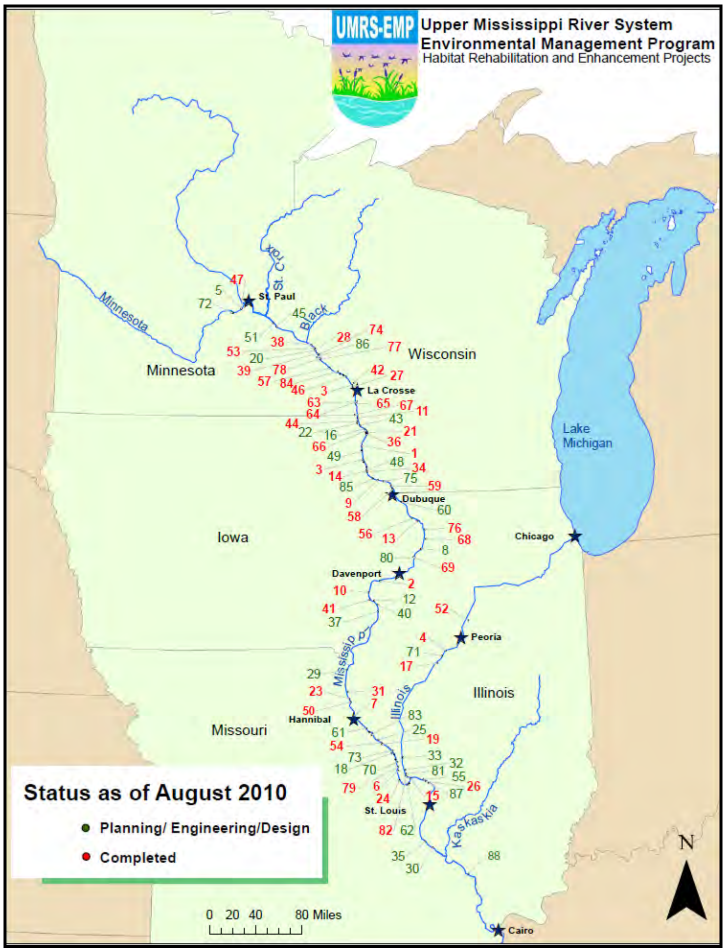
Habitat Rehabilitation and Enhancement Projects

Chapter 2

UPPER MISSISSIPPI RIVER RESTORATION ENVIRONMENTAL MANAGEMENT PROGRAM ENVIRONMENTAL DESIGN HANDBOOK

CHAPTER 2

HABITAT REHABILITATION AND ENHANCEMENT PROJECTS



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CHAPTER 2

HABITAT REHABILITATION AND ENHANCEMENT PROJECTS

FIGURE

TABLES

CHAPTER 2

HABITAT REHABILITATION AND ENHANCEMENT PROJECTS

A. INTRODUCTION

The UMRR-EMP restoration planning approach and techniques have served both nationally and internationally as models for other river restoration planners. Habitat Rehabilitation and Enhancement Projects (HREPs) modify the river's floodplain structure and hydrology to counteract the factors that are degrading habitat. For example, HREPs may alter sediment transport and deposition, water levels, or the connections between the river and its floodplain. These types of physical changes subsequently affect water quality parameters such as temperature, dissolved oxygen, and distribution of suspended sediments, thereby ultimately improving fish and wildlife habitat.

When UMRR-EMP began, HREP designers implemented and refined construction techniques to improve habitats in ways not previously imagined. The intent was to improve habitat through site specific modifications. HREPs successfully combined 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. HREPs continually build upon lessons learned in constructing and managing prior projects, as well as UMRR-EMP's foundational partner coordination and implementation mechanisms.

As of 2012, the UMRR-EMP has received and applied a total of $285,671,000 for its ecosystem restoration efforts, known as HREPs, since its 1986 authorization. The HREP locations are shown in Figure 2-1. This funding has allowed for completion of 54 projects (table 2-1), benefiting approximately 100,000 acres of UMRS habitat at an average approximate cost of $2,900 per acre. An additional 36 HREPs are currently under development or in construction (table 2-2).

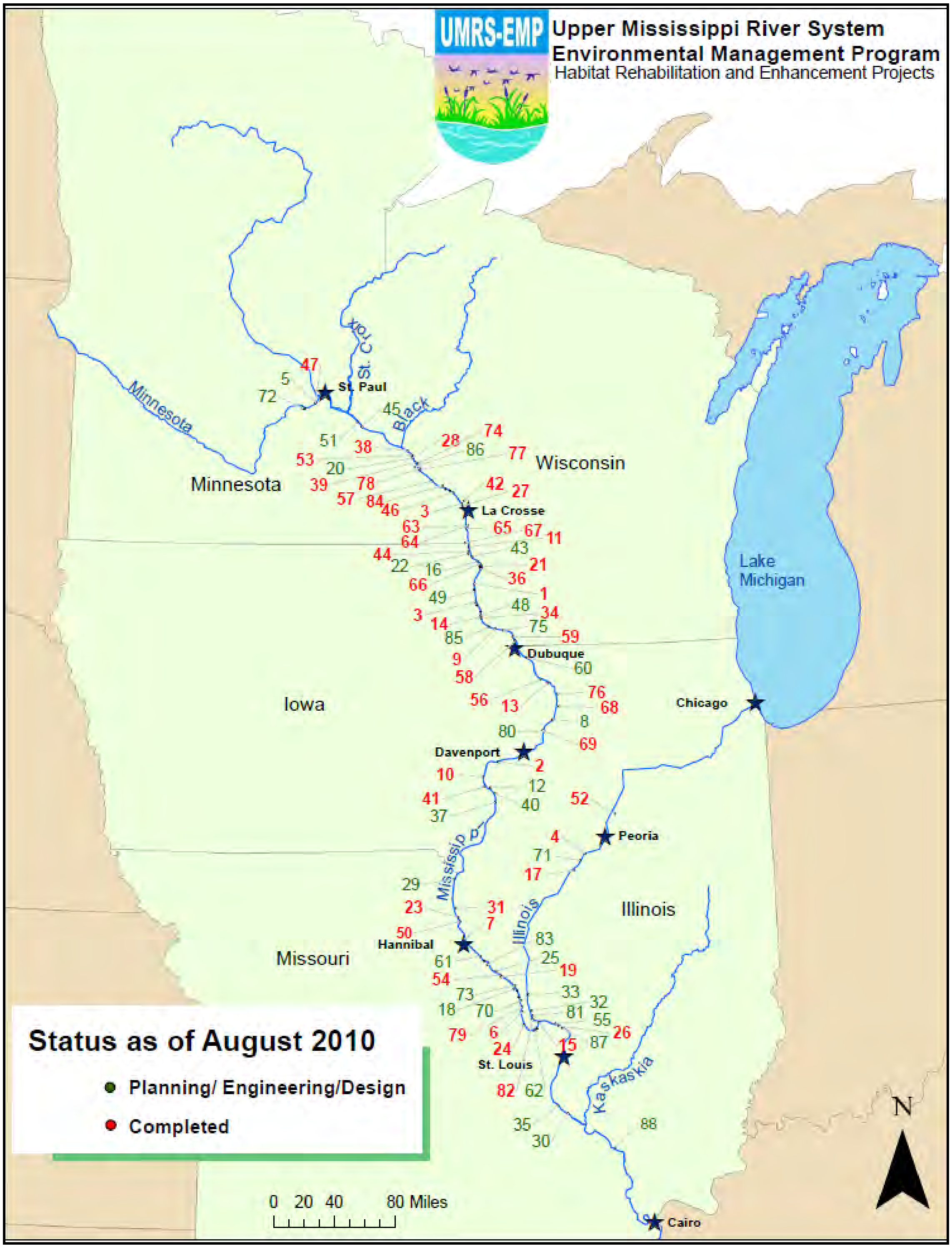

Figure 2-2. Habitat Rehabilitation and Enhancement Projects[1]

[1] Numbers in Figure 2-1 relate to the site reference numbers in Table 2-1.

