US Army Corps
Of Engineers
St. Paul District

UPPER MISSISSIPPI RIVER SYSTEM

ENVIRONMENTAL MANAGEMENT PROGRAM

FINAL
DEFINITE PROJECT REPORT
AND INTEGRATED
ENVIRONMENTAL ASSESSMENT
Project #114832

Main Report

CAPOLI SLOUGH
HABITAT REHABILITATION
AND ENHANCEMENT PROJECT

Pool 9
Upper Mississippi River
Crawford County, Wisconsin

June 2011

EXECUTIVE SUMMARY

The Capoli Slough Habitat Rehabilitation and Enhancement Project (HREP) is located on the Wisconsin side of the Upper Mississippi River in lower Pool 9, near Lansing, Iowa (see Executive Figure 1). The site lies within the Upper Mississippi River National Wildlife and Fish Refuge.

Executive Figure 1. Location of Capoli Slough HREP Study Area

The overall recommended plan is to protect 10 existing islands and construct 9 new islands at an estimated present cost of $10,093,700 (including sunk costs and Planning, Engineering, and Design and Construction Management costs). The project would protect, restore and/or create about 49 acres of islands, compared to the 74 acres of islands that were present shortly after inundation by Lock and Dam 9 in 1940.

The habitat concerns within the study area center around the general degradation of habitat quality in lower Pool 9. This degradation is the result of the loss of islands, declining bathymetric diversity, and a decline in aquatic vegetation, mainly emergent vegetation, over the past few decades. Submersed vegetation has rebounded in the last 20 years but is still not optimal. The study area lies within the Upper Mississippi River National Wildlife and Fish Refuge and is considered critical habitat for migrating waterfowl and other water birds. The decline in migration habitat quality is of great concern to the U.S. Fish and Wildlife Service and State resource management agencies.

The planning process focused on the protection and restoration of islands and river processes to restore habitat diversity within the 2,035-acre study area. Because it is not possible to restore or create ideal habitat conditions for all forms of fish and wildlife, measures were designed and evaluated primarily to improve conditions for State and Federal natural resource agencies' priority communities: migratory waterfowl and native fish species. However, once the basic island layouts and designs were developed, they were modified to benefit other fish and wildlife wherever possible. Islands were positioned to maintain and/or encourage flowing

channels for riverine fish and/or to provide protected deepwater habitat for overwintering Centrarchid fish such as bluegills, crappie, and largemouth bass. Measures such as emergent wetlands/mudflats were incorporated into the island designs to provide habitat for shorebirds and wading birds.

To identify alternatives, measures were combined in various logical combinations and constraints were imposed to protect the endangered Higgins eye mussel. The resulting 23 identified alternatives (including the No-Action Alternative) were evaluated in detail for the Capoli Slough HREP. The U.S. Fish and Wildlife Service's 1980 version of Habitat Evaluation Procedures (HEP) was used to quantify and evaluate the potential project effects and benefits. In addition to the base project of protecting the existing island complex (Alternative A), four action alternatives were considered "Best Buy" in evaluation of cost effectiveness and incremental cost using the Institute of Water Resources economic analysis program called IWR-PLAN. Based on the incremental analysis and other factors, Alternative E4, which included additional habitat dredging, creation of emergent wetland K, and creation of two cobble liners to create a riffle/pool complex is recommended for implementation.

Under Alternative E4, the acres (more than 200) of emergent and rooted floating aquatic vegetation will be maintained close to existing conditions. If the project is not completed, all emergent and rooted floating aquatic vegetation is predicted to disappear as the remaining islands disappear. The acreage of submersed aquatic vegetation is predicted to increase with the reduction of wind fetch and wave action.

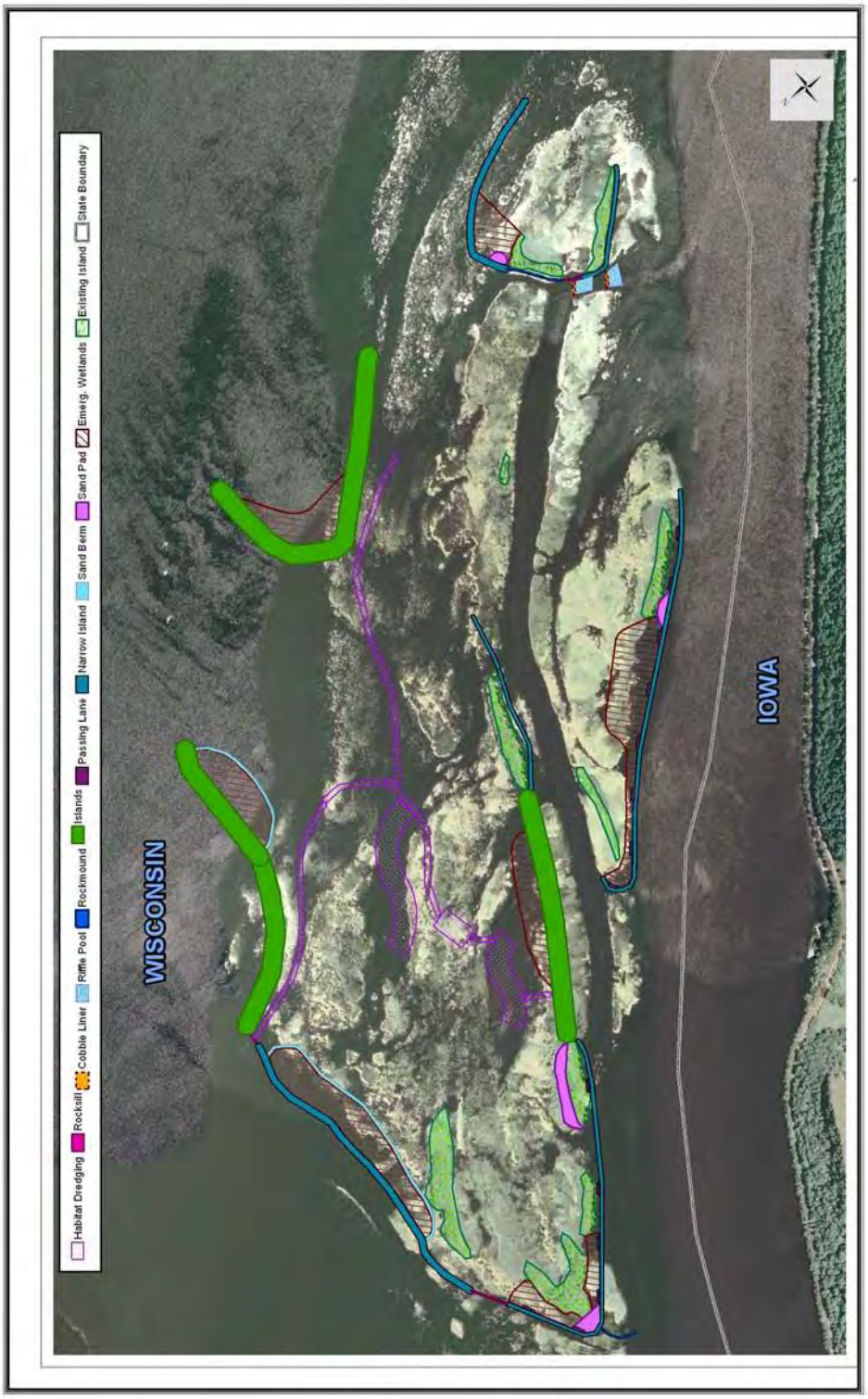
If Alternative E4 is implemented, substantial habitat benefits to shorebirds and wading birds are expected to accrue as a result of the creation of about 30,000 linear feet of sandy shoreline and at least one emergent wetland/mudflat totaling about 5 acres. The sand berms, pads and passing lanes of the islands will also provide a substantial amount of area available for turtle nesting. The 49 acres of islands protected or created under Alternative E4 will provide habitat for terrestrial and semi-aquatic species of wildlife. This type of habitat is nearly nonexistent in the areas where the islands would be constructed.

The islands would help maintain around 41 acres of Capoli Slough secondary channel, which would contribute to aquatic habitat diversity in this area, primarily for riverine fish species and mussels. The cobble liners would also increase aquatic habitat diversity in this secondary channel. Protected deepwater habitat about 10 acres in size would be created, providing overwintering habitat for Centrarchids and other backwater fish species. This type of habitat is of critical importance in lower Pool 9 where overwintering habitat is almost nonexistent due to the loss of islands.

Project construction would begin in 2012 and be completed in 2013 or 2014.

The entire project lies within the Upper Mississippi River National Wildlife and Fish Refuge. Once completed, the project would be turned over to the U.S. Fish and Wildlife Service for operation and maintenance.

Executive Figure 2. Recommended Project Measures for Capoli Slough HREP.



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FINAL DEFINITE PROJECT REPORT AND INTEGRATED ENVIRONMENTAL ASSESSMENT

CAPOLI SLOUGH
HABITAT REHABILITATION AND ENHANCEMENT PROJECT
POOL 9, UPPER MISSISSIPPI RIVER
CRAWFORD COUNTY, WISCONSIN

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CRAWFORD COUNTY, WISCONSIN

1. INTRODUCTION

1.1 AUTHORITY

Congress authorized the Upper Mississippi River System Environmental Management Program (UMRS-EMP) in Section 1103 of the 1986 Water Resources Development Act (WRDA). Over the course of its first 13 years, EMP proved to be one of this country's premier ecosystem restoration programs, combining close collaboration between Federal and State partners, an effective planning process, and a built-in monitoring process. This success led Congress to reauthorize EMP in WRDA 1999 (Public Law 106-53). Section 509 of the 1999 Act made several adjustments to the program and established the following two elements as continuing authorities:

- Planning, construction, and evaluation of fish and wildlife habitat rehabilitation and enhancement projects (known as Habitat Rehabilitation and Enhancement Projects (HREPs)).

- Long-term resource monitoring, computerized data inventory and analysis, and applied research (known collectively as Long-Term Resource Monitoring Program (LTRMP)).

1.2 PARTICIPANTS AND COORDINATION

Participants in the planning for the Capoli Slough project included the Upper Mississippi River National Wildlife and Fish Refuge and the Region 3 Offices of the U.S. Fish and Wildlife Service (USFWS); the Wisconsin and Iowa Departments of Natural Resources (Wisconsin DNR and Iowa DNR); and the St. Paul District, Corps of Engineers.

The USFWS and the Wisconsin and Iowa DNRs were involved in project planning because the study area is located within the Upper Mississippi River National Wildlife and Fish Refuge and within that portion of Pool 9 bounded by Wisconsin and Iowa. The USFWS is

considered a cooperating agency under Federal regulations governing the implementation of the National Environmental Policy Act of 1969 (NEPA).

The following individuals played an active role in the planning and design of the Capoli Slough project. For St. Paul District personnel, the discipline and contribution of the individual planning team members is listed. For resource agency personnel, the individual's position title is listed.

ST. PAUL DISTRICT, CORPS OF ENGINEERS

Name	Discipline	Contribution
Dennis Anderson	Fishery Biologist	Project Manager
Steven Clark	Fishery Biologist	Project Manager
Gary Palesh	Fishery Biologist	Project Manager (retired)
David Potter	Fishery Biologist	Environmental analysis, NEPA
Brad Perkl	Archaeologist	Cultural resources analysis
Mike Walker	Cartographer	GIS analysis
Scott Jutila	Hydraulic Engineer	Hydraulic analysis
Joel Face	Civil Engineer	Geotechnical analysis
Bob Dempsey	Civil Engineer	Design and layout
Jeff Hansen	Civil Engineer	Cost Estimating

U.S. FISH AND WILDLIFE SERVICE

Tim Yager	Refuge District Manager
Clyde Male	Refuge Assistant District Manager
Tim Loose	Wildlife Refuge Specialist
Sharonne Baylor	Habitat Projects Coordinator
Gary Wege	Twin Cities Field Office (retired)
Phil Delphey	Twin Cities Field Office
Pam Thiel	Project Leader–La Crosse Fisheries Resource Office

WISCONSIN DEPARTMENT OF NATURAL RESOURCES

Jeff Janvrin	Habitat Projects Coordinator
Patrick Short	Area Fisheries Manager
Mark Anderson	Area Wildlife Manager

IOWA DEPARTMENT OF NATURAL RESOURCES

Mike Griffin	Habitat Projects Coordinator
Scott Gritters	Area Fisheries Manager
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PRIMARY POINT OF CONTACT FOR THE PROJECT

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1.3 PROJECT PURPOSE

The purpose of this integrated Definite Project Report (DPR) and Environmental Assessment (EA) is to document the planning process for ecosystem restoration of the Capoli Slough study area on the Upper Mississippi River, provide the opportunity for participation in the planning process for river management partners and the public, meet Corps of Engineers planning guidance and meet NEPA requirements. The DPR and EA will document existing and predict future habitat conditions and deficiencies; identify problems, constraints, and opportunities; define habitat goals and objectives; identify and evaluate measures and alternatives that would address the goals and objectives; document the effects of the alternatives in accordance with NEPA and other environmental laws and regulations; and recommend a selected plan for habitat restoration and enhancement.

1.4 PROJECT AREA

The Capoli Slough project site within which proposed measures would be constructed is located in the lower reaches of Pool 9, about 5 miles below Lansing, Iowa, between river miles 658.4 and 656.7 (plate 1). The site is around 820 acres and is a complex of islands, backwaters, and sloughs. The site is located immediately adjacent to the main navigation channel along the left descending bank. An area of potential influence, which includes the project site and areas bordering it, has also been delineated for assessing habitat benefits associated with project alternatives (see Figure 1 of Appendix 4). This “study area” was identified based on criteria for projected changes to wind/wave action and is around 2,035 acres in size.

The entire study area lies within the boundaries of the Upper Mississippi River National Wildlife and Fish Refuge (Refuge).

1.5 RESOURCE PROBLEMS/OPPORTUNTIES

The habitat concerns within the study area center around the general degradation of habitat quality in lower Pool 9. This degradation is the result of the loss of islands, declining bathymetric diversity, and a decline in aquatic vegetation over the past few decades. However, submersed aquatic vegetation has recovered in the last 10 years, especially within the last 5 years. The study area lies within the Upper Mississippi River National Wildlife and Fish Refuge and is considered critical habitat for migrating waterfowl and other water birds. The decline in migration habitat quality is of great concern to the USFWS and State resource management agencies. The resource problems and opportunities are more fully described in Chapter 4, Problem Identification.

Habitat deficiencies in the Capoli Slough area include the continued loss of the mosaic of habitat, especially the continued disappearance of islands and emergent vegetation. The area also lacks a deep, protected aquatic habitat that would serve as overwintering habitat for Centrarchid fish and associated species. This type of over-wintering habitat is extremely rare in lower Pool 9 and has been declining with the loss of islands and bathymetric diversity.

The opportunity exists to protect and restore the Capoli Slough wetland complex before it is lost. In many locations within the study area, remnants of eroded islands still exist just beneath the water surface. These underwater remnants provide a solid base upon which to reconstruct islands.

Specific project needs to restore habitat diversity in the area include the following items. These needs will serve as the basis for selecting among the alternatives.

- Maintain and/or enhance habitat in the Capoli Slough backwater area for migratory birds.
- Create habitat for migratory and resident vertebrates with emphasis on marsh and shorebirds, bald eagles, and turtles.
- Improve and maintain habitat conditions for backwater fish species.
- Enhance secondary and main channel border habitat for riverine fish species and mussels.

1.6 DECISIONS THAT NEED TO BE MADE

1.6.1 US ARMY CORPS OF ENGINEERS

Because this potential project is funded by the U.S. Army Corps of Engineers, the District Engineer, U.S. Army Corps of Engineers, St. Paul District, will select one of the alternatives for potential implementation. The District Engineer will also determine, based on the facts and recommendations contained herein, whether this EA is adequate to support a Finding of No Significant Impact (FONSI) or whether an Environmental Impact Statement (EIS) will need to be prepared.

1.6.2 US FISH AND WILDLIFE SERVICE

Because this potential project is located on land managed by the Upper Mississippi River National Wildlife and Fish Refuge, the Regional Director, USFWS, Region 3, will determine whether the proposed project is compatible with refuge goals and objectives and the Refuge Comprehensive Conservation Plan. The USFWS Regional Director will also determine if the USFWS approves the selected alternative for potential implementation and if the USFWS will assume operation and maintenance of the selected alternative. The Regional Director will also determine, based on the facts and recommendations contained herein, whether the final integrated DPR and EA meets the USFWS's obligations under NEPA, the Fish and Wildlife Coordination Act, and the Endangered Species Act of 1973.

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2. GENERAL PROJECT SELECTION PROCESS

2.1 ELIGIBILITY CRITERIA

In January 1986, prior to enactment of Section 1103 of WRDA 1986, the North Central Division, U.S. Army Corps of Engineers, completed a "General Plan" for implementation of the UMRS-EMP. The USFWS, Region 3, and the five affected States (Illinois, Iowa, Minnesota, Missouri, and Wisconsin) participated through the Upper Mississippi River Basin Association. Programmatic updates of the General Plan for budget planning and policy development are accomplished through Annual Addenda.

Coordination with the States and the USFWS during the preparation of the General Plan and Annual Addenda led to an examination of the Comprehensive Master Plan for the Management of the UMRS. The Master Plan, completed by the Upper Mississippi River Basin Commission in 1981, was the basis for the recommendations enacted into law in Section 1103. The Master Plan report and the General Plan identified examples of potential habitat rehabilitation and enhancement techniques. Consideration of the Federal interest and Federal policies has resulted in the conclusions below:

a. From the First Annual Addendum.

> The Master Plan report... and the authorizing legislation do not pose explicit constraints on the kinds of projects to be implemented under the UMRS-EMP. "For habitat projects, the main eligibility criterion should be that a direct relationship should exist between the project and the central problem as defined by the Master Plan; i.e., the sedimentation of backwaters and side channels of the UMRS. Other criteria include geographic proximity to the river (for erosion control), other agency missions, and whether the condition is the result of deferred maintenance...."

b. From the Second Annual Addendum.

> (1) The types of projects that are definitely within the realm of Corps of Engineers implementation authorities include the following:
>
> - backwater dredging
> - dike and levee construction
> - island construction
> - bank stabilization
> - side channel openings/closures
> - wing and closing dam modifications
> - aeration and water control systems

- waterfowl nesting cover (as a complement to one of the other project types)
- acquisition of wildlife lands"

(2) A number of innovative structural and nonstructural solutions, which address human-induced impacts, particularly those related to navigation traffic and operation and maintenance of the navigation system, could result in significant long-term protection of UMRS habitat. Therefore, proposed projects that include such measures will not be categorically excluded from consideration, but the policy and technical feasibility of each of these measures will be investigated on a case-by-case basis and the measures will be recommended only after consideration of system-wide effects.

2.2 PROJECT SELECTION

Projects are nominated for inclusion in the District's habitat restoration program by a State natural resource agency or the USFWS, based on agency management objectives. To assist the District in the selection process, the States and USFWS have agreed to use the expertise of the Fish and Wildlife Work Group (FWWG) of the River Resources Forum (RRF) to consider critical habitat needs along the Mississippi River and prioritize nominated projects on a biological basis.

The FWWG consists of biologists responsible for managing the river for their respective agencies. Meetings are held on a regular basis to evaluate and rank the nominated projects according to the biological benefits they could provide in relation to the habitat needs of the river system. The ranking is forwarded to the RRF for consideration of the broader policy perspectives of the agencies involved. The RRF submits the coordinated ranking to the District, and each agency officially notifies the District of its views on the ranking. The District then formulates and submits a program that is consistent with the overall program guidance as described in the UMRS-EMP General Plan and Annual Addenda and supplemental guidance provided by the Mississippi Valley Division (a successor to the North Central Division).

Biologists familiar with the river have screened the potential projects. Resource needs and deficiencies have been considered on a pool-by-pool basis to ensure that regional needs are being met and that the best expertise available is being used to optimize the habitat benefits created at the most suitable locations.

In 1990 and 1991, the FWWG ranked the Capoli Slough project as the third priority project for inclusion in the fiscal years 1993 and 1994 St. Paul District programs, respectively. Initial study began on the project in fiscal year 1994. Study on the Capoli Slough project was given low priority during the period 1995 through 1999 as available funds were used for higher priority habitat projects. Also, at times during this period, it appeared there would be insufficient funds within the authorized life of the UMRS-EMP (2002) to complete the project due to other higher priority projects. With reauthorization of the UMRS-EMP in WRDA 1999, study on the project recommenced in May 2000.

3. ASSESSMENT OF EXISTING RESOURCES

3.1 PHYSICAL SETTING

Pool 9 is part of the 9-foot channel project on the UMRS and was created in 1938 by the construction of Lock and Dam 9. The entire pool extends over 31.3 miles (river miles 647.9 to 679.2). The project pool elevation is 620.0 feet above mean sea level (msl 1912 adjusted), which creates a pool surface area of 29,125 acres. The pool has a meandering outer perimeter shoreline length of approximately 90 miles. Wisconsin is located on the left descending riverbank and Minnesota and Iowa are on the right riverbank. The pool's valley varies in width from about 2 miles at Lynxville, Wisconsin, to more than 3½ miles at New Albin, Iowa. The bluffs are steep on both sides and highly dissected, with a maximum relief of 500 to 600 feet (elevation range from about 620 to 640 feet msl 1912 adjusted at river level to over 1,200 feet msl 1912 adjusted on the uplands). Steep-sided tributary valleys may widen abruptly as they enter into the river to form "coves" or elevated delta areas filled with alluvial materials, mostly sand and silt. The lower portion of Pool 9 is open and lake-like, with only scattered islands. The Pool 9 floodplain includes about 51,000 acres, of which about 16,500 acres is wet floodplain forest and meadow, 10,000 acres is submerged and floating leaf vegetated shallow water, 6,000 acres is emergent marsh, and 17,000 acres is open water (Theiling 2000).

The study area is 2,035 acres that extends across 2.2 miles of the river on the Wisconsin side, from river miles 658.5 to 656.3. A significant portion of this area is considered backwater and is devoid of aquatic vegetation (open water) with 3- to 5-foot depths. Within this area, the 820-acre project site (area containing the proposed measures) extends across 1.8 miles of the river, from river miles 658.3 to 656.5. The project site includes an intermingled complex of stump fields, sloughs, vegetation beds, and island remnants. The Capoli Slough channel (proper) branches off the main channel just below Ferry Slough. It parallels the main channel for about 1 mile before flowing easterly across the floodplain. Capoli Slough proper runs through the project area, and bathymetric surveys indicate it to be deep, ranging from 6 to 15 feet at the average pool elevation of 620.1 feet msl. Outside of this channel, depths range from 1 to 3 feet.

3.2 WATER RESOURCES

3.2.1 UPPER MISSISSIPPI RIVER

Early summer (June) discharges at Lock and Dam 9 generally range from 30,000 to 60,000 cubic feet per second (cfs). By late summer, discharges usually decrease to a range of 20,000 to 40,000 cfs. Winter low flows are usually in the range of 15,000 to 25,000 cfs. Table

3-1 shows the discharges and stages associated with the various high runoff events for the Mississippi River at Lock and Dam 9.

Table 3-1
Mississippi River Discharge Frequencies - Lock and Dam 9

Event	**Flow** (cubic feet per second)	**Stage @ LD 9** (ft amsl)[a]	**Stage @ RM 658** (ft amsl)[a]
1.5-year (67% chance)	80,000	620.50	621.80
5-year (20% chance)	140,000	625.20	626.15
10-year (10% chance)	168,000	627.10	627.97
20-year (5% chance)	195,000	628.85	629.65
50-year (2% chance)	230,000	631.00	631.77
100-year (1% chance)	260,000	632.81	633.57

[a] Feet above mean sea level 1912 adjusted.

Much of the floodplain was completely submerged when Lock and Dam 9 went into operation, greatly changing the hydrodynamic regime in the project area. The two primary changes that occurred include the continuous flow of water through the floodplain in the project area and the creation of a lake-like lower Pool 9 that is subject to wind-driven wave action. Approximately 50 percent of the total river flow is conveyed in the main channel in the project area making this a highly divided reach of the Upper Mississippi River. For the 1.5-year discharge event of about 80,000 cfs, average velocities in the main channel are 2 to 3 feet per second (fps), while average velocities in the floodplain are less than 1 fps. Wind generated waves create orbital velocities that in shallow waters can resuspend sediments. Due to the 4- to 5-mile southeasterly and 2- to 3-mile northeasterly wind fetches, wind-driven wave action during larger wind events can generate orbital velocities that exceed river flow velocities in the floodplain of the project area.

Pool 9 is regulated in a manner typical for navigation pools in the St. Paul District. When river discharges are greater than 64,000 cfs, the gates are removed from the water at Lock and Dam 9 and the pool is unregulated. When discharges are between 32,000 and 64,000 cfs the pool is in “secondary control”; i.e., a pool elevation of 619.0 feet msl 1912 adjusted is maintained at the dam. The pool upstream of the dam rises and falls with river discharge. Due to the slope on the pool, the range of fluctuation under secondary control is greater the farther upstream from the dam one progresses.

At a discharge of 32,000 cfs, regulation of the pool shifts to “primary control” whereby a water surface elevation of 620.0 feet is maintained at the primary control point at river mile 663.0 at Lansing. As discharges decline below 32,000 cfs, the water surface elevation at Lock and Dam 9 rises from 619.0 feet msl 1912 adjusted toward 620.0 feet msl 1912 adjusted. If river discharges were to decline to zero, the pool water surface would (in theory) be flat at elevation 620.0.

The current allowable drawdown at Lock and Dam 9 between project pool elevation 620.0 feet and the secondary control elevation of 619.0 feet is 1.0 foot. When the dam first went into operation, the allowable drawdown was 2.5 feet to elevation 617.5 feet. In 1947, the allowable drawdown was reduced to the current 1.0 foot. Additional discussion of the effects of water level regulation at the project site is provided in section 4.3.2.

