

An hourglass-shaped graphic with a globe inside. The top bulb is dark blue, and the bottom bulb is light blue. The globe is centered in the narrow neck of the hourglass. The top bulb has a dark blue cap, and the bottom bulb has a light blue cap.

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*Upper Mississippi River System: Proposals to Restore an
Inland Waterways Ecosystem*

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August 24, 2005

Abstract. This report describes the context for the congressional decision to authorize ecosystem restoration investments. First, the report provides a brief introduction and explains the ecosystem change of the UMRS. Second, it reviews the Corps preferred and alternative plans, including the Corps preferred 50-year plan, alternative 50-year plans, and the first 15-year increment. Last, this report presents key aspects of the debate over the congressional authorization of an ecosystem restoration effort, including the magnitude and cost, cost-share, scope, and linkage between ecosystem restoration and navigation investments.

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Upper Mississippi River System: Proposals to Restore an Inland Waterway's Ecosystem

Updated August 24, 2005

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Upper Mississippi River System: Proposals to Restore an Inland Waterway's Ecosystem

Summary

Recent proposals to expand the Upper Mississippi River-Illinois Waterway (UMR-IWW) — a major transportation route for products moving to and from Illinois, Iowa, Minnesota, Missouri, and Wisconsin — have met with significant controversy. Some of this controversy centers on the cumulative environmental effects of the current navigation system and the proposed expansion. The Upper Mississippi River System (UMRS) — which includes the navigation channel and surrounding floodplain — supports an unusually large number of species for a temperate river. The UMR-IWW navigation system alters UMRS habitat and contributes to a decline in the abundance of some species. For example, locks, dams, and other channel structures inhibit the movement of fish between and within river segments; fill side channels, backwaters, and wetlands with sediment; and suppress plant growth by reducing water clarity.

In 2001, in response to criticism that draft navigation feasibility studies did not look at navigation's cumulative environmental effects, the Corps restructured its feasibility study to include an ecosystem restoration component. In late September 2004, the Corps released a final feasibility report recommending that Congress approve a 50-year framework for combined ecosystem restoration and navigation improvements. The ecosystem restoration component is aimed at maintaining and restoring a broad array of habitats and ecosystem processes at a total cost of \$5.3 billion for the 50-year plan. Authorization of an initial set of both restoration projects at \$1.58 billion and navigation projects at \$2.03 billion has been proposed in the 109th Congress. (For a discussion of proposed legislation, see CRS Report RL32915, *Upper Mississippi River-Illinois Waterway Investments: Legislation in the 109th Congress*, by Nicole T. Carter and Kyna Powers.)

The federal responsibility (and more specifically the role of the Corps) for restoring ecosystems altered by federal projects is still being defined. Consequently, the scope of large-scale restoration efforts and the federal/non-federal cost-share are being developed largely on a case-by-case basis. The Corps' UMRS restoration plan recommends actions limited to the navigation system and its floodplain, with federal responsibility for more than 90% of the cost. The underlying question is whether, or in what form, Congress will authorize and appropriate funds for ecosystem restoration on the UMRS. If authorized, UMRS restoration would be the Corps' second large-scale restoration effort and the first large-scale restoration effort for a high-volume commercial waterway.

This report explains what is meant by restoration and why the UMRS ecosystem is being considered for restoration, the Corps' restoration plan, and some of the issues in the debate over federal investment in this restoration. This report will be updated as events warrant.

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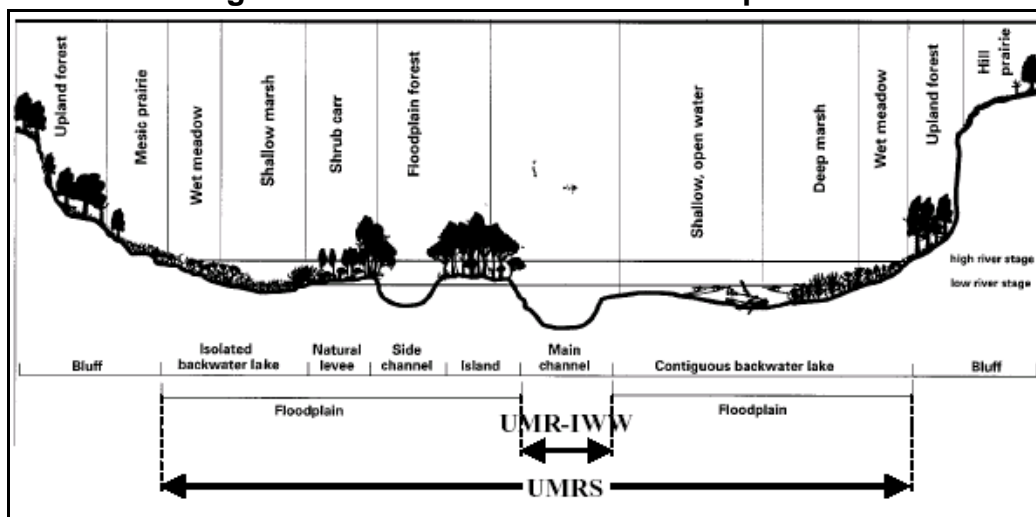
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Upper Mississippi River System: Proposals to Restore an Inland Waterway's Ecosystem