Table 2-1. HREP Project Listing

EMP HREP Projects	Site Ref.	EMP HREP Projects	Site Ref.
Ambrough Slough	1	Long Meadow Lake	47
Andalusia Refuge	2	Lower Pool 10 Island and Backwater Complex	48
Bank Stabilization	3	McGregor Lake	49
Banner Marsh	4	Monkey Chute	50
Bass Ponds, Marsh, and Wetlands	5	North and Sturgeon Lakes	51
Batchtown Management Area	6	Peoria Lake	52
Bay Island	7	Peterson Lake	53
Beaver Island Complex	8	Pharrs Island	54
Bertom & McCartney Lakes	9	Piasa/Eagle's Nest Islands	55
Big Timber	10	Pleasant Creek	56
Blackhawk Park	11	Polander Lake	57
Boston Bay	12	Pool 11 Islands-Sunfish Lake	58
Brown's Lake	13	Pool 11 Islands-Mud Lake	59
Bussey Lake	14	Pool 12 Overwintering	60
Calhoun Point	15	Pool 24 Islands	61
Capoli Slough	16	Pool 25 & 26 Islands	62
Chautauqua Refuge	17	Pool 8 Islands - Phase I	63
Clarence Cannon	18	Pool 8 Islands - Phase II	64
Clarksville Refuge	19	Pool 8 Islands - Phase III	65
Clear Lake	20	Pool 9 Islands	66
Cold Springs	21	Pool Slough	67
Conway Lake	22	Potters Marsh	68
Cottonwood Island	23	Princeton Refuge	69
Cuivre Island	24	Reds Landing	70
Delair Division	25	Rice Lake-IL	71
Dresser Island	26	Rice Lake-MN	72
East Channel	27	Rip Rap Landing	73
Finger Lakes	28	Small Scale Drawdown	74
Fox Island Habitat Rehab & Enhancement Project	29	Snyder Slough Backwater Complex	75
Ft Chartres Side Channel	30	Spring Lake	76
Gardner Division	31	Spring Lake Islands	77
Glades Wetland Complex	32	Spring Lake Peninsula	78
Godar Refuge Wetland	33	Stag and Keeton Islands	79
Guttenberg Waterfowl	34	Steamboat Island	80
Harlow Island	35	Stump Lake	81
Harpers Slough	36	Swan Lake	82
Huron Island	37	Ted Shanks Conservation	83
Indian Slough	38	Trempealeau Refuge	84
Island 42	39	Turkey River Bottoms Delta and Backwater Complex	85
Keithsburg Division	40	Weaver Bottoms	86
Lake Odessa	41	West Alton Tract	87
Lake Onalaska	42	Wilkinson Island	88
Lake Winneshiek	43		
Lansing Big Lake	44		
Lock & Dam 3	45		
Long Lake	46		

Table 2-2. UMRR-EMP HREP Completed Projects (F), as of April 2012, by District
St. Paul (MVP), Rock Island (MVR), or St. Louis (MVS)

Project Name	Corps District	Status	Percent Complete [1]	Acres Affected	Backwater Dredging	Water Level Mgmt	Islands	Bank Stabilization	Side Channel Restoration	Aeration	Other [2]
Ambrough Slough, WI	MVP	F	100	2,920	X			X	X	X	
Blackhawk Park, WI	MVP	F	100	150					X	X	
Bussey Lake, IA	MVP	F	100	1,680	X	X	X			X	
Clear Lake (Finger Lake) Dredging, MN	MVP	F	100	20	X						
Cold Springs, WI	MVP	F	100	30	X					X	
East Channel, WI, MN	MVP	F	100	320				X			
Finger Lakes, MN	MVP	F	100	530		X				X	X
Guttenberg Waterfowl Ponds, IA	MVP	F	100	80	X	X					
Indian Slough, WI	MVP	F	100	1000	X			X	X		X
Island 42, MN	MVP	F	100	420	X				X	X	
Lake Onalaska, WI	MVP	F	100	2,750	X		X	X		X	
Lansing Big Lake, IA	MVP	F	100	6,420					X	X	
Long Lake, WI	MVP	F	100	40				X		X	
Long Meadow Lake, MN	MVP	F	100	2,340		X					X
Mississippi Bank Stabilization, IA, MN, WI	MVP	F	100	1,300				X			
Peterson Lake, MN	MVP	F	100	990			X	X	X		
Polander Lake, MN	MVP	F	100	790	X		X	X			
Pool 8 Islands Phase I, WI	MVP	F	100	1000	X		X	X			
Pool 8 Islands Phase II,WI	MVP	F	100	600	X		X	X			X
Pool 8 Islands Phase III, WI	MVP	F	100	3,320	X		X	X	X		X
Pool 9 Islands, WI	MVP	F	100	410			X				
Pool Slough, IA, MN	MVP	F	100	620		X					
Rice Lake - MN	MVP	F	100	810	X	X					X
Small Scale Drawdown, WI	MVP	F	100	90		X					X
Spring Lake Islands, WI	MVP	F	100	520	X		X	X	X	X	X
Spring Lake Peninsula, WI	MVP	F	100	30	X		X	X	X		
Trempeleau, WI	MVP	F	100	5,900		X		X			

Project Name	Corps District	Status	Percent Complete [1]	Acres Affected	Backwater Dredging	Water Level Mgmt	Islands	Bank Stabilization	Side Channel Restoration	Aeration	Other [2]
Andalusia Refuge, IL	MVR	F	100	320	X	X	X			X	
Banner Marsh, IL	MVR	F	100	4,290		X					X
Bay Island, MO	MVR	F	100	750		X					X
Bertom McCartney Lakes, WI	MVR	F	100	2,340	X		X	X	X		X
Big Timber, IA	MVR	F	100	1,240	X						X
Brown's Lake, IA	MVR	F	100	1,120	X					X	X
Chautauqua Refuge, IL	MVR	F	100	3,940		X					
Cottonwood Island, MO	MVR	F	100	990	X						X
Lake Odessa, IA	MVR	F	99[3]	6,320	X	X		X	X		X
Gardner (Long Island) Division, IL	MVR	F	100	6,090	X			X			X
Monkey Chute, MO	MVR	F	100	110	X						
Peoria Lake, IL	MVR	F	100	2,500		X	X				X
Pleasant Creek, IA	MVR	F	100	680		X					
Pool 11 Islands-Mud Lake, IL, WI	MVR	F	100	4,550	X		X	X	X	X	X
Pool 11 Islands-Sunfish Lake, IL, WI	MVR	F	100	4,000	X		X	X	X	X	X
Potters Marsh, IL	MVR	F	100	1,200	X	X				X	X
Princeton Refuge, IA	MVR	F	100	1,080		X					X
Spring Lake, IL	MVR	F	100	3,610		X					X
Batchtown, IL	MVS	F	99[3]	3,280		X					X
Calhoun Point, IL	MVS	F	99[3]	2,140	X	X					
Clarksville Refuge, MO	MVS	F	100	310		X					
Cuivre Island, MO	MVS	F	100	2,180		X			X		X
Dresser Island, MO	MVS	F	100	1,030	X	X					
Pharrs Island, MO	MVS	F	100	670							X
Stag and Keaton Islands, MO	MVS	F	100	470					X		
Stump Lake, IL	MVS	F	100	3,170		X					
Swan Lake, IL	MVS	F	99[3]	4,920	X	X					
Completed Projects (54)				**98,380**							

[1] Includes planning, design, construction and close-out.
[2] This category includes floodplain and tributary restoration and other newer and complementary restoration techniques.
[3] Projects do not require additional construction funding to complete.