3.2.2 TRIBUTARIES

Tributaries to the Mississippi River near the project site include Village Creek (Iowa), Sugar Creek (Wisconsin), and Rush Creek (Wisconsin). Land use/land cover in the watersheds of these tributaries is dominated by agriculture in the uplands and bottomland forest. Although considered perennial streams, the amount of flow these tributaries contribute relative to the Mississippi River is minor.

3.2.3 GROUNDWATER

Large quantities of groundwater are present in the highly permeable, surficial sand deposits. The principle aquifer for shallow wells (less than 150 feet) would be the Franconia formation. Deeper wells in the northern end of the Pool 9 region may penetrate into the Galesville or Eau Claire formation, although water quality would not differ much from that of the Franconia formation. Groundwater is considerably harder than the Mississippi River in Pool 9.

3.2.4 IMPORTANT HYDROLOGIC UNITS IN IMMEDIATE PROJECT AREA

Prior to inundation of Pool 9, Ferry Slough branched off the main channel to the left at the upstream end of the Capoli Slough complex at river mile 658.4. Ferry Slough flowed in a generally southeasterly direction, joining Winneshiek Slough, a larger channel flowing on the Wisconsin side of the floodplain. Ferry Slough was inundated with the creation of Pool 9 and over time has become less evident due to the loss of the islands and aquatic plant beds that defined its location. The old channel of Ferry Slough is still discernable on bathymetry maps.

3.3 GEOLOGY AND SOIL/SUBSTRATE

The most significant geologic event explaining the nature of the Mississippi River within Pool 9 occurred at the end of the Pleistocene glaciation approximately 10,000 years ago. Tremendous volumes of glacial meltwater, primarily from the Red River Valley's glacial Lake Agassiz, eroded the pre-glacial Minnesota and Mississippi River valleys. As meltwaters

diminished, the deeply eroded river valleys aggraded substantially to about the present levels. Prior to impoundment, the broad floodplain of the river was depressions, sloughs, natural levees, islands, and shallow lakes. Since impoundment, a relatively thin veneer of silts, clays, or sands has been deposited over most of the river bottom within the pool. The sedimentation of fines (clay and silt) is generally greater in the slow moving backwater areas than in the major side channels and main channel portions of the impounded area.

In the bluffs of the Upper Mississippi River valley along Pool 9 are exposed Lower Paleozoic sedimentary rocks, dominantly carbonates (limestones and dolomites) and sandstones, overlain by unconsolidated materials of Quaternary (Upper Cenozoic) age loess of the earlier glacial advances. This stretch is part of the Driftless Area that was not covered by advances of the Wisconsin ice sheet. In the stretch from Lynxville north to Reno, Minnesota, the units exposed in the base of the bluffs are Cambrian age sandstones from the Dresbach Formation (Lower Cambrian) in the north to the Jordan Formation (Upper Cambrian) to the south. Overlying the Jordan Sandstone is the Lower Ordovician age Prairie du Chien Formation, a predominantly dolomite sequence generally divided into the Oneota and Shakopee Formations.

The principal parent materials of soils in the drainage basin associated with Pool 9 are loess, alluvium, and glacial drift. Loess over bedrock or over clay loam till is the major historical parent material of Pool 9 and associated uplands. The principal soil associations of the Pool 9 area are the Fayette and Fayette-Dubuque-Stonyland (FDS). The FDS association generally contains a higher percentage of shallow limestone soils on steep, stony land than the Fayette soil association. The sediment load carried into Pool 9 by the Upper Iowa River accumulates in backwater areas and in the navigation channel. The major soil type of upland peninsulas in Pool 9 is silt loam. Additional details on geology and soil characteristics within the study area are provided in Attachment 6 – Geotechnical).

From a contaminants perspective, sediment quality is generally good in Pool 9. Main channel sediments are primarily medium to coarse sands with only trace amounts (generally less than 3 percent by weight) of silts and clays. Sand, silt, and clay sediments are found within defined sloughs, while finer silt and clay materials are found in marshy backwater areas. Levels of pesticides and other chlorinated hydrocarbons are generally below detection limits in all main channel sediments and detected at low levels in backwaters. Sullivan and Moody (1996) conducted a pre- and post-1993 flood (1991 and 1994) longitudinal (Pools 1 through 11) survey of contaminants. This study compared the data to the Ontario Ministry of Environment and Energy's Sediment Quality Guidelines (Persaud et al. 1993). Nitrogen was found above Ontario's lowest effect level guideline both pre- and post-flood, but was typical of concentrations in adjacent pools. Polychlorinated biphenyls (PCBs) and chlorinated pesticides were found at low levels, below Ontario's lowest effect level guideline. In comparing backwater areas for this reach to other reaches in the Upper Mississippi River, metals concentrations were found at levels within the expected ranges.

The quality of sediments within the project site is also good. Six fine-grained sediment samples were collected with corers in 1999 and 2004. Most sample locations had an upper layer of soft to very soft fine-grained soil of varying thickness. There were no organic hits above Ontario's or the Wisconsin DNR's lowest effect level guidelines for sediment (Persaud et al. 1993; Solberg et al. 2003). However, some results were above the lowest effect level guideline

for manganese, nickel, ammonia and Total Organic Carbon. Metals were found at levels typical of backwater sediments and comparable to what Sullivan and Moody (1996) recorded for Pool 9 in 1994. Additional details on sample results are provided in Attachment 8 – Sediment Analysis.

3.4 WATER QUALITY

Mead (1995), in investigations of contaminants in the Mississippi River from 1987 to 1992, found water quality to be generally better in this reach of the Mississippi River than above Lake Pepin and in the reach downstream where tributaries that drain the Corn Belt begin to enter the Mississippi River.

In Pool 9, an assessment of selected parameters of water quality data suggests fair to good water quality. Data collected since 1977 were obtained from the Wisconsin DNR (Attachment 12) and are summarized in Table 3-2 for selected parameters in comparison to recommended guidelines recognized by EMP's LTRMP. Except for isolated sloughs and backwater lakes, the dissolved oxygen (DO) content of the water remains high year round and above levels required to sustain a quality fishery. Only rarely did DO levels drop below the established guideline of 5 milligrams per liter (mg/L). During the winter, high DO levels over 10 mg/L (along with temperatures close to freezing) have also been shown during recent surveys of the project site (Attachment 12). Because of its turbulent nature, the river is well aerated, and it can assimilate a considerable biochemical oxygen demand (BOD) loading. However, nutrient levels (nitrogen, phosphorus, potassium, calcium, etc.) were high, indicating ample support for luxuriant growth of rooted aquatics and algae. Concentrations of total phosphorus (TP) and total nitrogen (TN) regularly exceed guidelines, as did chlorophyll a concentrations. Total suspended solids also often exceeded guidelines. High nutrient levels are cause for concern regarding eutrophication.

Table 3-2
Water quality data (mean and range) for selected parameters in Pools 8 and 9
in comparison to established guidelines

	TP (mg/L)	Chl a (μ/L)	TN (mg/L)	Summer TSS (mg/L)	DO (mg/L)
Guidelines	0.01 – 0.08[a]	10 – 30[b]	0.6 – 2.18[a]	<25[c]	>5.0[d]
Pool 9[e]					
Mean	0.15	30.8	2.3	44	10.7
Range	0.04 – 0.35	0.3 – 154	0.6 – 5.7	9 – 171	3.4 – 20

[a] Source of procedures described for determining this: U.S. Environmental Protection Agency 2000; Smith et al. 2003.
[b] Source: Dodds et al. 1998.
[c] Source: summer average; Upper Mississippi River Conservation Committee 2003.
[d] Source: Upper Mississippi River Basin Association 2004.
[e] Source: Wisconsin DNR water quality data; 1977 – 2008 (Attachment 12)

3.5 VEGETATION

Impoundment resulted in an increase in development of aquatic and marsh vegetation in Pool 9. Prior to flooding, a coontail-elodea plant association was most common in ponds and lakes throughout the floodplain. Taxa from this plant group remained dominant in the Upper Mississippi River for some time after flooding. However, with continued stabilization of water levels, pondweeds such as American pondweed, sago, leafy pondweed, small pondweed, flat-stemmed pondweed, bush pondweed and curly muckweed are now much more common throughout much of Pool 9. Despite the overall changes in the plant community since impoundment, coontail, elodea, water stargrass, wild celery and the pond lilies remain established in certain areas. The lentic, open water portions of the pool have a relatively productive plankton community dominated by diatoms and green algae.

The wide variety of floodplain and riverine habitats within Pool 9 has allowed the development of a diverse vegetative assemblage. River birch and swamp oak are the dominant species at the upland edge of the floodplain. Areas with mature floodplain forest usually consist of an overstory dominated by green ash, silver and red maple, cottonwood and river birch. The understory in these areas consists primarily of tree seedlings, alder, wood nettle, poison ivy, wild grape and woodbine. In transitional zones between aquatic and terrestrial habitat (e.g., sandbars and mudflat areas), dense stands of alder, small black willow and cottonwood trees are common.

The extent of upland vegetation within the project site is limited due to eroding islands, but generally consists of mixed lowland hardwood forest and willows. Within the study area, aquatic vegetation is much more prevalent and consists of hornwort, duckweed, water lily, canary grass, broad arrowhead, pondweed, eelgrass, and water hyacinth.

Invasive plants are also found in the Upper Mississippi River and throughout Pool 9. These include common buckthorn, purple loosestrife, Japanese hops, Eurasian water milfoil, and curly-leaf pondweed. The USFWS and State resource agencies are pursuing methods to control the spread of invasive species on lands they manage.

3.6 HABITAT

Pool 9 has a high variety of terrestrial and aquatic habitat conditions. These habitats support a diverse and productive fishery and provide important waterfowl nesting, feeding, and resting areas. Aquatic habitat in Pool 9 consists mainly of the main channel, channel border, slough, river lakes, and tail water. Terrestrial habitat is predominately bottomland forest. The important characteristics of these habitat types, relative to fish and wildlife uses are described below.

3.6.1 AQUATIC HABITAT

Pool 9 contains main channel habitat where the majority of river discharge occurs and includes the navigation channel. This is the deepest part of the channel, which lacks rooted vegetation and varies in velocity with water stages. Sediments are usually dominated by sand and silt and, occasionally, gravel. Between the navigation channel and the riverbank is the channel border, which contains channel training structures (wing dams, closing dams, revetted banks) that create a high diversity of depths, substrates, and velocities. Pool 9 also contains secondary channels that carry less flow than the main channel. There are numerous river lakes and ponds that are usually dominated by mud or silt sediments with an abundance of rooted aquatic vegetation. Just below Lock and Dam 8 is a tail water area that is part of Pool 9 where sediments are composed of coarser substrates (sand to cobble) and no rooted aquatic vegetation is present.

The pool has little in terms of quality overwintering habitat for fish. Surveys conducted by resource agencies since 2002 illustrate the lack of quality habitat conditions between river mile 662 and Lock and Dam 9 (Janvrin, pers. comm. 2010). However, backwater areas of Pool 9 have the potential for high seasonal use by Centrarchids if conditions are appropriate. Evidence of this use has been observed in the backwaters of Pool 8, where largemouth bass and bluegill moved to the backwaters from late September to late October for overwintering (Bartels et al. 2008). Pool 8 backwater areas that were used for overwintering had the right combination of conditions, namely, lower current velocity, higher water temperatures, and greater water depth.

The study area is dominated by open water, followed by submersed, emergent, and rooted floating aquatic vegetation. Most depths are less than 5 feet, and modeled velocities during spring months range from 0.2 to 1.7 fps. During winter, current velocities have been shown during recent surveys of the project site to be around 0.4 fps (Attachment 12). Within the project site is a small area of marginal overwintering habitat for fish. The project site includes about 40 acres of slough (Capoli Slough proper) with a maximum depth of 27 feet and substrates composed of sand, silt, and clay (Ecological Specialists, Inc 2010). Most of the slough is open water, but it also contains some areas of aquatic vegetation. Sloughs generally provide excellent spawning, nesting, and rearing areas although sedimentation, loss of vegetation, and periodic strong water currents are causing a decline in the fish and wildlife habitat values of these areas.

3.6.2 TERRESTRIAL HABITAT

Terrestrial habitats within the floodplain of Pool 9 include areas of forest, brush and shrub areas, wet and upland meadows, areas disturbed by commercial or residential development and agricultural land. Areas previously disturbed by past dredged material placement are prevalent along the upper reach of the floodplain. Each of these areas can support a diversity of species, and they are important parts of the overall ecosystem. Forested areas in the region are of two types: upland xeric southern forests, and lowland forests of the floodplain (approximately 11,500 acres in Pool 9). Dominant tree species in the floodplain forest type are silver maple, black willow, cottonwood, American elm, and river birch. Species dominant in the better-

drained areas are American elm, silver maple, green ash, basswood, and black ash. Wet meadows cover approximately 3,000 acres of the floodplain in Pool 9, and willows/shrubs cover approximately 1,500 acres. These habitat types showed significant declines in acres when the pool was inundated, being converted to deep and shallow marshes and large contiguous open water areas above the lock and dam. These habitat types are important to a variety of wildlife. Terrestrial areas dominated by industrial, commercial or residential use are prevalent in the floodplain of the Pool 9 (approximately 400 acres). Agricultural areas (approximately 1,000 acres) include areas devoted to production of annual crops, pastures or landscape nurseries. Within the study area, terrestrial habitat is limited to the remaining islands.

3.7 FISH AND WILDLIFE

3.7.1 FISH

In Pool 9, 93 species of fish have been reported, and 38 species are known from its main tributary, the Upper Iowa River (Steuck et al. 2010). In general, the species assemblages found today in the Upper Mississippi River appear to be similar to what was found before the locks and dams were constructed (Janvrin 2005). Common game and panfish species include the walleye, sauger, northern pike, channel catfish, largemouth bass, white bass, bluegill, and white and black crappie. Common nongame fish include the freshwater drum, carp, redhorse, buffalo, and a wide variety of minnows. Catfishes, buffaloes, and carp are the primary fish of commercial interest. Largemouth bass, smallmouth bass, bluegill, crappie and walleye use side channels and sloughs for all life functions. Northern pike, white bass, carp and buffalo use side channels and sloughs for rearing, wintering and spawning. Tail waters are particularly important areas for species like paddlefish and sturgeon, which were largely displaced by inundation of the natural river.

Within the project site, fish surveys were conducted by the Wisconsin DNR from 2007 to 2010 (Attachment 12). Results of fish surveys show the presence of 16 species including bluegill, common carp, emerald shiner, largemouth bass, northern pike, pumpkinseed, sauger, shorthead redhorse, rock bass, smallmouth bass, yellow perch, carpsucker, golden shiner, Johnny darter, brown bullhead, and tadpole madtom.

3.7.2 WILDLIFE

Pool 9 contains an abundance of wildlife. The area contains a rich mixture of vertebrate animals from the northern and southern United States, as well as an overlapping of eastern and western species.

The great variety of bird species, especially waterfowl, that use Pool 9 can be attributed to its location within the Mississippi flyway. Although Pool 9 is not of great importance as a nesting area for waterfowl (other than wood ducks), it is an important resting area during spring and fall migration. During these seasons, ring-necked ducks, canvasbacks, and scaup use the

deeper areas of the backwater, while mallards, widgeon, blue-winged teal and wood duck use the shallower areas. Canvasbacks that use Pool 9 and similar areas in Pools 7 and 8 have been estimated to represent up to 90 percent of the continental population of this species east of the Rocky Mountains. Most of the eastern population of tundra swans (approximately 100,000 birds) also uses Pools 7, 8, and 9 during migration. High waterfowl use as measured by numbers of birds has been observed in these areas as a part of weekly surveys conducted by the USFWS in the spring and fall (although numbers of birds can be highly variable across sites and seasons) (see http://www.fws.gov/midwest/uppermississippiriver/waterfowl.html).

As with other pools in the Refuge, areas important for waterfowl migrants in Pool 9 are managed in accordance with the USFWS Upper Mississippi River Wildlife Refuge Comprehensive Conservation Plan (USFWS 2006). Closed areas, such as the Harpers Slough Closed Area (5,209 acres), located approximately 2 miles downstream from the Capoli study area along the right descending bank from river mile 648 to river mile 655, provide critical resting and foraging opportunities for these migratory waterfowl. Other areas in proximity to the project site but are open to hunting, such as the Lansing Big Lake, the large open water area off of Sugar Creek next to Capoli Slough, and Winneshiek Lake, also provide critical resting and foraging opportunities for these migratory waterfowl.

Pool 9 additionally provides nesting and foraging habitat for many passerine bird species. Some of these species spend the entire year in the area, while others migrate into the area at various times of the year. Many varieties of raptors use the river valley as a flyway, and a number of these species, such as eagles, hawks, and owls, overwinter in these floodplain areas. Several bird species occur in Pool 9 that are of special interest because of their status as rare or endangered species. Foremost among these is the bald eagle, of which there is a sizable winter population and increasing nesting population. Other species known to occur in Pool 9 that are of special interest include the osprey, double-breasted cormorant, and pileated woodpecker.

Pool 9 provides habitat to a wide variety of mammals. White-tailed deer use the area throughout the year. Many small carnivores such as fox, raccoon, and weasel also use the area. Larger carnivores such as bobcat and coyote use the area infrequently. Many smaller mammals such as beaver, muskrat, shrews, moles, bats, rabbits, and squirrels and numerous varieties of mice are relatively common in the area.

The floodplain of Pool 9 provides habitat for a wide variety of amphibians and reptiles. Common species typically found in sloughs of the floodplain may include fox snake, tiger salamander, American Toad, gray tree frog, green frog, snapping turtle, painted turtle, common map turtle, Eastern hognose snake, and Northern leopard frog. Lower Pool 9, because of the scarcity and continued decline in islands, does not provide good nesting and resting habitat for turtles.

Surveys for wildlife other than waterfowl within the study area have not been conducted; however, anecdotal accounts indicate that the small mammals, reptiles, and amphibians identified above use the area. As the islands have decreased in the study area, turtle resting and nesting habitat has become very limited in the study area. Use by large mammals is limited by the declining size of islands and isolation from the floodplain forest.

3.7.3 AQUATIC INVERTEBRATES

The diverse invertebrate assemblage within Pool 9 can be attributed to a wide variety of habitats available. Suitable lentic, lotic and transitional habitats are available for many different types of organisms. Also, rocks associated with wing dams and shoreline protection (as well as woody debris accumulated in backwater areas) provide a substantial amount of hard, stable substrate for many highly productive taxa. These taxa can represent a substantial dietary item for many fishes and other vertebrates. Other invertebrate taxa attach to emergent and submerged aquatic vegetation in backwater areas. Many of these taxa serve as an important food source for waterfowl.

The pool supports various species of mussels. Within the project site, species found include common species as well as some of the more rare species. A total of 22 species were observed in the most recent surveys (Ecological Specialists, Inc. 2010). A recent exotic introduction, the zebra mussel (*Dreissena polymorpha*) has been observed in very high numbers in the pool. This species has adversely affected the freshwater mussel populations. However, the ultimate effect of this exotic species on the native freshwater mussel resource is unclear at this time. Fingernail clams (*Musculium transversum*) thrive in areas of Pool 9 that have adequate oxygen and silt bottoms. They are important food items for both waterfowl, especially diving ducks, and several species of fish.

Pool 9 insect fauna is dominated by immature stages of mayflies, midges, and caddisflies, indicative of high dissolved oxygen levels. Being efficient converters of detritus, aquatic insects are an important link in the food web, providing food for fish and waterfowl.

3.7.4 THREATENED AND ENDANGERED SPECIES

The pool has many species of fish, mussels, plants, birds, mammals, and others listed by the Wisconsin, Iowa, and Minnesota DNR's as endangered, threatened, or of special concern. Several federally-listed species or candidate species occur in Crawford County, Wisconsin, and Allamakee County, Iowa. In coordination with the USFWS (see appendix 2 of the Biological Assessment in Attachment 7), the Corps' St. Paul District has found the following federally-listed threatened or endangered species within the project site: **Endangered** - Higgins eye mussel (*Lampsilis higginsii*).

Pool 9 contains good mussel populations, including the endangered Higgins eye. Within the project area, it is estimated that the density of Higgins eye is between 0.02 per square meter ($/m^{2)}$ and $0.12/m^2$). Several State-listed mussel species occur in Pool 9, and the Corps' St. Paul District and resource agencies found some within the Capoli Slough complex (Attachment 7). Because of the presence of good mussel fauna in the deeper flowing slough and main channel border habitats, avoidance measures have been incorporated into the recommended project plan.

The USFWS (2006) Final Environmental Impact Statement and Comprehensive Conservation Plan for the Upper Mississippi River National Wildlife and Fish Refuge provides a complete list of State-listed species on the Refuge, including Pool 9. Many might occur within the Capoli Slough island complex. One State-protected species (which was recently de-listed from the Federal list of threatened species), the bald eagle (*Haliaeetus leucocephalus*), has increased dramatically in recent years. Bald eagles use Pool 9 year-round. In addition, the pool is part of an important migration corridor. Although eagle nests in Pool 9 occasionally are located over water, most are found away from the immediate shoreline in large areas of undisturbed mature or old growth timber with an open and discontinuous canopy. Preferred nesting sites are usually tall, prominent trees, with an open structure and stable limbs that allow easy approach from the air. Pool 9 has many active nesting sites, which produce one to two young a year per nest. Also, a large amount of bald eagle use within the pool occurs during winter. Winter use is highest where the river is ice-free and adequate perch sites are available.

A recent survey has shown a bald eagle nest on the existing Island 11 in the Capoli Slough complex.

3.8 CULTURAL RESOURCES

Cultural resources are a major component of the Upper Mississippi River valley and are integral, nonrenewable elements of the physical landscape. Collectively, the archaeological record indicates continual human occupation along the river for approximately 12,000 years. Cultural resources are located throughout the pool and across a wide variety of landforms. Three cultural resource sites, discussed in detail below, are located within the projects Area of Potential Effect (APE; defined in 36 CFR §800.16(d)). Significant archaeological resources, like those present within the project area of influence, contribute to our knowledge of the past. Preserving, or minimizing the degradation of these important resources is one of the responsibilities of the Corps and other agencies.

Archaeological investigations have been ongoing along the Upper Mississippi River and in the Pool 9 locality for over a century and a half (e.g., Boszhardt 1995, Jalbert and Kolb 2003, Keyes 1928, Lewis 1889, Orr n.d., Thomas 1894). Early research in the area was conducted by antiquarians focused on the upland sites around the pool and was centered on the contents of burial mounds and who built them. As professional investigations ensued, a variety of academic and cultural resource management driven projects for road construction and other development activities were conducted (e.g., Penman 1984; Stanley and Stanley 1986, Wedel 1959). However, significant investigations within the floodplain did not commence until 1975 (Benn 1976). Since then, the Corps and the USFWS have sponsored several cultural resource investigations within the pool for various projects, including dredged material placement sites, flood control features and shoreline surveys along with several literature-based overviews, such as site inventories, geomorphic mapping, shipwreck locations and navigation features (e.g., Boszhardt 1992, 1995; Boszhardt and Moffat 1994; Jalbert and Kolb 2003, Jensen 1992;

Gnabasik 1993; Madigan and Shermer 2001; Overstreet et al. 1983; Pearson 2003; Perkl 2002; Vogel et al. 2003, Withrow 1983; Yourd and Anfinson 1982).

Cultural resource sites within the Pool 9 locality exist on a variety of landforms, including uplands, terraces, islands, the river floodplain (e.g., natural levees), and within the river channel. Identified cultural resources include precontact single artifact finds, lithic and artifacts scatters, village sites, rock shelters, caves, petroglyphs, burials and burial mounds. Historic cultural resources include fur trade sites, early American town sites, a battlefield, farmsteads, mills, cemeteries, clamming sites, historic standing structures, shipwrecks and river navigation structures (e.g., wing dams). As a whole, the assortment of cultural resource sites within and proximal to the Pool 9 locality have contributed to our knowledge base concerning the cultural history of this region of the Upper Mississippi River (e.g., Alex 2000; Benn 1979; Birmingham et al. 1997; Logan 1976; Theler and Boszhardt 2003).

Located in the impounded portion of Pool 9 (upper reaches of Lake Winneshiek), the Capoli Slough project area has suffered from extreme erosion through the effects of the construction of Lock and Dam 9 in the 1930s and operation/maintenance of the 9-Foot Channel Project. For example, only small, fragmented islands remain from a larger island complex that existed in the area prior to inundation. This widespread environmental degradation has undoubtedly affected cultural resources in the area.

Nonetheless, the project area contains three archaeological sites (47CR578, 47CR579 and 47CR580) situated on natural levees (Boszhardt 1995, Jalbert and Kolb 2003). Site 47CR578 is a historic artifact scatter, site 47CR 579 is a precontact lithic scatter and historic artifact scatter, and site 47CR580 is a historic shell midden. Sites 47CR578 and 47CR580 do not meet the criteria for listing on the National Register of Historic Places (NRHP). However, site 47CR579 is eligible for the NRHP under Criterion D (property has yielded, or is likely to yield, information important in prehistory or history). The project was designed to avoid any adverse impacts and to offer greater protection to this site.

3.9 RECREATION/AESTHETIC RESOURCES

The natural character of this portion of the river and the relatively good water quality in Pool 9 contribute to its recreational and aesthetic desirability. The fishery within Pool 9 is one of the most active in the Upper Mississippi River. A relatively high level of sport fishing activity occurs within the pool, and commercial fish harvest in Pool 9 is greater than any other area in the Upper Mississippi River. The commercial fishery is particularly active from the lower reaches of Capoli Slough downstream to the dam. A large amount of Federal land is in Pool 9; most of this land is managed for fish and wildlife as part of the Upper Mississippi River Wildlife and Fish Refuge.