Congressional Authorization Context

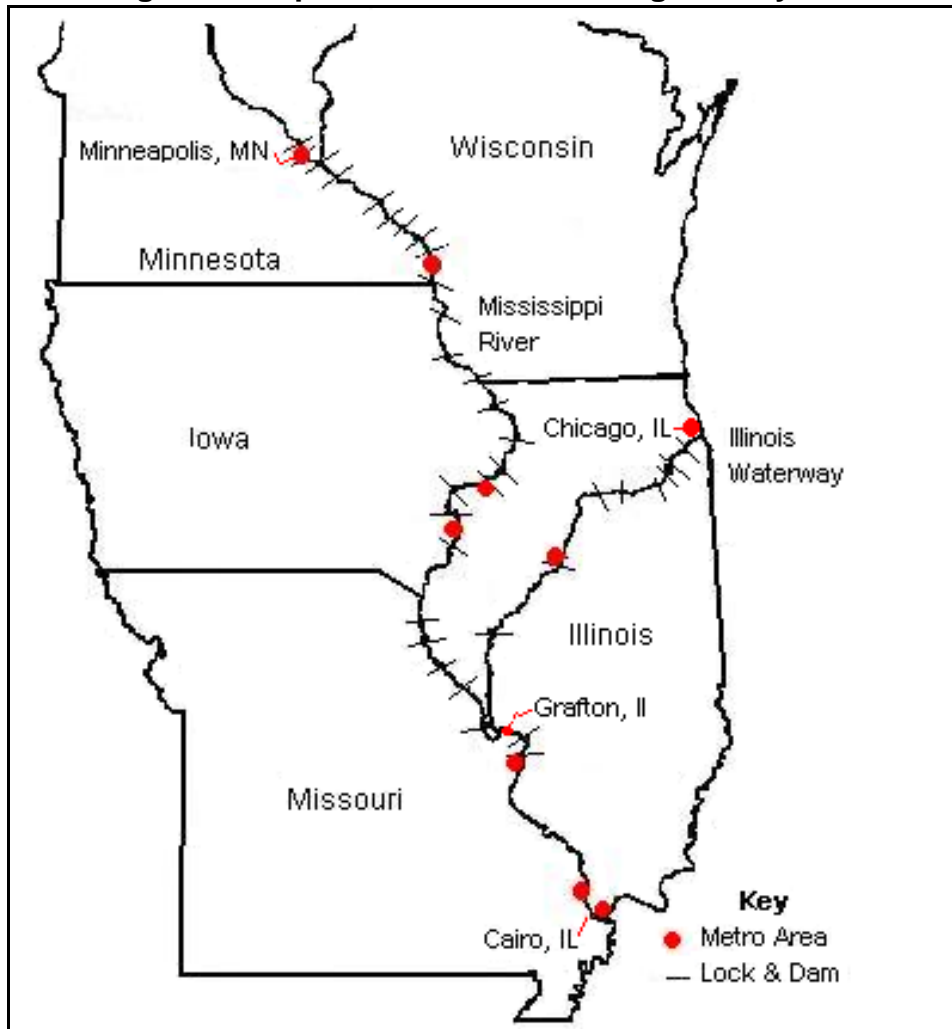
Navigation-Ecosystem Restoration Authorization Decision. Federal efforts to restore ecosystems over wide areas are being planned and initiated around the country. Restoration of the Upper Mississippi River System (UMRS) — the navigable portions of the Upper Mississippi River, Illinois Waterway, and other tributaries, and the associated floodplain (see **Figure 1**)¹ — is one of these efforts. Congress must authorize restoration investments before implementation can begin. The U.S. Army Corps of Engineers (Corps) has developed a plan for UMRS restoration as part of an effort to study measures to improve navigation efficiency on the Upper Mississippi River-Illinois Waterway (UMR-IWW) navigation system — a major transportation route for goods into and out of Illinois, Iowa, Minnesota, Missouri, and Wisconsin. The UMR-IWW includes 1,200 miles of navigable waterways and many navigational improvements (see **Figure 2**). According to commercial users of the navigation system — primarily shippers and agricultural producers — it has been beset by increasing traffic congestion and delays related to aging infrastructure and limitations of existing lock capacity.

Figure 1. UMRS and UMR-IWW Comparison



Source: Corps, *Final Integrated Feasibility Report and PEIS*, p. 4.

¹ The UMRS includes the Upper Mississippi River from Minneapolis, Minnesota, to Cairo, Illinois (854 river miles); the Illinois Waterway from Chicago to Grafton, Illinois (327 river miles); and navigable portions of the Minnesota (15 river miles), St. Croix (24 river miles), Black (1 river mile), and Kaskaskia River (36 river miles).

Figure 2. Map of the UMR-IWW Navigation System

Source: Corps, *Final Integrated Feasibility Report and PEIS*, p. 4.

To inform the congressional decision on whether to authorize investments in navigation and ecosystem restoration, the Corps released a *Final Integrated Feasibility Report and Programmatic Environmental Impact Statement for the UMR-IWW System Navigation Feasibility Study* in late September 2004.² The report proposes a 50-year plan for combined UMR-IWW navigation and UMRS restoration investments and recommends expanding the project purpose of the UMR-IWW to include ecosystem restoration, thus facilitating dual-purpose management. From the 50-year plan, the Corps recommends authorization of a first increment of investments — \$1.88 billion for seven new locks and small-scale navigation measures, and \$1.46 billion for a 15-year ecosystem restoration effort. A recommendation by the Corps' Chief of Engineers was released December 15, 2004 and sent to the Assistant Secretary of the Army (Civil Works) for further review. From there it will undergo review by the Office of Management and Budget (OMB).

² Hereafter referred to as Corps, *Final Feasibility Report and PEIS*. Available at [http://www2.mvr.usace.army.mil/umr-iwwsns/documents/Main_Report_Final.pdf].

This report describes the context for the congressional decision to authorize ecosystem restoration investments.³ First, the report provides a brief introduction and explains the ecosystem change of the UMRS. Second, it reviews the Corps' preferred and alternative plans, including the Corps' preferred 50-year plan, alternative 50-year plans, and the first 15-year increment. Last, this report presents key aspects of the debate over the congressional authorization of an ecosystem restoration effort, including the magnitude and cost, cost-share, scope, and linkage between ecosystem restoration and navigation investments. (For information on the navigation decision, see CRS Issue Brief IB10133, *Water Resources Development Act (WRDA) : Army Corps of Engineers Authorization Issues in the 109th Congress*, coordinated by Nicole T. Carter.)

Evolution of Ecosystem Restoration Plan. The Corps' feasibility study, which began in 1993 to investigate the long-run navigation needs of the UMR-IWW, has been the subject of much controversy. In particular, allegations contending that the Corps manipulated a benefit-cost analysis to support UMR-IWW navigation lock expansion and the subsequent investigation are cited by some Corps observers as evidence that fundamental changes need to be made in the Corps project development and approval process.⁴ The Corps had also been criticized by state and federal natural resource agencies and environmental groups, since the early years of the study, for not including mitigation of environmental impacts beyond the incremental environment impacts of lock expansion; the National Research Council (NRC) of the National Academy of Sciences repeated this criticism in a 2001 report reviewing the feasibility study.⁵ In response in 2001, the Corps reformulated the economic analysis and added an ecosystem restoration component to the study to examine measures to address the cumulative environmental impacts of navigation and other stressors of the UMRS ecosystem. The NRC continues to review the study. A second NRC panel produced a report in December 2003 that reviews the reformulated study,⁶ and another report in October 2004 that comments on a draft Corps feasibility report from April 2004.⁷ The same NRC panel is working on another report.

³ For more information on the Corps' proposal for navigation improvements, see CRS Report RL32470, *Upper Mississippi River-Illinois Waterway Navigation Expansion: An Agricultural Transportation and Environmental Context*, coordinated by Randy Schnepf.

⁴ For a discussion of Corps reform, see CRS Issue Brief IB10133, *Water Resources Development Act: Army Corps of Engineers Authorization Issues in the 109th Congress*, coordinated by Nicole T. Carter.

