

Upper Mississippi River Restoration Environmental Management Program



US Army Corps
of Engineers®

Environmental Design Handbook

December 2012

**UPPER MISSISSIPPI RIVER RESTORATION
ENVIRONMENTAL MANAGEMENT PROGRAM
ENVIRONMENTAL DESIGN HANDBOOK**

FOREWORD

Welcome to the 2nd Edition of the Upper Mississippi River Restoration – Environmental Management Program’s (UMRR-EMP) Environmental Design Handbook. This revision captures the extensive lessons learned over the past 26 years during the formulation and construction of 54 habitat rehabilitation and enhancement projects benefiting nearly 100,000 acres of aquatic and floodplain habitat within the 1,200 miles of the Upper Mississippi River System.

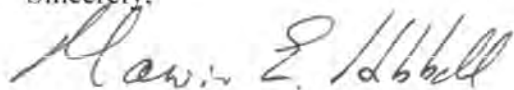
This revision incorporates not only the engineering lessons learned during this period but it also shows the linkage between regionally adopted goals and objectives and the restoration techniques being used within the UMRR-EMP to meet those goals and objectives. Additionally, while the UMRR-EMP has utilized an adaptive management philosophy from its inception, this revision explores the UMRR-EMP’s efforts to more explicitly apply adaptive management techniques to address restoration practices which continue to have elements of risk and uncertainty come.

The UMRR-EMP was authorized by Congress in the 1986 Water Resources Development Act. This authorization created the first large river ecosystem restoration program in the nation and as such opened the door to many new ecosystem restoration and engineering innovations.

The UMRR-EMP is a regional program encompassing three US Army Corps of Engineers Districts (St Louis, MO; Rock Island, IL; and St. Paul, MN) and five states (Illinois, Iowa, Michigan, Minnesota, and Wisconsin). All restoration efforts originate out of the three District offices. Each project is developed with a project sponsor, and the formulation of all projects is coordinated through multi-agency and multi-disciplinary teams working in the five states that comprise the UMRR-EMP.

This revised Environmental Design Handbook captures the current state of the art and science in large river ecosystem restoration efforts by the UMRR-EMP. It is intended to continue to ensure consistency and high quality restoration efforts over multiple offices and agencies covering 1,200 miles of navigable river. I hope that others working to restore large river ecosystems will also find it a useful guide to aid in their efforts.

Sincerely,



Marvin E. Hubbell, Regional Program Manager
Upper Mississippi River Restoration – Environmental Management Program

The Upper Mississippi River Restoration Environmental Management Program (EMP) is successfully implementing innovative and effective habitat projects and conducting cutting-edge monitoring and research. First authorized in Section 1103 of the Water Resources Development Act of 1986, the EMP has made significant contributions to ensure that the Upper Mississippi River System remains a nationally significant ecosystem.

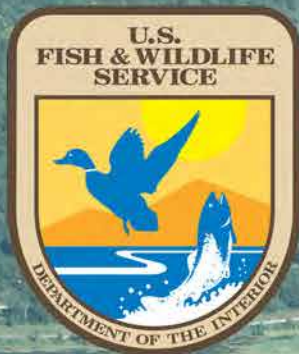
When the EMP began, Habitat Rehabilitation and Enhancement Project (HREP) designers implemented and refined construction techniques in ways not previously imagined. The intent was to improve habitat through site-specific modifications. Since 1986, the EMP's HREP component has evolved into a successful program that combines a broad range of construction techniques with approaches that strive to use or mimic natural riverine processes, providing benefits to the river at system, reach, pool and local scales.

Innovations and lessons learned in the HREP program have benefited not only the EMP, but also other programs on the Upper Mississippi River and throughout the United States where similar efforts are underway to preserve and restore habitat on large floodplain river systems. The EMP and the U.S. Army Corps of Engineers are internationally recognized leaders in such endeavors.

There has been significant documentation on individual HREPs, including feasibility level studies, as built construction drawings, operation and maintenance manuals, and performance evaluation reports. However, these reports have generally been project specific and often do not describe project lessons learned. This design handbook was created to describe project features common to HREPs.

