, and state nonpoint source funds are working together in more than six priority areas—consistent with the Clean Water Action Plan’s theme of cooperatively working to restore and protect water quality on a watershed basis.

**State of Wisconsin Nonpoint Source Pollution Program.** The Wisconsin DNR and the Department of Agriculture, Trade and Consumer Protection (DATCP) are working in partnership to provide support and

funding for five nonpoint source priority watershed projects. A number of smaller, individual, nonpoint projects that are primarily urban are funded under the nonpoint Targeted Resource Management Program (TRiM). Wisconsin's Nonpoint Source Program is undergoing significant changes, and in the last funding cycle received a large increase in funding for both urban and rural projects.

**The Upper Sugar River Initiative, Wisconsin.** The Upper Sugar River Initiative grew out of evolving pressure on the state's water resources, population growth, wastewater management and tightening fiscal resources. The Upper Sugar River Initiative is a project funded by a U.S. Environmental Protection Agency grant to involve stakeholders in the process of analyzing the Upper Sugar River Basin's pressing ecological issues, identifying solutions to those issues, and developing an action plan that addresses one or two priority issue areas such as sedimentation, habitat restoration, or growth and land use impacts in the watershed.

**Yellowstone Watershed Integrated Ecosystem Management Project.** This project is a partnership between the State of Wisconsin; U.S. Department of Agriculture; Lafayette County; Iowa County; Southwest Badger Resource, Conservation and Development Council; University of Wisconsin Extension; and several local conservation clubs. Efforts include land conservation practices in the watershed, instream habitat improvement, educational efforts, carp removal, stocking of predator fish, restrictive bag and size limits in the lake, and installation of a handicap accessible fishing facility.

**Rock River 2000 Sustainability Project, Wisconsin.** The Rock River 2000 Sustainability Project is a University of Wisconsin-Cooperative Extension demonstration project developing community environmental programs for businesses to help increase control of contaminant emissions into the environment. Their goal is to improve the level of compliance with environmental regulations through public education to increase awareness about environmental sustainability.

**Horicon Marsh Area Coalition, Wisconsin.** The Horicon Marsh Area Coalition is a collaborative watershed-based organization founded in 1993 comprised of 200 stakeholders representing citizens, interest groups, agencies, and local government agencies. Their goal is to build a future that balances environmental, economic, and social aspects of a unique ecosystem—the Horicon Marsh and its surrounding areas.

**Draft Fish Passage Guidance, Wisconsin.** Recent state legislation requires that administrative rules be developed for fish passage policy and states that fish passage cannot be required unless adequate state or Federal funds are available. The Wisconsin DNR is drafting guidance for fish passage on Wisconsin's rivers and streams. This document will describe the importance of fish movement within river systems. The document will guide DNR staff in evaluating the feasibility of fish passage at dams, recommending fish passage where appropriate, identifying pre-design criteria for fishways, and evaluating the effectiveness of constructed fishways.

**5. PLAN FORMULATION.** A number of local, state, and Federal agencies; academic institutions; and citizens groups have expressed interest in the reconnaissance study and participated in the initial development and formulation of the 905(b) Reconnaissance Analysis.

The Rock Island District has conducted numerous site visits to the study area to meet with local representatives, identify problems and needs, and evaluate potential actions to be addressed in the reconnaissance study. Based upon extensive coordination with the non-Federal customers and other stakeholders interested in the restoration and environmental well-being of the Rock River Basin, the following project evaluation criteria were developed for the reconnaissance study phase:

- Likelihood of developing technologically feasible and cost-effective actions to address problems in the watershed;
- Demonstrated national, regional, and local significance of the ecological resources within the study area;
- Reasonable probability that identified actions and alternative projects will contribute significantly to improvement in the ecosystem of the basin and are within the authority of the Corps of Engineers, other Federal agencies, or the non-Federal customers to implement;

- Ability to demonstrate a clear linkage between implementation of a plan and measurable improvements in the ecosystem; and
- Reasonable assurance that non-Federal sponsors will be identified who are capable and willing to participate in a cost-shared feasibility study.

**a. Identified Problems.**

**(1) Existing Conditions.**

**(a) General Description.** The Rock River originates in the lake region of southeastern Wisconsin and flows southward to the Wisconsin-Illinois state line, from which point it swings in a wide arc to the southwest, joining the Mississippi River just below the city of Rock Island, Illinois, 479.1 miles above the mouth of the Ohio River. The watershed includes all or parts of 13 counties in Wisconsin and 15 in Illinois. The total area of the Rock River watershed is 10,850 square miles. The Rock River is 318 miles in length from its source in Fond du Lac County, Wisconsin, to its mouth. The total fall from source to mouth is 500 feet, giving an average slope of 1.57 feet per mile. Major tributaries of the Rock River include the Green River, Rock Creek, Elkhorn Creek, Kishwaukee River, Pecatonica River, Sugar River (tributary of the Pecatonica River), Turtle Creek, and the Yahara River. Table 1 shows data concerning these major tributaries.

**Table 1. Major Tributaries of the Rock River**

Tributary	Drainage Area (square miles)	Mouth (miles above Mississippi River)	Source	Length (main channel miles)	Average Slope (feet per mile)
Green River	1,080	13.0	Lee County, IL	86	2.37
Rock Creek	246	41.4	Carroll County, IL	45	2.55
Elkhorn Creek	248	65.2	Ogle County, IL	42	3.22
Kishwaukee River	1,245	130.0	McHenry County, IL	54	2.95
Pecatonica River	2,625	157.1	Iowa County, WI	143	0.66
Sugar River (tributary of Pecatonica River)	757	163.8	Dane County, WI	63	2.18
Turtle Creek	256	162.5	Walworth County, WI	37	4.19
Yahara River	562	190.6	Dane County, WI	52	1.54
Crawfish River	*	*	Columbia County, WI	31.5	*
East Branch, Rock River	*	*	Washington County, WI	45	*

\* Data unavailable

**(b) Topography.** With the exception of the upper reaches of the Pecatonica, which are located in the driftless area of southwestern Wisconsin and northwestern Illinois, the entire Rock River watershed has been covered at various times by the Pleistocene ice sheets. The existing topography of the region has been largely determined by glaciation. At some locations such as near Oregon, Illinois, on the main river; near McConnel, Illinois, on the Pecatonica; and in the lower reaches of the Kishwaukee, the preglacial channels of the stream were blocked by morainal drift and the streams have been forced to cut new channels through rock ridges, resulting in narrow gorges. At other locations, the existing stream flows through a floodplain that was carved out by much larger streams during the periods when the ice sheets were receding. An example of this condition is found in the Rock River Valley between Erie and Barstow. The area above Janesville, Wisconsin, is generally flat and poorly drained and contains many lakes and marshes, the relief being furnished by mounds and ridges of drift material rising above the general plain. The headwaters of the Pecatonica River, lying in the driftless area of Wisconsin, present a typically mature topography, practically all of the area being in slope. The maximum relief in the Rock River Basin, about 500 feet, is found in this region. The maximum relief in the glaciated areas is about 200 feet.