⁵ The Department of Defense requested, in February 2000, that the National Research Council independently review the Corps' ongoing feasibility study. The National Academy of Sciences completed its report in 2001. National Academy of Sciences, *Inland Navigation System Planning: The Upper Mississippi River-Illinois Waterway* (Washington, 2001).

⁶ National Research Council, *Review of the U.S. Army Corps of Engineers Upper Mississippi-Illinois Waterway Restructured Study: Interim Report* (Washington: National Academy Press, December 2003).

⁷ The prepublication version of the October 2004 report, *Review of the U.S. Army Corps of Engineers Restructured Upper Mississippi River-Illinois Waterway Feasibility Study: Second Report* is available at [<http://books.nap.edu/catalog/11109.html>]. Hereafter referred to as October 2004 NRC report.

The Corps' reformulated analysis has not significantly reduced the debate over the urgency, necessity, and national benefit of expanded navigation capacity. The Corps' ecosystem restoration plan has been less controversial, with the discussion being largely focused on the magnitude and cost of the restoration effort, the federal/non-federal cost-share, the scope of the restoration effort (i.e., a focus on the navigation project or the larger watershed), and the linkage between navigation and restoration for river management and federal investments.

Legislation. The 109th Congress has introduced two bills to authorize ecosystem restoration as part UMR-IWW investments. These bills — S. 728 and H.R. 2864 (Water Resources Development Act (WRDA) of 2005) — would authorize many of the investments the Corps recommended; each would authorize \$2.03 billion for navigation, and \$1.58 billion for ecosystem restoration. These bills are discussed further in CRS Report RL32915, *Upper Mississippi River-Illinois Waterway Investments: Legislation in the 109th Congress*, by Nicole T. Carter and Kyna Powers.

UMRS Ecosystem Change

Congress identified the UMRS as a nationally significant ecosystem and commercial navigation system in the Water Resources Development Act (WRDA) of 1986 (P.L. 99-662). According to the Corps and basin state representatives, the UMRS ecosystem is in decline and action is needed if further degradation is to be avoided.⁸ The UMRS has been changed by multiple factors, with the construction of navigation infrastructure and water management for navigation being principal among these factors. Thirty-seven lock and dams and channel training structures that create a 9-foot deep navigation channel alter the distribution and movement of river water. These changes allow for low-cost transportation between the Upper Mississippi River Basin and the Gulf of Mexico's ocean ports; however, these structures also inhibit the movement of some animal species between and within river segments; fill side channels, backwaters, and wetlands with sediment; and suppress plant growth by reducing water clarity. Other factors also have contributed to ecosystem decline, including land-use practices in the watershed that cause sediment to enter the system and levees that isolate floodplains from the river. The Mississippi and Illinois Rivers also have a long history of impaired water quality attributable to contamination from agricultural, industrial, residential, and municipal sources. **Figure 3** shows the Upper Mississippi-Illinois River watershed — the area drained by the two rivers and their tributaries. The watershed, at 121 million acres (190,000 square miles; 6% of the lower 48 states), is much larger than the UMRS,

⁸ Corps, *Final Feasibility Report and PEIS*, p. 96; Gary R. Clark, Upper Mississippi River Basin Association (UMRBA), *Testimony on Upper Mississippi River and Illinois River Recommendations for Navigation Improvements and Ecosystem Restoration before the Subcommittee on Water Resources and Environment Committee on Transportation and Infrastructure U.S. House of Representatives* (June 24, 2004). Hereafter referred to as Upper Mississippi River Basin Association June 24, 2004 testimony. The UMRBA is an interstate organization of governor-appointed representatives from all five basin states to help coordinate the states' river-related programs and policies and work with federal agencies that have river responsibilities.

which is limited to the navigable river reaches and associated floodplains and covers 2.5 million acres (3,900 square miles).

UMRS Significance. According to the U.S. Geological Survey (USGS), the UMRS is one of the nation’s greatest ecological “treasures.”⁹ Due to the complexity of the system and its north-south orientation, the UMRS is unique among large temperate rivers in that it supports an unusually large number of fish species.¹⁰ More than 150 species of freshwater fish (25% of all North American fish) have been reported to inhabit the UMRS. Overall, the UMRS provides temporary or permanent habitat to more than 485 species of fish, birds, and animals.¹¹ The UMRS also supports recreational opportunities. Annually, there are 12 million recreational visits to the UMRS;¹² boating, sightseeing, sports fishing, hunting, and trapping are some of the more popular recreational uses.¹³ It is estimated that recreation activities generate \$1.2 billion and over 18,000 jobs annually.¹⁴

Congress has recognized the importance of UMRS habitat since early in the 20th century. Congress established the Upper Mississippi River National Wildlife and Fish Refuge in 1924, but specified that it is not to interfere with navigation.¹⁵ It provides 242,400 acres of habitat for migratory and local birds, animals, wildflowers and aquatic plants, fish, and other aquatic life. This refuge, which is administered by the U.S. Fish and Wildlife Service, covers 261 miles along the Mississippi River.

⁹ U.S. Department of the Interior, Geological Survey, *Ecological Status and Trends of the Upper Mississippi River System 1998*. p. 12-2. Hereafter referred to as USGS, *Status and Trends 1998*.

¹⁰ *Ibid.*, p. 12-2.

¹¹ Corps, *Final Feasibility Report and PEIS*, p. 470.

¹² A recreational visit is defined as one person visiting for one day. One person visiting for two days, or two people visiting for one day each, would equal two recreational visits.

¹³ Corps, *Final Feasibility Report and PEIS*, p. 146-147.

¹⁴ *Ibid.*, p. 147. This includes revenue from people who hunt, fish, boat, sightsee, or otherwise visit the river and communities.

¹⁵ Upper Mississippi River Wildlife and Fish Refuge Act of June, 1924 Ch. 346 (16 U.S.C. 721-731) The UMRS also includes four other fish and wildlife refuges. These are the Mark Twain, Trempealeau, Minnesota Valley, and Illinois River National Wildlife Refuges. Overall, the refuges cover 297,000 acres.

Figure 3. Upper Mississippi and Illinois River Watershed



Source: Upper Mississippi River Basin Association, at [<http://www.umrba.org/basinfacts.htm>]

Ecosystem Decline. Although the UMRB provides recreation and species habitat, the federal infrastructure on the UMR-IWW was authorized by Congress for the purpose of navigation. The Corps manages the Upper Mississippi River and the Illinois River to provide a 9-foot navigation channel. To create this channel, the rivers were transformed from free-flowing rivers into a series of separated navigation pools behind locks and dams. These changes in the hydrologic regime alter water quality parameters, such as temperature, dissolved oxygen, and sediment transport,

thereby ultimately affecting fish and wildlife and terrestrial and aquatic ecosystem processes, such as intermittent inundation and drying.¹⁶

Consequently, side channels, backwater, and wetlands are filling in with sediment (see **Figure 1**). While the loss of total aquatic habitat (1.4%)¹⁷ may be small, the proportional loss of backwaters exceeded 10% in more than half of the reaches examined.¹⁸ Some of the reaches are projected to lose from 20 to 30 percent of their backwaters in the next 50 years.¹⁹ Under current sedimentation rates, many backwater areas throughout the UMRS will probably become terrestrial areas within the next 50 to 100 years.²⁰ Including fish, mammals, birds, and amphibians, the UMRS is home to 36 federally listed rare, threatened, or endangered species.