Executive Summary





Upper Mississippi River Basin Association



The U.S. Army Corps of Engineers would like to express its appreciation to the following Federal and State agencies and non-governmental organizations that contributed to this report. Their coordination efforts and document reviews were invaluable.

- Illinois Department of Natural Resources
- Iowa Department of Natural Resources
- Minnesota Department of Natural Resources
- Missouri Department of Conservation
- Wisconsin Department of Natural Resources
- Natural Resources Conservation Service
- United States Environmental Protection Agency
- United States Fish and Wildlife Service
- United States Geological Survey
- Upper Mississippi River Basin Association



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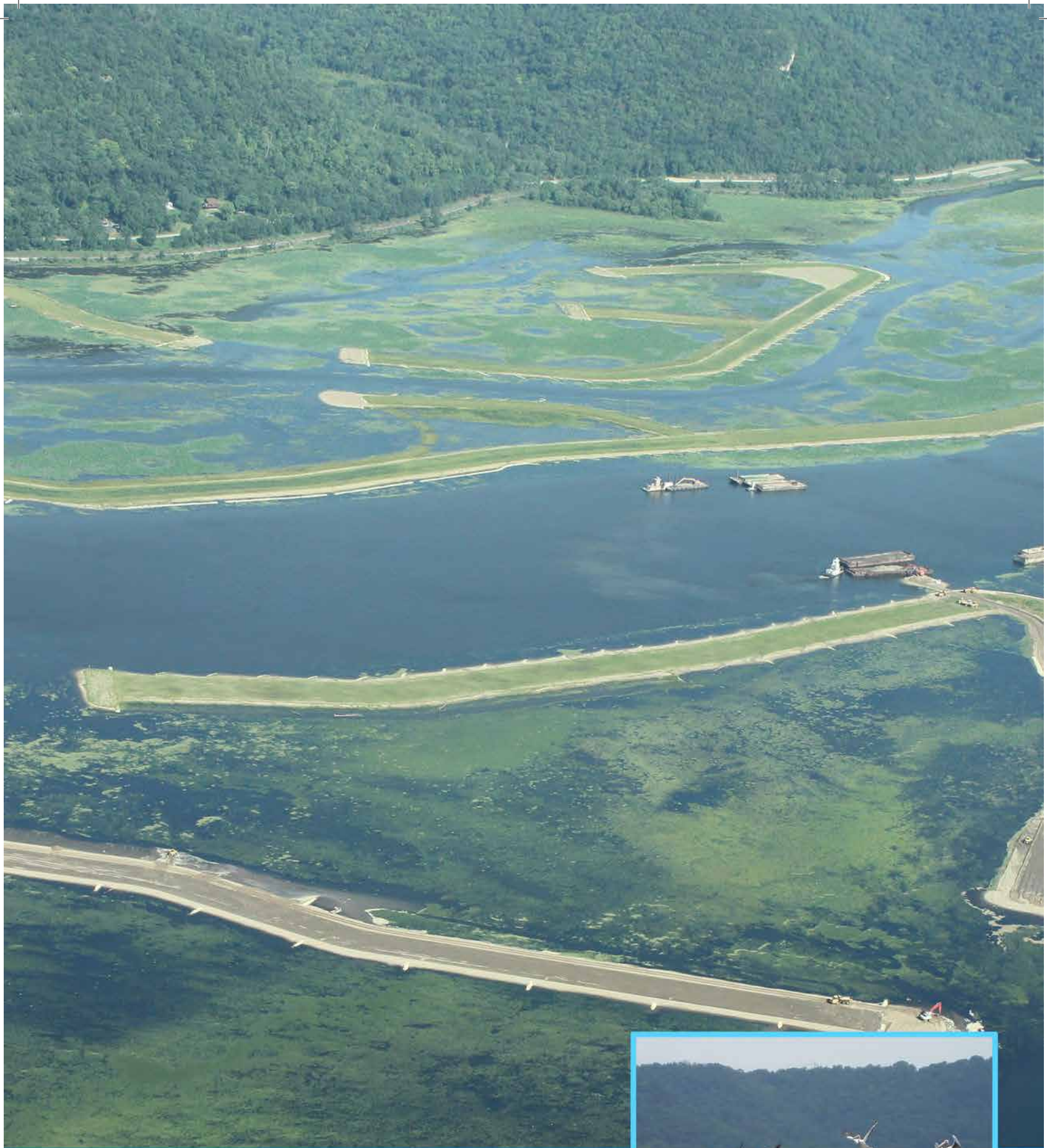
The U.S. Army Corps of Engineers solicited the service of the following individuals to author various sections of the *Upper Mississippi River Restoration Environmental Management Program Environmental Design Handbook*.