**(c) Geology.** The sedimentary rocks underlying the Rock River Basin all belong to the Paleozoic era and range in age from the Pennsylvanian limestones, which outcrop in the bluffs near the mouth, to the St. Peter sandstone and Oneota limestone, which outcrop in the bluffs near Oregon, where two anticlinal folds intersect to form a dome. With the exception of the driftless area in the headwaters of the Pecatonica and Sugar Rivers, the entire watershed is covered with a mantle of drift material deposited by the

various ice sheets. The rocks of economic importance in the area are the Galena limestone and other strata of the Ordovician period in the driftless area, which are used for stone protection and Portland Cement concrete aggregate; the St. Peter sandstone in the vicinity of Oregon, which furnishes a good quality of glass sand; and coal deposits of the Green River Basin. Deposits of sand and gravel of economic importance are found at many points in the glacial drift.

Unique glacial formations occur in the upper Rock River Basin. They consist of pitted outwash plains with small lake remnants and hills of sand and gravel. Ground moraines extend across large portions of the land. Within and on these are formations such as drumlins (elongated mounds of sand and gravel), and eskers of outwashed sand and gravel deposits. Many of the tributaries contain valley trains of alluvial sands and gravels. The Driftless Area is situated primarily in southwest Wisconsin, but also includes portions of southeast Minnesota, northwest Illinois, and northeast Iowa. The Driftless Area has a rugged stream-dissected landscape developed on sedimentary rocks of Early Paleozoic age. Characteristic features of glaciation such as moraines, glacial lakes, and striated bedrock are not present in the Driftless Area. Some workers concluded that the area had never been glaciated and referred to the area as being driftless. Another more widely held view is that glacial ice did cover the area, but that subsequent erosion has removed all, or nearly all, of the evidence of glaciation. The latter view is supported by observations in northeast Iowa where patches of Nebraskan drift have been noted on the uplands in the so-called Driftless Area.

**(d) Land Use.** Land use in the Rock River Watershed ranges from rural-agricultural to intensely urbanized. The dominant land use and industry in the watershed is agriculture, primarily row cropping and livestock operations. The farmland is generally productive. The primary row crops are corn and soybeans with some oats and hay. Counties within the Rock River watershed are among the top producers of cattle and hogs in their states. Dairying is a dominant land use in much of the Wisconsin portion of the watershed. A variety of incentives are offered through U.S. Department of Agriculture programs to encourage use of best management practices such as minimum or no tillage, planting riparian buffer strips, and setting aside land for conservation; however, landowner participation in these programs has not reached its full potential.

Major urban areas in the watershed include Madison, Janesville, and Beloit, Wisconsin; and Rockford, De Kalb, Moline, and Rock Island, Illinois. Smaller cities include Dodgeville, Monroe, Beaver Dam, Watertown, Oconomowoc, Jefferson, Fort Atkinson, and Delafield-Hartland, Wisconsin; and Sterling, Dixon, Freeport, and Rochelle, Illinois. Urban sprawl from the central urban regions to surrounding suburban areas has resulted in the loss of prime agricultural land, wetlands, and other open spaces in the basin.

**(e) Water Quality.** Activities in the basin have affected the water quality of rivers, streams, and lakes in the Rock River Basin. Most streams in the basin have been affected by urban and rural non-point source pollutants.

The Index of Watershed Indicators (IWI) is an index developed by the U.S. Environmental Protection Agency that compiles information on the health of aquatic resources in watersheds. The IWI looks at a variety of indicators that point to whether rivers, lakes, streams, and wetlands are “well” or “ailing” and whether activities on the surrounding lands that affect these waters are placing them at risk. The index is two-part, characterizing both the seriousness of water quality problems and the watershed’s vulnerability to stressors. Table 2 shows the IWI characterization for the major watersheds in the Rock River Basin.

**Table 2. Index of Watershed Indicators, U.S. Environmental Protection Agency**

Rating (1-6, 1 is best)	Water Quality and Vulnerability Descriptor	Name of Watershed
1	Better water quality Low vulnerability to stressors	
2	Better water quality High vulnerability to stressors	
3	Less serious water quality problems Low vulnerability to stressors	Sugar River Watershed Pecatonica River Watershed Kishwaukee River Watershed Lower Rock River Watershed Green River Watershed
4	Less serious water quality problems High vulnerability to stressors	Upper Rock River Watershed
5	More serious water quality problems Low vulnerability to stressors	Crawfish River Watershed
6	More serious water quality problems High vulnerability to stressors	

In accordance with Section 303(d) of the Clean Water Act, the states of Wisconsin and Illinois have identified waters that are not meeting water quality standards. A total of seventy (70) waterbodies in the Rock River Basin were identified as not meeting water quality standards—56 in the Wisconsin portion of the basin and 14 in the Illinois portion of the basin. Reasons for listing include flow alternations, nutrients, mercury, turbidity, organic enrichment, low dissolved oxygen, thermal modifications, pesticides, toxics, ammonia, siltation, suspended solids, noxious aquatic plants, and other habitat alternations. A water quality monitoring study conducted by the Wisconsin DNR shows that the Horicon Marsh watershed has the highest per acre loading of phosphorus and sediment in the basin.

Land use practices in the basin affect water quality. Agriculture has affected the watershed through drained and altered wetlands; stream channelization; increased runoff carrying soil, nutrients and pesticides to surface waters; and ground water contamination. Growth of suburban areas can result in water quality problems due to runoff from construction sites and increased runoff from expanding impervious surfaces such as streets, parking lots, and roofs. Construction site erosion is a major source of suspended solids and nutrients. In growing suburban areas, the amount of storm water runoff is often increased due to increased amount of hard surfaces and loss of naturally vegetated recharge areas where water sinks into the ground. Sprawl increases the number of homes using fertilizers, pesticides, and possible septic systems.

Hydrologic modifications such as dams, stream channelization and diversion, instream modification, and ditching and draining of wetlands are significant contributors to lower water quality in the basin. Numerous low-head dams trap nutrient-rich sediment, effectively reducing the stream's depth, increasing water temperature, and precipitating algal problems.

Many of the lakes in the Rock River Basin are shallow impoundments on streams with similar problems such as turbidity, sedimentation, high nutrient loading, and excessive algae growth and blooms. These problems are common for impoundments due to their high land drainage area to water surface area ratio.

A number of streams and lakes with high water quality are found in the basin, including cold water trout streams. Some examples are Rock Lake, Oconomowoc Chain of Lakes, Allen Creek, Turtle Creek, Bluff Creek, Spring Brook, Mount Vernon Creek and its tributaries, Story Creek, Raccoon Creek, Rutland Branch of Badfish Creek, and Scuppernong Creek. Increased development and changes in land use practices in their respective watersheds may result in water quality problems in the future.

Current and depth of the Rock River and its tributaries have been significantly altered by the construction of channel dams that have created pools throughout most of the mainstem of the Rock River and on many of its

tributaries. Seven dams are present on the mainstem of the Rock River in Illinois. These dams are found at Rock Island, Rock Falls, Sterling, Dixon, Oregon, Rockford, and Rockton. Ten (10) dams are found on the mainstem in Wisconsin with locations at Beloit, Janesville (2 dams), Indianford, Jefferson, Watertown (2 dams), Hustiford, and Horicon Marsh (2 dams). Dams at Rock Falls, Sterling, Dixon, Rockton, Beloit, Janesville, and Watertown are hydropower dams. Including those on the tributaries, there are approximately 219 dams in the Wisconsin portion of the watershed and 43 dams in the Illinois portion of the watershed.

Dams can affect streams by decreasing instream flow or augmenting flows, which in turn can change the stream morphology, plant communities, and habitat. Dams affect migratory and resident organisms instream, including blocking fish migration. Dams can create thermal conditions unfavorable for river organisms and can create a thermal barrier for upstream movement of coldwater species such as trout. Dams disrupt flow of sediments in the stream. When sediment loads are reduced, scouring of the downstream streambed and banks can occur, resulting in an incised channel and loss of instream and riparian habitats.