According to the United States Geological Survey, mussels are a good indicator of ecosystem health. While 50 species of mussels were once found in the UMRS, recent surveys have documented a drop to 30 species, two of which are federally listed as endangered.²¹ This decrease may indicate a broader ecosystem decline.

Ecosystem changes have not reduced the number of fish species found in the UMRS. However, they have affected the distribution and abundance of some species.²² For example, lack of suitable winter habitat threatens some popular backwater species, including bluegill, crappies, and large mouth bass.²³ The river also contains a federally listed endangered fish — the pallid sturgeon — and over 50 state-listed rare, threatened, or endangered fish.²⁴

Responding to Decline. In response to ecosystem changes, environmental enhancement projects have been undertaken since WRDA 1986 in which Congress established the Environmental Management Program for the UMRS. The EMP consists of habitat rehabilitation/enhancement projects and a long-term resource monitoring program. Under the EMP, the Corps has completed more than 40 habitat

¹⁶ Navigation requires elevated water levels during dry seasons, so sediment deposited in shallow backwater and side channels is not compacted by exposure to air. This results in the sediment being easily resuspended into the water column, where it reduces light penetration essential for plant growth. Less vegetation reduces aquatic insects, fish, waterfowl, and other animals.

¹⁷ Corps, *Final Feasibility Report and PEIS*, p. 100.

¹⁸ “Backwaters — A 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.” *Ibid.*, 611.

¹⁹ *Ibid.*, p. 106.

²⁰ USGS, *Status and Trends 1998*, p. 8-8.

²¹ *Ibid.*, p. 11-1.

²² *Ibid.*, p. 12-4.

²³ *Ibid.*, p. 7-17.

²⁴ *Ibid.*, p. 12-5.

rehabilitation and enhancement projects, improving habitat on almost 67,000 acres.²⁵ Another eight projects are under construction, and 16 are in the design stages. Together, these additional projects will improve approximately 74,000 acres of riverine and floodplain habitat.²⁶ According to the Corps, current annual environmental investments — \$33.9 million, on average, in federal and state funds — are inadequate to prevent continued degradation.²⁷

Pointing to indicators of ecosystem decline, many groups are concerned about the long-term effects of continued ecosystem alteration and argue for further investments in ecosystem restoration that will support habitat diversity. Some cite the loss of migratory birds in the areas of the Illinois River and the Middle and Lower Mississippi River as examples of a possible outcome if investments are not made.²⁸ Environmental groups want to reverse ecosystem decline and to increase the services and benefits provided by a healthy ecosystem (e.g., recreational uses).

The Corps' Proposal for Ecosystem Restoration

Corps' Preferred Ecosystem Restoration Plan

The Corps proposes in its *Final Feasibility Report and PEIS* to reverse ecosystem decline by making investments in restoration at the same time as investing in navigation expansion. The report puts forth a preferred alternative for a dual-purpose UMR-IWW navigation and UMRS ecosystem restoration plan — \$2.4 billion in navigation improvements and \$5.3 billion for ecosystem restoration over 50 years.²⁹ Under the Corps' recommended cost-share option, \$4.25 billion in measures under the ecosystem restoration plan, more than 80% of the total, would be paid for 100% by the federal government as they would address impacts from the existing 9-foot navigation project or for activities on federal lands. The remaining \$1.05 billion would be for floodplain restoration, backwater water level management, backwater dredging/restoration, island and shoreline protection, measures to increase topographic diversity of the floodplain, and some adaptive management activities; the costs would be shared with local sponsors (65% federal and 35% non-federal; \$680 million federal and \$370 million non-federal).

Unlike most of the Corps' mitigation efforts for its other projects, the Corps' preferred UMRS restoration plan is not focused on particular species. Instead it is

²⁵ The Corps provides before and after pictures for one of its EMP projects in Corps, *Final Feasibility Report and PEIS*, p.8.

²⁶ U.S. Army Corps of Engineers, Rock Island District. *2004 Report to Congress: Upper Mississippi River System Environmental Management Program*.

²⁷ Corps, *Final Feasibility Report and PEIS*, p. 104.

²⁸ Upper Mississippi River Conservation Committee, *Facing the Threat: An Ecosystem Management Strategy for the Upper Mississippi River* (1993).

²⁹ The \$200 million for mitigation of incremental environmental damage associated with navigation improvements is included in the navigation plan, not the restoration plan.

aimed at restoring an array of aquatic and terrestrial species; because of this more systemic approach, the preferred restoration plan combines multiple categories of measures that together are expected to benefit the physical, chemical, and biological health of the entire UMRS ecosystem. The Corps' preferred ecosystem restoration plan contains a total of 1,009 measures, including 248 for island building and protection, 14 for fish passage, 40 for floodplain restoration, 21 for water level management and dam operations, 208 for backwater restoration, 147 for side channel restoration, 64 for wing dam/dike alternation, 235 for shoreline protection, and 32 for topographic diversity. Because habitat is seen as a key component in restoring species diversity and abundance,³⁰ habitat is used as a gauge of what will be achieved under each measure; the 1,009 measures are estimated to influence a total of 703,717 acres of habitat — many times the level of effort under the existing EMP.

According to the Corps, the needed environmental and social mitigation for harm caused by the ecosystem restoration measures would be minimal. The *Final Feasibility Report and PEIS* indicates that the selected restoration alternative would have a net positive effect on ecosystem goods and services and no effect on commercial navigation, water supply, or hydroelectric power. It stated that navigation pool drawdowns could harm livestock watering and recreational boating, but the effects would be minimal. Moreover, recreational boating may see an overall benefit from restoration investments.