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INTRODUCTION

A. PURPOSE

The U.S. Army Corps of Engineers (Corps), with input from the Upper Mississippi River Restoration-Environmental Management Program (UMRR-EMP) partners, developed the Environmental Design Handbook to document the array of restoration tools and lessons learned to aid in the design of future Habitat Rehabilitation and Enhancement Projects (HREP). These restoration tools include shoreline protection, island creation, water level management, backwater dredging, secondary channel modifications and river training structures, aeration, and floodplain and tributary restoration. The 2006 Environmental Design Handbook¹ details the project features, design methodologies, and lessons learned since UMRR-EMP's inception. This 2012 Handbook includes an update to the 2006 information, captures new information about innovative restoration tools, and provides additional information on planning and ecosystem objectives.

B. UMRR-EMP AUTHORIZATION & DOCUMENTATION

The UMRR-EMP was authorized by Congress in Section 1103 of the Water Resources Development Act (WRDA) of 1986 (Public Law 99-662), as amended². The Corps is required by the authorizing language in WRDA to report the status of the UMRR-EMP to Congress at a specific frequency. Three reports to Congress have been completed to date and provide significant information regarding the UMRR-EMP, authorities and outcomes. These documents provide an excellent source of information regarding the history of the UMRR-EMP Program.

U.S. Army Corps of Engineers, *Upper Mississippi River Restoration Environmental Management Program Report to Congress*, 2010. This evaluation discusses UMRR-EMP's considerable accomplishments and shows 25 years of evolving legal authorities, management actions, and policy decisions have shaped the UMRR-EMP.

U.S. Army Corps of Engineers, *Upper Mississippi River Restoration Environmental Management Program Report to Congress*, 2004. This is the second formal evaluation of the UMRR-EMP which provides an opportunity to step back and take a critical look at the collective impact of the legal authorities, management actions, and policy decisions that have shaped the UMRR-EMP.

U.S. Army Corps of Engineers, *Upper Mississippi River System Environmental Management Program Report to Congress*, 1997. This report contains overarching conclusions drawn with respect to the UMRR-EMP outputs, strengths and weaknesses and the future needs of the UMRS.

In 2003, an effort to ensure that planning and sequencing of HREPs occurred in a consistent manner was undertaken. These efforts were documented in the U.S. Army Corps of Engineers, *Habitat Rehabilitation and Enhancement Project (HREP) Planning and Sequencing Framework*, 2003.

¹ As of January 2013, a copy of the 2006 report is available at <http://www.mvr.usace.army.mil/Missions/EnvironmentalProtectionandRestoration/UpperMississippiRiverRestoration/AboutUs/KeyDocuments.aspx>

² Authorizing language from the Water Resources Development Act is included in Appendix 1-A.

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The goals of this document were to:

- ensure that UMRR-EMP habitat projects address Upper Mississippi River System (UMRS) ecological needs at pool, reach, and system scales by building on existing HREP prioritization mechanisms and integrating the Habitat Needs Assessment Technical Report³ and other planning efforts into project evaluation;
- enhance public understanding and trust in the decision-making process by making HREP evaluation criteria explicit and consistent; and
- retain the flexibility necessary to ensure efficient, effective program execution and to apply adaptive management principles to project planning, design and implementation.

In 2009, the U.S. Army Corps of Engineers' *Upper Mississippi River System Ecosystem Restoration Objectives*, 2009 was completed as the final product of a planning process initiated in 2008 for the purpose of identifying areas for new restoration projects and identifying knowledge gaps at a system scale. The 2009 Report serves as a technical basis for investment decisions through 2013. The Report serves as a backdrop for the formulation of specific restoration projects and their adaptive ecosystem management components.