Water quality of the Rock River Basin is not just a local problem, but may impact nationally significant resources. The Rock River water quality affects receiving waterbodies such as Mississippi River and the Gulf of Mexico. Nutrient-rich waters from the Mississippi River Basin have been implicated as a contributor to seasonally depleted oxygen levels in the Gulf of Mexico known as Gulf Hypoxia. Reduction in the nutrient loads of Rock River waters entering the Mississippi River may contribute to reducing the extent of the Gulf hypoxic zone.

**(f) Flood History.** Agricultural and urban areas throughout the Rock River Basin have experienced flooding. In the past 65 years, the Corps has prepared numerous reports evaluating ways to reduce flood damages on the Rock River and its tributaries. The Corps has constructed flood control projects along the Kishwaukee River in De Kalb, Illinois; and along the Rock River in Milan, Illinois, and Penny Slough Drainage and Levee District in Henry and Whiteside Counties, Illinois. Portions of the Loves Park Flood Control Project along the Rock River in Loves Park, Illinois, are complete and functioning; the remaining portions (Stages I-A and I-B) are scheduled for completion in Calendar Years 2000 and 2002, respectively. Many of the studies concluded that structural flood control measures were not economically justified. Other studies such as that for Freeport, Illinois, were terminated because implantation of an economically justified plan would have violated state floodplain regulations.

The Corps continues to respond to flood events in the Rock River Basin in accordance with 69 Stat. 186, Public Law 84-99, Flood and Coastal Storm Emergencies. The Rock River Basin experienced flooding at least three times during the spring of 1993, resulting in flood damages at riverfront communities, including Erie, Hillsdale, Cleveland, Barstow, Joslin, and Moline, Illinois. Nearly 600 residential and commercial structures were flooded along the lower Rock River. A non-Federal levee at the Zuma Canoe Township Special Service area was overtopped, resulting in damages to agricultural and residential properties. This levee has since been repaired under the authority of Public Law 84-99, at a cost of \$130,000. Flood damages also occurred in 1996.

In addition to the Penny Slough Drainage and Levee District, which is a Federal levee, there are six non-Federal levees along the Rock River in Whiteside County. When these levees are overtopped, the protected areas fill with floodwaters, reducing peak flood heights downstream and providing relief to downstream areas. In past studies, the Corps evaluated structural and non-structural alternatives to reduce flood damages in these areas and was unable to identify an implementable project that was economically justified.

The Wisconsin portion of the Rock River Basin has also experienced considerable flooding. In 1993, there was extensive flooding in Jefferson County near Blackhawk Island. Numerous residents were forced to leave their homes and many were evacuated for up to 6 weeks as the floodwater slowly retreated. In response, Jefferson County developed a County Flood Mitigation Plan. Using FEMA grants, the county has purchased 30 residences and restored the property to a natural state. Landowners in the vicinity of the Town of Lebanon, Wisconsin, experienced flooding in 1999 and met with state legislative representatives during the summer of 1999 to inquire whether operation of upstream dams affects the height and duration of flooding on their properties. There are historic flooding problems between Hustiford and Watertown, Wisconsin.

Darlington, Wisconsin, on the Pecatonica River has experienced property damage due to flooding. A flood mitigation program involving floodproofing and warning systems is underway.

**(g) Natural Resources.** The Rock River Basin supports a wide variety of flora and fauna. Natural communities in the Rock River Basin include forest (upland, floodplain and sand), prairie (sand, gravel, and dolomite prairies), savanna, and wetlands (marsh, bog, shrub swamp, sedge meadows, fens, and seeps).

- **Aquatic.** Streams of the Rock River Basin support 41% of the fish, 42% of the mussels, and 25% of crayfish species native to Illinois. Aquatic insects for the area include 29 mayfly species and 29 caddisfly species. One hundred nine (109) species of fish have been recorded in the Rock River system in Illinois. Common fish in the larger rivers are gizzard shad, carp, spotfin shiners, bullhead minnows, smallmouth and largemouth buffalo, channel catfish, smallmouth bass, white bass, white and black crappies, walleye, northern pike, and freshwater drum. Common fish in creeks and rivers include bluntnose minnows, central stonerollers, common shiners, bigmouth shiners, spotfin shiners, sand shiners, white suckers, green sunfish, bluegills, and johnny darters. Common fish in headwaters are creek chubs, southern redbelly dace, common shiners, and brook sticklebacks. A number of state endangered or threatened species are known to occur in the Rock River Basin, including the lake sturgeon, pallid shiner, blacknose shiner, weed shiner, western sand darter, Iowa darter, rosyface shiner, slender madtom, redbelly dace, river redhorse, blackchin shiner, and gravel chub. The lake sturgeon has recently (1992) been found in the Rock River in Rock Island County.

A comprehensive survey of the mussels in the basin has not been done recently. Based on sporadic surveys, mussel species in the basin include white heelsplitter, plain pocketbook, squawfoot, maple leaf, pimpleback, mucket, and Wabash pigtoe. A number of mussel species have been reported from the Rock River Basin and its tributaries; however, a much smaller number of species have been collected in the past 20 years. Many of those not found in the past 20 years are considered to be extirpated or state protected.

Forty-three (43) mussel species are found in the Illinois portion of the Rock River system. The Higgins' eye pearly mussel is a federally endangered species. Six endangered or threatened Illinois species include the slippershell, spectaclecase, elephant-ear, creek heelsplitter, scaleshell, and sheepsnose.

Non-native species in the basin include the common carp, rusty crayfish, zebra mussel, and Eurasian water milfoil. The common carp is found throughout the Rock River Basin. It can be found in almost any type of habitat, but prefers warm, sluggish waters of streams and lakes and is very tolerant of high turbidity and low oxygen levels. The species tends to destroy vegetation and increase water turbidity by dislodging plants and rooting in the substrate, causing a deterioration of habitat for species requiring vegetation and clear water. The rusty crayfish was first found in the region in 1994 and is rapidly expanding its range. It is contributing to the decline of native crayfishes. Zebra mussels have been found in the Bark and Oconomowoc Rivers in the upper Rock River Basin and are also likely to inhabit the lower reaches of the Rock River. Eurasian water milfoil, an aggressive, non-native plant, is increasingly common in aquatic habitats of the Rock River Basin.

Adjacent land use and instream modifications have resulted in making stream habitats unsuitable for many aquatic species throughout the basin. Floodplain and riparian vegetation cools adjacent waters, stabilizes banks and reduces erosion, filters topsoil and pesticides from runoff waters, and provides feeding and spawning areas for aquatic organisms and nurseries for developing larvae. When riparian vegetation is removed, the floodplain can no longer provide these benefits to aquatic organisms. Rapid drainage of land resulting from tiling and ditching results in artificially extreme water levels, subjecting aquatic organisms to conditions to which they are not adapted. Siltation covers stream substrates and vegetation, reducing the amount of instream habitat available to aquatic organisms. Increased water temperatures negatively affect species adapted to cool waters such as brook trout, southern redbelly dace, and many aquatic macroinvertebrates. Impoundments create lake-like conditions upstream of the dam that are unsuitable for riverine species, fragment upstream and downstream populations of aquatic organisms, and block fish migration important to reproduction and can periodically cause low dissolved oxygen levels immediately downstream of dams. *Loss of certain fish species in a stream reach can lead to loss of mussels that use migratory fishes as hosts during part of the life cycle.*

- **Wetlands.** Prior to European settlement, the Rock River Basin contained thousands of acres of wetlands supporting diverse ecosystems, ranging from shallow wet meadows and prairies, to lowland wet forests, to deep water marshes. A large, undetermined portion of original wetland acreage has been lost due to agricultural, urban, and transportation development, or converted to other uses by filling, ditching and draining. About 47% of the wetlands in the State of Wisconsin and 90% of the wetlands in the State of Illinois have been ditched, drained, filled, or otherwise altered. Wetland remnants remain on state and private lands within the basin. Restoration potential for many of these altered wetlands is high.