Integrated Navigation and Ecosystem Management. The Corps' feasibility report recommends that the restoration measures be implemented within the context of a new overall dual-purpose management framework. Today, navigation is the sole purpose of the Corps UMR-IWW project, and ecosystem restoration activities are conducted separately under the EMP. The Corps recommends creating a structure for UMR-IWW/UMRS investments and operations consisting of three basic elements:

- adding ecosystem restoration as a UMR-IWW project purpose, creating a dual-purpose navigation and restoration authority,³¹
- approving a combined navigation and ecosystem restoration plan as a framework,³² and
- adaptively implementing navigation investments and adaptively managing ecosystem restoration investments.³³

³⁰ The USGS states that habitat is critical because “the diversity and abundance of species found in the river depends on the diversity and abundance of habitat.” USGS, *Status and Trends 1998*, p. 7-2. The plan places a particular emphasis on backwater habitat, which is one of the primary types of habitat being lost.

³¹ Navigation is currently the only authorized purpose of the UMR-IWW.

³² Corps, *Final Feasibility Report and PEIS*, p. 491.

³³ Part of the Corps definition of adaptive management is:

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

(continued...)

According to the Corps, these three elements combined would allow the agency to proceed with operational changes and near-term investments for navigation and ecosystem restoration. Investments would be planned as part of a long-term combined river management framework that minimizes risk by establishing a process to incorporate acquired information into ongoing decision-making, known as adaptive management, and they would be authorized in phases. According to the Corps, integrated management of the environmental and navigation purposes will improve operational efficiency, resulting in cost-savings and synergistic benefits.³⁴ The Corps also argues that dual-purpose authorization would give it flexibility to use operation and maintenance funds for ecosystem restoration and for navigation.³⁵

A representative of the Upper Mississippi River Basin Association testified before Congress that the “states enthusiastically supported the Corps’ decision to restructure the study, consistent with [their] long-standing commitment to integrated management of the river.”³⁶ A number of agencies and non-governmental organizations also support dual-purpose authorization. A barge industry group also testified that it supports the ecosystem restoration plan, but believes that ecosystem restoration should be implemented without adversely affecting the growth of navigation.³⁷ Moreover, entities such as the National Corn Growers Association and the Midwest Area River Coalition 2000, do not support dual-purpose operation or integration of operation and maintenance for navigation and ecosystem restoration, citing that an existing backlog of navigation operation and maintenance (O&M) activities and a lack of clarity regarding implementation criteria for integrating operations.³⁸

Adaptive Management. The third component of the Corps’ proposed management framework is adaptive management. Adaptive management is a mechanism for dealing with the uncertainty of undertaking a large-scale, multi-year effort to change a complex system. The adaptive management component of the Corps’ plan, which is budgeted for \$653 million, calls for a scientific panel, system level learning, and restoration plan bio-response monitoring.³⁹ This approach is a recognition that identifying and eliminating all uncertainties involved with restoration before initiating a project is impossible. Furthermore, reducing uncertainties consumes time and money, and may delay the initiation of restoration efforts, thus leading to further ecosystem degradation.

³³ (...continued)

and assumptions in management plans, using the resulting information to improve the plans. (sic) (Ibid., p. 611)

³⁴ Ibid., p. 512.

³⁵ Ibid., p. 491.

³⁶ Upper Mississippi River Basin Association June 24, 2004 testimony.

³⁷ Christopher J. Brescia, Midwest Area River Coalition 2000 (MARC 2000), *Testimony before the House Transportation and Infrastructure Subcommittee on Water Resources and Environment*, June 24, 2004.

³⁸ Corps, *Final Feasibility Report and PEIS*, p. 482 and 485.

³⁹ Ibid., p. 512.

While the built-in flexibility of adaptive management is seen as an asset for coping with uncertainty, adaptive management can be seen as risky because there is the potential that it could be used to justify delays in implementing important activities or to abandon previously set goals. Moreover, adaptive management is a relatively recent management approach, thus contributing its own uncertainties. Entities, such as the National Corn Growers Association has expressed concerns about adaptive management, but hopes that the Corps will continue to work closely with stakeholders. However, the U.S. Environmental Protection Agency, the basin states and environmental organizations support the Corps' proposal for adaptive management for UMRS restoration.

The October 2004 NRC report found the adaptive approach to be vital to the integrity of the Corps' preferred plan for combined ecosystem restoration and navigation investments. It states that the preferred plan:

... provides for a program of incremental implementation, an excellent framework for comprehensive adaptive management. If the Corps is provided the resources — and if it commits to the needed data collection, improved modeling techniques, and evaluation — many of the flaws and omissions in this study can be corrected in the course of implementation by the application of adaptive management principles.⁴⁰

At the same time, the NRC was critical of the Corps for not defining “a clear, science-based framework for implementation, monitoring, and evaluation.”⁴¹

Preferred and Alternative Plans

In addition to describing the Corps' preferred restoration plan and an integrated management framework, the feasibility report also describes how the Corps arrived at its recommendation. In selecting its preferred plan, the Corps analyzed five 50-year options for ecosystem restoration.⁴² Each of these alternatives has a different target, and, therefore, requires a different level of investment. The Corps describes alternatives (A-E) by scope as follows:⁴³

- (A) **Without Project Condition** — No action, current environmental activities continue;
- (B) **No Net Loss** — Protect and maintain existing environmental diversity;
- (C) **First Increment of Restoration** — Restore the habitats most directly affected by the navigation project;

⁴⁰ October 2004 NRC report, p. 8.

⁴¹ *Ibid.*, 56.

⁴² The Corps focused its alternatives analysis on 50-year plans. Analyses of the alternative plans (A, B, C, and E) do not include a discrete discussion of the first 15-year increment. The Corps also examined multiple options for navigation improvements; these are not discussed in this report.

⁴³ Corps, *Final Feasibility Report and PEIS*, p. 183.

- (D) **Restoration to an Intermediate Level** — Restore broad array of habitat types using management practices and cost effective actions; and
- (E) **Restoration to a High Level** — Restore to include most environmental objectives that can be accomplished in the context of the navigation project.

As shown in **Table 1**, the number of measures to be undertaken under the alternatives varies from no additional actions above the current EMP investments (Alternative A) to 1,202 measures (Alternative E). Within some categories of measures, the differentiation between alternatives is pronounced. The most dramatic difference is the number of fish passage projects and floodplain restoration plans (see **Table 1**). While there would be no fish passage at dam sites under Alternatives A through C, Alternative D has 14 and Alternative E has 33. For floodplain restoration specifically, Alternatives B and C have 2 and 5 projects, respectively, while Alternative D has 40 projects and Alternative E has 80 projects.⁴⁴

The level of investment under each restoration plan also affects the plans' expected benefits — measured by the Corps in *acres of influence*⁴⁵ — and cost. With the exception of the no-action alternative, the number of acres influenced by the projects increase from 148 thousand acres under Alternative B to 1,227 thousand acres under Alternative E. Similarly, the associated costs increase from \$1.7 to \$8.4 billion as the number of projects increase from Alternative B to Alternative E (see **Table 1**).