Recreational activities are most concentrated in the upper two-thirds of the pool, above Lansing. Accordingly, the Lansing Big Lake area is an important recreational resource. This area is heavily used for fishing, boating, and hunting, and a designated canoe route passes

through it (and the Upper Iowa River). Other important recreational activities in the pool include picnicking, camping, swimming, canoeing, and trapping, and a number of high quality recreational beaches, public day-use and camping recreation facilities, and private marina facilities are available. The Corps of Engineers operates Blackhawk Park, the largest developed recreation facility in Pool 9. It offers boat access facilities, other day-use facilities, and a large campground. Other public recreation facilities in Pool 9 include seven boat landing/parking areas that are scattered throughout the pool. Mt. Hosmer Park, located in Lansing, offers picnicking and scenic overlook facilities. In the summer, the public and private access facilities adequately serve the public. These boat access points also facilitate winter hunting, trapping, snowmobiling, and ice fishing. As result of past channel maintenance activities, a number of sand-covered island beach sites currently exist in Pool 9, and most of them receive extensive recreational use.

The nearest recreational facilities to the Capoli Slough project area are an Iowa DNR public boat landing located on the south side of Lansing, a USFWS public boat landing located at the east end of the bridge spanning the Mississippi River at Lansing, and a community-owned boat landing at Ferryville, Wisconsin. Recreational use in the project area consists primarily of fishing, waterfowl hunting, and wildlife observation.

3.10 SOCIOECONOMIC SETTING

The setting of the upland areas bordering lower Pool 9 can be characterized as rural-small town. Lansing is located approximately 5 miles upstream of the project area and has a population of about 1,300. Ferryville is located directly across the pool from the Capoli Slough project area; it has a population of about 200. The rural areas bordering lower Pool 9 contain a mixture of agriculture and wooded areas. Flat areas on the bluff tops and in the stream valleys are farmed. The areas that are too steep for farming are wooded.

An Interstate Power and Light electric generating station is located on the Iowa side of the river about 2 miles upstream of the project area.

Transportation corridors bound both sides of the floodplain in lower Pool 9. Railroad tracks border both sides of the river in lower Pool 9. On the Wisconsin side, State Highway 35 parallels the river. No paved road is along the river on the Iowa side between river miles 656 and 660. In addition, the river serves as a corridor for commercial navigation of barge traffic via the 9-foot navigation channel as authorized by Congress. Barge traffic transports a wide variety of essential goods on the UMRS. Agricultural commodities, petroleum products, and coal are the leading cargoes, with farm products accounting for approximately half the total tonnage shipped.

Based on the 2010 Census, the population of Allamakee County is 98 percent white. On the other side of the river, the population of Crawford County is 94 percent white. African American, Native American, Asian, and Native Hawaiian make up the rest of the population. The median annual income for a household in Allamakee County was $39,000 and in Crawford

County was $49,000. About 12.6 percent and 11.4 percent of the population was below the poverty line in Allamakee and Crawford counties, respectively.

4. PROBLEM IDENTIFICATION

4.1 EXISTING HABITAT CONDITIONS

Based on the data discussed above in Sections 3.1-3.10, baseline conditions for habitat in the remaining Capoli Slough complex (project site) would generally be considered marginal to good for a variety of fish and wildlife species expected to occur in this type of habitat. As more fully detailed above, the area contains a variety of habitats dominated by shallow aquatic areas with emergent and floating-leafed plants. Those areas slightly deeper support beds of submersed aquatic vegetation but also have areas devoid of any vegetation (open water). Running sloughs are within and bound the complex; they provide additional habitat diversity.

Concerns over habitat deficiencies include the continued loss of the mosaic of habitat, especially the continued disappearance of islands and emergent vegetation. Deep, protected aquatic habitat that would serve as overwintering habitat for Centrarchid fish and associated species is also lacking. This type of over-wintering habitat is extremely rare in lower Pool 9 and has been declining with the loss of islands and bathymetric diversity. Although habitat conditions have degraded, the major habitat concerns are not with the present habitat conditions within the complex, but instead with the anticipated future condition of the habitat without projects measures. Specifically, the major concerns are as follows:

1. The declining size of the Capoli Slough complex, especially when combined with the disappearance of similar habitat immediately downstream.

2. The loss of terrestrial habitat (islands) and protected off-channel aquatic habitat.

3. Future changes that will lead to additional degradation of habitat within the Capoli Slough complex.

4.2 HISTORICALLY DOCUMENTED CHANGES IN HABITAT CONDITIONS

The following documents the physical and vegetation characteristics of the study area at various points in time for which information exists. No attempt was made to estimate the quality of the fish and wildlife that existed at these points in time.

4.2.1 MISSISSIPPI RIVER COMMISSION MAPS

The Mississippi River Commission maps (circa 1896) show the Capoli Slough area as an undeveloped floodplain consisting of running sloughs, marshes, and wooded areas. No

development such as farming or buildings is shown on this map. A closing dam is shown near the head of Capoli Slough. A closing dam is also shown in Ferry Slough about 1,000 feet below the head of the slough.

4.2.2 1929 AERIAL PHOTOGRAPHS

These photographs show the Capoli Slough area to be undeveloped floodplain, similar to what is shown on the Mississippi River Commission maps (plate 2).

4.2.3 FLOWAGE SURVEYS

These maps (plate 3) show survey data taken in 1934-35 for the 9-Foot Navigation Channel Project. These surveys indicate that the pre-project water surface elevation in this area was between 613.0 and 614.0 feet msl 1912 adjusted. The closing dam at the head of Capoli Slough is shown on these maps, but the closing dam in Ferry Slough is not shown.

A "house" is shown along the shoreline at the head of Capoli Slough and an unnamed structure is shown along Ferry Slough, although there are no roads or evidence of agricultural use. These buildings may have been hunting shacks or similar structures.

4.2.4 1940 AERIAL PHOTOGRAPHS

Photographs taken in September 1940 (plate 2) show the Capoli Slough area and other portions of lower Pool 9 about 17 months after the creation of Pool 9. Based on the flowage survey data, some of the areas that look like islands on these photographs may actually be emergent vegetation or woody vegetation still surviving the initial inundation.

4.2.5 1973 AERIAL PHOTOGRAPHS

The 1973 aerial photographs (plate 2) still show the presence of islands/aquatic vegetation extending along the left bank of the main channel down to about river mile 654.5. Vegetation maps (plate 5) developed from these photographs indicate that below river mile 656.5 most of the vegetation visible on the photographs consists of beds of *Sagiattaria latifolia*. About 34 acres on plate 6 are typed as bottomland forest, willows, or reed canary grass, vegetation that would be expected to grow at or above normal pool elevation.

4.2.6 1989 AERIAL PHOTOGRAPHS

The 1989 aerial photographs (plate 4) show a minor decline in the amount of islands/aquatic vegetation in the reach above river mile 656.5. Below this reach, the decline is visible. No islands or aquatic plant beds are visible below about river mile 655.5.

4.2.7 2000 AERIAL PHOTOGRAPHS

The 2000 aerial photographs (plate 4) show a marked change from 1989. The island/aquatic plant complex from Ferry Slough to river mile 656.5 shows a visible decline in area. A visible gap between the Capoli Slough complex and the riparian islands/aquatic plants beds upstream is starting to develop. There are approximately 23 acres of islands.

4.2.8 2008 AERIAL PHOTOGRAPHS

The 2008 photo (plate 4) shows continued decline in vegetation along the eastern edge of the complex, which is exposed to long wind fetches from the northeast, east, and southeast. Some minor loss of islands is evident.

4.2.9 VEGETATION SURVEYS

Vegetation surveys are available for the project site and its surroundings from 1975, 1989 and 2000. Plate 5 shows a comparison for all of lower Pool 9, while plate 6 shows a more detailed comparison for this area. The following observations can be made from the information on plate 6.

1. The amount of area containing aquatic vegetation was about 27 percent less in 1989 than 1975 (1,174 acres versus 1,606 acres).

2. The area of emergent vegetation communities was about 34 percent less in 1989 than 1975 (215 acres versus 324 acres).

3. The area containing rooted floating aquatic vegetation was about 5 times greater in 1989 than 1975 (406 acres versus 81 acres).

4. The area classified as submersed aquatic vegetation was about 54 percent less in 1989 than 1975 (552 acres versus 1201 acres).

5. The 2000 land cover is similar to the 1989 land cover in most of lower Pool 9, except a significant increase in submersed vegetation occurred near river mile 656 to 655. Although

many factors may have contributed to this increase, the Pool 9 Island HREP was constructed in 1994 in this area and the protection that this island created may have contributed to this increase in submersed aquatic vegetation.

The results of the three vegetation surveys confirm the general observations of resource managers is that aquatic vegetation in the Upper Mississippi River pools has been generally declining. A significant decline in aquatic vegetation occurred in the 1980's and 1990's, with some recovery, mostly submersed aquatic vegetation, observed over the last 20 years.

4.2.10 SUMMARY

Available historic information, consisting primarily of aerial photographs and surveys show the following:

1. Prior to the creation of Pool 9, the Capoli Slough area was an undeveloped portion of the Upper Mississippi River floodplain.

2. Creation of Pool 9 in 1938 resulted in a permanent raise in water levels in the Capoli Slough area of between 6 and 7 feet during non-flood periods.

3. Inundation by the pool left few areas of high ground in the form of islands. Inundation resulted in conditions amenable to the growth of aquatic vegetation.

4. Immediately following inundation, the forces of wave action and currents began reworking the "landscape" of lower Pool 9. The result, with respect to the Capoli Slough area, has been the loss of the riparian islands/aquatic plant beds between river miles 654.5 and 656.5 and a decline in the area of riparian islands/aquatic plant beds between river miles 656.5 and 658.5.

5. Based on the preproject flowage surveys and the aerial photography, it is estimated that the area of islands in the Capoli Slough study area has declined from about 74 acres in 1940 to about 50 acres in 1973, to about 32 acres in 1989, and 23 acres in 2000.

4.3 FACTORS INFLUENCING HABITAT CHANGE

4.3.1 GENERAL

A number of factors have been identified that are believed to be influencing habitat changes in the lower Pool 9. Many of these factors are synergistic, combining to affect both the physical and biological environment.

Construction of Lock and Dam 9 submerged the natural levees and floodplain in the lower end of Pool 9 resulting in continuous flow of water and sediment through the floodplain for all conditions. The higher parts of the natural levee became islands. Submergence caused changes in the vegetation communities resulting in decreased floodplain resistance and increased floodplain conveyance with time. For river flows near and well above bank full, the majority of the conveyance is now in the floodplain in the lower pools. This change has decreased the hydraulic slope in the pools and subsequently the fluvial processes of erosion and deposition in channels. In other words, in the floodplain river currents do not have sufficient hydraulic energy to erode sediments. The result is a less dynamic, depositional river system.

Wind generated waves are believed to be one of the primary erosive forces that have led to the loss of islands in lower Pool 9. Island loss in lower Pool 9, with some exceptions, has generally progressed from south to north. The islands in the southern portion of the pool would have been inundated the greatest by the creation of Pool 9 and were likely the most susceptible to erosion by wave action and river currents. As island loss occurred, the remaining islands became exposed to considerable wind fetch from the north and south (southeast to south), which produces some of the most frequent and highest velocity winds during the open water season.

Wave action is also believed to be one of the factors contributing to the general loss of aquatic vegetation in the area. Wind generated waves suspend material in the water, increasing turbidity and reducing light penetration, and the waves exert a physical force on aquatic vegetation. In addition, the effects of wind-generated waves on aquatic vegetation have probably increased over recent time as the islands and the protection they afforded have decreased.

The resuspension and subsequent resettlement of sediment particles is believed to be a factor in the decline of bathymetric diversity in the lower portions of Upper Mississippi River navigation pools. This results in the general leveling of the bottom as material is resuspended from shallower areas by wave action and redeposited in deeper areas.

4.3.2 POOL REGULATION

Pool 9 was filled in April 1938. The project pool elevation was and still is 620.0 feet msl 1912 adjusted. During the first 8 years of operation, the allowable drawdown at the dam during the growing season was 2.5 feet to elevation 617.5. In 1947, operation was changed so the maximum drawdown at Lock and Dam 9 is 1.0 foot to elevation 619.0

The Capoli Slough project area lies between Lock and Dam 9 and the primary control point. Thus, for much of the time during the growing season, water surface elevations in this area are fluctuating between elevations 619.5 and 620.0. The following summarizes the approximate amount of time the pool is in primary control, secondary control, and unregulated for the months May through September.

	May	Jun	Jul	Aug	Sep
Unregulated	54%	22%	18%	7%	7%
Secondary control	26%	52%	41%	35%	40%
Primary control	20%	26%	41%	58%	53%

Pool regulation affects habitat conditions in the Capoli Slough project area in a number of ways. Obviously, the increased water depths associated with impoundment created aquatic habitat where previously it did not exist. Pool regulation creates a minimum water surface elevation below which inundation is permanent, creating a more lake-like condition as opposed to the prenavigation project riverine condition. In the project area, this minimum water surface elevation is about 619.5.

Pool regulation has little effect on high water or flood events. As noted earlier in Section 3.2, when river flows exceed 64,000 cfs, the dam gates are removed from the water and Pool 9 is unregulated.

4.3.3 FLOW AND CURRENT VELOCITY

Even though impoundment has created lake-like conditions in lower Pool 9, it still is a riverine system with flow passing through the pool. River flows have erosive effects, which reshape islands and other land areas, especially low-lying islands in the lower impounded area. River flows also have velocity, which can affect the suitability of habitat for fish species depending on their tolerance of current velocity. This factor can be especially critical in the winter, especially for species adapted to quiet water conditions such as bluegill and crappie. These species cannot tolerate much current velocity in the winter, and if overwintering areas offering refuge from current are insufficient, population levels will be adversely affected.

4.3.4 WIND AND WAVE ACTION

Lower Pool 9 is relatively open and subject to large wind fetches (see Appendix 9 - Wind and Wave Appendix). These large wind fetches result in the generation of large waves, which in turn affect habitat conditions. Wind generated waves are believed to be one of the primary erosive forces, along with river currents, that has led to the loss of islands in lower Pool 9.

Wind generated waves suspend material in the water, increasing turbidity and reducing light penetration, and the waves exert a physical force on aquatic vegetation. In addition, the effects of wind-generated waves on aquatic vegetation have probably increased over time as the islands and the protection they afforded have decreased.

The suspension and subsequent resettlement of sediment particles contributes to declines in bathymetric diversity. A general leveling of the pool bottom results as material is suspended from shallower areas by wave action and redeposited in deeper areas.

4.3.5 FACTORS AFFECTING AQUATIC VEGETATION

In general, aquatic vegetation in Pool 9 and other Upper Mississippi River navigation pools has declined. Changes were being noted as early as the 1950s and 1960s. During the last three decades, the most noticeable river-wide decline has been the loss of emergent vegetation. The early 1990s saw a river-wide crash in submersed aquatic vegetation as well. Recently, submersed aquatic vegetation has shown substantial recovery in Pool 9 and other pools.

A number of theories pertain to the decline of aquatic vegetation. A number of causative factors have been identified, and it is likely that most or all of them have had some effect. The following have been among the factors:

- Disruption of natural hydrology.
- Loss of islands and the shelter they provided.
- Changes in bathymetry.
- Increased turbidity due to wave suspended sediments.
- Drought of the late 1980s.

The creation of the locks and dams system has altered the natural river hydrology. The largest effect has been the loss of the natural late summer decline in water levels that would be associated with a natural riverine system. The navigation pools maintain a minimum water level that is higher than what would occur in an unimpounded system. This maintenance of artificially high water levels is believed to be an important factor in the decline of emergent aquatic vegetation (due to the loss of the natural process of sediment exposure). This in turn is believed to substantially inhibit the reproductive capabilities of many species of emergent vegetation.

The erosion of islands has resulted in the loss of the physical shelter islands provide to aquatic vegetation. With the loss of islands, aquatic vegetation becomes more exposed to the physical stresses associated with larger wind fetches and larger wind generated waves. All forms of aquatic vegetation can be affected to some degree, but the direct physical effects on emergent aquatic vegetation are probably greater than the effects on submersed vegetation.

Changes in bathymetry can have mixed effects on aquatic vegetation. Erosion of shallow areas can make them too deep to support emergent vegetation. Conversely, the filling of deeper areas can bring them within the photic zone and capable of supporting submersed vegetation.

The loss of islands and the subsequent increase in wind fetches and the size of wind generated waves increase ambient turbidity due to the resuspension of fine sediments. This in turn can reduce the photic zone and the productivity of submersed vegetation. The effect on emergent vegetation from a reduced photic zone is probably not significant.

A significant decline in aquatic vegetation of all types occurred on the Upper Mississippi River in the early 1990s. This decline followed 3 years of low river discharges in the late 1980s. The causal factors for this decline were never clearly defined. Changes in light-penetration may have been a factor. Nutrient deficiencies in the sediments (the low discharge stimulated plant growth, which consumed sediment nutrients) have also been theorized as a potential cause. Since that time, at least submersed aquatic vegetation has made a substantial recovery.

4.4 ESTIMATED FUTURE HABITAT CONDITIONS

Estimated future habitat conditions for the Capoli Slough complex are based on observed changes over time for the complex and areas downstream. Aerial photographs document the loss of islands and emergent aquatic plant beds downstream of the Capoli Slough complex. These same photographs also show the Capoli Slough complex itself declining in size. It is expected that the Capoli Slough complex will decline in size and eventually disappear, although predicting when that may occur is very difficult. It may occur within the next 10 years or it may take 20 to 30 years to happen.

The most likely scenario is that the complex will continue to be affected by northerly, southerly and southeasterly winds across a relatively large wind fetch. Wave action will suspend sediments at the shallow margins of the complex and these sediments will be transported away from the complex by river currents. The net effect will be continuous erosion of shallow areas capable of supporting emergent and floating-leafed vegetation. As this vegetation disappears, more and more of the complex, including the island remnants, will become subject to wave erosion. Eventually, the islands and emergent aquatic plant beds will become fragmented and disappear.

The complex will also be subjected to erosive forces from the river currents from the main channel side. However, based on the photo record, changes on the main channel side of the complex appear to be occurring at a slower rate and are more likely to change the character of the Capoli Slough complex rather than cause its total loss, at least within the time frame noted above. Breaches in islands and natural levees have occurred, and these will likely enlarge over time, creating new channels and associated habitats.

As the islands and emergent and floating-leafed vegetation decline, they likely will be replaced by submersed vegetation such as pondweeds, coontail, and wild celery as some of the area will still be within the photic zone for these species. As leveling continues the submersed vegetation is likely to also decline. Submersed vegetation is also likely to decline in the existing adjacent shadow zone of the Capoli Slough complex. Open water (devoid of vegetation) is likely to replace much of the submersed vegetation over time.

The entrance to Ferry Slough appears to be shifting to an upstream channel, and this change may become more permanent. Capoli Slough appears to be losing its direct deepwater connection to the main channel, and, if this change continues, the character of the remaining portions of Capoli Slough may change.

As Capoli complex continues to lose definition, conditions for backwater and lotic fish species would decline and use of the area would become very limited. The mussel fauna in Capoli Slough secondary channel, which is presently very good, would also decline, especially for riverine mussel species, including the endangered Higgins eye. Mussels would become less dense and the species composition would become dominated by generalists and substrate tolerant species like giant floaters, fragile papershells, and threeridge.

For purposes of the HEP analysis, a projection of acreages of major land cover types under future without project conditions was completed and is summarized in Table 4-1. This projection was largely based on observed rates of gains/losses of these cover types (derived from available land use/land class GIS data from 1979 to 2000), anticipated loss of bathymetric diversity as seen in adjacent areas, and the modeled increase in wind fetch and corresponding wave action. These projections are supported, in part, by comparing acres observed (17) versus predicted (15) for islands for the year 2008.

Table 4-1
Past and Future Acreages of Major Cover Types Under Future Without Project Conditions.

	COVER TYPES[a]				
Year	**LAND**	**EMERVEG**	**RFAVEG**	**SAV**	**OWATER**
2000	23	162	101	603	1147
2011	12	145	97	480	1303
2021	0	0	0	289	1747
2061	0	0	0	289	1747

[a] Legend: LAND = islands; EMERVEG = emergent vegetation; RFAVEG = rooted floating aquatic vegetation; SAV = submersed aquatic vegetation; OWATER = open water.

4.5 RESOURCE PROBLEMS AND OPPORTUNITIES

One of the critical steps in the initial planning process is the identification of problems and opportunities associated within the geographic scope of the project area. Problem statements are concise characterizations of the broad issue that will be addressed with the project. Opportunity statements follow each problem and consist of an array of opportunities presented by the virtue of planning and construction activities occurring at the site of the problem. Opportunities can be directly related to solving the problem at hand but can also be ancillary to the identified problem. From the list of opportunities, objectives for the project are drafted. The success of the project planning is determined by the fulfillment of the objectives through identified alternative measures.

The Capoli Slough complex currently is a relatively large area of moderate quality habitat, but if present stressors continue the Capoli Slough complex is expected to decline in size and quality and eventually disappear. The opportunity exists to protect and restore this habitat before it is lost. In many locations within the study area, remnants of eroded islands still exist just beneath the water surface. These underwater remnants provide a solid base upon which to reconstruct islands. The type of habitat provided by the complex is in decline in lower Pool 9 and in the lower reaches of many other Upper Mississippi River navigation pools. The specific resource problems and opportunities are described in sections 4.5.1 – 4.5.7.

4.5.1 RESOURCE PROBLEM: LOSS OF EMERGENT AND FLOATING LEAF AQUATIC VEGETATION

The emergent and floating-leafed aquatic plant communities are integral to habitat diversity in the Capoli Slough complex. If these communities are lost, the Capoli Slough complex will become an area similar to what exists downstream, an area of submersed aquatic plant beds with few surface features and no significant habitat diversity. From 1975 to 2000, emergent and floating leaf aquatic plants have experienced a 33 percent loss. Subsequent erosion of some of the areas that contained emergent and floating leaf aquatic vegetation in 1975 may preclude the reestablishment of this type of vegetation in these areas. Stressors include large wind fetches, with wave resuspension of sediments and plant breakage, reduced water clarity, elevated river current erosion, and stable growing season water levels.

Opportunities: Capoli Slough still contains a relatively large area of shallow water that, if protected from excess current and wind/wave action, with subsequent improved water quality conditions, could provide suitable habitat for emergent and floating-leafed aquatic plant communities. There is also an opportunity to increase elevations from disposal of access and habitat dredging in selected areas to promote the establishment of mud flats and emergent marsh. Water level management during the growing season could also increase the establishment of emergent and floating leaf aquatic vegetation.

4.5.2 RESOURCE PROBLEM: RESILIENCY AND SUSTAINABILITY OF SUBMERSED AQUATIC VEGETATION

Most of the area in the contiguous impounded area in lower Pool 9 is open water. The area is exposed to long wind fetches from the north to the southeast and water quality is greatly influenced by wind generated wave action. Submersed vegetation coverage has been highly variable from year to year, because of a variety of abiotic and biotic factors, making it difficult to provide specific target number of acres. Submersed aquatic vegetation has made a remarkable comeback in recent years, but the resiliency and sustainability are questionable, especially as the islands and shallow water continue to disappear. Stressors include large wind fetches, with wave resuspension of sediments and plant breakage, water clarity, and river current erosion.

Opportunities: The extent and quality of submersed aquatic vegetation could be increased by modifying current patterns and reducing wave action, thereby improving water clarity in areas in and adjacent to the Capoli Slough complex.

4.5.3 RESOURCE PROBLEM: DEGRADATION/LOSS OF SECONDARY AND TERTIARY CHANNELS

Running sloughs are an important component of habitat diversity in the Capoli Slough complex. These sloughs are valuable fish habitat and are being lost in lower Pool 9 as the islands and wetlands that defined them are lost. Important components of the habitat value of running sloughs are the slough margins adjacent to bordering islands and wetlands. The margins are generally the more diverse areas of the sloughs, containing fallen trees and snags, shallow flats, and aquatic vegetation. In addition to their value as fish habitat, running sloughs can be valuable habitats for mussels. A relatively diverse mussel assemblage, including the endangered *Lampsilis higginsi*, was found in Capoli Slough. Stressors include river currents and wind-generated wave erosion of channel defining features (islands, emergent vegetation).

Opportunities: The old island remnants bordering Capoli Slough provide an opportunity to reconstruct some of these islands and restore wetlands to confine flows and provide a self-sustaining running channel habitat. An old closing structure near the head of the slough provides a rock riffle, pool, and downstream gravel bar. This unique habitat provides valuable fish and mussel habitat; in mussel surveys the downstream gravel bar had one of the highest densities of native mussels, including the endangered *L. higginsi.* There are opportunities to create additional rock riffles and allow natural processes to form the riffle/pool/gravel bar habitat in Capoli Slough.

4.5.4 RESOURCE PROBLEM: LOSS OF PROTECTED WETLANDS AND AQUATIC AREAS

Within the Capoli Slough complex are wetlands and aquatic areas that are isolated to some degree from riverine forces during much of the year. These microhabitats are important to the overall habitat value of the complex because they provide fish and wildlife isolation from river currents and wave action. They also provide visual isolation important to certain wildlife species. As the islands and wetlands disappear this important microhabitat would be lost. Stressors include large wind fetches, with wave resuspension of sediments and plant breakage, water clarity, and river current erosion.

Opportunities: Protection of existing islands and reconstruction of islands on the old island remnants provide an opportunity to reduce current velocity and wind-generated wave action. There is also an opportunity to increase elevations from disposal of access and habitat dredging in selected areas to promote the establishment of mud flats and emergent marsh, important isolated microhabitat for fish and wildlife.