Table 2-3. Status of UMRR-EMP HREPs in Design (D)[1] and Construction (C), as of April 2012 by District St. Paul (MVP), Rock Island (MVR), or St. Louis (MVS) and Percent of Project Completed

Project Name	Corps District	Status	Percent Complete	Acres Affected	Backwater Dredging	Water Level Mgmt	Islands	Bank Stabilization	Side Channel Restoration	Aeration	Other
Capoli Slough, WI	MVP	C	35	820	X		X	X	X		X
Clear Lake Area Habitat Restoration, MN	MVP	D	1	185	X		X				
Lock & Dam 3 Fish Passage, WI	MVP	D	15	660							X
Lake Winneshiek, WI	MVP	D	8	5,170	X		X	X	X		X
Harpers Slough, IA, WI	MVP	D	10	1,880	X		X	X	X		
Conway Lake, IA	MVP	D	2	1,110	X	X	X	X	X	X	X
Bass Ponds, Marsh, and Wetland, MN	MVP	D	1	390	X	X			X		X
Lower Pool 10 Is. Backwater Complex, IA	MVP	D	1	2,000	X		X				X
McGregor, WI	MVP	D	1	1,000	X		X				X
North and Sturgeon Lakes, MN	MVP	D	1	4,600	X	X	X				X
Weaver Bottoms, MN	MVP	D	1	4,880	X		X				X
Fox Island, MO	MVR	C	60	2,030		X					X
Rice Lake-IL	MVR	C	50	6,350		X					X
Pool 12 Overwintering, IA, IL	MVR	D	25	7,990	X						X
Huron Island, IA	MVR	D	18	2,670	X	X					X
Beaver Island, IA	MVR	D	3	1,750	X					X	X
Boston Bay, IL	MVR	D	1	900	X	X				X	X
Delair Division, IL	MVR	D	1	2,080		X				X	X
Keithsburg Division, IL	MVR	D	1	1,390		X			X		X
Snyder Slough Backwater Complex, WI	MVR	D	1	4,280	X		X				X
Steamboat Island, IA	MVR	D	1	1,280	X		X				X
Turkey R. Bottoms Delta and Backwater, IA, WI	MVR	D	1	3,150	X	X		X			X
Pool 25 and 26 Islands, MO	MVS	C	35	4,020	X		X	X			
Ted Shanks, MO	MVS	C	15	3,330		X					X
Ft Chartres Side Channel, MO	MVS	D	7	60					X		
Rip Rap Landing, IL	MVS	D	6	1,810		X			X		
Clarence Cannon, MO	MVS	D	5	3,590		X			X		X
Glades Wetland Complex, IL	MVS	D	1	320	X	X					X

Project Name	Corps District	Status	Percent Complete	Acres Affected	Backwater Dredging	Water Level Mgmt	Islands	Bank Stabilization	Side Channel Restoration	Aeration	Other
Godar Refuge, IL	MVS	D	1	250		X			X		X
Harlow Island, MO	MVS	D	1	1,300					X		X
Piasa And Eagles Nest Islands, IL	MVS	D	1	390	X		X		X		X
Pool 24 Islands, MO	MVS	D	1	3,150	X					X	X
Red's Landing Wetlands, IL	MVS	D	1	1,620		X			X	X	X
Schenimann, MO	MVS	D	15	705	X				X		
West Alton Tract, MO	MVS	D	1	610	X		X		X		X
Wilkinson Island, IL	MVS	D	5	700	X		X		X		X
PROJECTS UNDER CONSTRUCTION (5)				**16,550**							
PROJECTS IN DESIGN (31)				**61,870**							
TOTAL (36)				**78,420**							

[1] In UMRR-EMP, projects are considered in design from when a project fact sheet is approved until approval of the Definite Project Report (DPR),which incorporates both reconnaissance and feasibility level planning with periodic review and approval by the Major Subordinate Command. Construction includes the deveoplment of plans and specifications.

B. HREP FEATURE COMPONENTS

To accomplish their habitat management and restoration objectives, HREPs employ a variety of techniques including: island creation, shoreline protection, water level management, backwater dredging, river training structures, secondary channel modification, aeration, floodplain restoration, and tributary restoration. Many projects combine these features to address more complex problems. The range of techniques that have been used, or are being considered for possible future use, is extensive (table 2-4.) These techniques are described in more detail in subsequent chapters.

Table 2-4. EMP HREP Features

Category	Actions	Features
Channel and Backwater Restoration	Islands	Barrier Islands
		Seed Islands
		Log Rock Structures
		Mud Flats
		Turtle Nesting Mounds
		Sand Flats
		Delta Formation
	Water Level Management	Pool Scale Drawdowns
		Backwater Scale Drawdowns
		Gate Operation Improvement
		Winter operation at top of band
	Dredging	Backwater dredge cuts
		Secondary Channel dredge cuts
	Channel Restoration	Partial/Complete Rock Closures
		Rock liners
		Dredging
		Wing dam/Closing Dam Mods.
	Island/Shoreline Stabilization	Groins, Vanes, Woody Structure
		Seed Islands
	Aeration channels/structures	Gated culverts
	Embankment Modifications	Rock Ramps
		Gated Culverts
		Spillway Notches
		Near-Shore Berms
	Topographic Diversity	Dredge Material Placement
	Regulation	Mooring Buoys
		No-wake zones
Floodplain Restoration	Land Protection	Fee title/easements
	Connectivity Restoration	Dike/Levee Breach
	Distributary Channel Restoration	Dike/Levee Breach
		In-stream Structures
	Moist Soil Management	Pump Stations
		Dike/Levee Construction
	Floodplain Vegetation Restoration	Reforestation, Planting Native Shrubs and Forbs
		Control of invasive species
		Forest Stand Improvement
	Topographic Diversity	Dredge material placement
	Native Floodplain Management	Prescribed Burns
		Control of invasive species

C. HREP IDENTIFICATION AND PRIORITIZATION

Based on information contained in the 1997 Report to Congress, habitat projects were initially nominated for inclusion in the EMP by the respective State natural resource agencies and/or the USFWS based on agency management objectives; documented habitat needs; professional judgment; funding availability; and, at times, social considerations. With this information, projects being considered reflected broader regional needs in addition to representing the best site-specific choices. Priority projects are then recommended to the Corps district for initiation of planning activities.

In 2003, an HREP Planning and Sequencing Framework was completed to describe the proposed four-stage HREP planning and sequencing process. This process builds upon the existing HREP selection process to create a more systemic, comprehensive approach that is transparent and accessible to project partners and stakeholders. The ecological merits of proposed projects remain the most important factor in determining HREP priorities. Other factors to be considered include project-specific administrative issues and consistency with overall program goals. The process includes the development of a fact sheet, then proceeding with four steps: a district ecological evaluation, a system ecologic evaluation, program planning, and Corps management decisions. Detailed descriptions of this process are included in the 2003 HREP Planning and Sequencing Framework document located on the UMRR-EMP web site.

The 2003 HREP Planning and Sequencing Framework is a systemic, comprehensive planning approach that is transparent and accessible to project partners and stakeholders. This approach facilitates selection of projects that address UMRS ecological needs at the local, reach, and system scales. In 2006-2007, UMRR-EMP used this Framework to identify new projects, which are now all either under MVD's review or in the initial design stage.

D. HREP PLANNING GUIDANCE DOCUMENTS

There are numerous planning policies that are used for developing projects, and the information provided below serves to highlight some of these processes, but should not replace these official documents. Ensure that each project has a team leader that is aware of the current requirements throughout the planning and design process.