C. HREP PROJECT SPECIFIC DOCUMENTATION

Each HREP Project should have associated with it:

- a Fact Sheet
- a Definite Project Report and Environmental Assessment (feasibility level document)
- Plans and Specifications
- Construction Contract(s)
- As-built Construction Drawing(s)
- an Operation and Maintenance Manual
- Performance Evaluation Report(s)

This documentation serves well to follow the history of a project and to compare those items planned, designed and constructed to the final results observed as a result of the construction of these projects.

Most documents associated with HREP projects, and many documents regarding the UMRR-EMP, can be found on the UMRR-EMP website⁴.

³ Theiling, Korschgen, DeHaan, Fox, Rohweder, Robinson, *Habitat Needs Assessment for the Upper Mississippi River System: Technical Report*, October 2000

⁴ As of January 2013, the website is located at <http://www.mvr.usace.army.mil/Missions/EnvironmentalProtectionandRestoration/UpperMississippiRiverRestoration.aspx>

D. UMRR-EMP HREP DATABASE

A database for HREP projects was developed in the 1990s, and revised in the 2000s. Additional updates such as an interactive mapping and conversion to an Oracle platform are being developed and expected to be implemented by 2013. The purpose of the database is to compile important information at each HREP site and allow the information to be shared and used for future projects. Output tables for the database can range from project specific fact sheets to program analysis of various feature impacts. The database is integrated with GIS data to allow for various query options. It is anticipated that the database, used in coordination with this handbook, will allow for more thorough and streamlined planning of future HREPs. The information in the database is available by contacting the UMRR-EMP Program Manager.

E. UMRR-EMP ENVIRONMENTAL DESIGN HANDBOOK FORMAT

It was determined that a Handbook should be created to describe project features common in HREPs. The UMRR-EMP program covers several rivers and extends through three Corps Districts (St. Paul, Rock Island, and St. Louis), which requires site specific attention be paid to new projects. However, there are numerous similarities in the design of these project features such that the design process can be summarized in this document. Design methodology, case studies, lessons learned, and references are included in each chapter, although the format of these chapters varies based on content. The chapters in the 2012 Handbook are as follows:

Chapter 1	Upper Mississippi River Restoration Environmental Management Program
Chapter 2	Habitat Rehabilitation and Enhancement Projects
Chapter 3	Ecosystem Restoration Objectives
Chapter 4	Shoreline and Riverbank Protection
Chapter 5	Localized Water Level Management
Chapter 6	Dredging
Chapter 7	River Training Structures and Secondary Channel Modifications
Chapter 8	Floodplain Restoration
Chapter 9	Island Design

F. UMRR-EMP ENVIRONMENTAL DESIGN HANDBOOK PREPARATION

This document addresses techniques that are either currently being used on the UMRS or are proposed for future projects. The Handbook addresses the physical characteristics of the process and the habitat objectives.

Work on the 2006 Handbook was initiated in 2004. A team was created, and the Handbook format was discussed in great detail during and UMRR-EMP HREP Design Meeting in January 2005, held at the U.S. Army Corps of Engineers, Rock Island District office. The recommended format was presented to the UMRR EMP Coordinating Committee (UMRR EMP-CC) during their quarterly meetings. The UMRR EMP-CC approved the final format. Primary authors were identified for each chapter and draft chapters were prepared by May 2005. The chapters were distributed to each district for review and to include their own district's information. All information was incorporated and an official draft report was completed in July 2005. In August 2005, the document was discussed at the UMRR-EMP Workshop, held in Davenport, IA. Comments were received during this workshop. An invitation for comments was sent out to the UMRR EMP-CC, service agencies, Corps employees, and

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others interested in the document. Comments were due by January 2006; however, due to emergency deployments by several individuals in response to Hurricane Katrina, and the War in Iraq, the comment period was extended to May 2006. The comments were incorporated by the primary authors, and the final chapters were completed in July 2006.