4.5.5 RESOURCE PROBLEM: LOSS OF ISLAND HABITAT

Islands provide habitat diversity and are an important "structural" component of the Capoli Slough complex. Islands help define running sloughs, add habitat complexity, break up wind fetch, provide visual isolation, and in and of themselves provide habitat for a variety of wildlife species. Along with the emergent and floating-leafed plant communities noted above, the islands in the Capoli Slough complex help define the complex for what it is. Stressors include wind-generated wave and river current erosion of islands.

Opportunities: In many locations within the study area, remnants of eroded islands still exist just beneath the water surface. These underwater remnants provide a solid base upon which to reconstruct islands.

4.5.6 RESOURCE PROBLEM: LACK OF TURTLE NESTING HABITAT

Turtle nesting habitat within or adjacent to Capoli Slough is very limited. Suitable nesting habitat is generally lacking in the lower Pool 9, except along the floodplain fringe. Providing this type of habitat would address this habitat need. Stressors include lack of nesting habitat in lower Pool 9.

Opportunities: In restoring some of the islands it is possible to create sparsely vegetated, sand habitat that would be suitable for turtle nesting in some of the more protected areas of the islands. Because of the relatively isolated nature of the Capoli Slough complex, egg predation would be low and nesting success high.

4.5.7 RESOURCE PROBLEM: LACK OF PROTECTED OFF-CHANNEL LACUSTRINE FISHERIES HABITAT

Protected off-channel lacustrine fisheries habitat is an important component of the Mississippi River ecosystem. This type of habitat has declined in lower Pool 9 with the loss of islands and the leveling effects of sedimentation in off-channel areas. No appreciable habitat of this type exists below river mile 664 in Pool 9. The Wisconsin DNR, in 8 years of late fall electrofishing in Lower Pool 9, has documented the poor quality of late fall and winter habitat for backwater species in the lower 16 miles of Pool 9 (Janvrin 2011). Restoration of backwater complexes would improve habitat conditions for a large variety of backwater and channel fish species. The complexes should include a diversity of water velocities, including areas of undetectable velocity during below bank-full conditions. Adequate water depths (greater than 4 feet) will need to be provided to improve Centrarchid overwintering habitat. Stressors include lack of protected deepwater habitat as fish overwintering habitat because of excessive velocities and lack of deepwater (greater than 4 feet).

Opportunities: The limited existing deepwater habitat receives excess flows, which is likely to increase as islands continue to erode, and provides only very limited overwintering habitat for bluegills and other lacustrine species. There is an opportunity to reduce flows by the creation of barrier islands, thereby creating protected deepwater areas and expanding the deepwater habitat by dredging for use as topsoil/random fill on constructed islands and creation of emergent marsh/mudflats.

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5. PROJECT OBJECTIVES

5.1 INSTITUTIONAL FISH AND WILDLIFE MANAGEMENT GOALS

5.1.1 UPPER MISSISSIPPI RIVER NATIONAL WILDLIFE AND FISH REFUGE GOALS

Fish and wildlife management goals and objectives for the area fall under those defined more broadly for the Upper Mississippi River National Wildlife and Fish Refuge and those designated specifically in the Comprehensive Conservation Plan. The management goals and objectives of the Upper Mississippi River National Wildlife and Fish Refuge that apply most directly to the study area include the following:

Environmental Health Goal: Improve the environmental health of the Refuge by working with others.

- Working with others and through a more aggressive refuge program, seek a continuous improvement in the quality of water flowing through and into the refuge in terms of parameters measured by the LTRMP (DO, major plant nutrients, suspended material, turbidity, sedimentation, and contaminants).
- Increase efforts to control invasive plants and animals through active partnerships with States and other service programs and Federal agencies and increase public awareness and prevention.

Wildlife and Habitat Goal: Habitat management will support diverse and abundant native fish, wildlife, and plants.

- By 2021, in cooperation with various agencies and States, implement at least 30 percent of the refuge-priority Environmental Pool Plan actions and strategies in Pools 4 through 14.
- Adopt and use the following guiding principles when designing or providing input to design and construction of habitat enhancement projects:
    - Management practices will restore or mimic natural ecosystem processes or functions to promote a diversity of habitat and minimize operation and maintenance costs. Mimicking natural process in an altered environment often includes active management and/or actions.
    - Maintenance and operation costs of projects will be weighed carefully because annual budgets are not guaranteed.
    - Terrestrial habitat on constructed islands and other areas needs to best fit the natural processes occurring on the river, which in many cases will allow for natural succession to occur.

    - If project features in Refuge Closed Areas serve to attract the public during the waterfowl season, spatial and temporal restrictions of uses may be required to reduce human disturbance of wildlife.
    - The esthetics of projects in context of visual impacts to the landscape should be considered in project design.

- Develop and implement monitoring and management plans for threatened and endangered species, fish, mussels, turtles, furbearers, and forest species.

Wildlife-Dependent Recreation Goal: Manage programs and facilities to ensure abundant and sustainable hunting, fishing, wildlife observation, wildlife photography, interpretation, and environmental education opportunities for a broad cross-section of the public.

- Provide a balanced approach between the needs of the waterfowl and the public.
    - Provide migrating waterfowl a more balanced and effective network of feeding and resting areas.
    - Minimize disturbances to feeding and resting waterfowl in closed areas.
    - Provide waterfowl hunters with more equitable hunting opportunities over the length of the refuge.
- Enhance fishing opportunities on suitable areas of the refuge through habitat, access, and facilities improvements.

5.1.2 FISH AND WILDLIFE WORK GROUP GOALS AND OBJECTIVES

In 2004, the interagency FWWG and RRF developed Environmental Pool Plans (EPPs). The EPPs identify a desired future habitat condition which resource agencies and river interests can strive to attain. The overall goal in the EPP for Pool 9 is to maintain and increase aquatic and terrestrial diversity.

The pertinent specific actions identified to address these goals are:

- Increase Depth Diversity in Channels and Backwaters
- Maintain Existing Quality Habitats
- Protect and Restore Islands
- Manage River Flows and Connectivity to Improve Habitat

Quantitative desired cover types from the Pool 9 EPP were used, where possible, to provide quantitative objectives for the Capoli Slough study area; i.e. acres of island, secondary channel, fish overwintering habitat, emergent vegetation, etc.

5.2 PROJECT GOALS AND OBJECTIVES

5.2.1 PROJECT GOAL

Prevent the further loss and expand the 820-acre Capoli Slough island/wetland complex and improve habitat quality and diversity within the complex.

The Capoli Slough project area is a diverse complex of sloughs, islands, wetland, and aquatic plant beds. The complex provides high value habitat for a wide variety of fish and wildlife species. This type of diverse habitat is disappearing from lower Pool 9 as a result of the forces of wave action and river currents and is being replaced by relatively featureless shallow open water habitat of lower habitat value. The loss of this habitat can be documented from aerial photos. The Capoli Slough complex has been declining in size and is now the lower end of the chain of islands/wetlands bordering the main channel in this reach of Pool 9. At one time, these islands and wetlands extended approximately 2 miles farther downstream.

As a minimum, the goal is to maintain the existing area of islands and wetlands. Opportunities to restore additional island and wetland area should be pursued where practical.

5.2.2 PROJECT OBJECTIVES

Because the study area is within the Upper Mississippi River National Wildlife and Fish Refuge, the Refuge management goals and objectives and the FWWG Desired Future Habitat Conditions, together with input from State and Federal agency natural resource managers, were used to guide the development of specific project objectives. However, this study is only one part of a larger cooperative natural resource management effort on the river. The long-term effectiveness of any project will eventually be evaluated from a system-wide perspective.

Earlier sections of this report discussed in detail existing habitat conditions and problems (see Section 4.1 Existing Habitat Conditions, Section 4.4 Estimated Future Habitat Conditions, and 4.5 Resource Problems and Opportunities). The habitat objectives were developed as part of a coordinated effort on the part of all of the resource agencies involved in the study. The following factors were considered important in the development of the objectives:

1. Management objectives of the Upper Mississippi River National Wildlife and Fish Refuge, FWWG, and of the Wisconsin and Iowa DNRs.

2. Historic and existing fish and wildlife habitat conditions.

3. Resource problems, opportunities, and constraints.

4. Habitat deficiencies, now and in the future, for Pool 9 in general.

5. Species groups and individual species habitat requirements.

6. Desirable hydraulic and sediment transport conditions to sustain habitat.

The Project Objectives developed through this process are:

Objective 1: Maintain/increase the acreage (339 acres) of emergent and floating leaf aquatic vegetation.

Objective 2: Maintain/increase the acreage of submersed aquatic vegetation in Capoli Slough and surrounding area.

Objective 3: Within the Capoli Slough complex, maintain Capoli Slough (41 acres) as a well-defined, self-maintaining running slough habitat and restore similar habitat where possible.

Objective 4: Maintain protected wetlands and aquatic areas (600 acres) within the Capoli Slough complex.

Objective 5: Maintain existing islands and increase the acreage of island habitat (120 acres).

Objective 6: Provide turtle nesting habitat (3 acres) within or near the Capoli Slough complex.

Objective 7: Enhance and/or develop protected off-channel lacustrine fisheries habitat within the Capoli Slough complex, including 10 acres of deepwater (greater than 4 feet) habitat meeting winter water quality criteria for overwintering fish habitat.

The relationship between resource problems, opportunities and the objectives are summarized in table 5-1.

Table 5-1
Resource Problems, Opportunities, and Objectives

Resource Problems	Opportunities	Objectives
Loss of emergent and floating leaf aquatic vegetation.	Protection of existing and creation of additional islands to reduce wind/wave and river current erosion would protect and expand emergent and floating leaf aquatic vegetation.	Objective 1: Maintain/increase the acreage (339 acres) of emergent and floating leaf aquatic vegetation.
Submersed aquatic vegetation (SAV) has been highly variable, but as the islands continue to disappear, SAV are likely to lack resilience and sustainability and show even greater fluctuations in the future.	The extent and quality of submersed aquatic vegetation could be maintained/increased by modifying current patterns and reducing wave action; thereby improving water clarity in areas in and adjacent to the Capoli Slough complex.	Objective 2: Maintain/increase the acreage of submersed aquatic vegetation in Capoli Slough and surrounding area.
Capoli Slough is a valuable secondary channel that is expected to degrade as the islands and wetlands that define Capoli Slough and other tertiary and secondary channels are lost.	Protection and reconstruction of islands bordering Capoli Slough provides an opportunity to confine flows and provide a self-sustaining running channel habitat. There is also an opportunity to increase substrate diversity by creating rock riffle, pool, and downstream gravel bar habitat.	Objective 3: Within the Capoli Slough complex, maintain Capoli Slough (40 acres) as a well-defined, self-maintaining running slough habitat and restore similar habitat where possible**.**
The past and future loss of islands and emergent wetlands has reduced and would eventually eliminate the wetlands and aquatic areas that are isolated and protected from riverine forces during much of the year.	Protection and creation of islands provide an opportunity to reduce current velocity and wind-generated wave action. There is also an opportunity to increase elevations from disposal of access and habitat dredging to promote the establishment of mudflats and emergent marsh, an important isolated habitat for fish and wildlife.	Objective 4: Maintain protected wetlands and aquatic areas (600 acres) within the Capoli Slough complex.
Islands help define running sloughs, add habitat complexity, break up wind fetch, provide visual isolation, and in and of themselves provide habitat for a variety of wildlife species.	In many locations within the study area, remnants of eroded islands still exist just beneath the water surface. These underwater remnants provide a solid base upon which to reconstruct islands.	Objective 5: Maintain existing islands and increase the acreage of island habitat (120 acres).
Turtle nesting habitat within or adjacent to Capoli Slough is very limited and is generally lacking in lower Pool 9, except along the floodplain fringe.	There is an opportunity on the newly created islands to create sparsely vegetated, sand habitat that would be suitable for turtle nesting.	Objective 6: Provide turtle nesting habitat (3 acres) within or near the Capoli Slough complex.
The limited existing deepwater habitat in Capoli Slough complex receives excess flows, which is likely to increase as islands continue to erode and provides only very limited overwintering habitat for bluegills and other lacustrine species. Overwintering habitat is lacking throughout the lower 16 miles of Pool 9.	There is an opportunity to reduce flows by the creation of barrier islands, protecting the existing deepwater areas and expanding the deepwater habitat by dredging for use as topsoil/random fill on constructed islands and creation of emergent marsh/mudflats.	Objective 7: Enhance and/or develop protected off-channel lacustrine fisheries habitat within the Capoli Slough complex, including 10 acres of deepwater (greater than 4 feet) habitat meeting winter water quality criteria for overwintering fish habitat.

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6. ALTERNATIVE MEASURES

6.1 PLANNING CONSTRAINTS

6.1.1 INSTITUTIONAL

The Capoli Slough project area lies within the boundaries of the Upper Mississippi River National Wildlife and Fish Refuge. Refuge management goals and objectives must be complied with, as well as the laws and regulations governing refuge management.

6.1.2 ENGINEERING

Because of shallow water depths, access for construction equipment would be difficult in many areas without extensive dredging. Equipment restrictions and construction access will need to be considered in the planning and design of habitat restoration measures.

6.1.3 ENVIRONMENTAL

The endangered mussel species *Lampsilis higginsii* was found in Capoli Slough and adjacent main channel border areas in 1995 and 2007. Any project developed for the Capoli Slough area will need to avoid adversely affecting this species.

6.1.4 CULTURAL

Three archaeological sites (47 CR 578, 47 CR 579, and 47 CR 580) have been identified on the remnant islands of the Capoli Slough/Ferry Slough complex (Boszhardt 1995, Jalbert and Kolb 2003). Site 47CR578 is a historic artifact scatter, site 47CR 579 a precontact lithic scatter and historic artifact scatter, and site 47CR580 is a historic shell midden. Sites 47CR578 and 47CR580 do not meet the criteria for listing on the NRHP. However, site 47CR579 is eligible for the NRHP under Criterion D (property has yielded, or is likely to yield, information important in prehistory or history). The design of the project must be such that the project has no adverse effect on this site.

6.1.5 SOCIOECONOMIC/RECREATIONAL

In developing ecosystem restoration measures and alternatives, it was assumed that Operation and Maintenance of the 9-Foot Navigation Channel would continue, including maintaining the impounded conditions and water regulation.

No other specific socioeconomic constraints have been identified. No appreciable development is located within or adjacent to the study area. The study area is not heavily used by recreational boaters due to shallow water and/or a lack of beach sites.

6.2 ALTERNATIVE MEASURES IDENTIFIED FOR FURTHER STUDY

6.2.1 NO ACTION

The no action alternative is defined as no implementation of a project to modify habitat conditions in the study area.

6.2.2 OBJECTIVES AND POTENTIAL MEASURES

Table 6-1 outlines the objectives; the chemical, physical, and biological stressors that need to be addressed to reach the objectives; and the potential management measures to address these stressors. Sections 6.2.3 through 6.2.9 address the potential management measures in more detail.

6.2.3 ISLAND RESTORATION/CREATION

Island restoration/creation could serve a variety of habitat purposes at the Capoli Slough complex. Island creation was the primary habitat restoration feature evaluated for the Capoli Slough backwater area. Restoration of islands protects shallow areas from wind and wave action, which in turn protects existing aquatic vegetation beds and improves conditions for the growth of aquatic vegetation in other shallow areas.

Islands provide terrestrial habitat, and their restoration increases habitat diversity and provides habitat niches that have been lost through the erosion of islands in this area. Islands can also be designed in a manner to channel flows to enhance or restore secondary channel habitat and to maintain bathymetric diversity.

Through brainstorming and coordination with resource management agencies, a number of island locations and configurations were identified for consideration.

Table 6-1
Objectives, Stressors and Management Measures

Objectives	Stressors	Management Measures
Objective 1: Maintain/increase the acreage (339 acres) of emergent and floating-leafed aquatic vegetation.	Wind/wave action, river currents	Bank protection, island restoration/creation, rock sills, creation of emergent wetlands
Objective 2: Maintain/increase the acreage of submersed aquatic vegetation in Capoli Slough and surrounding area	Wind/wave action, river currents, water clarity	Bank protection, island restoration/creation, rock sills
Objective 3: Within the Capoli Slough complex, maintain Capoli Slough (41 acres) as a well-defined, self-maintaining running slough habitat and restore similar habitat where possible.	Wind/wave action, river currents, and lack of substrate and bathymetric diversity	Bank protection, island restoration/creation, rock sills, cobble liners to create riffle/pool/gravel bar habitat
Objective 4: Maintain protected wetlands and aquatic areas (600 acres) within the Capoli Slough complex.	Wind/wave action, river currents	Bank protection, island restoration/creation, rock sills
Objective 5: Maintain existing islands and increase the acreage of island habitat (120 acres).	Wind/wave action, river currents	Bank protection, island restoration/creation, rock sills
Objective 6: Provide turtle nesting habitat (3 acres) within or near the Capoli Slough complex.	Lack of adequate nesting habitat in lower pool 9	Island restoration, with pockets of sparsely vegetated sand
Objective 7: Enhance and/or develop protected off-channel lacustrine fisheries habitat within the Capoli Slough complex, including 10 acres of deepwater (greater than 4 feet) habitat meeting winter water quality criteria for overwintering fish habitat.	Lack of protected overwintering fish habitat in lower pool 9, including areas greater than 4 feet deep meeting water quality criteria	Bank protection, island restoration/creation, rock sills, habitat dredging (greater than 4feet)

6.2.4 BANK PROTECTION

Bank protection is a tool that can be used to control erosion. Generally, with habitat projects on the Upper Mississippi River, bank protection is in the form of vanes, groins, a rock layer on the bank (traditional riprap design), or a rock mound. Bank protection was evaluated for all the remnant natural islands in the study area.

6.2.5 ROCK SILLS

Closures are generally structural measures designed to control or reduce flow. Closure structures are generally constructed with rock, though new design concepts involving the incorporation of woody material are being developed. Closure structures were identified as measures for consideration between Islands 1 and 2 and Islands 10 and 11 and between new islands. These closures are designed to be overtopped first, essentially providing a relief point under higher flows.

6.2.6 DREDGING

Dredging has been proposed as a potential measure to improve bluegill habitat as well as obtain materials for island construction. Dredging when combined with construction of islands would incrementally improve Centrarchid habitat in the Capoli Slough major area. Increased availability of deeper water combined with reduced velocities would greatly improve wintertime conditions for bluegills.

6.2.7 CHANNEL STRUCTURES

Capoli Slough offers the opportunity to add structure to its channel for lotic fish and mussel habitat improvement. Structures will be evaluated in the locations shown on plate 8 and possibly in other locations.

6.2.8 EMERGENT WETLANDS/MUDFLATS

Emergent wetlands or mudflats could be created in the shallow flats near the existing or new islands. They would be constructed to an elevation near normal pool. This would restore the amount of emergent vegetation or mudflat habitat in the Capoli Slough area. It would also provide placement sites for unsuitable and/or excess material dredged for access and habitat dredging for use as granular fill or topsoil for the islands.

6.2.9 ISOLATED WETLANDS

Creation of isolated wetlands was considered for the Capoli Slough HREP. Isolated wetlands would be shallow wetlands (less than 2 feet deep under normal pool) that would not be connected to other aquatic areas during bank-full conditions. These areas would generally be fish-free, because they would not provide suitable habitat for fish. These areas could provide excellent habitat for amphibians, reptiles, and other similar wildlife. However, some of the resource managers expressed concern that the lack of similar habitat in lower Pool 9 could make any habitat created a population sink.

6.3 PLANNING AND DESIGN CONSIDERATIONS

River managers and engineers provided a number of ideas for consideration in the planning and design of project measures and alternatives. The Environmental Design Handbook (USACE 2006) also provides recommendations for consideration in planning and design of

project measures. In addition, a specific Value Engineering (VE) study on the Harpers Slough HREP, which has similar measures to the Capoli Slough HREP, was completed. These recommendations were also considered in the planning and design for Capoli Slough (see attachment 11). Because Harpers Slough, which proposes similar project measures, had a VE study completed, an additional VE study was not completed for the Capoli Slough HREP. A VE study will be completed during the 35-percent review of plans and specifications to see if additional VE recommendations are warranted. In addition, the FWWG developed conceptual models for biota, including performance criteria, to assist in future ecosystem restoration efforts. Pertinent performance criteria developed for lentic fish are summarized in section 6.4.4.

6.3.1 RIVER PROCESSES

Restoration of natural river processes disrupted by creation of the locks and dams is an overall goal for habitat restoration on the Upper Mississippi River. It is believed that restoration of these processes will generally result in improved habitat conditions for a wide variety of fish and wildlife. While restoration of natural river processes has merit from a systematic perspective, it is difficult to define this goal on a site-specific basis in a quantifiable manner. Also, the primary source of disruption of river processes, the navigation system with regulated pools, will remain in place. Planning for habitat restoration measures must take into account that the navigation project is in place, the operation of which is going to affect what can be accomplished with various restoration measures. As long as the navigation project is in place there will be limitations on the restoration of natural river processes. Therefore, the approach selected is to view restoration of natural river processes as a long-term systemic goal. Restoration of these processes will be incorporated into the development of the habitat restoration project where possible.

In the large relatively open area of lower Pool 9, barrier islands provide critical physical infrastructure to diversify flow and sediment transport and to reduce wind fetch and wave resuspension of sediments. Water level management in Pool 9, including summer drawdowns, is being evaluated as part of a more systemic evaluation. It is likely that the a combination of water level management and restoring critical physical infrastructure in these large contiguous impounded areas will yield the greatest ecosystem services and goods. Currently, the Corps is not authorized to implement regular drawdowns for ecosystem benefits on a regular basis. This is being examined as part of the Navigation and Ecosystem Sustainability Program (NESP), which has been authorized for planning, but not for implementation. Past drawdowns have been conducted on an experimental or one-time basis, which has required considerable planning and deviations from the Corps water control plan for maintaining conditions for the 9-foot navigation channel. A long-term periodic drawdown plan would likely trigger significantly more analysis (including impacts to listed mussels). An analysis of the changed hydrology of the system (as compared to a system of regular drawdowns) would not change proposed project features.

6.3.2 ISLANDS

The Engineering and Design Handbook provides a variety of recommendations on island layout, elevation, width, side slopes, topsoil and vegetation. Some of the more germane recommendations from the Engineering and Design Handbook and the Harpers Slough VE recommendations are summarized below.

a. Islands should be located in locations and configurations comparable to the natural islands that previously existed in the study area.
b. Islands should be positioned to reduce wind fetch to less than 3,500 feet in 2 feet of water.
c. A mix of high and low elevation islands is preferred.
d. Use of rock should be minimized to allow for more aesthetic and natural looking conditions. Shorelines deemed critical to maintaining the integrity of an island or an overall island complex should be protected using bioengineering techniques, if possible. Noncritical shorelines should be vegetated with grass or left as sand.
e. Slopes of 10:1 extending from the toe of islands outward for 30 feet or more are desirable. This objective could be accomplished either through direct construction or providing sufficient material in an island berm for beach formation.
f. Willows should not be planted on every portion of an island. Create dynamic shorelines with a transition zone (i.e., an above-water beach) to provide more habitat that is suitable for shorebirds.
g. Islands should be located to induce the maintenance and/or formation of channels to maintain/improve bathymetric diversity.
h. Islands should be located in shallow water to reduce costs and increase stability.
i. Existing island remnants should be incorporated into restored islands for aesthetics.
j. Islands should be positioned so that shoreline stabilization is in shallow water.
k. Access dredging should be minimized to minimize secondary effects and costs.
l. Islands should be positioned to have the greatest effect on hydraulic and sediment regimes.
m. Rock sills should be incorporated to provide floodplain flow for more frequent floods.
n. Flood impacts should be minimized with low elevation islands, or islands should be aligned in upstream/downstream orientation.
o. Pile dikes should be used to induce sedimentation in areas of active sediment transport (VE attachment 11).
p. The slope of rock mounds should be increased from 1V:3H slope (VE attachment 11).
q. Geotubes (with vegetation openings) should be used (VE attachment 11).
r. Rock should be replaced with wood bundles (VE attachment 11).
s. Thickness of sand, random fill, and fines should be adjusted to reduce higher cost material (VE attachment 11).
t. Geosynthetic and bioengineering for erosion protection should be evaluated (VE attachment 11).
u. Other materials should be used for rock sill (log rock structure) (VE attachment 11).

6.3.3 EMERGENT WETLANDS/MUDFLATS

Germane recommendations on emergent wetlands/mudflats from the Engineering and Design Handbook and the Harpers Slough VE are summarized below.

a. Emergent wetlands located in proximity to islands are the optimum condition.
b. It is important to maintain and enhance microtopography within expanses of sand and mudflats.
c. Mini wetlands should be created by modifying islands (VE attachment 11).

6.3.4 LENTIC FISH

The conceptual models developed as part of Upper Mississippi River System Ecosystem Restoration Objectives report (2009) provide a variety of recommendations on performance criteria for evaluating and planning lentic fish habitat restoration. Pertinent ones are summarized below.

a. Restore/maintain lentic fish habitat to yield desired electro-fishing catch per unit effort of age 1 plus fish in overwintering sites.
    - Fair to Good:
        - 100 to 200 bluegills/hour
        - 50 to 100 largemouth bass/hour
    - Good to Excellent:
        - 200 to 300 bluegills/hour
        - 100 to 150 largemouth bass/hour
    - Excellent:
        - More than 300 bluegills/hour
        - More than 150 largemouth bass/hour
b. Aquatic vegetation cover in the range of 40 to 60 percent (summer) and 25 to 50 percent (winter) in off-channel areas.
c. Water depth greater than 4 feet in 30 to 60 percent of the lake.
d. 1 to 6 backwater lakes (greater than 10 acres) per square mile of floodplain (more than 10 percent of aquatic area).
e. 80 percent of lakes "connected" to adjacent channels within backwater complex at base flow.
f. High quality overwintering areas less than 2 to 4 miles apart.
g. Substrates of sand and/or gravel available for spawning.
h. DO levels as measured at mid-depth:
    - Spring/summer: greater than 5mg/l
    - Winter: greater than 3 mg/l
i. Water temperature (winter):
    - 4 C^0 over 35 percent of the area,
    - 2 to 4 C^0 over 30 percent of the area,
    - 0 to 2 C^0 over 35 percent of the area.

j. Winter current velocity less than 0.3 cm/sec over 80 percent of the backwater lake area.