Table 1. Corps Analyzed Ecosystem Restoration Alternatives

	Restoration Alternatives				
	A	B	C	D	E
Total No. of Ecosystem Measures	0	617	808	1,010 ^a	1,202
Fish Passage Measures	0	0	0	14	33
Floodplain Restoration Measures	0	2	5	40	80
Total Acres of Influence (in thousands)	0	148	252	704	1,227
Construction and Other First Costs (millions)	\$0	\$1,692	\$2,817	\$5,300 ^a	\$8,417

Source: Corps, *Final Feasibility Report and PEIS*.

^a These estimates include embankment lowering to promote connectivity and measures to decrease water level fluctuations on the IWW. These are refinements to the D plan made by the Corps, that is referred to in the final report as D*.

⁴⁴ These projects correspond to the following acreage for alternatives B through D: (B) 1,000, (C) 16,000, (D) 105,500, and (E) 251,500.

⁴⁵ The Corps describes “acres of influence” as “the area positively affected by the restoration measure” (ibid., p. viii). It is estimated using data gained from already implemented restoration measures, primarily EMP projects. The October 2004 NRC report (p. 8) is critical of the acres of influence metric as poorly correlated with ecological outcomes.

Plan Selection. The Corps evaluated its five ecosystem restoration alternatives using a combination of qualitative analyses and estimated quantitative outputs. Qualitative assessments included ecosystem diversity, ability to address ecosystem objectives, maintenance and enhancement of ecosystem goods and services, acceptability, and adaptability.⁴⁶ Quantitative measures included costs, acres of influence, cost effectiveness, ecosystem completeness, and regional economic development. From this evaluation, the Corps rated Alternatives D and E as close in their overall ranking, but recommended Alternative D. Specifically, “Alternative D was identified as the preferred alternative primarily because it is likely to achieve a high degree of completeness and diversity in the most efficient manner.”⁴⁷ While the basin states and environmental organizations generally support the Corps preferred alternative (D*), a number of entities, including the U.S. EPA, the U.S. Fish and Wildlife Service, and a number of basin states would prefer the more extensive alternative E.

In its analysis, the Corps compared environmental benefits with the cost of achieving those benefits. This comparison is called a cost effectiveness analysis. A cost effectiveness analysis is used as an optimization technique to identify either the least costly alternative for an established policy objective that defines the level of benefits desired or to maximize what can be achieved for a given investment. In the case of the *Final Feasibility Report and PEIS*, the Corps does not use cost effectiveness analysis for either of these purposes. Instead, the alternatives analyzed describe a range of benefits for a range of investments. That is, each of the five analyzed alternatives generates a different quantity of benefits, measured as acres of influence. Benefits were estimated by examining the acres of habitat affected through restoration activities under the EMP. Comparing acres of influence and cost helps the Corps to compare alternative plans; however, the usefulness of the comparison is limited by the fact that different acres of habitat are of different quality. Moreover, the Corps analysis is not particularly useful for comparing the benefits and costs of the UMRS restoration effort with the benefits and costs of other large-scale restoration efforts or Corps flood control and navigation investments.⁴⁸

The Corps’ Proposal for a 15-Year First Increment

After analyzing the 50-year alternatives, the Corps recommends approval of a 50-year framework for ecosystem restoration investments, and authorization of a first 15-year increment at \$1.46 billion.⁴⁹ Following the Corps’ preferred cost-sharing option, most projects would be a 100% federal responsibility, and some would be cost-shared with non-federal sponsors. Overall, responsibility for construction costs and other first costs (e.g., land acquisition) would be approximately 91% federal

⁴⁶ Ibid., p. 232.

⁴⁷ Ibid., pp. 469 and x.

⁴⁸ Corps navigation projects are evaluated using benefit-cost analyses, in which benefits are monetized, thus facilitating comparison across projects. This analysis is not used for restoration projects because computing the economic value of restoration benefits is difficult.

⁴⁹ Corps, *Final Feasibility Report and PEIS*, p. 515.

(\$1.33 billion) and 9% non-federal (\$0.13).⁵⁰ In addition to the first-cost, the Corps estimates that operating and maintaining the ecosystem restoration components will cost \$76 million.⁵¹ The Corps would likely be responsible for operation and maintenance (O&M) costs associated with fish passage facilities, water level management, and dike and wing dam alterations. These costs are estimated at \$12 million. The remaining \$64 million would be borne primarily by the U.S. Fish and Wildlife Service and the states. The cost share allocation is currently unclear. However, O&M costs associated with floodplain restoration projects would largely be paid by the states and non-profit entities and the U.S. Fish and Wildlife Service would likely assume responsibility for operating and maintaining completed habitat projects.⁵²

While the feasibility report does not include an analysis of alternative 15-year increments, the Corps states that measures were selected to provide (1) the best return on investment, (2) the best gains in habitat and species diversity, and (3) additional knowledge that will facilitate adaptive implementation of the 50-year plan. The Corps also selected measures for which there would be sufficient time to plan, design, construct, and monitor within the 15-year time frame.⁵³ However, some environmental organizations contend that a 15-year time frame is insufficient to achieve tangible results and that a longer-term authorization is needed. The U.S. Fish and Wildlife Service, for example, states that there will be a need for ecosystem restoration authority for as long as the navigation system is operated and maintained.⁵⁴ On the other hand, the state of Wisconsin supports the 15-year time frame on the basis that it will likely allow time to document the need for Alternative E. As it stands, the Corps' proposed 15-year increment includes 225 measures, under three main activities:⁵⁵

- *Fish Passage and Dam Operations.* Fish migration is largely impeded by the locks and dams on the navigation system. To help fish stocks move more freely through the system, the 15-year plan would include about 30% of the fish passage and dam operations measures recommended in the 50-year plan. Specifically, the 15-year plan would include fish passage construction at 4 dams and fish passage planning and design at 2 dams (\$209 million), and new dam operating procedures (and related land acquisition or easements) at 2 dams (\$41 million). (**\$250 million total — 100% federal**).
- *Programmatic Restoration Authority.* Programmatic authority to improve a wide array of habitat types through island building, floodplain restoration, water level management, backwater

⁵⁰ Ibid., p. 515.

⁵¹ Ibid., p. 515.

⁵² Ibid., p. 515.

⁵³ Ibid., pp. 511-512.

⁵⁴ Ibid., p. 477.

⁵⁵ Ibid., pp. 512-513.

restoration, side channel restoration, wing dam/dike alternation and shoreline protection. (**\$935 million total, not to exceed \$25 million/measure — 100% federal**).