Horicon Marsh is located in Dodge County, Wisconsin, in the uppermost portion of the basin. It is the largest freshwater cattail marsh and one of the largest freshwater wetlands in the United States. Horicon Marsh consists of both the Horicon National Wildlife Refuge (HNWR), which is administered by the U.S. Fish and Wildlife Service, and the Horicon Marsh Wildlife Management Area (HMWMA), which is administered by the Wisconsin DNR. The HNWR covers 20,976 acres in the northern 2/3 of the marsh, and the HMWMA covers 10,928 acres in the southern 1/3 of the marsh for a combined total of 31,904 acres.

A total of 268 species of birds have been sighted on this marsh, including several rare, state threatened and endangered species, such as the great egret, Forster's tern, and trumpeter swan (re-introduced in 1998). Hundreds of thousands of migratory waterfowl stop at Horicon Marsh during spring and fall migrations. A wide variety of fish, aquatic animals, and mammals also utilize the marsh. In 1991, Horicon Marsh was designated as a "Wetland of International Importance; Especially as Waterfowl Habitat" under the Ramsar Convention due to the extremely large size of the marsh, as well as other factors such as the diversity of flora and fauna and the large populations of waterfowl it supports. The marsh also was awarded the title of a "Globally Important Bird Area" in 1997 by the American Bird Conservancy.

Several severe problems continue to threaten many of the important resources of the marsh. The most severe problems are sedimentation and high nutrient inflow. Other major problems in the marsh are rough fish infestation (mainly carp), purple loosestrife infestation, and the loss of wildlife habitat.

According to Wisconsin DNR documents, heavy silt loads, particularly from the East Branch Rock River, contribute to the marsh becoming much shallower in many of its bays and channels. The largest source of sediment to the marsh is soil erosion from agricultural lands. Farming practices such as wetland drainage, fall plowing, farming too close to streambanks, farming on steep slopes, and livestock grazing on streambanks all contribute to the marsh's siltation problems. Fish and wildlife habitat use and recreational use are greatly affected by this problem.

High inflow of nutrients from surrounding farms results in excessive algae and aquatic plant growth which can lead to serious dissolved oxygen problems and may cause fishkills, especially in the winter months. Past water quality monitoring in the marsh has detected levels of pesticides and inorganic fertilizers in the marsh. The effects of these substances on the marsh ecosystem are unknown at this time. The USFWS and state managers are concerned that sediment and nutrient loading to the marsh from surrounding lands may affect its long-term quality. Water quality monitoring studies show that the Horicon Marsh watershed has the highest per acre loading of phosphorus and sediment in the basin.

It is clear that land use practices around Horicon Marsh are slowly degrading the quality of this valuable natural resource. Nonpoint source pollution especially needs to be addressed in a *comprehensive and holistic* manner if the problems of the marsh are to be resolved. One of the most important projects to be addressed is the gathering of quantifiable data on sediment and phosphorus loading to the marsh from streams in the Upper Rock River watershed and from the East Branch Rock River watershed.

The problems at Horicon Marsh are typical of the smaller wetland areas found throughout the basin.

- **Wildlife.** The Rock River Basin is an important flyway for waterfowl and neotropical migrants. It is at the northern end of breeding ranges for many southern species and the southern end of the breeding range for many northern species.

The Rock River Basin in Wisconsin contains other sites for important bird habitat in its watershed, in addition to Horicon Marsh, but the dominant land uses of agriculture and rural residential housing have significantly constrained this important wildlife habitat. The Rock River provides a significant migratory travel corridor for birds during spring and fall. Many birds appear to follow the Mississippi and Rock River corridors as travel routes, taking them to Horicon Marsh as their final destination or as a migratory rest stop for species continuing on to more northerly nesting grounds. While habitat may be limited or severely impacted throughout much of the watershed, opportunities exist to protect the ecological integrity of Horicon Marsh and to restore upland and lowland habitats throughout the Rock River Basin.

The Rock River area in Illinois has the largest number of species of breeding forest birds in the state, with 85 native species reported. State protected forest bird species include: Cooper's hawk, red-shouldered hawk, brown creeper, and veery. Other protected breeding birds recorded in the Rock River Basin include: great egret, osprey, northern harrier, sandhill crane, upland sandpiper, long-eared owl, short-eared owl, loggerhead shrike, and Henslow's sparrow. In addition, the diversity represented in this area by 20 breeding species of warblers is greater than any other comparably wooded area in Illinois. Wintering bald eagles, a Federal threatened species, are also found here.

Approximately 38% of Illinois' native vascular flora and 65% of the state's vertebrate fauna (41% avian, 35% amphibian and reptile, 66% mammal) are represented within the Rock River Basin. State listed species include 28 endangered and 9 threatened plants, and 10 endangered and 9 threatened animal species. Federally threatened species include the eastern prairie fringed orchid and prairie bush clover. There are 39 native mammal species documented in the Rock River area of Illinois, including the Indiana bat, a federally endangered species; the river otter, a state endangered species; and the bobcat, a state threatened species.

There are 13 amphibian species and 22 reptile species known or thought to occur in the Rock River Basin. This represents all of the amphibian species and 91% of the reptile species whose current or pre-settlement range includes the Rock River Basin. Two protected amphibian and reptile species and one state watch species occur in the basin: the four-toed salamander, western hognosed snake, and Blanding's turtle, respectively.

**(h) Recreation.** The Rock River and its tributaries provide innumerable recreation opportunities to those who live in the basin. Numerous dams create lakes, which provide pleasure boating, fishing, and other outdoor recreation opportunities. Other activities associated with the Rock River and its tributaries include canoeing, fishing, birdwatching, and hunting. It is estimated that Horicon Marsh, Wisconsin, attracts over 400,000 people per year to participate in activities such as wildlife watching, photography, hunting, and fishing. The Rock River Coalition (WI) is working on a project to establish canoe trails on the Rock River. Wisconsin communities such as Janesville, Beloit, and Watertown are interested in establishing riverwalks.

**(2) Expected Future Conditions.** Continued degradation of ecosystem structure, function, and processes in the Rock River Basin is anticipated in the future without-project condition. Urban sprawl, agricultural activities, flooding of low-lying areas, and hydrologic modifications are expected to continue to negatively affect water quality and fish and wildlife habitat in the basin. It is anticipated that landowners and businesses, along with local, state, and Federal agencies, will continue separate initiatives towards reducing point and nonpoint sources of sediment and nutrients from rural and urban areas. While these will have some beneficial effects on fish and wildlife habitats, it is assumed that in general resources will remain degraded in the without-project future. In order to holistically, effectively, and efficiently address the water quality and habitat needs in the basin, an integrated plan is needed that builds on and increases the varied capabilities and efforts of the two states, local governments, USDA Natural Resources Conservation Service, U.S. Environmental Protection Agency, U.S. Fish and Wildlife Service, Federal Emergency Management Agency, and the Corps of Engineers.