6.3.5 CONSERVATION MEASURES FOR MUSSELS AND BALD EAGLES

During the planning process for the Capoli Slough HREP, several modifications have been made to reduce impacts to mussels including *L. higginsii*. After the 2007 mussel survey results were available, island and access dredging footprints were moved away from areas where there were concerns for impacts to mussels, including *L. higginsii*. In addition, there are concerns over project effects on bald eagle nesting activity, which is prevalent in Pool 9 as evidenced through recent surveys by the USFWS that estimated nearly 100 nests in Pool 9 (S. Baylor, pers. comm. 2010). The USFWS has concurred in the use of the following constraints/avoidance measures for the planning of this project.

a. Island measures should be confined to the shallow muck shelf surrounding most of the islands to avoid habitat more favorable to mussels along Capoli Slough and the main channel borders.

b. An area proposed to be dredged for sand borrow along the main channel border should be eliminated from the plan to avoid impacts to mussels, including *L. higginsii*.

c. Narrow islands to be constructed along the Capoli Slough secondary channel should be reconfigured to wide islands that can be constructed with equipment on top of the islands with only a single access point needed for each to eliminate impacts to mussels, including *L. higginsii*.

d. Work and work vessels should be restricted from Capoli Slough proper during construction to avoid impacts to mussels, including *L. higginsii*.

e. Access dredging should be minimized and confined to designated areas and closely monitored to avoid impacts to mussels, including *L. higginsii*. The actual footprints of access dredging will be mapped and reported to the USFWS.

f. The project should produce no substantial changes to flow conditions and sedimentation patterns in Capoli Slough.

g. Access for project construction should be limited to shallow draft vessels to minimize access dredging, and/or access areas should be identified through additional mussel surveys as containing few to no mussels.

h. If any project activities will occur during the nesting season within 660 feet of one or more bald eagle nests, a permit to disturb bald eagles per the requirements of the Bald and Golden Eagle Protection Act may be necessary – this buffer would be extended to one-half mile if the project will cause loud noises (e.g., pile driving, etc.) during the nesting season. In Wisconsin and Iowa, nesting season is generally mid-January to early

August, although these dates may be adjusted by monitoring the behavior at individual nest sites. Regardless of timing, a permit may also be necessary if vegetation removal, damage to a nest tree's critical root zone, or permanent landscape changes occur within 330 feet of a bald eagle nest. Buffer distances may be decreased if landscape barriers exist between the eagle nest and the proposed activity or if the eagles have a demonstrated tolerance to similar activities in the area.

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7. DEVELOPMENT AND EVALUATION OF ALTERNATIVES

Alternatives were developed as groups of measures to protect, restore, and enhance habitat quality in the Capoli Slough complex. The development of island restoration alternatives actually began as a brainstorming exercise to identify possible locations for island protection and restoration. Figure 7-1 shows some of the various conceptual measures that were considered during the planning. One of the conceptual plans depicted on Figure 7-1 shows the desired future habitat conditions for Capoli Slough area prepared by the interagency FWWG of the RRF in 2004. Preliminary runs of the wind fetch and wave models and hydraulic models were used to design measures. The presence of the endangered Higgins eye and the need to avoid impacts constrained alternative development, including the sequence of construction. Because of the mussel concerns, access dredging will not be allowed in the Capoli Slough secondary channel except at the downstream end. Access from the main channel will also be very limited. The following multiple-measure alternatives are defined and summarized in Table 7-1. Plate 7 (on bathymetry) and Plate 8 (aerial photograph) show the various measures that were evaluated in detail.

Alternative A: Stabilization of existing islands. This alternative was considered to be the minimum project to protect the existing resources from further degradation.

Alternative B: Alternative A measures plus restoration/protection of interior islands along Capoli Slough. The purposes of these islands are to protect additional existing islands and the wetland complex and confine flows to the Capoli Slough secondary channel to provide a self-maintaining running slough.

Alternative C: Alternative A measures, with and without measures in Alternative B, plus construction of Islands F, K, and K1. The primary purpose of Islands K and K1 is to provide protection of the interior of Capoli Slough complex from excess current and wind-generated wave action from the north and east. Island F would provide additional protection from wind-generated wave action from the south and east.

Alternative D: Alternative A measures, with and without measures in Alternative B, plus construction of Island G. The primary purpose of Island G is to provide protection to the interior of Capoli Slough complex from wind-generated wave action from the south and east.

Alternative E: Alternative A measures, with and without selected measures in Alternative B, and construction of Islands G, K, K1, and/or F. Island F was also evaluated to provide additional protection from wind-generated wave action from the south and east.

Cobble liners (riffle structures) were evaluated as an independent add-on feature that could be included with any alternative. They were not considered as an independent

alternative because it is highly unlikely they would be constructed if no other measures were constructed at Capoli Slough.

Habitat Dredging – The primary purpose of the fine borrow site Habitat Dredging A is to provide fines to top the constructed islands (specifically Islands C, E, K, K1, and G). It is assumed that fine material from access dredging would be available for topsoil for the narrow Islands A, B, E, E1, F, and L. The size of Habitat Dredging A would depend on which of the islands are recommended for implementation. Habitat Dredging B would approximately double the amount of fines available for topsoil and would provide additional winter fish habitat. Material from Habitat Dredging B would be placed in either wetland A or K or both. Dredging to create this additional winter fish habitat depends on construction of measures in Alternative A and Islands C, E/E1 and K. Without these measures, Habitat Dredging Area B would experience excessive current and not meet the objectives for overwintering fish habitat. It was evaluated as an add-on feature that can be included with alternatives C or E. It was not considered as an independent alternative because it is highly unlikely that this action would be pursued if no other measures were constructed at Capoli Slough.

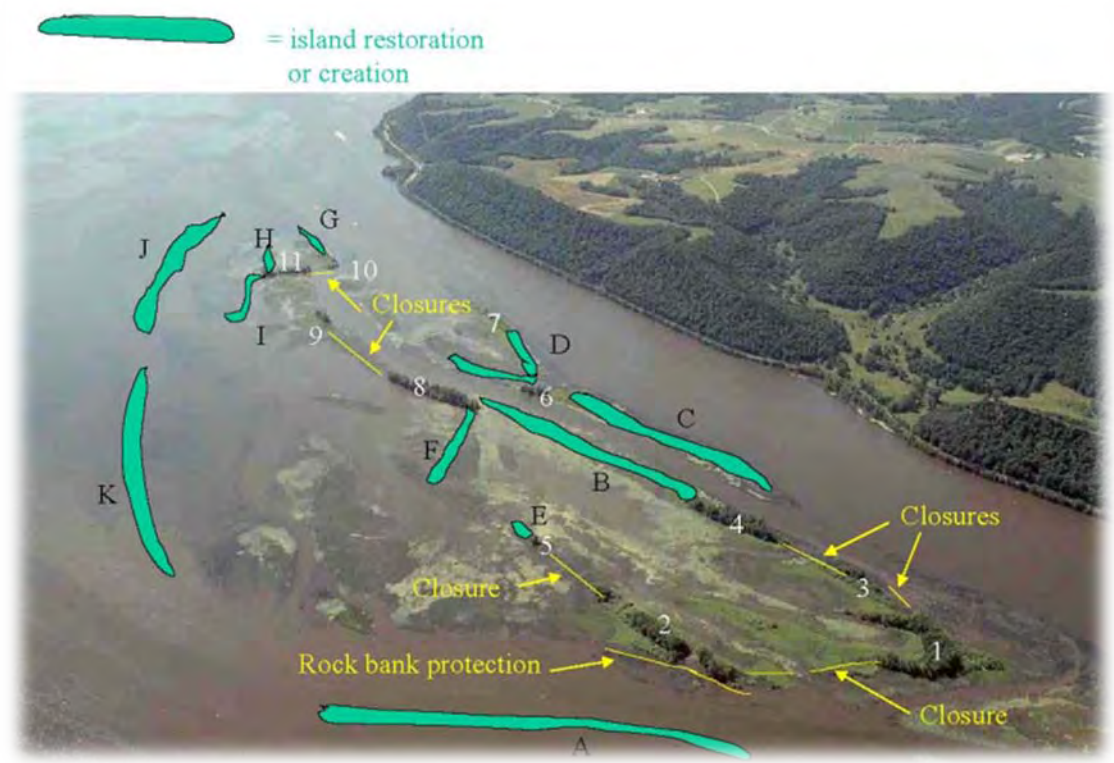
Emergent wetlands (mud flats). These measures are dependent on the construction of their respective island measures. The number and size of the mudflats will be based on the need for disposal sites (i.e., there is no target for emergent wetland acreage through mudflat construction), except as indentified for placement of Habitat Dredging B material. However, the construction of the emergent wetlands will help meet objective 1, which is to increase emergent and floating-leafed vegetation.

The following conventions were used for labeling natural versus proposed man-made islands.

Remaining natural islands are numbered; e.g., Island 8
Proposed man-made islands use capital letters; e.g., Island G

Figure 7-1 Various conceptual plans since late-1990s for Capoli Slough HREP

Brain storming conceptual measures from late-1990s – looking downstream



Conceptual measures contained in 2001 Problem Appraisal Report - looking downstream

Fish and Wildlife Work Group – 2004 Environmental Pool Plan – looking upstream

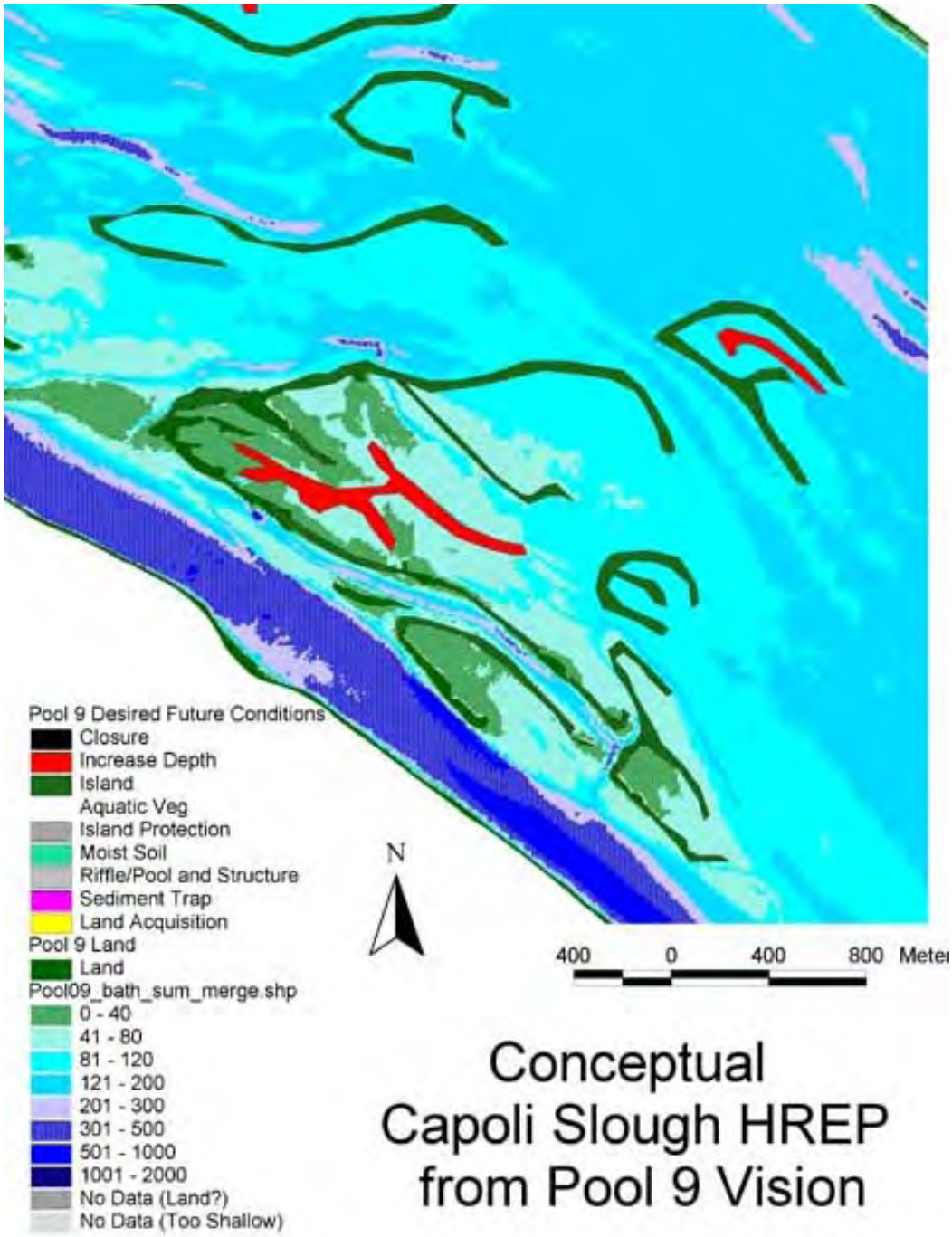


Table 7-1

Measures and alternatives considered in detail in addition to the No Action Alternative – the measures are also presented as a matrix to clarify which measures go with each alternative.

Alternatives	Measures
A	Islands A,B, D, L, Rock sills A and D, Rock Mound I (minimum alternative)
B1	Alt. A measures, plus Island C
B2	Alt. A measures, Island C, plus Island E/E1
B3	Alt. A measures, Islands C and E/E1, plus Island J
B4	Alt. A measures, Islands C, E/E1, and J, plus Island H
C1	Alt. A measures, plus Island K
C2	Alt. A measures, Island K, plus Island K1
C3	Alt. A measures, Island K, plus Island C
C4	Alt. A measures, Island K, Island C, plus Island E/E1
C5	Alt. A measures, Islands K, C, & E/E1, plus Island K1
C6	Alt. A measures, Islands K, C, & E/E1, plus Island F
D1	Alt. A measures, plus Island G
D2	Alt. A measures, Island G, plus Islands C and F
D3	Alt. A measures, Islands G, C and F, plus Island E/E1
E1	Alt. A measures, plus Islands K and G
E2	Alt. A measures, Islands K and G, plus Island K1
E3	Alt. A measures, Islands K and G and , plus Islands C and E/E1
E4	Alt. A measures, Islands K, G, C, and E/E1, plus Island F
E5	Alt. A measures, Islands K, F, G, C, and E/E1, plus Island K1
E6	Alt. A measures, Islands K, K1, G, C, E/E1, F, and Island J and H
Riffles	Stand alone measure that could be added to any of the action alternatives
Habitat Dredging A	Incidental measure as source of fine material for topsoil
Habitat Dredging B	Additional measure includes the construction of Emergent Wetland K and/or A
Emergent Wetland K	Placement of Habitat Dredging B fine material
Emergent Wetland A	Placement of Habitat Dredging B fine material

Notes:

1. Islands C, E/E1, J, H, K, K1, Rock Sill E, G, H, Habitat Dredging A and B, Cobble liner, and Emergent Wetlands are all dependent on Alternative A measures.

2. Islands C, K/Rock Sill E, G, F, and cobble liners are independent measures that could be added to Alternative A measures.

3. Due to constraints imposed to protect mussels, Island H could not be constructed independently of Island J, which would be needed for access to Island H.

4. Island portion E and E1 are essentially one island but with different designs for each portion.

5. Island E/E1 is dependent on Island C for construction access because of constraints to protect mussels.

6. Island K1 is dependent on construction of Island K.

7. Habitat Dredging A is considered incidental to the other project measures as a borrow source of fine material for topsoil for the islands. The size will depend on Islands C, K, K1, and/or G.

8. Habitat Dredging B requires the construction of Emergent Wetlands K and/or A.

9. Other emergent wetlands, sand pads, and passing lanes are optional measures to facilitate construction of project measures.

	Measures													
Alternative	Island A, B, D, L Rock sills A,D Rock Mound I	Island C	Island E/E1	Island H	Island J	Island G	Island K	Island K1	Island F	Cobble liners	Habitat Dredge A	Habitat Dredge B	Wetland K	Wetland A
A	X													
B1	X	X									X			
B2	X	X	X								X			
B3	X	X	X	X	X						X			
C1	X						X				X			
C2	X						X	X			X			
C3	X	X					X				X			
C4	X	X	X				X				X			
C5	X	X	X				X	X			X			
C6	X	X	X				X		X		X			
D1	X					X					X			
D2	X	X				X			X		X			
D3	X	X	X			X			X		X			
E1	X					X	X				X			
E2	X					X	X	X			X			
E3	X	X	X			X	X				X			
E4	X	X	X			X	X		X		X			
E5	X	X	X			X	X	X	X		X			
E6	X	X	X	X	X	X	X	X	X		X			
E4 w/K	X	X	X			X	X		X		X	X	X	X
E4 w/K&A	X	X	X			X	X		X		X	X		X
Riffle - Stand alone										X				

Construction costs for each feature are presented in Table 7-2. Construction costs (total and annualized) for each alternative which incorporate Planning, Engineering and Design (PED) and Contract Supervision and Administration (SA), are presented in Table 7-3. The annualized cost allows a comparison among the alternatives for Average Annual Cost per Average Annualized Habitat Unit (AAHU).

Table 7-2
Construction Costs by Measure.

Measures	Construction Costs
MOB (2 separate)	$1,739,000
Island A (option 1) with wetland A	$638,700
Island A (option 2) without wetland A	$676,208
Rock Sill A	$73,700
Island B	$405,400
Island D	$781,200
Rock Sill D	$31,400
Island L	$111,100
Rock Mound I	$43,100
Island C	$907,300
Island E	$104,700
Island E1	$120,100
Island J	$301,900
Island H	$231,800
Island K	$1,107,400
Rock Sill E	$47,500
Island K1	$233,200
Island G	$1,099,300
Island F	$311,700
Habitat Dredging A	Topsoil for islands*
Habitat Dredging B (wetland K)	$302,900
Habitat Dredging B (wetland K&A)	$733,800
Cobble liner	$9,400

***** Habitat Dredging A is a borrow area for obtaining topsoil for the islands and the costs are included in the topsoil costs for the islands.

To quantify habitat benefits of the proposed alternatives for the Capoli Slough Complex, the USFWS Habitat Evaluation Procedure (HEP) was used (U.S. Fish and Wildlife Service 1980). The HEP methodology uses a Habitat Suitability Index (HSI) to rate quality of habitat on a scale of 0 to 1 (1 being optimum). The HSI is multiplied by the number of acres of available habitat to obtain Habitat Units (HUs), and, in this case, considers the acreages of cover types projected to occur in the future (Table 7-3). One HU is defined as 1 acre of optimum habitat. HUs are then averaged for each year of the project's lifespan (assumed to be 50 years) to estimate AAHUs. By comparing the AAHUs of the no-action alternative to each of the action alternatives, the benefits can be quantified (net AAHUs). Based on the management objectives of the resource agencies in this portion of the river, waterfowl and fish models were used to quantify habitat benefits and evaluate the effectiveness of the proposed measures. A detailed discussion of the HEP conducted for this project is presented in Attachment 4.

Models selected were those which have been used successfully in evaluating benefits of other HREPS in the upper Mississippi River: Bluegill Winter Habitat Suitability (Palesh and Anderson 1990), Smallmouth Bass Habitat Suitability (Edwards et al. 1982), Diving Duck Migration Habitat Suitability (Devendorf 1995), and the Wind Fetch and Wave Model

(Rohweder et al. 2008). Inherent in the use of these models (and other "bluebook" models used for HEP analysis) is a level of risk and uncertainty that is not quantified due to the complexity in projecting future conditions associated with a wide range of alternatives (i.e., there is a high degree of variability across alternatives over time). In addition, models used to assess habitat benefits may lack the sensitivity for determining the direct effects of project measures for certain taxa. For example, the benefits of the Islands H and J combination may not be fully quantified for mussels and other riverine species in the Capoli Slough proper area as determined by the smallmouth bass model.

In light of these uncertainties, numerous other fish and wildlife benefits are acknowledged that would accrue with project construction but may not be captured in the HEP analysis (i.e., incidental benefits). Island construction would create conditions allowing for the re-establishment of extensive and diverse aquatic vegetation beds and restoration of bathymetric and flow diversity to the area. These conditions would result in the creation of microhabitats conducive to increases in the diversity and population levels of aquatic invertebrates including aquatic insects, amphipods, gastropods, and mussels. Likewise, habitat conditions for a wide variety of fish species would be expected to improve as food and cover resources become more widespread and diverse. Dredging holes would provide overwintering habitat for many species of fish, especially Centrarchids. Studies have indicated that winter habitat on the river may be a critical component to maintaining fish populations on the river. The establishment of additional winter fish habitat in this part of Pool 9 could contribute to maintaining healthy fish populations in the pool.

The islands and associated vegetation would provide habitat for a wide variety of wildlife species including roosting, nesting and migration habitat for many species of birds, including neotropical migrants, and nesting habitat for turtles. The islands and associated shoreline and shallow water zones would provide marsh habitat for marsh and water birds such as grebes, bitterns, herons, egrets, terns, and shorebirds and improved habitat conditions for many species of reptiles and amphibians.

A summary of the acreages projected for each cover type, habitat benefits, and costs for each alternative across the Capoli Slough complex (or study area) is provided in table 7-3.

Table 7-3
Summary of Cover Type Acreages, Habitat Benefits, and Costs by Alternative.

Alternative	Cover Types [a] (acres) @ TY 50				Habitat Benefit (Net AAHUs)	Total Cost ($)	Ave Annual Cost ($/yr)
	LAND	EM & RFAVEG	SAV	OWATER			
2000 acres:	23	263	603	1,147			
2011 acres:	12	242	480	1,303			
No Action	0	0	289	1,747	0	0	0
A	21	237	817	961	207.4	3,109,982	149,124
B1	28	234	896	879	241.9	4,462,933	213,998
B2	29	233	895	879	251.0	4,798,642	230,095
B3	30	233	895	878	259.8	5,249,882	251,732
B4	31	234	896	875	268.3	5,596,383	268,347
C1	28	234	1,022	752	322.2	4,833,276	231,756
C2	32	233	1,031	741	337.1	5,181,633	248,459
C3	35	232	1,018	751	397.6	6,186,227	296,630
C4	36	231	1,017	751	418.6	6,523,235	312,789
C5	39	230	1,026	740	430.0	6,871,591	329,493
C6	38	230	1,082	685	446.5	6,988,082	335,079
D1	32	233	1,084	687	285.4	4,749,288	227,728
D2	39	231	1,079	687	305.6	6,102,239	292,602
D3	40	231	1,079	687	322.5	6,439,247	308,762
E1	39	231	1,202	564	380.4	6,472,582	310,360
E2	43	230	1,279	485	413.7	6,820,939	327,064
E3	47	229	1,196	564	474.4	8,162,540	391,394
E4	49	228	1,275	483	506.8	8,627,388	413,683
E5	52	228	1,284	472	511.0	8,975,745	430,387
E6	54	227	1,283	472	522.2	9,773,486	468,639
E4 w/ Dredge B & Wet K	49	229	1,283	475	519.7	9,082,800	435,520
E4 w/ Dredge B & Wet K & A	49	232	1,275	480	522.9	9,785,736	469,226

[a] Legend:

LAND = natural or constructed islands
EM VEG = emergent vegetation
RFA VEG = rooted floating aquatic vegetation
SAV = submersed aquatic vegetation
OWATER = open water, devoid of vegetation

7.1.1 MEASURES

This alternative consists of the following measures, which are shown on plates 7 and 8.

Island A
Rock Sill A
Island B
Island D
Island L
Rock Sill D
Rock Mound I

This alternative is considered the minimum plan to protect the existing island complex from further loss.

7.1.2 COSTS

The estimated cost of alternative A is $3,109,982 as shown in table 7-3. At the current discount rate of 4 1/8 percent, the average annual cost for a 50-year project life would be $149,124.

7.1.3 HABITAT BENEFITS

The primary function of alternative A is to protect the remaining natural islands from erosion by flowing water. The islands provide habitat diversity and are an important "structural" component of the Capoli Slough complex. The islands help define running sloughs, add habitat complexity, break up wind fetch, provide visual isolation, and in and of themselves provide habitat for a variety of wildlife species. Along with the emergent and floating-leafed plant communities noted above, the islands in the Capoli Slough complex help define the complex for what it is.

Based on historic loss rates and inspection of the most current aerial photographs, it is predicted that, under no action, the remaining 23 acres of islands in the Capoli Slough complex (study area) as measured in 2000 will be reduced to 12 acres by 2011 (baseline condition) and will be completely gone by 2021. The islands also protected the emergent plants (EM VEG), floating-leaved plant beds (RFA VEG), and submersed aquatic vegetation (SAV) within the Capoli Slough complex. In 2000, EM and RFA VEG were estimated to be about 263 acres and SAV to be 603 acres throughout the complex. Based on observations of

what has occurred in lower Pool 9 downstream of the Capoli Slough complex, it appears that, once islands and the protection they provide are lost, these type of plant beds also are lost. By 2011, acreages for EM/RFA VEG and SAV under no action are projected to be 242 and 480, respectively. This represents losses since 2000 of 8 percent and 20 percent, respectively. It is further projected that EM/RFA VEG will be totally lost by 2031 with no project measures in place. Associated with the losses of these cover types, open water (OWATER) that is devoid of vegetation is projected to grow in size. In 2000, OWATER was estimated at 1,147 acres (56 percent of the study area) and is projected to reach 1,303 acres (64 percent of the study area) in 2011 (baseline). Under a no action condition, OWATER is further projected to grow to 1,747 acres in size or 86 percent of the study area.