- The 1997 Report to Congress provides a detailed description of the planning, engineering and design for HREP projects.
- U.S. Army Corps of Engineers, ER 1105-2-100, *Planning - Planning Guidance Notebook*, April 2000. ER 1105-2-100 states that numerous Federal laws and executive orders establish National policy for and Federal interest in the protection, restoration, conservation and management of environmental resources. These provisions include compliance requirements and emphasize protecting environmental quality. Recent water resources authorizations have enhanced opportunities for Corps involvement in studies and projects to specifically address objectives related to the restoration of ecological resources and ecosystem management. Specific authorities for new individual studies and projects to restore ecological resources have also been provided in legislation. Examples of legislation that broadly supports Federal involvement in the restoration and protection of ecological resources include: Federal Water Project Recreation Act of 1965, as amended; Water Resource Development Acts of 1986,

1988, 1990, 1992, 1996 and 1999; and Coastal Wetlands Planning, Protection and Restoration Act of 1990 (Title III of P.L. 101-646)

- The Corps ecosystem restoration policy is described in more detail in ER 1165-2-501, Civil *Works Ecosystem Restoration Policy*, 30 September 1999
- EP 1165-2-502, *Water Resources Policies and Authorities - Ecosystem Restoration - Supporting Policy Information*, 30 September 1999 policy applies to all ecosystem studies and projects
- Planning Community Toolbox is a web site maintained by the U.S. Army Corps of Engineers Headquarters which provides a list of Chief's Reports, Guidance Memos and Planning ECs, Ems, EPs, ERs, EGMs, and PGLs as well as WRDA and Related Laws. As of May 2012, the link to this site was as follows: http://planning.usace.army.mil/toolbox/library.cfm?Option=Start
- In 2010, a meeting was held between the Corps offices in MVD, MVR, MVS and MVP to discuss the programmatic review process for UMRR-EMP HREP. A copy of the memo documenting the meeting, which describes the appropriate steps for the review process, is available from the UMRR-EMP Program Manager.

E. THE DEFINITE PROJECT REPORT

The UMRR-EMP HREP process conducts and integrated environmental assessment and a feasibility study in the Definite Project Report (DPR). While the report formats have varied over the life of the UMRR-EMP HREP to address changes in Corps planning process, the general criteria included in the DPR are as follows:

1. Introduction
2. Assessment of Existing Resources
3. Project Objectives
4. Potential Project Features
5. Evaluation of Feasible Project Features and Formulation of Alternatives
6. Recommended Plan
7. Schedule for Design and Construction
8. Cost Estimates
9. Environmental Effects
10. Project Performance Assessment Monitoring
11. Real Estate Requirements
12. Implementation Responsibilities and Views
13. Coordination, Public Views, and Comments
14. Conclusions

Appendices to the DPR often include some or all of the following:

A. Correspondence
B. Memorandum of Agreement or Cooperation Agreement
C. Cost
D. Design Calculations
E. Water Quality
F. Clean Water Act Compliance

G. Geotechnical Considerations
H. Hydrology and Hydraulics
I. Hazardous, Toxic and Radioactive Waste
J. Structural
K. Mechanical
L. Electrical
M. Baseline Biological Monitoring
N. Habitat Evaluation and Quantification
O. Plan Formulation
P. Monitoring and Adaptive Management
Q. Value Engineering
R. Real Estate Plan
S. Literature Cited
T. Distribution List
U. Plates

F. EXISTING RESOURCES, GOALS, OBJECTIVES, AND POTENTIAL PROJECT FEATURES

When funds are received for detailed planning and design on a proposed project, a multidisciplinary team of Corps planners, engineers, scientists, and technicians is assembled to initiate detailed project planning. This team works closely with an interagency team of biologists and natural resource managers to identify site-specific resource problems, constraints, and project goals and objectives.

Coincident with the formulation of goals and objectives is the identification of potential project features. For early HREPs, pre-project monitoring data was often limited, and performance data for similar projects was not available for comparison or refinement of design parameters; so the interagency project team worked together to develop project designs using the following general criteria to identify and assess alternative project features:

- Locate and construct features consistent with UMRR-EMP directives and guidance and best planning and design practices

- Construct features consistent with Federal, State and local laws

- Establish goals and objectives that can be monitored

G. PRELIMINARY DESIGN

As interagency teams planned individual projects, HREP design was further refined based on the following factors:

- project goals and objectives
- hydraulic, geotechnical, structural engineering factors
- economics (habitat benefits versus project costs)
- constructability
- aesthetics
- acceptable level of risk and uncertainty

While these criteria and factors continue to be used, project design has evolved because of lessons learned on earlier projects, input from researchers, and evolving natural resource management philosophies. In addition, mathematical and analytical modeling of flow, wind effects, and sediment transport has advanced since the program's beginnings and is used extensively in project design. Essentially, HREP engineering and design developed as the program developed, resulting in enhanced habitat benefits and reductions in most project implementation costs.

HREP construction, monitoring results, and improved technological tools have all contributed to advances in HREP design. Through the use of GIS and 2-dimensional numerical hydrodynamic models, the outcome resulting from construction of certain HREP features can be more reliably predicted. For example, two dimensional hydrodynamic models have been used to refine the layout of islands. Design standards have been adjusted to promote innovation and reduce project costs. Project successes have become the basis for development of design standards for various types of HREPs.

H. EVALUATION OF FEASIBLE PROJECT FEATURES AND FORMULATION OF ALTERNATIVES

For project planning purposes, formulation of alternatives is accomplished through habitat assessment and Incremental Cost Analysis (ICA). Habitat assessment uses ecological models to provide a numerical score (e.g., model output) to the current habitat condition and to the predicted future habitat condition with and without enhancement features. The difference between the numerical score with the enhancement feature and score without the feature is the feature's habitat benefit. The outputs of the ecological models are use in an incremental cost analysis to evaluate what enhancement features, individually or in combination, are most cost-effective. Costs for each feature, including construction, operation, maintenance, and monitoring are annualized and input into the ICA. Alternative development is basically a four-step procedure:

1. calculate the habitat benefit for each feature;
2. estimate the cost of each feature;
3. evaluate the cost/benefit ratio of each feature, and
4. determine the best buy project alternative based on habitat benefits, cost, and achievement of project goals and objectives.

I. PLANNING MODELS & HABITAT ASSESSMENT

The Corps' Planning Models Improvement Program (PMIP) was established in 2003 to assess the state of planning models in the Corps and to make recommendations to assure that high quality methods and tools are available to enable informed decisions on investments in the Nation's water resources infrastructure and natural environment. The main objective of the PMIP is to carry out "a process to review, improve and validate analytical tools and models for U.S. Army Corps of Engineers Civil Works business programs." The PMIP Task Force collected the views of Corps leaders and recognized technical experts, and conducted investigations and numerous discussions and debates on issues related to planning models. It identified an array of model-related problems, conducted a survey of planning models, prepared papers on model-related issues, analyzed numerous options for addressing these issues, formulated recommendations, and wrote a final report that is the basis for the development of EC 1105-2-412, *Assuring Quality of Planning Models, 31 March 2010*.

Planning models are defined as any combination of models and analytical tools that planners use to define water resources management problems and opportunities, to formulate potential alternatives to address the problems and take advantage of the opportunities, to evaluate potential effects of alternatives and to support decision-making. It includes all models used for planning, regardless of their scope or source. This does not cover engineering models used in planning activities. Guidance on quality assurance for engineering models is contained in ER 1110-2- 1150, *Engineering and Design for Civil Works Projects*.