**(3) Planning Objectives and Constraints.** The principal focus of the reconnaissance study is to identify opportunities for restoring degraded ecosystem structures and functions, including the ecosystem's hydrology, plant, fish, and wildlife communities, to a less degraded condition. Primary emphasis is on

identifying potential restoration measures involving modifications of the hydrologic regime to restore the study area.

**Planning objectives** are listed below:

**Objective 1 - Restore hydrologic structure and function:**

Stabilize unstable stream reaches  
Restore filtration functions of land  
Increase runoff storage capacity of wetlands

**Objective 2 - Increase aquatic habitat value:**

Increase instream structure  
Increase heterogeneity of aquatic habitats  
Reduce fragmentation of aquatic communities

**Objective 3 - Improve water quality:**

Reduce point and nonpoint pollution  
Increase filtration of water and pollutants

**Objective 4 - Reduce flood damages in urban and rural areas:**

Reduce flood damage in urban and rural areas in association with restoration features that may affect flood protection  
Reduce flood damages where economically justified

**Planning constraints** are listed below:

**Constraint #1 - Minimize loss of services provided by the Rock River, its tributaries, and existing water resource related structures:**

Maintain existing levels of flood protection  
Minimize loss of recreational opportunities  
Minimize loss of water supply  
Minimize loss of natural floodplain and wetland areas  
Maintain existing capacity to generate hydroelectric power

**Constraint #2 - Protect threatened and endangered species and critical habitat.**

**Constraint #3 - Minimize extent of non-native plants and animals.**

**Constraint #4 - Minimize regional and local social and economic disruption:**

Minimize disruption to agriculture, tourism, and other businesses  
Minimize disruption to communities  
Minimize impacts to adjacent property values

**(4) Problems and Opportunities.** Potential opportunities are listed below that could be addressed in a feasibility study for implementation by the Corps of Engineers or in collaboration with the non-Federal sponsors and other Federal and local agencies.

- Restore riparian buffers along the Rock River and its tributaries to infiltrate runoff; filter sediments, nutrients and chemicals; cool adjacent waters; provide instream habitat for aquatic organisms; and provide wildlife habitat and environmental corridors.
- Stabilize unstable stream segments on tributaries to the Rock River to reduce streambank and streambed erosion, provide instream habitat, and reduce sediment input to the Rock River.
- Restore fish passage at dams on the mainstem of the Rock River and its tributaries.
- Reconnect the Rock River and its floodplain to restore floodplain wetlands.

- Maximize utilization of Federal and state programs to reduce sediment and nutrient inputs, stabilize streams, and restore aquatic habitats in the Rock River Basin.
- Reduce flood damages in the Rock River Basin.

**b. Alternative Plans.** To address the restoration of the Rock River, it is realized that it must be a collaborative effort with a variety of local, state, and Federal stakeholders who are concerned about or charged with the protection and restoration of the Rock River resource. Potential alternatives to be developed in the feasibility phase to address the above problems and opportunities include, but are not limited to, the following:

- Restore and build wetlands in floodplain and upland areas.
- Establish riparian buffers to increase filtration of sediments, nutrients, and other pollutants.
- Modify or remove low head dams to provide fish passage and increase public safety.
- Modify or set back levees to allow for temporary storage of floodwaters.
- Buy out frequently flooded lands and restore habitat.
- Install Newbury weirs or other grade control structures to stabilize unstable streams and provide instream habitat.
- Re-meander stream segments to stabilize unstable stream segments and restore aquatic and wetland habitat.
- Improve monitoring of water and sediment of Rock River Basin streams.
- Deep water dredging to improve conveyance and provide aquatic habitat.
- Create a clearinghouse to coordinate watershed activities of local, state, and Federal agencies in the basin.
- Investigate, assess, and propose the implementation of regional strategies to protect, restore, and expand critical habitats through restoration of public lands, developing public/private partnerships, management agreements and technical assistance. This action would be a collaborative effort with other local, state, Federal, non-government organizations, and private individuals.
- Develop models and actions to reduce tributary sedimentation.

Because of the limited nature of the 905(b) analysis, four of these alternatives were investigated in detail to demonstrate the *potential* for restoration work in the Rock River Basin. The number and types of alternatives to be evaluated will be fully addressed in developing a Project Study Plan (PSP) in coordination with our non-Federal sponsors. The four alternatives investigated for this report were: (1) riparian buffer restoration, (2) stabilization of streams through installation of low stone weirs creating a pool and riffle system, (3) dam modification for fish passage, and (4) reconnecting the Rock River and its floodplain through levee setback combined with floodplain restoration.

The estimates below reflect the approximate scale of restoration needed to substantially meet the stated planning objectives and address the identified problems. The full array of alternatives to be evaluated will be developed in the Project Study Plan and Feasibility Report, and the number and location of sites at which the alternatives will be implemented will be determined in the Feasibility Study. The quantities below were used to identify the *magnitude* of work possible. No O&M costs were included in the following cost estimates due to the preliminary stage of project development.

**c. Preliminary Evaluation of Alternatives.**

(1) *Restoration of riparian buffers* would be conducted in headwaters identified as contributing significantly high amounts of sediment, nutrients, or chemicals or where changing land uses indicate a high potential to increase the amount of pollutants entering the stream or river. The riparian buffers would be designed to increase infiltration of water, sediments, nutrients, and chemicals; to cool adjacent waters; and to decrease overland flow. When possible, wetlands could be integrated into the buffer to intercept and filter flow from tile systems. In addition to improving water quality for aquatic organisms, the vegetation falling into the water would provide instream habitat.

The cost estimate was based on the river miles (RM) of streams buffered, assuming a 20-meter vegetation buffer would be established on each side of the river or stream. One RM of riparian buffer, 40 meters wide equals 16 acres. Costs were estimated at \$1,000 per acre. Riparian buffers would be established/restored along 400 miles of Rock River tributaries for a total cost of \$21 million. The estimate includes acquiring a permanent easement on these buffers. The local sponsor will be responsible for acquiring all lands, easements, rights-of-way, relocations, and disposal areas (LERRD).

**Riparian Buffer Restoration/Creation**

Item	Quantity	Unit Cost (\$)	Total Cost (\$)
Buffer Establishment	6,400 acres	1,000	\$ 6,400,000
Real Estate (LEERD)	1 LS	14,080,000	14,080,000
<b>Total</b>			<b>\$20,480,000 *</b>

\* Does not include E&D, S&A, or acquisition administrative expense. Will be addressed in feasibility.

(2) *Reestablishing the pool and riffle systems* of a natural, stable stream can stabilize channelized and eroding streams. This can be accomplished by installing a series of low stone weirs sometimes called Newbury weirs. The pools behind the weirs dampen floodwater velocity and energy, reducing streambed and bank erosion. The riffles are spaced closely enough together so that the energy of the floodwaters carries the stream sediment load out of each pool.

These structures perform multiple natural stream functions. The pools provide fish refuge during summer low flows. The riffles create instream habitat for fish and other aquatic organisms, re-aerate the water, and also can allow fish passage upstream of a former head cut or dam. Nutrients in the water can be assimilated by microorganisms on cobble substrates in the oxygenated waters of the riffle.