With alternative A and the projected reduction to wind/wave action, it is projected that the acreages of EM/RFA VEG will slightly decrease from the baseline condition (from 242 to 237 acres), and that SAV will increase (from 480 to 817 acres). This trend is also observed for all other action alternatives. It is assumed for this and all action alternatives that these conditions would be realized within a relatively short time period (3 to 5 years) after construction as aquatic vegetation will quickly colonize disturbed areas from upstream sources.

With alternative A, very little fish overwintering habitat would be present, similar to base line conditions. The existing poor quality overwintering habitat would be maintained over the future without action.

With alternative A (as with all action alternatives), differences in the acreages of cover types are especially pronounced when compared to the future without-project condition. In effect, any acres of LAND and EM/RFA VEG created represents the net gain of these cover types. For this alternative, a net increase of 21 acres of LAND and 237 acres of EM/RFA VEG are projected. For SAV, acreages would be increased (from 289 to 817 acres), but for OWATER, this acreage would be decreased (from 1,303 to 961).

The estimated habitat benefit of alternative A as estimated through HEP is a net gain of 207 AAHUs.

7.2 ALTERNATIVE B

7.2.1 MEASURES

The B alternatives consist of all of the measures described for Alternative A. In addition, Islands C, E/E1, J and/or H would be constructed along the left descending bank of Capoli Slough. The purposes of these islands are to protect existing islands, further confine flows in Capoli Slough, and have some minor effect on wind fetch reduction. These measures are shown on plates 7 and 8. Note: To avoid impacts to mussels, Islands C, E and

E1 would have to be built in sequence. Also Island J would have to be constructed before Island H to provide construction access.

7.2.2 COSTS

The estimated costs of the B alternatives are between $4,462,933 (B1) and $5,596,383 (B4) as shown in table 7-3. At the current discount rate of 4 1/8 percent, the average annual cost for a 50-year project life would be between $213,998 and $268,347.

7.2.3 HABITAT BENEFITS

Islands C, E/E1, and J/H would function to provide additional protection to the aquatic plant beds lying within the Capoli Slough complex and would create up to 19 acres of island habitat. These islands would also serve to increase/maintain flows in Capoli Slough, maintaining Capoli Slough proper as a flowing side channel. Islands C and E/E also would function to reduce flows into an area proposed for the creation of winter fish habitat.

With alternatives B1 through B4, the range in acreages projected for each of the cover types are LAND, 28 to 31; EM/RFA VEG, 233 to 234; SAV, 895 to 896, and OWATER, 875 to 879. The quantifiable net gain in habitat benefits of alternative B1, B2, B3, and B4 in comparison to the no action alternative are estimated at 242, 251, 260, and 268 AAHUs, respectively (see attachment 4 – Habitat Evaluation Appendix for details). The average increase in net AAHUs over that of alternative A is about 48 AAHUs.

7.3 ALTERNATIVE C

7.3.1 MEASURES

The C alternatives consists of the measures in Alternative A, with and without selected measures in Alternative B, plus the construction of Islands K and K1 as shown on plates 7 and 8. Islands K and K1 are design to create protected areas from current and reduce northeasterly and easterly wind generated waves.

7.3.2 COSTS

The estimated costs of the C alternatives are between $4,833,276 (C1) and $6,988,082 (C6) as shown in table 7-3. At the current discount rate of 4 1/8 percent, the average annual cost for a 50-year project life would be between $231,756 and $335,079.

7.3.3 HABITAT BENEFITS

The C alternatives, including the construction of Islands K and K1, would provide habitat benefits in two ways. First, and most importantly, they would protect the islands and aquatic plant beds within the Capoli Slough complex from the erosive forces of wave action from the large wind fetches to the north and east. Second, they would provide additional island habitat and new sheltered area where aquatic plant beds could become established. Islands K and K1 would also reduce velocities in the complex and protect/increase the value of the existing limited quality overwintering fish habitat and/or any new fish overwintering areas to be created by dredging for topsoil for the islands.

One major effect of the C alternatives would be to significantly increase the acreage of island habitat within the complex by the construction of up to 27 acres of new island. The C alternatives are comparable to alternative A in terms of protecting the remaining natural islands within the complex. However, it is predicted that the C alternatives would be more effective in improving habitat to promote the growth of submersed aquatic vegetation beds.

With alternatives C1 through C6, the range in acreages projected for each of the cover types are LAND, 28 to 39; EM/RFA VEG, 230 to 234; SAV, 1,017 to 1,082; and OWATER, 685 to 752. The quantifiable net gain in habitat benefits of Alternative C compared to the no action condition are estimated between 322 and 447 AAHUs (see attachment 4 - Habitat Evaluation Appendix for details). The average increase in net AAHUs over that of alternative A is about 185 AAHUs.

7.4 ALTERNATIVE D

7.4.1 MEASURES

The D alternatives consist of the measures in Alternative A, with and without selected measures in Alternative B, plus the construction of Island G as shown on plates 7 and 8. Island G is designed to create areas protected from current and reduce easterly and southerly wind generated waves.

7.4.2 COSTS

The estimated costs of the D alternatives are between $4,749,288 (D1) and $6,439,247 (D3) as shown in table 7-3. At the current discount rate of 4 1/8 percent, the average annual cost for a 50-year project life would be between $227,728 and $308,762.

7.4.3 HABITAT BENEFITS

For the D alternatives, the construction of Island G would provide habitat benefits in two ways. First, and most importantly, Island G would protect the islands and aquatic plant beds within the Capoli Slough complex from the erosive forces of wave action from the large wind fetches to the south and east. Second, Island G would provide additional island habitat and new sheltered area where aquatic plant beds could become established. Table 7-3 shows the predicted future conditions in terms of island habitat and aquatic cover types with alternative D. The information for alternative A is included for comparison purposes.

One major effect of alternative D would be to significantly increase the acreage of island habitat within the complex by the construction of up to 28 acres of new island. Alternative D is comparable to Alternative A in terms of protecting the remaining natural islands within the complex. It is predicted that alternative D would be more effective in improving habitat conditions for submersed aquatic vegetation.

With alternatives D1 through D3, the range in acreages projected for each of the cover types are LAND, 32 to 40; EM/RFA VEG, 231 to 233; SAV, 1,079 to 1,084; and OWATER, 687. The quantifiable net gain in habitat benefits of the D alternatives are estimated between 285 and 323 AAHUs (see attachment 4 - Habitat Evaluation Appendix for details). The average increase in net AAHUs over that of alternative A is about 97 AAHUs.

7.5 ALTERNATIVE E

7.5.1 MEASURES

The E alternatives consist of the measures in Alternative A, with and without selected measures in Alternatives B, C, and D as shown on plates 7 and 8.

7.5.2 COSTS

The estimated costs of the E alternatives are between $6,472,582 (E1) and $9,773,486 (E6) as shown in table 7-3. At the current discount rate of 4 1/8 percent, the average annual cost for a 50-year project life would be between $310,360 and $468,639.

7.5.3 HABITAT BENEFITS

The E alternatives, which combine elements of Alternatives B, C, and D, would provide habitat benefits in the ways already described, with consideration of potential synergistic effects. For instance, the addition of islands C, K, and G to Alternative A is anticipated to create aquatic areas with favorable winter water temperatures for Centrarchid fishes. However, alternatives without all three of these additional islands would have a strong hydrologic connection to main stem flows and, thus, would experience winter temperatures much less favorable to this taxa.

The E alternatives are comparable to Alternative A in terms of protecting the remaining natural islands within the complex. In addition to creating 27 to 42 acres of new island habitat, a major effect of the E alternatives would be to significantly increase the acreage of submersed aquatic vegetation beds.

Islands A, K, G, and F provide the greatest protection for Capoli Slough from the north to the southeast compass bearings, the directions with the greatest fetches and potential for wind generated wave erosion. The UMR EMP Environmental Design Handbook (2006) provides a guideline (reduce wind fetch to 3,500 feet for 2 feet of water) when planning HREPs. Table 7-4 compares the results of selected alternatives for reduction in mean weighted fetch and sediment suspension reduction (see appendix 9 for more information). Alternative A with Island A provides protection to the complex from the north and northeast and a resultant reduction in fetch and suspended sediment probability over existing and future without action. Alternatives G3 and C6, which provide greater protection from the southeast and northeast, respectively, yield similar reductions in fetch and sediment suspension. The E4 alternative that contains all the islands that will affect wind and wave action shows a significant reduction in fetch and sediment suspension. The E alternatives are the only ones that meet the Environmental Design Handbook guidelines for reduction in fetch.

Table 7-4
Comparison of the Effects of Selected Alternatives on Wind Fetch and Wave Sediment Suspension Probability

Alternatives	Mean weighted fetch (feet) during growing season (April – July)	Sediment suspension probability (percent of days during growing season where orbital velocities exceed 0.1 meter/second)
No action – existing	7,500	69%
No action – Future without	9,300	79%
Alternative A (includes Island A)	6,200	59%
Alternative D3 (includes Islands A, G, and F)	4,700	49%
Alternative C6 (includes Islands A, K, and F	4,700	47%
Alternative E4 (includes Islands A, K, G, and F)	3,300	36%

With alternatives E1 through E6, the range in acreages projected for each of the cover types are LAND, 39 to 54; EM/RFA VEG, 227 to 231; SAV, 1,196 to 1,284; and OWATER, 472 to 564. The quantifiable net gain in habitat benefits of the E alternatives are estimated between 380 and 522 AAHUs (see attachment 4 - Habitat Evaluation Appendix for details). The average increase in net AAHUs over that of alternative A is about 258 AAHUs.

7.6 WINTER FISH HABITAT CREATION

7.6.1 MEASURES

Increases in winter fish habitat would be completed as part of the island project as a source of fine fill for the islands (Habitat Dredging A). The size of Habitat Dredging A will depend on which of the islands are recommended for implementation (4 acres for the C alternatives and 7 acres for the E alternatives). The resource agencies did not feel that Habitat Dredging A created enough deep water overwintering fish habitat in the area and requested that additional increments of habitat dredging be evaluated (Habitat Dredging B) to create 4 to 7 acres of additional deepwater habitat. Dredging to create this additional winter fish habitat depends on construction of Islands A, C, E/E1 and K. Without these measures, Habitat Dredging Areas A and B would experience excessive current and not meet the objectives for overwintering fish habitat. Habitat Dredging B area, if all were dredged, would approximately double the amount of fines needed for topsoil and would provide additional winter fish habitat. Two equal additional increments (approximately 3 acres each) of Habitat Dredging B were evaluated, with material from going to construct either Wetland K or Wetland K and A, if both increments of Habitat Dredging B were completed. It was evaluated as an add-on measure that can be included with alternatives C or E. Between 7 to 13 acres of protected deepwater overwintering habitat would be created depending on which island alternative (C or E) was selected and whether one or both increments of Habitat Dredging B were constructed. The material would be used to create areas next to Islands K or K and A to provide an area near normal water surface elevation to serve as a mudflat and/or to promote the establishment of emergent vegetation. This would also add to meeting objective 1 to increase the areal extent of emergent wetlands (3.3 acres for Wetland K and 9 acres for Wetland A). Wetland K would be the preferred wetland, because it was felt that it would help reduce the eddy affect around Island K and increase the likelihood of achieving the winter water quality performance criteria for the overwintering fish habitat.

If Habitat Dredging B is pursued, emergent wetland areas would be constructed near Islands K or A and K. The interior sand berm of K would be moved to along the outside edge of the designated emergent wetland area K (see plate 10 for typical cross section). Island A would be reduced to a top width of 20 feet and a low sand berm would be constructed from Island A along the outside edge of the designated emergent wetland area (see plate 10 for typical cross section). This sand berm would contain the fine material. The design elevation of the mudflat is 621.5; however, a relatively wide tolerance will be allowed (such as ±0.5 foot) to promote a diversity of elevations within the mudflat to promote a

diversity of emergent vegetation. Other emergent wetlands depicted on plate 9 are optional items that would be allowed as potential placement areas by the contractor for access dredging. They would have a similar design as above.

7.6.2 COSTS

The estimated costs of adding additional habitat dredging (B) and creation of emergent wetlands are $320,900 for emergent wetland near Island K (Dredging B and Wet K) and $771,308 for emergent wetlands near Islands K and A (Dredging B and Wet K and A). At the current discount rate of 4 1/8 percent, the average annual cost for a 50-year project life would be $21,837 and $55,543, respectively.

7.6.3 HABITAT BENEFITS

Habitat benefits specific to this measures were quantified by looking at differences between the no action, Alternative E4, and Alternative E4 with two levels of habitat dredging in combination with emergent wetlands. Table 7-3 shows the predicted future conditions in terms of island habitat and aquatic cover types with these additional measures.

The incremental net gain (in comparison to alternative E4) in habitat benefits of alternative E4 with Habitat Dredge B and emergent wetlands K was 12.9 AAHUs, and with Habitat Dredging and emergent wetlands A and K was 16.1 AAHUs (see attachment 4 - Habitat Evaluation Appendix for details).

7.7 RIFFLE STRUCTURES

The addition of rock riffle structures in Capoli Slough was evaluated as a feature to improve habitat quality within Capoli Slough. These structures could be constructed under any alternative.

7.7.1 MEASURES

The rock riffle structures would consist of submerged rock sills that would be placed in Capoli Slough to create shallow rock habitat and deeper scour holes, similar to the scour hole that exists below the old wing dam at the upper end of Capoli Slough near Island 4. The rock riffles would have a top elevation 615.0, a top width of 20 feet and 1V:2H side slopes (see plates 9 and 10).

7.7.2 COSTS

The estimated construction cost including PED and SA for the riffle structures is $11,600. At the current discount rate of 4 1/8 percent, the average annual cost for a 50-year project life would be $556.

7.7.3 HABITAT BENEFITS

Due to the small size of the riffle feature and the lack of sensitivities of this feature to the species models considered, the net increase in habitat benefits as determined by the HEP was not shown to be relevant. However, the general consensus of biologists involved in this project was that the addition of this feature to the Capoli Slough area will provide a number of incidental benefits not captured in the HEP analysis. Placement of riffle structures at key locations in the slough will create scour holes that, among other things, create hydraulic and depth diversity and increase substrate complexity and cover. The riverbed associated with these types of structures would be expected to transition from that dominated by fines/sands to one dominated by gravels/cobble. These changes would provide benefits to benthic macroinvertebrates, mussels, and fish.

7.8 PLAN SELECTION

7.8.1 INCREMENTAL ANALYSIS

When combined with estimated costs of proposed actions, an analysis of both cost effectiveness and incremental costs associated with the identified alternatives and independent measures can be completed. An evaluation of cost effectiveness and incremental cost analysis was completed using the Institute of Water Resources economic analysis program called IWR-Planning Suite (IWR-PLAN). This analysis identifies the subset of a scenario's cost effective plans that are superior financial investments, called "best buys," through incremental cost analysis. Best buys are the most efficient plans at producing the output variable. In this case, best buys provide the greatest increase in AAHUs for the least increase in cost. The first best buy is the most efficient plan, producing output at the lowest incremental cost per unit. If a higher level of output is desired than that provided by the first best buy, the second best buy is the most efficient plan for producing additional output, and so on.

The estimated total average annual cost and net AAHUs were entered into IWR-PLAN for the 23 identified alternatives (including the No-Action Alternative) for the Capoli

Slough HREP. Of the possible solutions, IWR-PLAN identified nine that were cost-effective and seven that were termed "best buy" plans (Table 7-5; Figures 7-2 and 7-3). The Best Buy plans and associated incremental costs/AAHU are as follows: (1) No Action Alternative, $0; (2) Alternative A, $719; (3) Alternative C1, $720; (4) Alternative C6, $831; Alternative E4, $1,304; Habitat Dredge B and Emergent Wetlands K and A (Dredge B and Wet K), $1,693; and, (5) Alternative E4 with Habitat Dredge B and Emergent Wetlands K and A (Dredge B and Wet K and A), $10,533. The incremental cost associated with both emergent wetlands is substantially higher than that of the other "best buy" alternatives (Figure 7-2).
All the incremental costs/AAHU compared to the base plans (Best Buy Alternatives) are shown in Table 7-6.

Construction of islands would protect existing islands and increase habitat suitability over existing conditions by increasing island areas, increasing the amount of protected areas, expanding emergent and floating leaf vegetation, and improving other habitat parameters for bluegill, smallmouth bass, and dabbling ducks. The islands would also serve to a certain degree to protect the existing vegetation and natural island areas, by reducing southerly wind and wave action. The alternative of protecting the existing islands (alternative A) as a stand-alone alternative would also have an average annual cost per habitat unit that would normally be consider acceptable. Protecting the existing islands would essentially maintain existing conditions. However, this alternative would provide no protection from northeasterly, easterly and southeasterly wind and wave action. Alternative A in combination with some of the larger peripheral islands (Islands K and C; Alternatives C1-6) has an incremental cost that is also within acceptable ranges.

When island protection of the downstream islands (Island G, F) in combination with some of the slough-bordering islands (Islands C, E/E1, J, and H) is incrementally added to the construction of the lowest cost feature (Alternatives D1-3 and B3 and B4), the incremental annual cost per annual habitat unit gain becomes rather high and is not shown to be justified.

Table 7-5
Incremental AA Cost per AAHU (only for Best Buy Alternatives) and Cost-Effective Determination for all Alternatives

Alternative	Incremental AACost/AAHU	Cost Effective?
No Action	$0	Best Buy
A	$719	Best Buy
B1		Yes
B2		No
B3		No
B4		No
C1	$720	Best Buy
C2		Yes
C3		Yes
C4		Yes
C5		Yes
C6	$831	Best Buy
D1		Yes
D2		No
D3		No
E1		No
E2		No
E3		Yes
E4	$1,304	Best Buy
E5		Yes
E6		Yes
E4 Dredge B &Wet K	$1,693	Best Buy
E4 & Dredge B & Wet K & A	$10,533	Best Buy

Table 7-6.
Incremental Costs for all Cost Effective Alternatives Compared to Best Buy Plans

Alternative	Increment 1 - Compared to No Action	Increment 2 - Compared to Alt A	Increment 3 - Compared to Alt C1	Increment 4 - Compared to Alt C6	Increment 5 - Compared to Alt E4	Increment 6 -Compared to Alt E4 with Wet K
A	$719					
C1	$719	$720				
C2	$737	$766	$1,121			
C3	$746	$746	$860			
C4	$747	$775	$841			
C6	$750	$778	$831			
C5	$766	$810	$907			
E2	$791	$863	$1,042			
D1	$798	$1,008				
E4	$816	$884	$986	$1,304		
E3	$825	$907	$1,049			
E5	$842	$926	$1,052	$1,478	$3,977	
B1	$885	$1,880				
E6	$897	$1,015	$1,184	$1,764	$3,569	
E4 Dredge B & Wet K					$1,693	
E4 Dredge B & Wet K&A					$8,332	$10,533

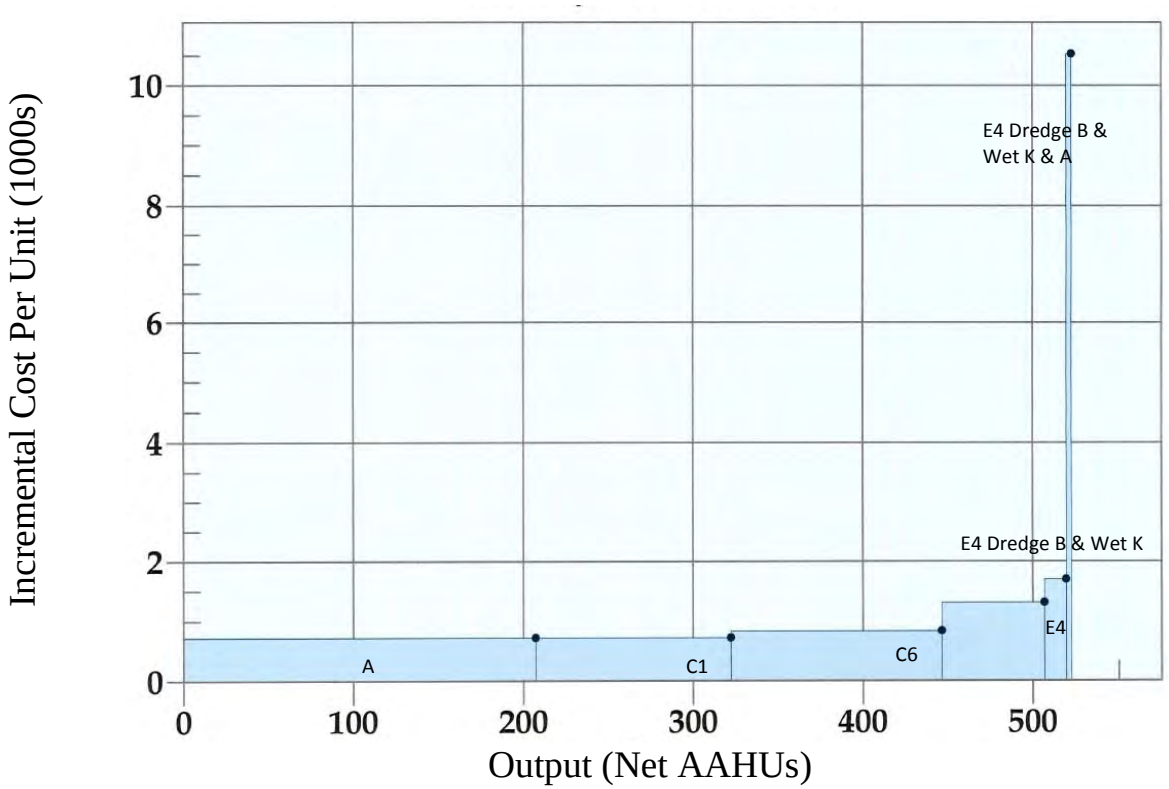


Figure 7-2. Incremental Cost Per Unit for Best Buy Alternatives.

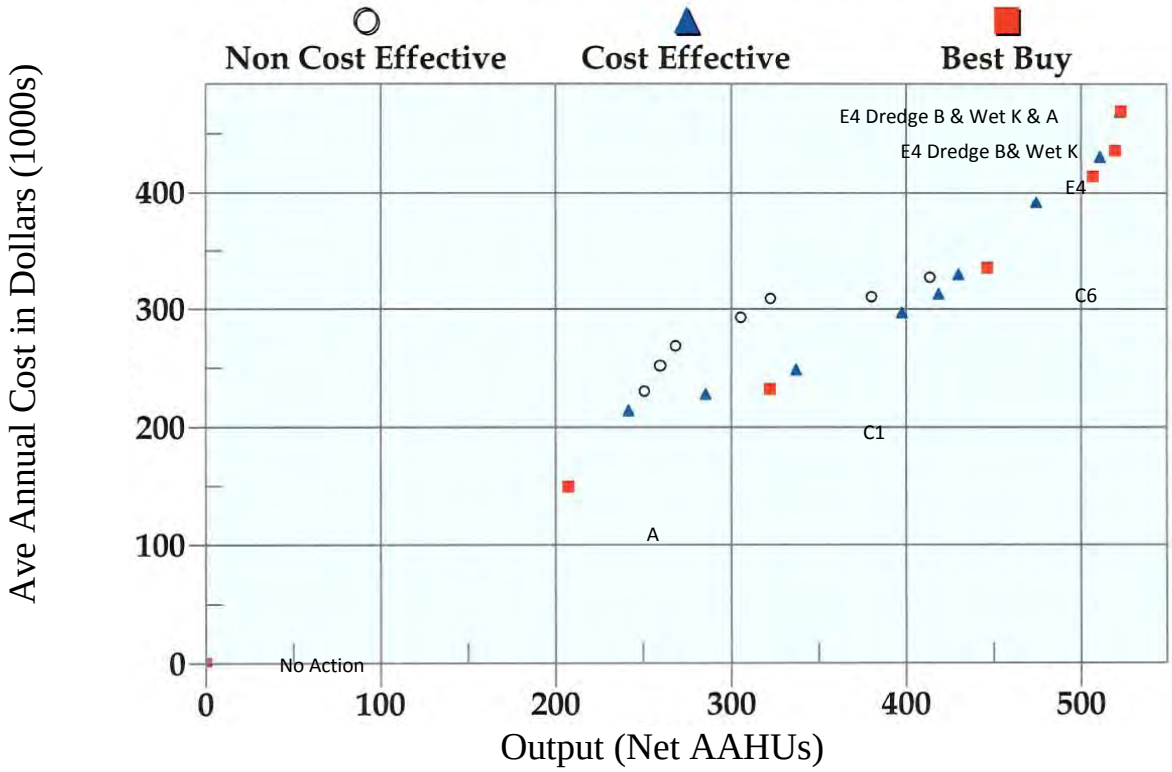


Figure 7-3. Results of Cost-Effective Analysis for All Identified Alternatives.

7.8.2 NATIONAL ECOSYSTEM RESTORATION PLAN

Based on the incremental analysis of quantified habitat benefits, there is a natural break point going from the best buy alternatives C6 to E4 and E4 with Habitat Dredging B and Wetland K. Alternative C6 provides 86 percent of the benefits for 77 percent of the cost and E4 with Habitat Dredging B and Wetland K only provides 73 additional AAHU for an additional $2M in first cost. However, by eliminating Island G, the only difference between Alternative C6 and E4, there would be no protection of the complex from the southeast winds and it may not be possible to achieve the ecosystem restoration objectives. Wind generated waves are one of the primary stressors to the Capoli Slough complex. According to table 7-4 and Appendix 9 Wind and Wave, the mean weighted fetch is reduced from 4,700 feet with Alternative C6 to 3,300 feet with Alternative E4. The Environmental Design Handbook (2006) provides a guideline for planning island layout of less than 3,500 feet fetch for water depths of 2 feet. The E alternatives are the only alternatives that meet this design guideline. Also table 7-4 and Appendix 9 shows a substantial reduction in sediment suspension probability, nearly a 20-percent reduction between Alternatives C6 and E4. Based on the wind/wave model output, the addition of Island G is expected to substantially increase the amount of highly productive aquatic vegetation in comparison to open water. For example, Alternative E4 (with Island G) as compared to Alternative C6 (without Island G) is expected to result in an increase of close to 200 acres of submersed aquatic vegetation (see Table 7-3 of the report). The Habitat Evaluation and incremental analysis did not adequately quantify these additional benefits of Alternative E4 in comparison with Alternative C6. The incremental annualized cost of $1,304 per average annual habitat seems reasonable in light of additional unquantified benefits.