Planning models are either certified or approved. A certified model is one which has been reviewed and certified by the appropriate Planning Center of Expertise (PCX) and Headquarters (HQ). Models will be considered for approval (rather than certification) if they have been developed by an entity outside the Corps. Models will also be considered for approval in cases where a model has been developed by the Corps and is viewed by the vertical team (including the District, MSC, PCX, and HQ) as single-use or study-specific (which will include many ecosystem output models).

Habitat evaluation procedures use ecological models to assess existing and future without-project conditions in the study area, and to evaluate the anticipated habitat outputs of features or alternatives. Recent guidance, EC 1105-2-412, *Assuring Quality of Planning Models, 31 March 2010*, requires that models used to evaluate enhancement features be certified. The Corps' Ecosystem Restoration PCX Model Library [2] serves ecosystem restoration planners and practitioners by consolidating and providing access to information about ecosystem restoration planning models and software. The website provides a list of certified ecosystem models and guidance for model certifications and reviews. The library provides information about each model's scope and geographic range of applicability, documentation availability, points of contact, and review status relative to U.S. Army Corps of Engineers requirements for model quality assurance review. Engineering Circular 1105-2-412, *Assuring Quality of Planning Models, 31 March 2010* provides guidance on model certifications, as does the HQ Memorandum, *Policy Guidance on Certification of Ecosystem Output Models*, August 2007. Model certification guidance can also be found in the Corps' National PCX document *Assuring Quality of Planning Models – Model Certification/Approval Process, Standard Operating Procedures, February 2012*.

J. INCREMENTAL COST ANALYSIS

An ecosystem restoration proposal must be justified on the basis of its contribution to restoring the structure and function, or both, of a degraded ecosystem, when considering the cost of the proposal. Ecosystem restoration projects are justified through a determination that the combined monetary and non-monetary benefits of the project are greater than its monetary and non-monetary costs. An ICA is a planning tool rooted in economic production theory and utilizes such economic principles as scarcity, choice and opportunity cost. The cost analysis examines changes in cost and output that result from decisions to implement alternatives and alternative components. An ICA can be used to identify the least-cost alternative for producing every attainable level of environmental output, as well

[2] As of May 2012, this information was available at the following web site: http://cw-environment.usace.army.mil/model-library.cfm?CoP=Restore&Option=Start

as identifying those alternatives where more output could be produced for the same or less cost. Environmental scale selection choices based on average, instead of incremental cost information, can lead to misinformed and improper decision-making. The rationale behind ICA is to *reveal* the variation in cost between one alternative and another, whereas average cost tends to *obscure* the variation in cost between alternatives. An ICA is an invaluable tool in determining the appropriate scale of mitigation or restoration by revealing variations in cost between alternative; explicitly asking for each attainable increment of output, “Is it worth it?”

The information used in formulating, evaluating and selecting ecosystem restoration features/alternatives includes both quantitative and qualitative information about outputs, costs, significance, acceptability, completeness, effectiveness, and reasonableness of costs. This information is summarized in EP 1165-2-502, *Ecosystem Restoration - Supporting Policy Information*, 1999 and guidance on developing this information and descriptions of the four evaluation criteria (acceptability, completeness, effectiveness, and efficiency) are provided in ER 1105-2-100, *Planning Guidance Notebook*, 2000.

An ecosystem restoration plan should represent a cost effective means of addressing the restoration problem or opportunity. It should be determined that a plan's restoration outputs cannot be produced more cost effectively by another alternative plan. Cost effectiveness analysis is performed to identify least cost plans for producing alternative levels of environmental outputs expressed in non-monetary terms. Incremental cost analysis identifies changes in costs for increasing levels of environmental output. It is used to help assess whether it is worthwhile to incur additional costs in order to gain increased environmental outputs.

K. NATIONAL ECOSYSTEM RESTORATION (NER) PLAN

Engineering Regulation 1105-2-100 directs that Corps of Engineers ecosystem restoration projects should contribute to national ecosystem restoration. The NER plan reasonably maximizes ecosystem restoration benefits compared to costs, considering the cost effectiveness and incremental cost of implementing other restoration options. The NER plan must be identified within the DPR, and may or may not be the same as the recommended plan.

L. TENTATIVELY SELECTED PLAN/RECOMMENDED PLAN

The PDT will select a tentatively selected plan (TSP). Once the TSP goes through various levels of review and is approved by the Mississippi Valley Division, it will become the recommended plan. A recommended ecosystem restoration plan must make a justified contribution to addressing the specified ecosystem restoration objectives. Information regarding resource significance and the significance of expected restoration outputs is used in conjunction with information from cost effectiveness and incremental cost analyses to help determine whether an alternative is justified. Discussions concerning significance should address the following:

- relevant recognition of the environmental resources in terms of institutional, public, and technical importance,
- effects on the resources in terms of differences between estimated future without- and with plan conditions, and,

- other relevant information concerning duration, frequency, location, magnitude, and other characteristics, such as reversibility, irretrievability, and the relationships to short-term uses and long-term productivity

Following completion of these analyses, the interagency team selects the combination of enhancement features that best serves the needs of the resource, while being cost effective. Also, less conservative, experimental designs are considered and, if feasible, incorporated into project design. Project design involves individuals from State and Federal agencies, as well as nongovernmental organizations and the general public. The results of the analyses and investigations described above are documented in a Definite Project Report (DPR) prepared by the Corps with input from the States and the USFWS. T he DPR also evaluates the TSP for potential impacts to the human environment in accordance with applicable State and Federal environmental laws and regulations. Real estate requirements are identified, operation and maintenance requirements are evaluated, and a detailed project cost estimate is developed. The DPR is coordinated with the other involved Federal and State agencies and resource interests, and made available for general public review. The DPR is forwarded to the Corps' higher authority with a recommendation for project implementation approval.

M. PROJECT COOPERATION AGREEMENTS

UMRR-EMP habitat projects are either 100 percent federally funded or require a non-Federal sponsor to pay 35 percent of the project cost. Which of these options applies is governed by Section 906(e) of the 1986 WRDA. Section 906(e) authorizes 100 percent Federal funding for projects that (1) are located on lands managed as a national wildlife refuge, (2) benefit federally-threatened or endangered species, or (3) provide benefits that are determined to be national (e.g., benefit anadromous fish or species subject to treaty). All other UMRR-EMP habitat projects require a 35 percent non-Federal cost share.

For habitat projects that require a 35 percent non-Federal cost share, the Corps and the non-Federal project sponsor sign and execute a Project Partner Agreement (PPA) detailing the obligations and responsibilities of both parties. For these projects, the non-Federal sponsor (normally a State natural resource agency but it may also be a Non-Government Organization) assumes the responsibility of the non-Federal sponsor. For projects with a Federal sponsor, a Memorandum of Agreement (MOA) is written and signed.

N. PROJECT DESIGN

After approval of the project, the responsible Corps district prepares detailed project plans and specifications with input from the project sponsor. The plans and specifications refine the recommended plan as presented in the DPR and comply with Corps guidance and regulations and good engineering practices. The Corps works closely with the sponsor and with construction personnel during the development of plans and specifications to ensure that all considerations are adequately addressed. The plans and specifications process follows the standard Corps review process, and when complete are advertised for construction.

O. PROJECT CONSTRUCTION

HREPs have provided new opportunities to test construction techniques and project design in the river floodplain environment. One of the greatest challenges in project construction can be site conditions, as projects are often located in remote areas of the floodplain. To meet this challenge, more recently constructed HREPs have featured contracts with shorter construction seasons to reduce the risk of flooding, utilized materials such as sheet pile to cut dewatering costs, or staged construction to facilitate access to the site. Construction modifications and unforeseen costs of early HREPs emphasized the importance of sound engineering investigations during design, including collection of sufficient geotechnical, hydraulic, and surveying data.