The Illinois DNR and others have successfully completed a number of these pool riffle projects to stabilize unstable streams. While a large number of stream reaches in the Rock River Basin could benefit from stream stabilization efforts, not all of them can be addressed through this study. The cost estimate for this feature assumed that 40 stream reaches would be stabilized with 10 weirs per reach for a total of 400 weirs. It was assumed that each weir would cost \$18,000 to construct, including materials and placement. This cost estimate was based on the experience of engineers at the Illinois State Water Survey. It was assumed that permanent easements would be acquired at the weir sites and road access easements would be required to access the sites. Temporary construction easements also were included in the cost estimate. The local sponsor will be responsible for acquiring all lands, easements, rights-of-way, relocations, and disposal areas (LERRD).

**Stream Stabilization**

Item	Quantity	Unit Cost (\$)	Total Cost (\$)
Grade control structures (Newbury weirs) (10 weirs per reach)	40 reaches	180,000	\$7,200,000
Real Estate (LEERD)	1 LS	520,875	520,875
<b>Total</b>			<b>\$7,720,875 *</b>

\* Does not include E&D, S&A, or acquisition administrative expense. Will be addressed in feasibility.

**(3) Modification of low-head dams to provide fish passage** was another potential project feature. The 19 dams on the mainstem of the Rock River and roughly 272 dams in the basin negatively affect fish and other aquatic organisms including mussels. In recent years, several streams in the Rock River Basin have had dams removed or fish passage structures installed. Dams at Hebron and Slabtown on the Bark River have been removed, along with the Malthouse Dam on the Maunsha River and the Fulton Dam on the Yahara River. Recommendations have been made to restore fish passage at several locations, including the Shopiere Dam on Turtle Creek, the Dunkirk Dam on the Yahara River, and the dam at Rockdale on Koshkonong Creek. Installation of a fish passage structure at the Jefferson Dam on the Rock River is being pursued under the Section 206 Aquatic Ecosystem Restoration Program in partnership with the City of Jefferson, Wisconsin. If this trend continues, streams and fish populations in the Rock River will continue to move toward a greater overall connectivity, leading to greater diversity and healthier ecosystems. Restoration of fish passage as part of the Rock River Study would be another big advancement in the restoration of fragmented fish populations in the Rock River Basin.

Alternatives to restore fish passage include dam removal, modification of the downstream slope, and bypass structures such as a Denil fishway or pool and riffle fishway. Efforts will be made to minimize impacts to recreational, municipal, and industrial uses of the upstream pool and to minimize upstream and downstream impacts on stream flows and water levels. Any dam removal alternatives would address potential head cutting impacts.

The cost estimate was based on constructing a fish passage structure by modifying the downstream slope of the dams to create a man-made rock rapids (roughened chute). A roughened chute takes the appearance and function of a natural rock rapids. The relatively flat slope (approximately 3%) and protruding rocks in the slope result in significantly reduced velocities compared to existing flows on the downstream face of the dam. Besides allowing fish to migrate to important spawning habitat, the rock rapids also creates habitat for fish and other aquatic organisms, as well as improved downstream water quality. Other benefits include improved public safety, aesthetics, and recreational opportunities.

The cost estimate assumes that fish passage through dam removal or construction of passage structures would be implemented at the 18 dams on the mainstem of the Rock River, 8 dams on major tributaries to the Rock River, and 5 dams on small tributaries. Construction costs of \$400,000 per dam were used for the Rock River and its major tributaries. Construction costs of \$40,000 were used for small tributary dams. Fee simple title would be required for the passage structures. The local sponsor will be responsible for acquiring all lands, easements, rights-of-way, relocations, and disposal areas (LERRD).

<b>Fish Passage</b>			
<b>Item</b>	<b>Quantity</b>	<b>Unit Cost (\$)</b>	<b>Total Cost (\$)</b>
Mainstem Dams and Major Tributaries	26 dams	400,000	\$10,400,000
Small Tributary Dams	5 dams	40,000	200,000
Total Construction			\$10,600,000
Real Estate (LERRD)	1 LS	1,998,750	1,998,750
<b>Total</b>			<b>\$12,598,750 *</b>

\* Does not include E&D, S&A, or acquisition administrative expense. Will be addressed in feasibility.

**(4) Floodplain Restoration/Levee Setback.** Another alternative considered is **reconnecting the Rock River and its floodplain** to restore floodplain wetlands and functions. Frequently flooded lands could be acquired from willing sellers through easements or fee title. Wetland restoration could be accomplished by a combination of disabling tile systems, restoring flows, levee removal or setback, and vegetation plantings. Not only would this alternative provide habitat benefits, but it also could reduce flood heights downstream and thus reduce flood damages. A 1984 Corps study on the Lower Rock River found constructing setback levees between Erie and Hillsdale, Illinois, to be economically justified based on flood damage reduction benefits (project was never implemented). Other benefits include aesthetics and consumptive and non-consumptive recreational opportunities. Examples of other areas to investigate include Lebanon Township, Wisconsin, and Blackhawk Island in Jefferson County, Wisconsin.

The cost estimate for this alternative was based on setting back an existing agricultural levee to reconnect and restore 5,800 acres within the 100-year floodplain. Based on available information, permanent easements and/or fee simple title will be the required real estate interests for this project. It was assumed that once hydrology is restored, much of the wetland vegetation would establish without intensive planting efforts. It also was assumed that intensive restoration efforts would be required on 200 acres at a cost of \$25,000 per acre. Planting of bottomland hardwoods would occur on 300 acres at a cost of \$3,000 per acre.

<b>Floodplain Restoration/Levee Setback</b>			
<b>Item</b>	<b>Quantity</b>	<b>Unit Cost (\$)</b>	<b>Total Cost (\$)</b>
Wetland Restoration	200 Acres	25,000	5,000,000
Tree/Shrub Planting	300 Acres	3,000	900,000
Levee Setback	1 Job	12,900,000	<u>\$12,900,000</u>
Total Construction			\$18,800,000
Real Estate (LERRD)	1 LS	10,850,000	10,850,000
<b>Total</b>			<b>\$29,650,000 *</b>

\* Does not include E&D, S&A, or acquisition administrative expense. Will be addressed in feasibility.

**Total estimated cost of all alternatives is \$70 million:**

<b>Riparian Buffer Restoration/Creation</b>	<b>\$20,480,000</b>
<b>Stream Stabilization</b>	<b>7,720,875</b>
<b>Fish Passage</b>	<b>12,598,750</b>
<b>Levee Setback/Floodplain Wetland Restoration</b>	<b>29,650,000</b>
<b>Total</b>	<b>\$70,449,625</b>

**6. FEDERAL INTEREST.** Ecosystem restoration projects are defined as high priority outputs in the Administration's budget policy. Within the Civil Works program, priority is given to restoration projects that restore degraded ecosystem structures and functions, including the ecosystem's hydrology, plant, and animal communities to a less degraded condition. The principal problems impeding the restoration of aquatic and associated fish and wildlife habitat in the Rock River Basin are changed hydrologic regimes and input of sediment, nutrients, and chemicals and other impacts upon the system caused by human activity. Restoration activities to ameliorate these problems within the watershed are a critical need that is within the Federal interest and appropriate for Corps of Engineers involvement.

Accordingly, the selected restoration efforts identified during the reconnaissance study are consistent with Federal law, regulation, and policy. No long-term adverse environmental impacts are anticipated from any of the proposed actions. The preliminary analysis conducted during the reconnaissance phase indicates that the ecological benefits of restoration activities, such as fish passage, restoration of pools and riffles, and restoring wetlands and riparian buffers, will exceed project costs, that restoration measures are technologically feasible, and that they can be accomplished collaboratively with other local, state, and Federal entities in a cost-effective and efficient manner.