The resource agencies did not feel that enough deepwater overwintering fish habitat would be created with only using the fine material for topsoil on the islands (only 7 acres for Alternative E4). Habitat Dredging B was added in two equal increments to Alternative E4 with the dredged material used to construct Emergent Wetland K (first increment) or Emergent Wetland K and A (both increments) to increase the amount of deepwater overwintering fish habitat (3 acres for Emergent Wetland K increment and 6 acres for Emergent Wetlands K and A). Alternative E4 with Habitat Dredge B and Emergent Wetland K and A creates 13 acres of overwintering habitat and exceeds Planning Objective 7, to create 10 acres of deepwater overwintering habitat. The incremental cost of both dredging increments and the creation of Emergent Wetlands K and A is rather high ($10,533/AAHU) and does not seem warranted. Alternative E4 and Habitat Dredge B and Emergent Wetland K would create around 10 acres of deepwater overwintering habitat and meets Planning Objective 7. The incremental cost for the first increment of Habitat Dredging B and creation of Emergent Wetland K is $1,693/AAHU. The scarcity of this type of habitat in lower Pool 9 makes it essential to optimize the areal extent of this deepwater protected habitat. Also, creation of Emergent Wetland K contributes 3 acres to Objective 2, which is to increase the extent of emergent and floating leaf aquatic vegetation. Emergent Wetland K would also reduce the potential eddies around K, which could increase the likelihood of winter current velocity performance criteria not being met. The incremental annualized cost of $1,693 per average annual habitat seems reasonable in light of the scarcity and importance of fish overwintering habitat and the ancillary benefits associated with this alternative.

Therefore, the alternative plan that reasonably maximizes the benefits in relation to cost and meets the overall planning objects is Alternative E4 with habitat dredging B and creation of emergent wetland K, tentatively selected as the National Ecosystem Restoration (NER) Plan. Because of the relatively low total costs and the potential benefits, creation of riffle structures is also recommended.

When viewed relative to the costs of similar ecosystem restoration projects, the $838 per AAHU created by the project is efficient in achieving the stated ecosystem objectives. The largest incremental annualized cost of $1,693/AAHU for the recommended plan seems reasonable. During the early stage of planning for the EMP, habitat project and individual measures yielding an Average Annual Cost per AAHU of $2,000 have generally been accepted as reasonable, although $3,000 has been accepted in some circumstances. These numbers have not been adjusted for inflation since they were developed in the early 1990s. These criteria have been used to justify construction of around $46 million in habitat projects within the St. Paul District since the program began. The NER Plan has strong support from the USFWS, as mangers of the resource, and is consistent with regional and State planning for the area. The Federal objective of water and related land resources planning is to contribute to national economic development consistent with protecting the Nation's environment, pursuant to national environmental statutes, applicable executive orders, and other Federal planning requirements. Achievement of the Federal objective is measured in terms of contribution to Federal accounts intended to track the overall benefits of a given project. The two accounts most applicable to the Capoli Slough HREP are the National Economic Development (NED) account and the Environmental Quality (EQ) account. Regional Economic Development (RED) and Other Social Effects (OSE) are discretionary accounts for display in Ecosystem Restoration Projects in accordance with Engineering Regulation (ER) 1105-2-100 Ch. 2.2-3.d(4) and are briefly discussed below.

Regional Economic Development (RED) Account

The RED account is intended to illustrate the effects the alternatives would have on regional economic activity, specifically, regional income and employment. While a detailed regional economic development analysis was not performed for the proposed action, it is generally accepted that the ecosystem restoration projects that are part of the EMP have contributed RED benefits in small ways as each project is constructed, and then in a much larger scale, by strengthening the overall economic condition to the Upper Mississippi River system by creating added eco-tourism opportunities and increasing the local economic opportunities in the communities and region along the entire Upper Mississippi River system. EMP, throughout its 25+ year history, has created thousands of employment opportunities related to HREP planning, construction, and evaluation; LTRMP monitoring; and research. Once completed, habitat projects create new opportunities for outdoor recreation, further stimulating local and regional expenditures in the region.

Other Social Effects (OSE)

The OSE account is intended to illustrate the effects the alternatives would have on lives of residents and the social fabric of the communities in the study area and to assist in

plan formulation and in the decision-making process for choosing an alternative that maximizes social benefits. Ecosystem restoration projects such as this one typically have positive net effects to the OSE account. Primarily, the quality of life variables such as health and safety, material well being, social connectedness, and civil rights are improved to a degree with EMP projects. While the increment may be slight or difficult to measure for any individual EMP project, it is reasonable to assume that the restoration of the ecosystem in a greater theme is beneficial to these social factors. Also, in the big picture of the entire EMP program, the numerous completed restoration projects in the over 25 years of effort has greatly benefited the social variables and human needs for the Upper Mississippi River system. Improvements to the ecosystem are direct contributors to social and personal recognition of a valued asset, improving the well-being for the region as a whole

National Economic Development (NED) Account

Contributions to NED are increases in the net value of the national output of goods and services, expressed in monetary units. Contributions to NED are the direct net benefits that accrue in the planning area and the rest of the nation. For an ecosystem restoration project, the NED is the average annual costs of the ecosystem restoration measures, which is $435,520 for Capoli Slough HREP.

Environmental Quality (EQ) Account

EQ attributes are the ecological, cultural, and aesthetic properties of natural and cultural resources that sustain and enrich human life. Evaluation of EQ in the planning process consists of the assessment and appraisal of effects. Four general actions are the phases of these procedures: define, inventory, assess, appraise. For ecosystem restoration projects, contributions to the EQ account are detailed through NEPA compliance and calculation of net ecosystem benefits. The Capoli Slough Habitat Rehabilitation and Enhancement Project DPR includes an integrated EA where the necessary components of a NEPA evaluation are combined within each of the planning steps. This evaluation is summarized in a qualitative summary of environmental effects detailed in Table 9-1 as well as Section 9 of this report. In addition, Section 7 and Appendix 4 of this report contain quantitative information regarding net ecosystem benefits through use of Habitat Evaluation Procedures/Habitat Suitability Index. The credit to the EQ account is the quantified benefits resulting from the project, which, in the case of the tentatively selected plan, provides a net gain of 519.7 AAHUs over the 50-year period of analysis.

7.8.3 COMPLETENESS, EFFECTIVENESS, EFFICIENCY, ACCEPTABILITY

ER 1105-2-100 states that the selected plan should meet “planning objectives and constraints and reasonably maximize environmental benefits while passing tests of cost effectiveness and incremental cost analysis, significance of outputs, acceptability, completeness, efficiency and effectiveness.” The definition of these terms and an evaluation of the alternatives are as follows:

Completeness – the extent to which an alternative plan provides and accounts for all necessary investments or other actions to ensure the realization of all planned effects.

Best Buys Alternatives: All the best buy alternatives would be considered complete, in that no other actions or investments would be required to achieve their respective output.

Effectiveness – The extent to which an alternative plan alleviates the specified problems and achieves the specified opportunities, as established in the planning objectives.

Best Buys Alternatives: All the best buy alternatives would at least partially meet the planning objectives, with Alternative A being the least effective and Alternative E4 with all of Habitat Dredging B and Wetlands K and A being the most effective.

Efficiency – the extent to which an alternative plan is the most cost effective means of alleviating the specified problems and realizing the specified opportunities as established in the planning objectives, consistent with protecting the nation's environment.

Best Buys Alternatives: Alternatives A, C1 and C6 have similar low incremental costs. Alternative E4 would have a greater incremental cost. However, it is the only best buy alternative that addresses the need to reduce wind fetch to less than 3,500 feet to reduce wave resuspension of sediments and erosion of islands and shallow areas. It is the only Best Buy alternative that would provide needed protection from waves from the southeast. Alternative E4 with Habitat Dredging B and Emergent Wetland K provides additional critical deepwater overwintering fish habitat.

Acceptability – the workability and viability of the alternative plan with respect to acceptance by State and local entities and the public and compatibility with existing laws, regulations and public policies.

Best Buys Alternatives: All the best buy alternatives would be compatible with existing laws, regulations and public policies. The USFWS and the States of Wisconsin and Iowa support Alternative E4 and Habitat Dredging B and Wetland K.

It is important to recognize that the Capoli Slough area is a dynamic system that is influenced by a combination of factors that result in its current and projected further degraded state. Improving conditions within the Capoli Slough is contingent upon fully addressing each of the ecosystem restoration objectives outlined in Section 5. Acknowledging that implementation of many of the identified measures alone or in combination would provide benefits to Capoli Slough, Alternative E4 with Habitat Dredge B and Emergent Wetland K and the two cobble liners is the only plan to include the full array of measures that would most cost-effectively address all of the ecosystem restoration problems opportunities and objectives identified. Implementation of these alternative measures in combination would provide the greatest potential for successfully changing the Capoli Slough ecosystem state. While Alternative E4, with Habitat Dredge B and Emergent Wetlands K and A, produces slightly greater environmental benefits (effectiveness) than the tentatively selected plan, Alternative E4, with Habitat Dredge B and Emergent Wetland K ultimately ranks higher in two key areas, cost effectiveness and acceptability.

7.9 RECOMMENDED PLAN

Based on the incremental cost analysis; discussion of other benefits; consideration of components of the NER plan; and an evaluation of the acceptability, completeness, efficiency and effectiveness of the Best Buy Alternatives, the Best Buy Alternative E4 with Habitat Dredging B and Creation of Emergent Wetland K is recommended for implementation. Because of the relatively low total costs and the potential benefits, creation of riffle structures is also recommended.

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8. RECOMMENDED PLAN WITH DETAILED DESCRIPTION/DESIGN AND CONSTRUCTION CONSIDERATIONS

8.1 RECOMMENDED PLAN

This section provides details on the selected plan. The selected plan is Alternative E5, with additional habitat dredging, emergent wetland K, and riffle pool structures. The selected measures are shown on Plate 9 and in Table 8-1. The estimated fully funded implementation costs (including contingencies indexed for inflation) are summarized in Table 8-2 and in attachment 2. Pertinent design parameters are summarized in Tables 8-3 and 8-4 and in attachment 5.

Table 8-1
Summary of the Recommended Plan Measures

Island A (narrow island with rock berm)
Rock Sill A
Island B (narrow island with rock berm and passing lanes)
Island D (narrow island with rock berm and passing lanes)
Island L (narrow island tied into existing island with vanes)
Rock Sill D
Rock Mound I
Island F (narrow island with rock berm)
Island C (type A island)
Island E (narrow island tied into existing island with vanes)
Island E1 (narrow island with rock berm)
Rock Sill E
Island K (type A island)
Island G (type A island)
Emergent Wetland K
Habitat Dredging A
Habitat Dredging B
Cobble Liner (2)

Table 8-2
Summary of the Recommended Plan Costs (including sunk costs)

Cost Item Description	Fully Funded Amount Plus Contingency
Lands and Damages	Not/Applicable
Construction Fish and Wildlife Facilities	$8,095,000
Planning, Engineering and Design (15%)	$1,443,700

Construction Management (7%)	$555,000
Total	$10,093,700

Table 8-3
Summary of Design Data

Feature	Length (ft)	Top width including 5:1 slope to berm (ft)	Exterior berm width (ft)	Ext. slope	Interior berm (ft)	Int. slope	Top elevation (ft)	Berm elevation (ft)
Island A	2,420	44		1v:1.5h		1v:4h	623.0	
Rock Sill A	281	10		1v:3h		1v:3h	622.5	
Rock Sill D	120	10		1v:3h		1v:3h	622.5	
Rock Sill E	70	10		1v:3h		1v:3h	622.5	
Island B	1,930	24		1v:1.5h		1v:4h	623.0	
Island C	200	100	40	1v:4h	30	1v:4h	628.4	622.0
	300	90	40	1v:4h	30	1v:4h	626.5	622.0
	370	80	40	1v:4h	30	1v:4h	625.0	622.0
	570	70	40	1v:4h	30	1v:4h	624.0	622.0
	200	60	40	1v:4h	30	1v:4h	622.5	622.0
Island D	3,200	24		1v:1.5h		1v:4h	623.0	
Island E	920	30		1v:4h		1v:4h	623.0	
Island E1	440	24		1v:1.5h		1v:4h	623.0	
Island F	1,550	44		1v:1.5h		1v:4h	623.0	
Island G	400	100	40	1v:4h	30	1v:4h	628.4	622.0
	450	90	40	1v:4h	30	1v:4h	626.5	622.0
	500	80	40	1v:4h	30	1v:4h	625.0	622.0
	650	70	40	1v:4h	30	1v:4h	624.0	622.0
	500	60	40	1v:4h	30	1v:4h	623.0	622.0
Island L	920	30		1v:4h		1v:4h	623.0	
Island K	400	100	40	1v:4h	30	1v:4h	628.4	622.0
	400	90	40	1v:4h	30	1v:4h	626.5	622.0
	600	80	40	1v:4h	30	1v:4h	625.0	622.0
Island K(with wetland)	860	70	40	1v:4h	10	1v:4h	624.0	622.0
Rock mound I	425	4		1v:1.5h		1v:1.5h		
Wetland K	860			1v:4h	20	1v:4h	621.0	622.0
Cobble liner	200 ea	10		1v:3h		1v:3h	615.0	

Table 8-4
Summary of Quantities and Protection

Feature	End Protection	Exterior Protection	Interior Protection	Sand Fill (cubic yards)	Random Fill (cubic yards)	Fine Fill (cubic yards)	Rock (cubic yards)
Island A	Rock mound	Rock mound	Willow planting	20,113	0	2,689	5,670
Rock Sill A	Rock mound	Rock mound	Rock mound	0	0	0	1,405
Rock Sill D	Rock mound	Rock mound	Rock mound	0	0	0	600
Rock Sill E	Rock mound	Rock mound	Rock mound	0	0	0	905
Island B	Rock mound	Rock mound	Willow planting	8,332	0	1,288	4,538
Island C	Vanes	Vanes	Willow planting	46,537	10,850	3,585	3,280
Island D	Rock mound	Rock mound	Willow planting	23,354	0	2,937	7,472
Island E	Vanes	Vanes	None	5,367	0	767	1,840
Island E1	Rock mound	Rock mound	Willow planting	2,347	0	367	880
Island F	Rock mound	Rock mound	Willow planting	6,475	0	861	3,661
Island G	Vanes	Vanes	Vanes	55,383	10,255	5,668	437
Island L	Vanes	Vanes	None	5,376	0	767	115
Island K	Vanes	Vanes	Willow planting	43,855	16,210	5,201	322
Rock mound I	Rock mound	Rock mound	Rock mound	0	0	0	761
Wetland K		none	none	0	0	11,100	0
Cobble liner				0	0	0	222
Total				217,139	37,315	35,230	32,108

8.2 ROCK MOUND BANK STABILIZATION AND ROCK SILLS

8.2.1 ROCK MOUND I

Rock mound bank stabilization would be placed along Island 11 as shown on plates 7 and 8. The bank stabilization for Island 11 would consist of an offshore rock mound with a top elevation of 623.0, 3 feet higher than project pool elevation. The rock mounds would have a top width of 4 feet and 1V:1.5H side slopes. The purpose of using this type of bank protection is to avoid the shoreline disturbances associated with placing a riprap layer on the bank. Typical designs for the rock mound are shown on plate 10.

8.2.2 ROCK SILLS A, D, AND E

The rock sill closures would have a top elevation of 622.5, a top width of 10 feet, and 1V:3H side slopes. The primary purposes of the rock sills are to control erosion of the openings between the island remnants and to provide an initial overtopping point for high flow. The rock sills serve to decrease the head differential across the sand islands during overtopping events and minimize increases in water surface elevation for extreme flood events such as the 100-year flood. The sill structures would be rock with a top elevation 1 foot lower than the attached island or rock mound.

Rock sills would be constructed across the openings between Islands A and B, Islands A and K, and Islands 10 and 11 to prevent erosion of these openings. Typical designs for the rock sills are shown on plate 10.

8.3 ISLANDS

The layouts and design cross sections shown on plates 9 and10 are the result of an iterative process designed to maximize reduction in wind-generated waves, maximize habitat benefits, control costs, and minimize constructability constraints. The wind-fetch and wave models were used to assist in the layout of islands. Substantial constraints were placed on the design of the islands because of the need to minimize access dredging to minimize impacts to the endangered Higgins eye. The islands would need to be constructed from very limited access points. Therefore, the island design needed to facilitate truck hauling and other land based heavy equipment, at least for the placement of rock protection. A couple of different island designs were included to increase diversity, maximize benefits and reduce costs.

8.3.1 NARROW ISLANDS B, D, AND E1

Islands B, D, and E1 would be a narrow island with a top elevation of 623.0, a top width of 20 feet, and 1V:4H side slope on the protected side (south, downstream side). A rock mound would be placed on the exposed side (north, upstream side) with a top width of 4 feet and a 1V:1.5H side slope. Passing lanes to facilitate construction vehicle traffic would be added every 300 feet, 40 feet long and 20 feet wide on the protected side. See plate 10 for a typical cross section.

8.3.2 NARROW ISLANDS A AND F

Islands A and F would be a narrow island with a top elevation of 623.0 feet, a top width of 40 feet and a side slope on the protected side of 1V:4H (south, downstream side). A rock mound would be placed on the exposed side (north, upstream side) with a top width of 4 feet and a 1V:1.5H side slope. The top width was increased on these narrow islands, because they have fewer island remnants on the protected side and, therefore, there were greater concerns that at least portions of these islands might disappear. The rock mounds should be stable, even if some of the granular portions of the islands erode.

8.3.3 NARROW ISLANDS E AND L

Islands E and L are designed to protect and increase Islands 8 and 10, respectively. Islands E and L would be a narrow island (sand berm tied into existing islands) with a top elevation of 623.0 feet, a top width of 30 feet, and 1V:4H side slope on the exposed side (Capoli Slough and main channel side, respectively). Vanes would be placed along the exposed shoreline.

8.3.4 ISLANDS C, G, AND K

Islands C, G, and K are wider and taller islands typical of many of the other islands that have been constructed under EMP (plate 10 shows a typical cross section). The lower section of each island decreases in elevation in a downstream direction so that the lower ends of the islands are overtopped first during flood events. This reduces the hydraulic forces across the upper ends of the islands during overtopping. A wide distribution of the top elevations has been shown to improve vegetative species diversity and overall habitat quality. Design elevations for the island sand berms are set at 1.9 feet above the average water surface elevation of 620.1. This elevation is above the average water surface elevation but will be under water for minor floods. These berms provide protection against wave driven erosion and allow for the development of vegetation.

Island C is located to provide a thermal and visual barrier from Capoli Slough and to constrains flows in Capoli Slough. Island C would be a wide island starting with a top elevation of 628.4 feet and tapering down to 622.5, top width of 100 feet tapering down to 60 feet at the downstream end, 1V:4H side slopes, and vanes on the exposed side (Capoli Slough side).

Island K is located to provide the Capoli Slough complex with protection from large wind fetches from the north and east. Island K would be a wide island starting with a top elevation of 628.4 feet and tapering down to 622.5, top width of 100 feet tapering down to 60 feet at the downstream end, 1V:4H side slopes, and vanes on the exposed side (north and east side).

Island G is located to provide the Capoli Slough complex with protection from large wind fetches from the south and east. Island G would be a wide island starting with a top elevation of 628.4 feet and tapering down to 622.5, top width of 100 feet tapering down to 60 feet at the downstream end, 1V:4H side slopes, and vanes on the exposed sides.

8.3.5 EMERGENT WETLAND/MUDFLAT

An emergent wetland would be constructed on the south side of Island K. The interior 30-foot berm of Island K would not be constructed along this reach. Instead a low sand berm would be constructed along the outside edge of the designated emergent wetland area. This sand berm would serve as the containment berm for the material used to create the emergent wetland. Material would most likely be placed within the emergent wetland area by a small hydraulic dredge. The design elevation of the emergent wetland is 621.0; however, a relatively wide tolerance will be allowed (such as $\pm$ 0.5 foot) to provide a diversity of elevations within the mudflat to promote vegetation by a variety of species. For the wetland interior, random fill or fine fill could be used.

The sand berm would be breached or allowed to erode naturally. The decision would be made after the emergent wetland is constructed and it can be determined how stable the material is. The other emergent wetlands depicted on plate 9 are optional items that the contractor would be allowed to use to dispose of excess access material. A similar design would be used for these optional emergent wetland areas.

8.4 WINTER HABITAT CREATION

Habitat dredging, in combination with the influence of islands on winter water velocities, would create suitable winter habitat conditions. Dredging would start at the deeper water near Island G or from the Access Only (see plate 9). The contractor would be given the option to use either or both access channels. A 4-foot deep channel, elevation 616.1, 40 feet wide would be dredged to Habitat Dredging A. A similar dredge cut would be completed connecting Habitat Dredging A and Habitat Dredging B. Habitat Dredging B would be first priority for obtaining fine material. Habitat Dredging A and B would be dredged to different depths, 4 feet and 6 feet, elevation 616.1 and 614.1, respectively. The side slopes would be the angle of repose, which might flatten with time. All material for habitat dredging, including the 4-foot deep access channel along Island G, would be placed in Emergent Wetland K, used as topsoil on the islands, and/or placed in one of the optional emergent wetlands.

8.5 RIFFLE STRUCTURES

The design for the riffle structures is shown on plate 10. The riffles would be constructed so that a 4-foot deep channel is maintained over the riffle for safe boater access. There are three options for the deep riffles: a rock liner, log liner and a W rock weir. The log liner would be constructed from tree trunks cabled together and anchored to the bottom by concrete blocks and rock. The rock liner and log liner should have a horseshoe shape in plan view with the legs at the downstream side. For the purposes of cost estimating, a cobble liner was assumed. This feature would be evaluated further during plans and specifications and a few different designs may be recommended to compare the effects of each structure. The maximum velocity at this location on April 27, 1994, was 1.5 fps with a Lock and Dam 9 discharge of 93,881 cfs.

8.6 CONSTRUCTION METHODS

Construction of the rock measures would likely be a combination of marine plant and land based equipment. The equipment used to place the rock would likely be hydraulic backhoe on a barge or land-based from the newly constructed island. No site preparation work would be necessary aside from moving snags or fallen trees from the work area. They would be moved out of the way and placed along the island shorelines.

How islands are constructed is generally left to the discretion of the contractor. The contractor is responsible for providing the finished product (the islands as designed) in a manner best suited to his operation. Experience with construction of other island projects within the St. Paul District (28 islands in 6 different locations) has shown that there is a general pattern to cost effective construction of islands.

The sand base for an island is placed using hydraulic or mechanical dredging equipment. Because of the large quantities involved, it is usually much more cost effective to use hydraulic dredging equipment than mechanical dredging equipment. The sand, as it is discharged from the pipeline, firms up quite rapidly and is capable of supporting bulldozers that are then used to generally shape the island.

The random fill sections of the island can be filled using either hydraulic or mechanical dredging equipment. If the contractor does not need the random fill sections to dispose of access dredging materials, the most cost effective approach is to fill these sections with sand as part of the sand placement process. If excess access dredging material is used, the method of placement would depend on the type of equipment the contractor uses for access dredging.

Fine material is placed on islands by a variety of methods. Placement of fine material using mechanical equipment is slower and more costly in terms of actual placement. However, mechanically placed material dries more quickly, so that it can be shaped and graded in a shorter time following placement. Initial placement of fine material using hydraulic dredging equipment is faster. However, hydraulically placed material must be contained and takes longer to dry before it can be shaped and graded. Meeting water quality limitations for the discharge of the

dredge carriage water may affect the operation. These factors may negate the initial cost savings associated with the hydraulic placement.

New technologies are evolving which involve dredging of fine materials with a small hydraulic dredge and passing them through a mechanical dewatering process using flocculents and presses. The end product is dewatered fine material that can then be placed, shaped, and graded without an extensive drying period. This process was used on an island construction project in the St. Paul District in 2000 and holds promise in the future as a cost effective method of fine material placement. Geotubes will also be evaluated during plans and specifications, especially for use on the narrow islands. At a minimum, the contractor would be allowed to use these newer technologies, if they are able to meet all the other conditions, including any necessary State permits and/or water quality certifications.

Rock is barged to the islands and placed using hydraulic backhoes from either the new island base or from barges. The most limiting factor on rock placement is usually water depths for the rock barges and push boats. To limit the amount of access dredging or double handling of rock along the islands, contractors may place rock protection during periods of high water. Very limited access will be provided. Therefore, the islands were designed to facilitate trucking the rock to the placement sites. Passing lanes were incorporated into the narrow islands to increase the efficiency of trucking. Sand pads were incorporated into the narrow islands to facilitate unloading of equipment and material.

Nothing in the design of the Islands G and K suggests that any innovative or unusual construction methods would be necessary.