- *Land Acquisition.* The 50-year plan includes the acquisition of approximately 105,000 acres of floodplain and other riparian habitat. The 15-year plan would work to restore about 40% of that acreage. Specifically, it would include land acquisition of 35,000 acres from willing sellers, for floodplain connectivity and wetland and riparian habitat protection and restoration. (**\$277 million total — 65% federal**).

Debate Over the Corps' Ecosystem Restoration Proposal

If Congress decides to authorize an ecosystem restoration plan for the UMRS, it will face a number of policy decisions. The more contentious aspects of such authorization may deal with the plan's magnitude and cost, cost-share, scope, and relationship to authorization of navigation investments and navigation operations. These decisions are briefly described below.

Restoration Magnitude and Cost. The Corps' analysis of ecosystem restoration includes five alternative plans of which restoration goals can be achieved at different levels of investment. Policymakers are now confronted with deciding on the magnitude of restoration efforts, if any, to be undertaken. Should the restoration effort *maintain* existing ecosystem conditions (i.e., no net loss), or should it *restore* ecosystem conditions without trying to attain some pre-existing situation? If restoration is the objective, how much of the earlier ecosystem function should be restored? Answers to these questions are based on value judgements and depend on balancing what the federal government and the basin states are willing to invest in restoration with the desire for a restored ecosystem.

As previously described, the Corps' \$5.3 billion restoration plan would maintain and restore ecosystem function. One factor that some restoration supporters argue should be considered in deciding on federal investments is the relative spending on restoration and navigation. Implementing the Corps' 50-year restoration plan would result in an average annual cost (including both initial investments and O&M) of almost \$140 million; this compares to the \$185 million, on average, annually spent on the O&M and rehabilitation of the existing navigation system, and the additional \$60 million annually for implementing the Corps' 50-year navigation plan.⁵⁶

Cost-Share. Another investment consideration is the distribution of financial responsibility among federal and non-federal sponsors. The UMRS restoration plan

⁵⁶ These estimates were updated by Congressional Research Service based on data provided in the U.S. Dept. of the Interior, U.S. Fish and Wildlife Service. *Draft Supplement to the April 2002 Draft Fish and Wildlife Coordination Act Report for the Upper Mississippi and Illinois River System Navigation Feasibility Study* (April 2004).

raises the question of who is responsible for paying for restoration of ecosystems partially damaged by existing federal projects. Since WRDA 1986, non-federal sponsors have been responsible for a greater portion of Corps project costs; the cost-share formulas evolved out of a debate over having beneficiaries (i.e., non-federal sponsors) pay for the benefits received by footing a portion of project costs.⁵⁷ The established cost-share for Corps' ecosystem restoration projects is 65% federal / 35% non-federal; however, the Corps recommends for the UMRS a cost-share arrangement that increases federal responsibility because of the role of the federal UMR-IWW navigation system in earlier degradation, the extensive federal land holdings, and the multi-state nature of the effort. The recommended arrangement, which is generally supported by the states, agencies, and environmental and navigation organizations, would result in the \$5.3 billion of restoration costs being split 91% federal / 9% non-federal. This cost share could be viewed as reflecting federal responsibility for mitigating damage caused by existing federal projects. Other federal agencies, basin states, environmental organizations, and the NRC support the Corps' proposed cost-share; observers outside the basin and others less likely to be direct beneficiaries of investments may argue that non-federal beneficiaries should pay a higher portion of the cost.

Although the Corps provides a justification for the dominance of federal financing, some observers may dispute this dominance for various reasons. One reason stems from part of the perceived motivation for adopting cost-share arrangements in WRDA 1986: "The cost-share formulas can't guarantee that every new project will be worth the price. But they will force state and local interests to weigh the costs against the benefits more conscientiously."⁵⁸ In this view, one purpose of cost-sharing is to put Corps projects to a "market test," whereby state and local beneficiaries confirm the value of a project by agreeing to share in the cost;⁵⁹ another benefit is that nonfederal sponsors may have a greater sense of project ownership. In contrast, the absence of local financial involvement can be seen as particularly problematic for a restoration project which lacks a benefit-cost analysis that identifies the level of investments at which the costs outweigh the benefits of longer term ecosystem services supporting human/economic endeavors and other societal values. On the other hand, one could argue that the willingness of a local partner to pay for ecosystem restoration does not provide an accurate litmus test given the ecosystem's national significance. Some environmental organizations are concerned with how the costs-share arrangement will effect the Corps' restoration priorities; they fear that requiring the non-federal sponsors to contribute 35% for some activities will discourage the Corps from aggressively pursuing these activities, particularly floodplain management activities.

⁵⁷ M. Reuss, *Reshaping National Water Politics: The Emergence of the Water Resources Development Act of 1986* (Alexandria, VA: U.S. Army Corps of Engineers, Institute for Water Resources, Oct. 1991).

⁵⁸ *Ibid.*, p. 199.

⁵⁹ The October 2004 NRC report (p. 52) was critical of using a market test for UMRS investments because of the role of the UMR-IWW navigation project in ecosystem decline and because the benefits of restoration investment may not be local.

A second objection to the dominance of federal financing for UMRS restoration may be that the available federal funding for UMRS restoration could be a constraint on restoration progress. The federal government, and the Corps in particular, is or may become involved in other large-scale, multi-billion dollar restoration efforts, such as the Florida Everglades restoration and the Coastal Louisiana wetlands restoration. This growing financial commitment to restoration investments is happening within the context of large projected federal budget deficits and a backlog of Corps construction projects currently estimated at more than \$40 billion.

Restoration Scope. The Corps constrained the restoration plan by limiting its geographic scope. The Corps' plan targets restoration for the UMRS, that is, the UMR-IWW and its floodplain. As a result, reducing stressors that are beyond the floodplain in the larger watershed are not included among the recommended measures; instead the plan recommends measures to address the symptoms of these stressors. That is, the Corps' restoration plan does not include changes to land use practices related to increased sedimentation and degradation of other water quality parameters, flood damage reduction practices on a large-scale, or significant alterations to navigation infrastructure. For example, the Corps' plan recommends backwater dredging measures; dredging addresses the symptom of elevated sedimentation, but not the land use practices that can cause it, because these practices are considered outside the scope of the navigation study and navigation project. Substantial restoration benefits are not in the Corps' plan because they would interfere with navigation.

The Corps also limits the recommended restoration measures to the scope of the navigation project and study; that is, the measures are to address the cumulative impacts of operations of federal projects and other ecosystem stressors, without harming navigation. For example, dramatic water level changes that could produce substantial restoration benefits are not in the Corps' plan because they would interfere with navigation.