Work on the 2012 Handbook was initiated in December 2011. Again, primary authors were identified for each chapter and draft chapters were prepared by May 2012. The chapters were distributed to the UMRR EMP-CC for their review. All information was incorporated and an official draft report was completed in July 2012. In August 2012, a second internal review was completed for the report. The comment response period was extended to allow for emergency deployments or support in response to Hurricane Ivan. The comments were incorporated by the primary authors, and the final chapters were completed in October 2012.

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APPENDIX A

ENVIRONMENTAL MANAGEMENT PROGRAM AUTHORIZATION

Section 1103 of the Water Resources Development Act (WRDA) of 1986 (P.L. 99-662) as amended by Section 405 of the WRDA of 1990 (P.L. 101-640), Section 107 of the WRDA of 1992 (P.L. 102-580), Section 509 of the WRDA of 1999 (P.L. 106-53), Section 2 of the Water Resources Development Technical Corrections of 1999 (P.L. 106-109), and Section 3177 of the WRDA of 2007 (P.L. 110-114).

Additional Cost Sharing Provision

Section 906(e) of the WRDA of 1986 (P.L. 99-662) as amended by Section 221 of the WRDA of 1999 (P.L. 106-53).

SEC. 1103. UPPER MISSISSIPPI RIVER PLAN

(a)(1) This section may be cited as the "Upper Mississippi River Management Act of 1986".

(2) To ensure the coordinated development and enhancement of the Upper Mississippi River system, it is hereby declared to be the intent of Congress to recognize that system as a nationally significant ecosystem and a nationally significant commercial navigation system. Congress further recognizes that the system provides a diversity of opportunities and experiences. The system shall be administered and regulated in recognition of its several purposes.

(b) For purposes of this section --

(1) the terms "Upper Mississippi River system" and "system" mean those river reaches having commercial navigation channels on the Mississippi River main stem north of Cairo, Illinois; the Minnesota River, Minnesota; Black River, Wisconsin; Saint Croix River, Minnesota and Wisconsin; Illinois River and Waterway, Illinois; and Kaskaskia River, Illinois;

(2) the term "Master Plan" means the comprehensive master plan for the management of the Upper Mississippi River system, dated January 1, 1982, prepared by the Upper Mississippi River Basin Commission and submitted to Congress pursuant to Public Law 95-502;

(3) the term "GREAT I, GREAT II, and GRRM studies" means the studies entitled "GREAT Environmental Action Team--GREAT I--A Study of the Upper Mississippi River", dated September 1980, "GREAT River Environmental Action Team--GREAT II--A Study of the Upper Mississippi River", dated December 1980, and "GREAT River Resource Management Study", dated September 1982; and

(4) the term "Upper Mississippi River Basin Association" means an association of the States of Illinois, Iowa, Minnesota, Missouri, and Wisconsin, formed for the purposes of cooperative effort and united assistance in the comprehensive planning for the use, protection, growth, and development of the Upper Mississippi River System.

(c)(1) Congress hereby approves the Master Plan as a guide for future water policy on the Upper Mississippi River system. Such approval shall not constitute authorization of any recommendation contained in the Master Plan.

(2) Section 101 of Public Law 95-502 is amended by striking out the last two sentences of subsection (b), striking out subsection (i), striking out the final sentence of subsection (j), and redesignating subsection "(j)" as subsection "(i)".

(d)(1) The consent of the Congress is hereby given to the States of Illinois, Iowa, Minnesota, Missouri, and Wisconsin, or any two or more of such States, to enter into negotiations for agreements,

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Environmental Management Program Authorization

not in conflict with any law of the United States, for cooperative effort and mutual assistance in the comprehensive planning for the use, protection, growth, and development of the Upper Mississippi River system, and to establish such agencies, joint or otherwise, or designate an existing multi-State entity, as they may deem desirable for making effective such agreements. To the extent required by Article I, section 10 of the Constitution, such agreements shall become final only after ratification by an Act of Congress.

(2) The Secretary is authorized to enter into cooperative agreements with the Upper Mississippi River Basin Association or any other agency established under paragraph (1) of this subsection to promote and facilitate active State government participation in the river system management, development, and protection.