P. OPERATION, MAINTENANCE, REPAIR, REHABILITATION AND REPLACEMENT

HREPs pose a significant operation, maintenance, repair, rehabilitation and replacement (OMRR&R) responsibility for states and the USFWS. As more HREP projects are completed, OMRR&R costs continue to increase. HREPs can be designed to reduce OMRR&R intensity. However, those projects are typically more expensive to construct. Thus, UMRR-EMP should consider 1) the appropriate balance between reducing OMRR&R expenses and construction costs, 2) how to address increasing cumulative OMRR&R responsibilities for the states and the USFWS, and 3) a protocol for documenting OMRR&R costs and activities.

In accordance with Section 107 (b) of the WRDA of 1992, Public Law 102-580, UMRR-EMP cost-sharing provisions were amended to assign sole responsibility for OMRR&R of habitat projects to the agency that manages the lands on which the project is located.

The HREP projects now consist of over 100,000 acres of restored or enhanced habitat that require various levels of OMRR&R. Some HREP project features require more intensive OMRR&R than others, such as those necessary for water level management and sediment reduction. In 2000, the USFWS submitted a letter to the Corps of Engineers identifying short falls in OMRR&R funding within the agency. A similar, if not more pronounced, condition also confronts State partners. The overall effectiveness of the environmental restoration program for the UMRS is largely dependent upon adequate OMRR&R funding for HREPs. The USFWS previously projected that its annual OMRR&R obligation for HREP projects on national wildlife refuge lands will grow to over $740,000 by 2015. The States' respective funding needs are unknown at this time; however, OMRR&R costs are outlined in each HREP's OMRR&R Manual.

Operation and maintenance of UMRR-EMP habitat projects is similar to that undertaken by the partner agencies in day-to-day management of parks, boat ramps, wildlife management areas and other such public use areas. Activities include inspections, debris removal sediment removal, road or access maintenance, seeding, mowing, pumping, water control structure operation, structure maintenance, etc. Occasionally, feature damage or component failure requires investment by the sponsor that was not planned for in sponsor's budget. Particular examples include earthworks, pump motors, and water control structures. The purpose of assigning OMRR&R costs to the federal or nonfederal partner is to ensure commitment and accountability to the EMP by the project sponsor. While the projects are analyzed over 50 years, they are constructed to last into perpetuity or until deauthorized.

Operation, maintenance, repair, rehabilitation and replacement considerations may extend outside of the typical 50 year period of analysis, as the project sponsor is expected to maintain the HREP Project until it is no longer authorized. Items in this area can include electrical systems, gates, trash racks, stoplogs, and concrete structures. Rehabilitation is the reconstructive work that significantly exceeds the annual operation and maintenance requirements and is needed as a result of major storms or flood events.

Funding for OMRR&R comes from both federal dollars budgeted through the Department of the Interior (USFWS) and from state funds through the five UMRS states' (IL, IA, MN, MO, and WI) natural resource agencies. If a sponsor were f another Federal agency or a non-governmental agency, funding would be their responsibility. Prior to 1992, HREP OMRR&R was governed by Section 906(e) of WRDA 86, which required cost-sharing of OMRR&R. This administratively complex approach was simplified in WRDA 92, which assigned 100 percent of OMRR&R responsibility to the agency that manages the project lands. This policy was reinforced during the first Report to Congress in 1997. There were no recommendations in the 1997 Report to Congress that would change the responsibility for HREP projects. However, since the EMP has completed 25 years of construction of HREP projects, the number of projects and associated OMRR&R costs are increasing.

Q. ADAPTIVE MANAGEMENT

The UMRR-EMP is continually enhancing its restoration and monitoring techniques using insights gained from completed projects, systemic and project monitoring, and applied research findings. The UMRR-EMP has an explicit process for incorporating engineering lessons learned through a prescribed planning and design process, operations manuals, project performance inspections, and the Environmental Design Handbook which integrates best practices of the program. However, the program does not have a similar explicit process to learn about ecosystem responses or to link ecosystem responses with engineering techniques. Active adaptive management (AM) offers explicit approaches to learn about biological responses related to ecosystem restoration.

Throughout its history, the UMRR-EMP has implemented ecological monitoring, focused research, and HREP biological response monitoring to gain insights on the UMRS ecosystem and to enhance future restoration efforts.

The UMRR-EMP has been a national leader in ecosystem restoration implementation and the lessons learned on the UMRS and on other large aquatic ecosystems have been incorporated into recent USACE policy updates. The Corps was granted greater authority and responsibility for AM and ecosystem restoration response monitoring under Section 2039 of WRDA 2007. All Corps ecosystem restoration projects will include plans to review project performance and need to consider opportunities for AM. Whereas prior project performance monitoring focused on constructed features, the 2007 authority allows for greater consideration for biological response to be included in project performance evaluation.

UMRR-EMP has and continues to pioneer new ecosystem restoration and biological monitoring techniques for large rivers. Learning has always been a central theme for the program. This has resulted in improved project formulation, engineering, and design and the adoption of new technologies and techniques for monitoring and research, allowing the program to maintain and enhance its efficiency and effectiveness over the past 26 years. Therefore, implementing AM is a natural step as it is part of an ongoing process to improve the program. The anticipated benefits of

AM are to help in prioritizing information needs, establishing review processes, integrating program elements, and increasing communication.

R. PROJECT MONITORING & PERFORMANCE EVALUATION REPORTS

Physical and biological response monitoring of HREPs has added significantly to the wealth of information available on the river. Ongoing monitoring of projects will produce data necessary to develop physical and biological response models for use in refining future project designs.

Pre-project physical and biological monitoring is done to quantify resource problems such as low dissolved oxygen levels, island erosion, and backwater sedimentation. Post-project monitoring allows specific measurement of physical and biological variables affected by projects and provides data for use in future project development.

The physical effects of HREPs on water movement are well understood. While many of the physical and chemical responses to a project (e.g., changes in dissolved oxygen, water temperature, or water velocity) can usually be determined shortly after construction, several years of monitoring may be required to determine certain selected physical and biological responses to the project (e.g., changes in sediment deposition, fish populations, invertebrates, and vegetation composition). The initial response to project construction may be much different than what happens over the life of a project.

Much of the intensive monitoring of biological response to HREPs has been accomplished using HREP funds. The decision to limit biological response monitoring was made early in the program because the individual and cumulative cost of pursuing detailed, quantitative assessments of the biological effects of every HREP constructed would be high and would reduce available funds for HREP design and construction.. Where detailed monitoring has been completed, the results have generally supported management's evaluations of habitat problems.

Because an HREP project provides benefits within a larger surrounding system, the need for and success of the project must be assessed in this broader context. Fish abundance estimates conducted at an HREP site may only indicate how local population change. The actual benefit of the project may lead to population improvements off site that are undetectable by short-term, site-specific sampling. Because of this, the species specific area of influence is important (e.g., fish that can move 8 to 10 miles can utilize more widely dispersed habitat than one limited to a couple of miles). To this end, input from natural resource managers, scientists, and resource users (i.e., anglers, hunters, and other recreationists) is extremely valuable.

Existing Biological Monitoring consists of forestry survey, aquatic macrophytes, aquatic macroinvertebrates, migratory waterfowl, fish, and aquatic vegetation.

Existing physical and chemical monitoring in the 3 districts includes discharge and velocity in project areas, water surface elevations bathymetry/topography, water quality, sediment transects, levee transects/cross sections, aerial photography, LIDAR, land use/land cover, soil borings Site visits and interviews with Resource Managers are also used to assess project conditions

Performance Evaluation Reports (PER) are used to:

1. Document the pre- and post-construction monitoring activities

2. Summarize and evaluate project performance on the basis of project goals and objectives
3. Summarize project operation and maintenance efforts to date
4. Provide recommendations concerning future project performance evaluation
5. Share lessons learned and provide recommendations concerning the planning and design of future HREPs

Table 2.5 provides the status of PERs, as of February 2012, for the completed HREPs within the UMRS.