The NRC recommended in its December 2003 report that the Corps should, to the extent feasible, use a more holistic approach that includes factors such as water quality, flood damage reduction, and sediment transport. The Corps maintains that a more comprehensive, watershed-type approach is beyond the scope of the authorization under which the agency is conducting the feasibility study.⁶⁰ According to the Corps, another reason for the current restoration scope is that the five basin states support the concept that the study should remain focused on navigation and an environmentally sustainable navigation system.⁶¹ Because only some of the stressors causing ecosystem degradation are managed under the Corps plan, not all of the ecosystem's natural river processes are restored, resulting in the need for regular human intervention to obtain some restoration benefits. Some environmental organizations, such as American Rivers, would prefer to have ecosystem restoration authorized for the entire watershed; activities under the Corps proposal would be limited in scope to the UMRS. The October 2004 NRC report showed less concern about the geographic scope of the restoration effort, and was more interested in

⁶⁰ Corps, *Final Feasibility Report and PEIS*, p. QM-5.

⁶¹ *Ibid.*, p. QM-5.

restoring natural river processes that shape floodplains.⁶² Consequently, the NRC supports not only dual purpose authorization, but also multi-purpose authorization that includes flood management.⁶³ Would a more comprehensive watershed approach accomplish restoration at less cost in the long-run, and if so, would this reduced cost be offset by potential constraints on navigation and flood damage reduction benefits?

Linked Authorization. As described above, the Corps limited the scope of its ecosystem restoration proposal to the navigation channel and surrounding floodplain. The Corps selected this scope because restoration plans were developed in the context of the navigation study; that is, the study has restoration as half of a dual-purpose plan. The environmental community uniformly support the need for restoration investments and dual-purpose management. The community, however, is not united on how to achieve this. Some environmental groups,⁶⁴ such as the Mississippi River Basin Alliance and Audubon, support authorizing a package of restoration and navigation investments within a dual purpose management context. Other environmental groups would like to see additional ecosystem restoration authorized through the existing structure of the EMP, without authorizing large-scale investments in navigation.

Legislation on the Corps proposal could link navigation funding to ecosystem restoration. Alternatively, legislation could authorize ecosystem restoration without authorizing the navigation project, or vice versa.⁶⁵ Should authorization or funding for ecosystem restoration and navigation be linked? If so, how closely should they be joined? These questions apply beyond the Corps' proposal for the UMR-IWW/UMRS to other Corps projects and other federal restoration efforts. As the first combined large-scale navigation and ecosystem restoration project, it could set a precedent for future proposals. What is the threshold for adding ecosystem restoration to other federal projects? Should all large-scale water projects (e.g., locks, dams, and levees) have an ecosystem restoration component? In addition to their ecosystems, rivers are resources that may be used for multiple purposes such as hydro power, navigation, flood control, recreation, and water supply. While many

⁶² This interest in natural river processes and floodplain connectivity is linked to another criticism made by the NRC; the October 2004 NRC report (p. 8) states that ... proposed restoration measures represent an impressive range and number of candidate actions. The assembly of those measures into restoration alternatives, however, is not adequately grounded in principles and theories of large river floodplain science and restoration.

⁶³ *Ibid.*, pp. 2-3. The October 2004 NRC report also questions if the Corps' assumption that the navigation season and 9-foot channel depth will remain unchanged is appropriate, and if this assumption implicitly gives navigation a superior position to other river uses (*ibid.*, pp. 19-20).

⁶⁴ These organizations do not necessarily support the Corps entire navigation proposal. They tend to oppose lock expansion but support small-scale measures.

⁶⁵ For more information on current legislation, see CRS Report RL32574, *Upper Mississippi River-Illinois Waterway Investments: Proposed Authorization Legislation in the 108th Congress*, by Nicole T. Carter and Kyna Powers.

facilities, such as dams,⁶⁶ are managed for multiple purposes, agencies have been directed to construct and operate a number of federal projects for single purposes. Should all federal projects be managed for multiple purposes? Linking ecosystem restoration and navigation, as with any multi-purpose designation, is ultimately a policy question of how Congress wants federal agencies to manage public resources.

Conclusion

The Army Corps of Engineers has released a final feasibility report and Chief's Report recommending that Congress authorize a 15-year, initial increment of ecosystem restoration measures as part of a combined 50-year investment and management framework for UMR-IWW navigation and UMRS restoration. Authorization of UMRS restoration poses policy questions for decision makers, such as: What level of restoration should be authorized, and at what cost? What should be the federal responsibility for UMRS restoration investments? Congress is being asked to answer these questions in the context of interest in and debate over navigation expansion on the UMR-IWW. The answers that Congress may provide are likely to be viewed as precedent setting for other large-scale restoration efforts, especially efforts for ecosystem restoration of other inland waterways and rivers.

An additional challenge is the uncertainty of what would be achieved through UMRS restoration investments. This uncertainty comes from multiple sources: ecosystem restoration is a young science; the Corps' plan only addresses some of the stressors causing ecosystem decline; and restoration implementation depends on available appropriations. The issue for policymakers is further complicated because analytic tools to assist in decision-making for restoration projects are less robust than for other Corps projects that use benefit-cost analysis. The Corps has recognized these challenges in its feasibility report. In response, the agency recommends an adaptive management and implementation strategy for restoration; however, some observers see adaptive management as contributing another element of uncertainty and risk. Congress may weigh these risks when considering the level of ecosystem restoration and federal investment for the UMRS, if it wants to make these restoration investments in conjunction with navigation expansion, or separately, and what role it wants during implementation and funding.

⁶⁶ Most federal dams are managed for multiple purposes. Furthermore, licenses issued by the Federal Energy Regulatory Commission for non-federal dams often contain provisions aimed at retaining or enhancing the river's recreational, ecological, or tribal benefits.

Related CRS Documents

CRS Congressional Distribution Memorandum, *UMR-IWW Project History*, by Kyna Powers, May 3, 2004.

CRS Issue Brief IB10133, *Water Resources Development Act: Army Corps of Engineers Authorization Issues in the 109th Congress*, coordinated by Nicole T. Carter.

CRS Report RL30928, *Army Corps of Engineers Civil Works Reform Issues in the 107th Congress*, by Nicole T. Carter.

CRS Report RL32401, *Agriculture as a Source of Barge Demand on the Upper Mississippi and Illinois Rivers: Background and Issues*, by Randy Schnepf.

CRS Report RL32470, *Upper Mississippi River — Illinois Waterway Navigation Expansion: An Agricultural Transportation and Environmental Decision*, coordinated by Randy Schnepf.

CRS Report RL32574, *Upper Mississippi River-Illinois Waterway Investments: Proposed Authorization Legislation in the 108th Congress*, by Nicole T. Carter and Kyna Powers.

CRS Report RL32915, *Upper Mississippi River-Illinois Waterway Investments: Legislation in the 109th Congress*, by Nicole T. Carter and Kyna Powers.