The study will utilize a watershed perspective to orchestrate the individual restoration efforts of the multitude of local, state, and Federal agencies and local and regional partnerships to more effectively address the problems in the Rock River Basin. The study and resulting projects will contribute toward the goals of the Clean Water Action Plans of the States of Wisconsin and Illinois, the North American Waterfowl Management Plan, and the Mississippi River/Gulf of Mexico Watershed Nutrient Task Force.

**7. PRELIMINARY FINANCIAL ANALYSIS.** The Illinois DNR and the Wisconsin DNR have agreed to act as the non-Federal cost-sharing partners in the environmental restoration feasibility study for this project. The Illinois DNR indicated by letter of intent, dated January 15, 1998, that it understands the feasibility and construction cost-sharing responsibilities and is willing to enter into negotiations for the feasibility phase of the investigation. A copy of the letter of intent is included as Attachment 2. The Wisconsin DNR indicated by letter of intent, dated January 14, 1999, that it understands the feasibility and construction cost-sharing responsibilities and is willing to enter into negotiations for the feasibility phase of the investigation. A copy of the letter of intent is included as Attachment 3. The sponsors are aware that they will be responsible for all lands, easements, rights-of-way, relocations, and disposal areas of the project (LERRD), plus a cash contribution of a minimum of 5% of the total project costs. In the event that the LERRD costs plus 5% of total project costs does not equal at least 35% of total project costs, the non-Federal sponsors are aware that they must contribute additional cash to equal their combined 35% contribution. The non-Federal sponsors also are aware that they will be responsible for operating and maintaining the project at 100% non-Federal expense upon completion of construction.

#### **8. SUMMARY OF FEASIBILITY STUDY ASSUMPTIONS.**

The Feasibility Study will include development of a restoration needs assessment that will identify the restoration needs and opportunities by sub-basin. The list of potential restoration projects identified in the restoration needs assessment will be evaluated. It is anticipated that the Feasibility Study will recommend a prioritized list of restoration projects to be constructed over a 10-20 year period.

Due to the large size and scope, it is anticipated that the Feasibility Study will fully develop a limited number of recommended restoration projects. The remaining restoration projects would be fully developed during implementation.

The Feasibility Study will include preparation of an Environmental Impact Statement (EIS). The EIS will be tiered with the initial EIS addressing certain features in detail and other features programmatically. Subsequent EISs or Environmental Assessments (EAs) will be prepared to address the site-specific impacts of those features addressed programmatically.

A programmatic agreement (PA) between the Advisory Council on Historic Preservation, the State Historical Society of Wisconsin, the Illinois Historic Preservation Agency, and the Corps of Engineers shall be included in the initial EIS. The PA is the necessary method of compliance with the National Historic Preservation Act since effects to historic properties will not be fully determined in the initial EIS, but rather in the subsequent site-specific EISs and/or EAs.

Cost effectiveness and incremental cost analysis will be performed. Other factors will be considered in plan selection such as significance of resources, impacts/benefits to threatened and endangered species, and support and involvement of other agencies.

Draft schedule assumes timely completion and signing of Feasibility Cost Sharing Agreement (FCSA).

**9. ESTIMATED FEASIBILITY PHASE MILESTONES.** The following is a draft schedule subject to revision during the development of the detailed Project Study Plan.

Preliminary Draft Project Study Plan	August 2000
Supervisory and QC review of Preliminary Draft PSP	August 2000
Preliminary Draft PSP reviewed and approved by sponsors/ response to QC comments	September 2000
FCSA signed	Fall 2000
Notice of Intent published in Federal Register/Public Notice circulated	Winter 2000/2001
Public scoping meetings	Winter 2000/2001
Advance Draft Feasibility Report and Draft Environmental Impact Statement (DEIS) complete	Spring 2002
Alternative Formulation Briefing	Spring 2002
Draft Feasibility Report Draft Environmental Impact Statement (DEIS) to public	Fall 2002
Final Feasibility Report and FEIS	Spring 2003
Division Engineer's Public Notice	Spring 2003

**10. FEASIBILITY PHASE COST ESTIMATE.** The following is a draft cost estimate that is subject to revision during the development of the detailed Project Study Plan.

Major Work Items	Study Cost (\$) *
COST SHARING FOR FEASIBILITY STUDY	
TOTAL STUDY COSTS	2,700,000
50% FEDERAL SHARE	1,350,000
Public Involvement	50,000
Environmental Studies	500,000
Economic Studies	50,000
Project Management	500,000
Engineering	700,000
Real Estate Studies	50,000
Model Studies	200,000
Review Contingency	10,000
TOTAL FEDERAL SHARE + SPONSORS' CASH FUNDS	\$2,060,000
50% SPONSORS' SHARE	1,350,000
IN-KIND SERVICES	
Public Involvement	30,000
Environmental Studies	300,000
Economic Studies	
Project Management	
Engineering	300,000
Real Estate Studies	
Model Studies	
Review Contingency	10,000
Subtotal	640,000
CASH FUNDS	710,000
TOTAL SPONSORS' SHARE	\$1,350,000

\* Estimates were based on a preliminary non-technical analysis. Detailed cost estimates will be developed in the PSP.

**11. RECOMMENDATIONS.** I hereby recommend that this Section 905(b) Reconnaissance Analysis be approved, that permission be given to develop the Project Study Plan, and that negotiation begin of the Feasibility Cost Sharing Agreements with the State of Illinois and the State of Wisconsin.

**12. POTENTIAL ISSUES AFFECTING INITIATION OF FEASIBILITY PHASE.** None.

**13. VIEWS OF OTHER RESOURCE AGENCIES.** Corps of Engineers and Natural Resource Conservation Service staff in Illinois met to discuss the opportunities to work together under the Rock River Study to accomplish restoration in the basin. Meetings also have been held with the Blackhawk Hills Resource Conservation and Development (RC&D) Council and Interstate Resource Conservation and Development Council.