S. HREP LESSONS LEARNED

There have been many lessons learned during the design, construction, operation, and evaluation of HREP projects. Many of these lessons are included in the following chapters. There are many lessons that should be applied across the entire HREP process, and a list of these have been compiled and are included in table 2.6.

Table 2.5. Completed PER Reports as of February 2012

Project Name	River	Pool	Initial PER Completed	PER Date	PER Date	PER Date	PER Date
Rice Lake	Minnesota		31-May-2012				
Island 42	Mississippi	5	1-Aug-1995				
Blackhawk Park	Mississippi	9	1-Sep-2004				
Guttenberg Ponds	Mississippi	11	1-Dec-2011				
Lake Onalaska	Mississippi	7	1-Sep-2004				
Pool 8 Phase 1 Stage 1 & 2	Mississippi	8	1-Sep-2004				
Bussey Lake Stage 1,1B & 2	Mississippi	10	1-Sep-2004				
Indian Slough Stage 1 & 2	Mississippi	4	1-Dec-2011				
Cold Springs	Mississippi	9	1-Sep-2004				
Peterson Lake	Mississippi	4	1-Dec-2011				
East Channel	Mississippi	8	1-Sep-2004				
Small Scale Drawdown	Mississippi	5 & 9	4-Sep-2012				
Chautauqua	Illinois	LaGrange	(Bio responses)				
Cottonwood	Mississippi	21	1-Jun-2001	1-Apr-2002			
Long Island (Gardner)	Mississippi	21	1-Jul-2003	1-Jun-2004			
Pool 11	Mississippi	11					
Spring Lake	Mississippi	13	2006 water quality report				
Pleasant Creek	Mississippi	13	31-August-2012				
Bay Island	Mississippi	22	1-Dec-1999	1-Apr-2002	1-Mar-2003		
Andalusia	Mississippi	16	1-Aug-1997	1-Jun-2001	1-Apr-2002	1-Jul-2003	
Banner Marsh	Illinois	LaGrange	1-Aug-2002	1-Aug-2002			
Bertom and McCartney	Mississippi	11	1-May-1995	1-May-2002	1-Sep-2003		
Big Timber	Mississippi	17	1-Oct-1995	1-Feb-1996	1-Aug-1998	1-Jun-2001	1-Apr-2002
Brown's Lake	Mississippi	13	1-Feb-1993	1-Sep-1996	1-Apr-1997	1-Oct-2003	
Peoria	Illinois	Peoria	1-Mar-2001	1-May-2002			
Potters Marsh	Mississippi	13	1-Nov-1998	1-Aug-2002	1-Oct-2003		
Princeton	Mississippi	14	1-Nov-2001	1-Sep-2005			
Cuivre Island	Missouri	26	Draft 2007				
Swan Lake	Illinois	26	2010				
Stump Lake	Illinois	26	2012				
Clarksville Refuge	Missouri	24	1996				

Table 2-6. HREP Lesson Learned

Topic	Description	Addressing Phase	Evaluation Phase
Access Dredging	Access Dredging should be limited to locations shown on the drawings. Material from access dredging can be used for placement on island depending on material characteristics as determined by soil samples.	Design	Construction
Access Pads	Pool 8 Islands - Access Pads are a construction feature that limits the amount of access dredging required. They can either be left in or removed depending on stakeholders and Government desires. Typical size is max of 100 x 250 ft.	Design	Construction
As-Built Drawings	Closeout Spec should describe the format and detail to be provided with the As-Built Drawings. Meta Data format is needed for As-Built info. to be useful in doing Long Term Monitoring.	Design	Construction/ Long Term Monitoring
Borrow Sources/ Cost Sharing	Channel Granular Borrow Sources - Use Operations (Channel Maintenance) granular borrow sites where possible and quantify savings and work with Operations on Project Cost Sharing.	Planning	Design
Borrow Sources - Locations	Identify Borrow Sources meeting design requirements that are as close to the work area as reasonably possible. Borings should be done where necessary before solicitation to confirm proposed borrow source has material meeting specifications.	Planning	Construction
Construction Schedules	Limited Work Windows - One of greatest challenges is working through all the limited work windows associated with critter requirements - bats, astors, eagle nests, etc. Work windows are also affected by high water durations as well as seeding and planting restrictions. Carefully planning work -developing project activity schedules during planning & design phase is critical to understanding how best to 'package' and contract the work to minimize cost impacts of these restrictions.	Planning/Design	Construction
Construction Schedules	Agency Work Restrictions - Working with the agencies to forego a hunting season can be a cost & time & accident saver. Many projects are constructed in USFWS "closed areas" significantly shortening the length of constructions seasons.	Planning/Design	Construction

Table 2-6. HREP Lesson Learned

Topic	Description	Addressing Phase	Evaluation Phase
Construction Schedules	Splitting up Projects to Match Available Funding. Too often funding availability (or lack thereof) drives a construction schedule rather than when construction can be realistically completed given all the government imposed restrictions. Splitting Projects into stages can result in duplicate contractor mobilizations, construction inefficiencies, (and design inefficiencies). Good planning in how work is staged can eliminate many of the inefficiencies.	Planning/Design	Construction
Contract Types	LPTA (lowest price technically acceptable) or best value type contracts and evaluations of contractor qualifications can be valuable contracting tools for environmental restoration projects to ensure that the contractor is aware of the environment in which they will be constructing (flooding, droughts, coordination with resource agencies)	Contracting	Construction
Differing Site Conditions	Changes routinely occur in the field during a project. Ensure that the design team is aware of these changes as it may greatly affect how the project functions or additional coordination that will be needed with the sponsor. Regular partner or coordination meetings facilitate communication during construction	Construction	Construction
Emergent Wetlands	Pool 8 Stages 2B and 3A - Emergent wetlands elevations should vary between up to 2ft with the mean elevation .5ft below LCP. Wetlands should not be table smooth and should slope toward the sand berm and away from islands. Sand berms (containment dike) are required for hydraulic placement during construction, but the height is left up to contractor. Contractor work plan as required by specification, should describe construction details.	Design	Long Term Monitoring
Erosion Protection	Erosion Protection is required as soon as possible after granular placement begins. Contractor may want to construct the vanes or groins concurrent with granular placement. All islands must be completed in full section at the end of each construction season.	Design	Construction
Fine Material - Depth	***Low Islands -*** minimum of 9" is required for fine materials (these islands have increased access to moisture). ***Medium or High Islands -*** Minimum of 12' fine materials is required.	Design	Long Term Monitoring

Table 2-6. HREP Lesson Learned

Topic	Description	Addressing Phase	Evaluation Phase
Geotechnical - General	Borings are an issue on many projects. (1) Get input from construction personnel on locations to take borings. (2) When feasible, some borings should obtained after the island features, or borrow sites are identified, ***so the borings are within the footprint of these features.***	Planning/Design	Construction
Geotechnical Considerations	Fox Island - Design of water distribution channels did not account for approximately 50% of the channel excavation being comprised of pure sand which isn't conducive to moving water in the volume and distance required to fill existing ponds. Borings on the channel excavation alignments would have been beneficial.	Design	Construction
Geotechnical Considerations	Fox Island - Borings did not account for ground water elevations at critical excavation levels for new water control structure construction. Borings at the structure sites would have been beneficial.	Design	Construction
Geotechnical Considerations	Fox Island - Test bore holes for new well construction failed to identify large cobble and rocks at approximately the 30' depth at both new well locations approximately 1 mile apart. Cost and time escalation was realized and well installation methods were changed dramatically upon the discovery of the cobble.	Design	Construction
Geotechnical Considerations	Sand lenses are quite typical in HREP areas. If at all possible coordinate with local onsite individuals that can verify if locations typically hold water or tend to dry up quickly once high water recedes.	Planning/Design	Construction
Inlet/Outlet Structures	Inlet and outlet channels have routinely had sedimentation challenges. To the greatest extent possible, locate inlet/outlet structures and pump stations closer to the river rather than further away.	Design	Long Term Monitoring
Inlet/Outlet Structures	Ensure that sufficient riprap/bank stabilization is placed around inlet/outlet structures. The tendency is to keep the stabilization to a minimum when going for the maximum is usually the better approach.	Design	Long Term Monitoring
Levees	Shallower berm/embankment/levee slopes equals less muskrat burrowing damage (Spring Lake).	Design	Long Term Monitoring