(3) For the purpose of ensuring the coordinated planning and implementation of programs authorized in subsections (e) and (h)(2) of this section, the Secretary shall enter into an interagency agreement with the Secretary of the Interior to provide for the direct participation of, and transfer of funds to, the Fish and Wildlife Service and any other agency or bureau of the Department of the Interior for the planning, design, implementation, and evaluation of such programs.

(4) The Upper Mississippi River Basin Association or any other agency established under paragraph (1) of this subsection is hereby designated by Congress as the caretaker of the master plan. Any changes to the master plan recommended by the Secretary shall be submitted to such association or agency for review. Such association or agency may make such comments with respect to such recommendations and offer other recommended changes to the master plan as such association or agency deems appropriate and shall transmit such comments and other recommended changes to the Secretary. The Secretary shall transmit such recommendations along with the comments and other recommended changes of such association or agency to the Congress for approval within 90 days of the receipt of such comments or recommended changes.

(e) Program Authority

(1) Authority

(A) In general. The Secretary, in consultation with the Secretary of the Interior and the States of Illinois, Iowa, Minnesota, Missouri, and Wisconsin, may undertake, as identified in the master plan (i) a program for the planning, construction, and evaluation of measures for fish and wildlife habitat rehabilitation and enhancement; and

(ii) implementation of a long-term resource monitoring, computerized data inventory and analysis, and applied research program, including research on water quality issues affecting the Mississippi River (including elevated nutrient levels) and the development of remediation strategies.

(B) Advisory committee. In carrying out subparagraph (A)(i), the Secretary shall establish an independent technical advisory committee to review projects, monitoring plans, and habitat and natural resource needs assessments.

(2) REPORTS. — Not later than December 31, 2004, and not later than December 31 of every sixth year thereafter, the Secretary, in consultation with the Secretary of the Interior and the States of Illinois, Iowa, Minnesota, Missouri, and Wisconsin, shall submit to Congress a report that —

(A) contains an evaluation of the UMRR-EMPs described in paragraph (1);

(B) describes the accomplishments of each of the UMRR-EMPs;

(C) provides updates of a systemic habitat needs assessment; and

(D) identifies any needed adjustments in the authorization of the UMRR-EMPs.

(3) For purposes of carrying out paragraph (1)(A)(i) of this subsection, there is authorized to be appropriated to the Secretary \$22,750,000 for fiscal year 1999 and each fiscal year thereafter.

(4) For purposes of carrying out paragraph (1)(A)(ii) of this subsection, there is authorized to be appropriated to the Secretary \$10,420,000 for fiscal year 1999 and each fiscal year thereafter.

(5) Authorization of appropriations.—There is authorized to be appropriated to carry out paragraph (1)(B) \$350,000 for each of fiscal years 1999 through 2009.

(6) Transfer of amounts.—For fiscal year 1999 and each fiscal year thereafter, the Secretary, in

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consultation with the Secretary of the Interior and the States of Illinois, Iowa, Minnesota, Missouri, and Wisconsin, may transfer not to exceed 20 percent of the amounts appropriated to carry out clause (i) or (ii) of paragraph (1)(A) to the amounts appropriated to carry out the other of those clauses.

(7)(A) Notwithstanding the provisions of subsection (a)(2) of this section, the costs of each project carried out pursuant to paragraph (1)(A)(i) of this subsection shall be allocated between the Secretary and the appropriate non-Federal sponsor in accordance with the provisions of section 906(e) of this Act; except that the costs of operation and maintenance of projects located on Federal lands or lands owned or operated by a State or local government shall be borne by the Federal, State, or local agency that is responsible for management activities for fish and wildlife on such lands and, in the case of any project requiring non-Federal cost sharing, the non-Federal share of the cost of the project shall be 35 percent.

(B) Notwithstanding the provisions of subsection (a)(2) of this section, the cost of implementing the activities authorized by paragraph (1)(A)(ii) of this subsection shall be allocated in accordance with the provisions of section 906 of this Act, as if such activity was required to mitigate losses to fish and wildlife.