**14. PROJECT AREA MAP.** The project area map is included as Attachment 1.

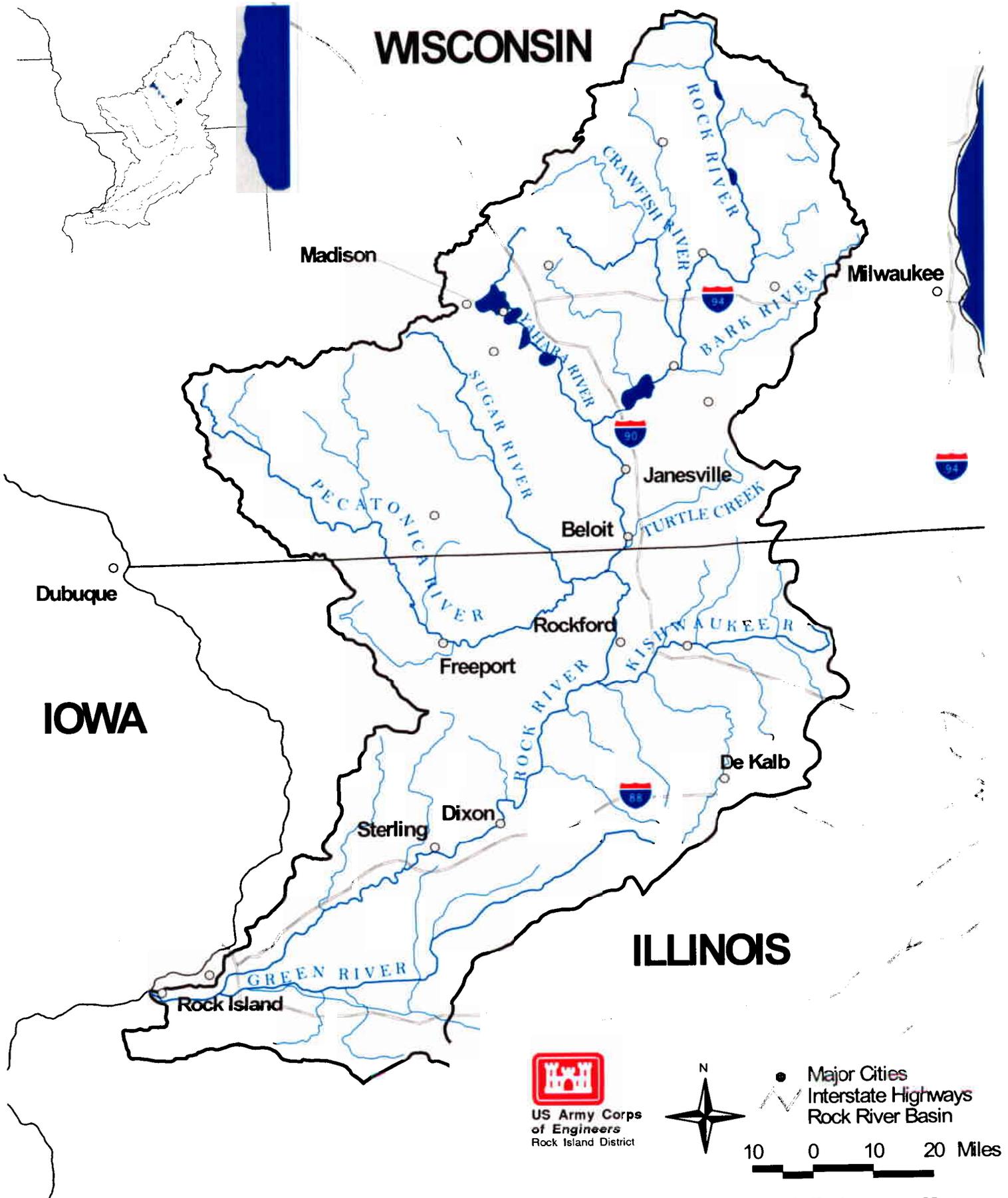


James V. Mudd  
Colonel, U.S. Army  
District Engineer

**Attachments:**

1. Project Area Map
2. Illinois DNR Letter of Intent
3. Wisconsin DNR Letter of Intent

# Rock River Ecosystem Restoration



US Army Corps  
of Engineers  
Rock Island District



● Major Cities  
— Interstate Highways  
— Rock River Basin

10 0 10 20 Miles

Attachment 1. Project Area Map



ILLINOIS  
DEPARTMENT OF  
NATURAL RESOURCES

524 South Second Street, Springfield 62701-1787

Jim Edgar, Governor ● Brent Manning, Director

January 15, 1998

Colonel James V. Mudd  
District Engineer  
U.S. Army Engineer District, Rock Island  
ATTN: Planning Division  
P.O. Box 2004  
Rock Island, Illinois 61204-2004

Dear Colonel Mudd:

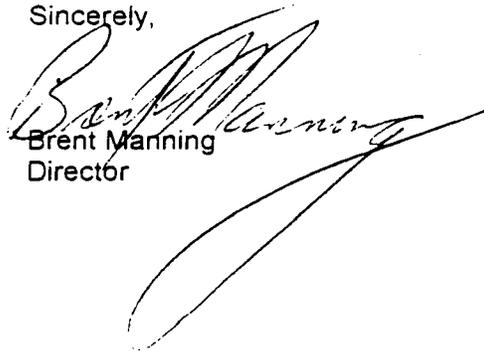
The State of Illinois, Department of Natural Resources, wishes to express their support and willingness to participate with the U.S. Army Corps of Engineers in the Rock River reconnaissance water resource study. The Rock River basin is one of Illinois' greatest natural resources and continues to be seriously impacted by excessive siltation and flooding. Impacts to drinking water supplies, losses of personal property, and damages to natural resource values are devastating to the local communities as well as the State of Illinois.

Under the Corps basin study process, I understand that this is a two-phase study process to address water resource problems including, but not limited to, ecosystem restoration and sedimentation issues. It is also understood that a reconnaissance phase study will be paid for in total by the Corps of Engineers.

However, it is understood that in subsequent phases (feasibility, design, engineering, and construction phases) the IDNR or the Corps may discontinue the project development if the funds necessary to complete the particular phase are not appropriated in either agency's annual budgets, or if either agency has no interest in the construction of the planned project. If the initial reconnaissance phase study indicates that additional studies are warranted to investigate the problems and solutions in greater detail, and if economically and environmentally feasible measures are identified, the State of Illinois, Department of Natural Resources will give serious consideration to providing all or a portion of the required non-federal cost share.

We support the initiation of a reconnaissance study and look forward to assisting the Corps of Engineers in completing a Rock River Study.

Sincerely,



Brent Manning  
Director

Effective July 1, 1995, the Illinois Department of Natural Resources was created through the consolidation of the Illinois Department of Conservation, Department of Mines and Minerals, Abandoned Mine Land Reclamation Council, the Department of Transportation's Division of Water Resources, and the Illinois State Museum and Scientific Surveys from the Illinois Department of Energy and Natural Resources.

(printed on recycled and recyclable paper)

Attachment 2



**State of Wisconsin \ DEPARTMENT OF NATURAL RESOURCES**

Tommy G. Thompson, Governor  
George E. Meyer, Secretary

Box 7921  
101 South Webster Street  
Madison, Wisconsin 53707-7921  
TELEPHONE 608-266-2621  
FAX 608-267-3579  
TDD 608-267-6897

January 14, 1999

Colonel James V. Mudd, District Engineer  
U.S. Army Engineer District, Rock Island  
ATTN: Planning Division  
P.O. Box 2004  
Rock Island, IL 61204-2004

**SUBJECT: Rock River Environmental Restoration Initiative**

Dear Colonel Mudd:

The Wisconsin Department of Natural Resources fully supports and is willing to participate with the U.S. Army Corps of Engineers, and the State of Illinois in the development of the Rock River Basin water resources reconnaissance study. The Rock River is an important cultural and ecologic resource to the State of Wisconsin. It has been impacted significantly by structural modifications as well as sedimentation which have reduced the ecological diversity within the basin. Periodic flooding has also caused damage to personal property as well as municipalities along its shores.

I understand that the reconnaissance phase of this project is fully funded by the Corps of Engineers and that the scope of this work is to evaluate engineering solutions to the ecological problems which are identified. Department staff have expressed a significant amount of interest in this project. As I'm sure that you are aware, we are already fully engaged in at least three ecological restoration projects in the Rock River Basin with the Rock Island District, and we look forward to finding additional opportunities to achieve our common goals.

As this study begins, please feel comfortable in working with Greg Hill, the Department's liaison to the Corps and Margie Devereaux, the Department's South Central Region Water Program Leader. Greg can be reached at (608)267-9352 and Margie can be reached at (608)275-3316.

Sincerely,

George E. Meyer  
Secretary

c: Ruthe Badger, SCR  
Margie Dexereaux, SCR  
Greg Hill, WT/2

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Quality Natural Resources Management  
Through Excellent Customer Service

Attachment 3