Table 2-6. HREP Lesson Learned

Topic	Description	Addressing Phase	Evaluation Phase
Moist Soil Units	HREPs that include moist soil units typically hold water for extended periods of time. To the greatest extent possible provide bank stabilization methods above and below the projected water line.	Design	Long Term Monitoring
Partnering - During Planning, Design, and Contraction	Work to involve sponsors and stakeholders during planning and design phase and keep them engaged during construction through use of "Partner Meetings" . These meeting are typically held every 1 to 2 weeks during active construction. Issues raised at the meetings are either resolved immediately, or an action plan is developed to get resolution to not impact construction schedules.	Planning, Design, and Construction	Construction
Partnering - Training	If working with new Contractor or if there is there is need to improve the Partnering Process either with the Contractor or stakeholders, schedule a formal or facilitated Partnering Session	Construction	Construction
Plantings	Fox Island, Banner Marsh, Gardner - Marry up cover crop, seeding requirements and maintenance of tree planting areas to promote tree maturation and survival.	Design	Construction
Plantings	In MVP contracts, willows have proven to be cost effective for shoreline erosion control. Experience has shown that successful planting is limited to the spring (or no later than 15 June). To save money and to engage stakeholders and the public, additional tree planting has been coordinated by OP-RNR after construction.	Design	Construction
Plantings - Trees	Tree planting on narrow, elevated ridges to increase survival rates tends to hinder growth. Close coordination with foresters on the appropriate height and width of planting areas is required to ensure an increase in tree survivability.	Design	Long Term Monitoring
PPA/MOA	PPAs: Coordinate with HQ personnel to ensure the preferred model PPA is used at the outset, don't rely on regs/guidance. Also check the HQ website for required PPA package items because no review is started until all items are received.	Planning	?

Table 2-6. HREP Lesson Learned

Topic	Description	Addressing Phase	Evaluation Phase
Pump Stations	Ensure that pump tests, pump inspections, float tests, surge protectors, humidity devices, etc. (i.e. everything that has to do with pump stations) are checked, inspected, verified and fully accepted before allowing the contractor to proceed on. We have had more problems with pumps than probably all other items combined.	Contract	Construction
Pump Stations	Ensure that all hatches and grating have a procedure in place to lock them open so that the hatches to do not close unexpectedly causing a safety hazard.	Design	Construction
Pump Stations	Channels constructed to pump stations or inlet structures have high sedimentation rates. To the greatest extent possible, locate inlet/outlet structures and pump stations closer to the river rather than further away. Build these structures as close to the main channel as possible (Brown's Lake has recurring problem).	Design	Long Term Monitoring
Pump Stations	Electrical equipment and pump stations are subject to damage from high water. Ensure that electrical equipment is placed above the 500 year (or higher if possible) flood level.	Design	Long Term Monitoring
Pump Stations	Chautauqua - Maintenance and/or repair of pump station components requires the dewatering of the pump station sump area. Pump station component maintenance and repair should be examined for user friendliness.	Design	Long Term Monitoring
Pump Station	Ventura Marsh – Consider carefully discharge configurations to address pressurization and soil characteristics. Ensure that soil will rebound when the dewatering system for construction is demolished.	Design	Construction
Real Estate Considerations	Fox Island - Temporary and permanent easements are not in place for reasonable contractor - and eventually user - access to one new water control structure. Assure any and all easements are acquired ahead of construction activities.	Permits	Construction

Table 2-6. HREP Lesson Learned

Topic	Description	Addressing Phase	Evaluation Phase
Real Estate/ Construction Access	Chautauqua and Fox Island - If a contract feature of work is going to require excessive access through a small town (Goofy Ridge, IL and Alexandria, MO) do not rely on a contractor to be required to repave existing streets after several thousand tons of materials have been delivered on those streets. If there is only one way in and one way out via public roads for delivery of construction materials and a contractor is in compliance with all load requirements of those access routes - a contractor can't be held accountable for rehabilitation of those streets/haul routes.	Contract	Construction
Seeding	Pool 8 Islands - Seeding: (1) Keep the seed mix simple since the first overtopping changes the seed mix to what is carried by the river. (2) Seeding in spring is preferable, but successful establishment can be achieved for seeding in all but the 15 June to 15 August time period, if moisture conditions are favorable.	Design	Construction
Seeding - Mulching	Pool 8 Islands - Most specifications require mulching of newly seeded areas. Mulching is the best alternative if it will not result in excessive rutting of seeded areas. Successful establishment has been achieved without mulching.	Design	Construction
Survey	Fox Island & Several Other EMP Projects - Reliance on a single or minimal design cross sections (channel & levee) doesn't always fit the actual field conditions encountered during construction. Design should be applicable to all field conditions.	Design	Construction
Survey	Fox Island - Designed water management water levels do not match existing lake bottom and channel conditions. Assure design and future use is based on recent and accurate survey - especially if the site is subject to frequent flooding.	Design	Construction
Survey	Ensure that surveys are checked and rechecked and the contractor checks and rechecks the surveys. We have had many problems with old surveys, incorrect surveys, pieced together surveys, cheap surveys, etc. It has ALWAYS been worth the money to make sure the surveys are right.	Design	Construction

Table 2-6. HREP Lesson Learned

Topic	Description	Addressing Phase	Evaluation Phase
Survey - Deliverables	It is recommended that survey specifications include: (1) a survey plan as a submittal and (2) list of survey and quantity deliverables. At a minimum, deliverables should include: (a).pre-survey with quantities by feature, (b) interim surveys (as necessary) for payment verification and (c) final surveys with cross sections and quantities within neat lines or required tolerances.	Design	Construction
Surveys - General	Pool 8 Stage 3A - Bathymetry Data used for planning and design is sometimes old and does not represent current conditions. Inaccurate data greatly affects project quantities, site access, and can lead to a differing site condition.	Design	Construction
Water Level Management	Chautauqua - Assure the contract specifically addresses ownership or responsibility of any and all water control structure levels from the construction site to any adjoining rivers. At Chautauqua, nobody (Owner/sponsor, USACE or contractor) wanted to take responsibility for gate openings on a water control structure from the ILWW to the upper lake and eventually that indecision was at least in part cause to a complete loss of that existing structure and construction of a new structure.	Planning	Construction
Water Management Plan	Ensure that the contractor has a detailed water management plan and that the Corps has thoroughly reviewed it for both dewatering and for rising high water. We have had two times (Chautauqua and Banner Marsh) where this has caused major problems.	Construction	Construction
Wells	HREPs with wells need to address iron eating bacteria maintenance/concerns so that waterfowl fully use the ponded water areas constructed	Planning	Long Term Monitoring
Work Conditions	HREPs are constructed in typically wet and potentially flooded areas. Insure that the contractors are fully aware of the normal conditions that exist on the site in a "typical" year.	Design	Construction