(8) None of the funds appropriated pursuant to any authorization contained in this subsection shall be considered to be chargeable to navigation.

(f) (1) The Secretary, in consultation with any agency established under subsection (d)(1) of this section, is authorized to implement a program of recreational projects for the system substantially in accordance with the recommendations of the GREAT I, GREAT II, and GRRM studies and the master plan reports. In addition, the Secretary, in consultation with any such agency, shall, at Federal expense, conduct an assessment of the economic benefits generated by recreational activities in the system. The cost of each such project shall be allocated between the Secretary and the appropriate non-Federal sponsor in accordance with title I of this Act.

(2) For purposes of carrying out the UMRR-EMP of recreational projects authorized in paragraph (1) of this subsection, there is authorized to be appropriated to the Secretary not to exceed \$500,000 per fiscal year for each of the first 15 fiscal years beginning after the effective date of this section.

(g) The Secretary shall, in his budget request, identify those measures developed by the Secretary, in consultation with the Secretary of Transportation and any agency established under subsection (d)(1) of this section, to be undertaken to increase the capacity of specific locks throughout the system by employing nonstructural measures and making minor structural improvements.

(h)(1) The Secretary, in consultation with any agency established under subsection (d)(1) of this section, shall monitor traffic movements on the system for the purpose of verifying lock capacity, updating traffic projections, and refining the economic evaluation so as to verify the need for future capacity expansion of the system.

(2) Determination.

(A) In general. The Secretary in consultation with the Secretary of the Interior and the States of Illinois, Iowa, Minnesota, Missouri, and Wisconsin, shall determine the need for river rehabilitation and environmental enhancement and protection based on the condition of the environment, project developments, and projected environmental impacts from implementing any proposals resulting from recommendations made under subsection (g) and paragraph (1) of this subsection.

(B) Requirements. The Secretary shall

(i) complete the ongoing habitat needs assessment conducted under this paragraph not later than September 30, 2000; and

(ii) include in each report under subsection (e)(2) the most recent habitat needs assessment conducted under this paragraph.

(3) There is authorized to be appropriated to the Secretary such sums as may be necessary to carry out this subsection.

(i) (1) The Secretary shall, as he determines feasible, dispose of dredged material from the system pursuant to the recommendations of the GREAT I, GREAT II, and GRRM studies.

(2) The Secretary shall establish and request appropriate Federal funding for a program to facilitate productive uses of dredged material. The Secretary shall work with the States which have, within their boundaries, any part of the system to identify potential users of dredged material.

(j) The Secretary is authorized to provide for the engineering, design, and construction of a second lock at locks and dam 26, Mississippi River, Alton, Illinois and Missouri, at a total cost of \$220,000,000, with a first Federal cost of \$220,000,000. Such second lock shall be constructed at or in the vicinity of the location of the replacement lock authorized by section 102 of Public Law 95-502. Section 102 of this Act shall apply to the project authorized by this subsection.

SEC. 906(e). COST SHARING

(e) In those cases when the Secretary, as part of any report to Congress, recommends activities to enhance fish and wildlife resources, the first costs of such enhancement shall be a Federal cost when--

- (1) such enhancement provides benefits that are determined to be national, including benefits to species that are identified by the National Marine Fisheries Service as of national economic importance, species that are subject to treaties or international convention to which the United States is a party, and anadromous fish;
- (2) such enhancement is designed to benefit species that have been listed as threatened or endangered by the Secretary of the Interior under the terms of the Endangered Species Act, as amended (16 U.S.C. 1531, et seq.), or
- (3) such activities are located on lands managed as a national wildlife refuge.

When benefits of enhancement do not qualify under the preceding sentence, 25 percent of such first costs of enhancement shall be provided by non-Federal interests under a schedule of reimbursement determined by the Secretary. Not more than 80 percent of the non-Federal share of such first costs may be satisfied through in-kind contributions, including facilities, supplies, and services that are necessary to carry out the enhancement project. The non-Federal share of operation, maintenance, and rehabilitation of activities to enhance fish and wildlife resources shall be 25 percent.