8.7 CONSTRUCTION RESTRICTIONS

Construction restrictions could be applied for any number of reasons. Restrictions are generally applied in the construction of habitat projects to minimize the adverse effects of construction and to protect valuable habitats. The following are the basic construction restrictions that would likely be applied in the construction of the island measures.

a. Access dredging would be limited to the minimum considered necessary to construct the project and confined to the access areas on plate 9. Alternate access dredging would be subject to the conditions in Section 8.7.

b. Work and work vessels would be restricted from Capoli Slough proper during construction to avoid impacts to mussels, including Higgins eye. Construction activities would also be restricted along the main channel border to avoid impacts on mussels

c. Water quality limitations would be imposed on the hydraulic placement of sand material for island bases. The criterion used in past island construction projects has generally been that a specified suspended solids concentration has to be met within a certain distance from the discharge point; e.g., 500 mg/l at 500 feet below the discharge point.

d. Contractors are usually allowed to propose alternative borrow sites. The contract documents would define acceptable borrow areas. Alternate borrow sites would be evaluated on a case-by-case basis for approval and would likely require mussel surveys to evaluate potential impacts on mussels. The Government would not approve alternative borrow sites in areas such as existing aquatic plant beds, mussel beds, or other environmentally sensitive areas.

8.8 ACCESS DREDGING

Access dredging would be required to construct the project. Generally, a balance must be struck to provide reasonable access for the contractor while minimizing the environmental disturbances associated with the dredging. In addition, being able to incorporate the access dredging material into the islands avoids the costs of having to transport this material elsewhere for disposal.

Plate 9 shows proposed access routes for construction of the project measures that should provide adequate access for construction while minimizing secondary effects. The access cuts depicted on plate 9 could be dredged to 6 feet, elevation 614.1, with an 80-foot bottom width. The slopes would be the angle of repose and may flatten out with time. An access only route is depicted on plate 9 upstream of Island A. Because of concerns with potential impact on mussels, no dredging would be allowed in this access area, unless additional mussel surveys are completed and it is determined there would only be a minor impact on mussels. It should be noted that these are routes where dredging could occur to obtain access. If a contractor can access portions of the construction without dredging, he is generally free to do so. Access dredging should be minimized and confined to designated areas and closely monitored to avoid impacts to mussels, including endangered Higgins eye. The actual footprints of access dredging will be mapped and reported to the USFWS.

Contractors are allowed (and occasionally do) request alternate access routes. These would be evaluated on a case-by-case basis for approval and would likely require mussel surveys to evaluate potential impacts on mussels.

The contractor would be allowed to place access material in the optional emergent wetlands identified on plate 9 or as random fill in the island cross sections.

8.9 SOURCES OF MATERIAL

8.9.1 GRANULAR FILL

A number of options for obtaining granular fill for the islands were evaluated and still may be considered during preparation of plans and specifications for project construction. The

granular fill would need to meet the requirements of less than 10% fines (less than P200). Additional borings, as needed, would be collected during development of plans and specifications and the precise area of borrow would be defined.

Main Channel of the Mississippi River: The main channel of the river is a known source of sand. This source is considered the primary alternative, because no acceptable other source was found. Habitat for mussels is poor in the main channel, and there would not be any concerns with potential impacts on Higgins eye. The main channel border in the area does provide good mussel habitat, including the Higgins eye Whiskey Rock Essential Habitat. Borrow of material in the main channel border would not be allowed. Excavating holes in the main channel of the river would provide only limited secondary habitat benefits.

9-Foot Navigation Channel Maintenance Material: A review of historic dredge cuts in lower Pool 9 indicates three channel maintenance cuts are in the vicinity of the Capoli Project: Indian Camp Light, Lansing Upper Light, and Above Atchafalaya. The Atchafalaya cut could be used for the Capoli project, but the other two cuts are reserved for the beneficial use site below the Lansing Bridge. An Environmental Assessment for the "Atchafalaya Bluff Dredging, Operation and Maintenance of the 9-Foot Navigation Channel, Upper Mississippi River, Pool 9" has been completed, with the FONSI signed October 7, 2010. An estimated 30,000 cubic yards were available in Atchafalaya for a dredge cut in 2010. Use of this material to construct Capoli Slough project measures would be considered if it is found to be most-cost effective or cost neutral for both EMP and 9-foot Channel Operation and Maintenance programs.

Off-Channel Sites: Borrow dredging from off-channel areas would also be an option. Borrow dredging from off-channel areas, depending on location, could provide substantial secondary fish habitat benefits and would normally be the preferred source for material. However, no suitable off-channel sites were identified during the planning and design. The borings do indicate that if there was a cost-effective way of removing the over-burden of fines, off-channel borrow areas might be used. However, concerns with potential impacts to mussels may preclude the use of off-channel sites. Mussel surveys and evaluation of potential impacts to mussels would be required, prior to approval.

8.9.2 RANDOM FILL

It is expected that most random fill would come from access dredging material that contains too much fine material to be used in the sand sections of the islands and too little fine material to be considered fine fill for topsoil. Random fill could also come from the habitat dredging. If the contractor does not need to use the random fill island sections for disposal of access dredging material or habitat dredging, it is expected that it would be most cost effective for the contractor to use sand for the random fill. Excess random fill from access or habitat dredging could be placed in emergent wetland K and/or any of the optional emergent wetlands.

8.9.3 FINE FILL

It is expected that the fine fill (topsoil) would come from Habitat Dredging A and B and access dredging. Fine material for emergent wetland K could come from either Habitat Dredging areas.

8.9.4 ROCK

The rock would come from an approved local quarry. The loading site would depend on the location of the quarry. It is expected that the rock would probably be loaded in the Lansing area.

8.10 CONSTRUCTION SCHEDULE

The scope of the project would require a minimum of 2 years of construction. Because of the location and nature of the construction, nearly all the work would require use of marine equipment. Construction of this type is limited to the open water season on the Upper Mississippi River. Construction in certain years can begin in April, but May is a more typical for beginning construction due to the constraints associated with spring high water. At the other end of the spectrum, late November is the end of the construction season due to winter freeze-up.

The construction schedule for the project would depend on the funds available for construction and other factors such as the potential for combining construction with District operation and maintenance activities or the need to accommodate other habitat measures such as pool drawdown. Based on current and expected UMRS-EMP budgets and project priorities within the St. Paul District, it is estimated that construction of the project would begin in 2012.

The optimum approach would be to construct the project under one construction contract. Because of the restrictions on access dredging to protect mussels, there would be limitations on how the measures can be constructed and construction of the measures might need to be done sequentially. However, it would be possible to stage construction if necessary due to funding constraints. The upstream islands and islands along Capoli Slough proper could be constructed in one to two contracts and Islands G and D and the downstream islands in another contract. The two potential stages are as follows:

Stage 1: Islands A, B (part), D and K; Rock Sills A and E; Habitat Dredging A and B (part); Access Dredging B and E; and Emergent Wetland K. Only the portion of Island B that would be required to get to Island A would be constructed in Stage 1. The remainder of Island B would be constructed in Stage 2, when Islands C and E would be constructed. Island D is included in stage 1 to dispose of Access Dredging B material, if necessary.

Stage 2: Islands L, B (part), C, E/E1, and G; Rock Sill D; Rock Mound I; Habitat Dredging A and B (part); Access Dredging H. The remainder of Island B would be constructed to allow construction access Islands C and E. Access dredging H material could go to Island C or G and/or be placed in the optional emergent wetland behind Island F.

9. ENVIRONMENTAL EFFECTS

An environmental evaluation in accordance with NEPA (42 USC 4331) has been conducted for the recommended action, and a discussion of the impacts follows and is summarized in table 9-1. This discussion also examines the no action alternative and other action alternatives as represented by the base alternative (Alternative A; see Section 7 for details), which is identified as one of the cost effective alternatives and likely encompasses the minimal effects of all possible action alternatives. To maintain brevity, the discussion does not include those parameters where there are "no effects," but this information is included in table 9-1.

As specified by Section 122 of the 1970 Rivers and Harbors Act, the categories of impacts listed in table 9-1 were reviewed and considered in arriving at the final determination. In accordance with Corps of Engineers regulations (33 CFR 323.4(a)(2)), a Section 404(b)(1) evaluation has been prepared and is included in Attachment 3 of this DPR. A draft FONSI is attached at the end of the report. If determined appropriate, the FONSI will be signed after the public review.

The significant natural resources of the project area and its surroundings are described in sections 3 and 4 (Existing Resources) of this integrated DPR and EA. Additional descriptions of the ecological effects and benefits associated with the no action, recommended plan, and alternative plans can be found in Section 7, Section 8, and Attachment 4.

9.1 APPLICABLE ENVIRONMENTAL LAWS AND REGULATIONS

This integrated DPR and EA was prepared and the proposed work designed to comply with all applicable environmental laws and regulations (table 9-2). A highlight of compliance with the major environmental laws and regulations follows. In the final DPR, the statuses of compliance for several acts/orders are listed as only partial. Full compliance with these acts/orders has been or will be achieved before the signing of the FONSI.

In compliance with the Fish and Wildlife Coordination Act, project plans have been coordinated with the Upper Mississippi River National Wildlife and Fish Refuge and the Region 3 Offices of the USFWS and the Wisconsin and Iowa DNRs. Further Federal coordination was conducted with the USFWS as a part of section 7 consultation under the Endangered Species Act of 1973, as amended , 16 U.S.C. § 1536 (Attachment 7). The dredging and fill activities associated with island building would have effects on water quality. Under the Clean Water Act, the Corps will apply for a Chapter 30 and 401 water

quality certification from Wisconsin DNR based on final estimates of quantities of materials determined as part of the Plans and Specifications phase. Preliminary indications are that these permits will be issued without major restrictions. A 404(b)(1) analysis is also in the process of being finalized (Attachment 3). Under the Floodplain Management Executive Order, Federal agencies "are to provide leadership and shall take action to reduce the risk of flood loss, to minimize the impacts of floods on human safety, health, and welfare, and to restore and preserve the natural and beneficial values served by floodplains." This project has been designed to minimize the flood impacts by creating low-elevation islands (usually located adjacent to existing islands) that would become submerged during flood events. Minimal impact on flood flows would also be accomplished by orienting the topographic measures of new islands in relation to flow. This design is intended to have little to no measurable effect on the 100-year flood event (see Attachment 5 – Hydraulics Appendix for more details). This project is also in compliance with the Protection of Wetlands Executive Order (EO) because it would create new wetland habitat. The Farmland Protection Policy Act does not apply to this project because no prime, unique, or State or locally important farmland would be converted to nonagricultural uses.

Table 9-1

Environmental Assessment Matrix for the Capoli Slough Habitat Rehabilitation and Enhancement Project

								Section 122 of the River and Harbor and Flood Control Act of 1970 (Public Law 91-611)													
Alternative	No Action							Alternative A (Base Project)							Recommended Alternative (Alt E4 w EW K)						
	BENEFICIAL[a]				ADVERSE[b]			BENEFICIAL[a]				ADVERSE[b]			BENEFICIAL[a]				ADVERSE[b]		
PARAMETER	+++	++	+	0	-	--	---	+++	++	+	0	-	--	---	+++	++	+	0	-	--	---
A.SOCAL EFFECTS																					
1. Noise Levels				X								X							X		
2. Aesthetic Values						X				X		X				X			X		
3. Recreational Opportunities					X					X						X			X		
4. Transportation				X							X							X			
5. Public Health and Safety				X							X							X			
6. Community Cohesion (Sense of Unity)				X							X							X			
7. Community Growth & Development				X							X							X			
8. Business and Home Relocations				X							X							X			
9. Existing/Potential Land Use				X							X							X			
10. Controversy					X						X							X			
B. ECONOMIC EFFECTS																					
1. Property Values				X							X							X			
2. Tax Revenue				X							X							X			
3. Public Facilities and Services				X							X							X			
4. Regional Growth				X							X							X			
5. Employment				X						X							X				
6. Business Activity				X						X							X				
7. Farmland/Food Supply				X							X							X			
8. Commercial Navigation				X							X							X			
9. Flooding Effects				X							X							X			
10. Energy Needs and Resources				X							X							X			
C. NATURAL RESOURCE EFFECTS																					
1. Air Quality				X								X							X		
2. Terrestrial Habitat						X				X						X					
3. Wetlands						X				X						X			X		
4. Aquatic Habitat						X				X						X			X		
5. Habitat Diversity and Interspersion						X				X						X					
6. Biological Productivity						X				X						X			X		
7. Surface Water Quality					X					X		X					X		X		
8. Water Supply				X							X							X			
9. Groundwater				X							X							X			
10. Soils				X							X							X			
11. Threatened or Endangered Species						X				X		X				X			X		
D. CULTURAL RESOURCE EFFECTS																					
1. Historic Architectural Values				X							X							X			
2. Pre- & Historic Archeological Values				X							X							X			

[a] Beneficial: '+++' = significant; '++' = substantial; '+' = minor.

[b] Adverse: '---'= significant; '--' = substantial; '-' = minor.

'0' = No effect.

Table 9-2
Compliance Review with all Applicable Environmental Regulations and Guidelines

Environmental Requirement	Compliance[1]
Federal Statutes	
Archaeological and Historic Preservation Act	Full
Bald and Golden Eagle Protection Act of 1940, as amended	Full
Clean Air Act, as amended	Full
Clean Water Act, as amended	Partial[2]
Coastal Zone Management Act, as amended	N/A
Endangered Species Act of 1973, as amended	Full
Federal Water Project Recreation Act, as amended	Full
Fish and Wildlife Coordination Act, as amended	Full
Land and Water Conservation Fund Act of 1965, as amended	Full
Migratory Bird Treaty Act of 1918, as amended	Full
National Environmental Policy Act of 1969, as amended	Partial[3]
National Historic Preservation Act of 1966, as amended	Full
National Wildlife Refuge Administration Act of 1966	Full
Noise Pollution and Abatement Act of 1972	Full
Watershed Protection and Flood Prevention Act	N/A
Wild and Scenic Rivers Act of 1968, as amended	N/A
Farmland Protection Policy Act of 1981	N/A
Executive Orders, Memoranda	
Floodplain Management (EO.. 11988)	Full
Protection and Enhancement of Environmental Quality (E.O. 11514)	Full
Protection and Enhancement of the Cultural Environment (E.O. 11593)	Full
Protection of Wetlands (E.O. 11990)	Full
Analysis of Impacts on Prime and Unique Farmland (CEQ Memorandum, 30 August 1976)	Full

[1] The compliance categories used in this table were assigned according to the following definitions:
a. Full - All requirements of the statute, E.O., or other policy and related regulations have been met for the current stage of planning.
b. Partial - Some requirements of the statute, E.O., or other policy and related regulations remain to be met for the current stage of planning.
c. Noncompliance (NC) - Violation of a requirement of the statute, E.O., or other policy and related regulations.
d. Not Applicable (N/A) - Statute, E.O., or other policy and related regulations not applicable for the current stage of planning.

[2] 401 water quality certification and Chapter 30 permits required.

[3] Full compliance to be achieved with the District Engineer's signing of the Finding of No Significant Impact.

9.2 NO ACTION ALTERNATIVE

The No Action alternative would result in continued degradation of aquatic and terrestrial habitat as described in Section 4-4. As a result of losses in terrestrial habitat (islands), wetlands, and aquatic vegetation, there would be a corresponding loss in habitat diversity and interspersion and biological productivity. Surface water quality would also degrade somewhat, primarily through higher turbidities associated with island erosion and through less filtration by aquatic plants. Threatened or endangered aquatic species would be adversely affected by degraded habitat and water quality. As degraded conditions provide less support for fish and wildlife, recreational opportunities in the project area (primarily hunting, fishing, and wildlife-viewing) would degrade as well. A loss of this type of ecosystem would result in reduced recreational opportunities and would adversely affect the aesthetic value of the area. This is likely to be viewed as controversial to the public.

9.3 RECOMMENDED PLAN

9.3.1 SOCIAL AND ECONOMIC EFFECTS

9.3.1.1 Noise

The immediate vicinity around the project area and at access points (e.g., boat landings) would experience elevated noise generated by construction equipment, especially heavy machinery. However, Capoli Slough is rather isolated and the impacts to residents in the general area should be negligible. This impact would be temporary, and adverse effects to the general public would be short-lived and minor.

9.3.1.2 Aesthetics

In general, the aesthetic environment of the project area over the long term would be improved over the existing and future without-project conditions in which islands are completely eroded. The project measures and the resulting aquatic vegetation would return the project area to a desirable condition similar to that found in the past. Existing islands would be preserved, and new ones would be created. However, rock measures would generally be considered aesthetically displeasing. During the period of construction, the aesthetic value of the area would be diminished as a result of disturbance. This effect would be temporary until vegetation establishes and matures, anticipated to be within 10 years of construction.

9.3.1.3 Recreation

Recreation in the project area (primarily in the form of fishing, hunting, and wildlife-viewing) would likely be negatively affected during project construction. However, after completion, the project would likely have long-term positive effects on recreation. Improvements to overwinter habitat (via habitat dredging) for backwater fish would increase ice-fishing opportunities. Preserving natural islands and creating new ones will provide terrestrial habitat that could be used by migrating birds and mammals that are a source for wildlife viewing and hunting. The creation of mud flats would promote use by dabbling ducks. Islands would also serve as wind-breaks that would create additional fishing and hunting areas as well as places for recreational boaters to anchor.

9.3.1.4 Other Social Effects

The project might have slight effects on other social factors such as transportation, public health and safety, community cohesion and growth, business and home relocations, and controversy. For example, during construction, materials such as riprap would have to be transported to the site, which might affect local traffic conditions between the rock source and the project site. Also, strong support for the habitat restoration might be somewhat tempered by a sentiment of fiscal constraint, thus triggering controversy. For most of these factors, it is difficult to determine the level of these effects. However, it is anticipated these effects would not rise to the level of even a minor effect; thus, they are identified as having no effect in table 9-1.

9.3.1.5 Other Economic Effects

Improved habitat and water quality and the resulting increase in fish and wildlife populations would enhance recreation opportunities and business activities over the long term, primarily in the form of hotel accommodations, outdoor sporting equipment sales, and dining. Temporary benefits would also accrue to local businesses during project construction, contributing to employment opportunities. Other slight effects might be felt on other economic factors such as property values, tax revenue, public facilities, regional growth, commercial navigation, and energy needs and resources. For example, construction activities would be located near the 9-foot navigation channel, thus having the potential to affect commercial barge traffic. However, these effects would not be expected to rise to the level of even a minor effect.

9.3.1.6 Environmental Justice

Environmental Justice is a national goal and is defined as the fair treatment and meaningful involvement of all people regardless of race, color, national origin, or income with respect to the development, implementation, and enforcement of environmental laws, regulations, and policies. Project goals and objectives were established to provide environmental restoration and enhance the quality of the environment for all people. The proposed project would be constructed on public lands; no private lands would be acquired. Public involvement, via public meetings and distribution of information concerning the proposed project, has and will continue to be an integral part of planning for this project to ensure that concerns of all people will be fully considered in the decision-making process. In summary, the proposed action would not have a disproportionate adverse impact on any population.

9.3.2 NATURAL RESOURCE EFFECTS

Summary: The recommended alternative would improve aquatic habitat and island habitat on more than 2,000 acres in Pool 9 of the Upper Mississippi River. The restoration of island complexes and the effects on lessening wind/wave action would result in increases in vegetation and diversity in this area and would improve migration habitat for waterfowl. Increased vegetation diversity and extent, the creation of deep holes in selected areas, and the addition of riffle/pool sequences in the slough would improve aquatic habitat for fish as well as many other aquatic species. The recommended alternative would also create about 50 acres of island habitat in this area. These islands and associated mudflats would provide important habitat for a wide variety of wildlife species such as shorebirds, as well as important migration habitat for neotropical migrants. In addition, project measures would include the creation of deepwater areas and a riffle/pool complex, which would benefit fishes by creating more depth and substrate diversity. Deep pools would also function as valuable overwintering areas.

9.3.2.1 Air Quality

Emissions from heavy equipment used during construction would have a minor negative impact on air quality in the project area. Combustion of gasoline and diesel fuels would contribute hydrocarbons, nitrogen oxides, and carbon monoxide to the air. However, this effect would be short-term and would be most pronounced at the construction site, which is largely isolated from human populations.

The Clean Air Act General Conformity Rule (40 CFR parts 51 and 93) was designed to ensure that Federal actions do not impede local efforts to control air pollution. The final rule dictates that a conformity review be performed when a Federal

action generates air pollutants in a region that has been designated a non-attainment or maintenance area for one or more of the six National Ambient Air Quality Standards (NAAQS) criteria pollutants. Crawford and Allamakee Counties are in "attainment" of the NAAQS for each of the six criteria pollutants. Because of this, no detailed conformity analyses is required for this project.

9.3.2.2 Terrestrial Habitat

The proposed project would have a substantial positive effect on terrestrial habitat in the Capoli Slough area. Constructing islands would create about 50 acres of new terrestrial habitat (in the form of islands) and protect about 12 acres of existing islands.

Terrestrial habitat in the lower portions of the pools in this geomorphic reach (Pools 5 through 9) has been declining since the construction of lock and dams on the Upper Mississippi River and is projected to significantly decline in the future. By the year 2050, the habitat types present and/or likely to develop on the islands (including scrub-shrub, salix community, and wet floodplain forest) are projected to decline by 25 percent (9,691 acres) in this geomorphic reach (Theiling et al. 2000). This trend has also been observed within the Capoli Slough area. For example, in 1975 island habitat was estimated at 50 acres, and in 2000 it was estimated to be around 23 acres. The proposed project would help to offset the projected future losses of this habitat cover type and associated habitats. Soil cover around existing islands may initially experience disturbance with project construction; however, additional soil cover would be created (from dredged material) on new islands.

9.3.2.3 Wetland Habitat

The proposed project would likely disturb wetland habitats during the construction of project measures. This area is estimated to be about 15 acres. Some of this disturbance would be temporary as vegetation becomes established and matures as this disturbed portion reverts back to wetlands. However, a portion of existing wetlands (about 8 acres) might be converted into other habitat types such as islands or pools.

The proposed project would have substantial long-term positive benefits from the creation of new wetland habitat. More than 9 acres of mudflats would specifically be constructed as part of project measures, which would lead to the establishment of emergent vegetation over a relatively short period (3 to 5 years). Moreover, in comparison to future without-project conditions in which a complete loss of islands and wetlands is projected (discussed in the HEP analysis section), the project would protect the existing wetlands at the time of construction. By year 50 after project construction, the end result is projected to be a net gain of about 140 acres.

Newly-established or protected existing wetlands would provide habitat benefits for amphibians, aquatic insects, waterfowl, shorebirds, fish, and some mammals. Supporting evidence of these habitat benefits is provided in the HEP analysis in which the dabbling ducks migration habitat HSI showed an increase from 0.19 (future without-project) to 0.55 (future with-project) (see Attachment 4). In addition, improvements in habitat associated with the terrestrial-aquatic interface would benefit aquatic mammals such as muskrats (*Ondatra zibethicus*) and many species of reptiles and amphibians. Improvements to wetlands would help improve water quality by filtering nutrients and contaminants.

9.3.2.4 Aquatic Habitat

The proposed project would disturb about 50 acres of aquatic habitat during the construction of project measures. Some of this disturbance would be temporary as a part of habitat dredging. Access dredging for providing borrow material and equipment access for construction of the proposed island measures would disturb about 10 acres of aquatic habitat. Other short-term adverse effects will be from disturbance during construction activities, primarily as a result of sedimentation. However, this disruption would be temporary, and the increased depths associated with dredging would improve aquatic habitat for backwater fish species. Long-term adverse effects would include the conversion of about 32 acres of aquatic habitat to new islands.

Despite the loss in quantity of aquatic areas, project measures would result in a long-term increase in the quality of this habitat. The area is currently limited in this due to sedimentation, lack of bathymetric diversity, extensive susceptibility to wind fetch, and lack of aquatic vegetation. The existing HSI values for bluegill and smallmouth bass are 0.37 and 0.52, respectively. In the future, these conditions would continue to degrade without project measures and HSIs would decrease to 0.13 and 0.45, respectively, over a 50-year period (see HEP analysis section - Attachment 4). However, the protections provided from new islands, habitat dredging for overwinter refuge areas, and a new riffle/pool complex would increase HSIs to 0.63 for bluegill and 0.60 for smallmouth bass, respectively, over this same period. The expected increase in habitat quality (primarily in the form of deepwater areas) and the additional protection measures (e.g., wind breaks) are expected to more than offset aquatic habitat losses associated with construction. Island measures would provide protection from wave action, thereby decreasing sediment resuspension, increasing photic depth, increasing aquatic plant growth and diversity, and preventing uprooting. Vegetation beds in the form of submersed or rooted aquatic vegetation have higher HSIs for bluegill life requisites relative to open water. These areas are expected to expand substantially in comparison to future without-project conditions.

Project measures would also provide long-term benefits to waterfowl using aquatic areas bordering islands. Specifically, the increased aquatic vegetation extent and diversity and restoration of island complexes affording protection from prevailing winds

and disturbance would contribute to an increase in the value of the project area as waterfowl migration habitat. Evidence for this is observed for diving duck HSIs as it increased from 0.43 to 0.60 when compared to a future without-project condition over a 50-year period (see Attachment 4 - HEP analysis section).

9.3.2.5 Habitat Diversity and Interspersion

Since the construction of Lock and Dam 9, the habitat in Capoli Slough has become less diverse for a number of reasons: islands have eroded, deeper water has filled in, aquatic vegetation has declined, and flow characteristics have become more uniform. The proposed project would have a substantial positive effect on habitat diversity and interspersion in Capoli Slough area. Island construction would increase plan form, flow pattern, and aquatic vegetation diversity in Capoli Slough. The proposed rock structures would provide a unique substrate in the project area and would therefore increase substrate diversity. Proposed dredging activities would increase depths in some areas, resulting in greater bathymetric diversity. Construction of the island complexes would restore the riverine process to a great degree, especially as it relates to channel flow, thus reducing sedimentation in key areas and restoring bathymetric and flow diversity.

The benefits of the project are especially pronounced when compared to future without-project conditions. Without the project it is projected that the remaining islands will be completely lost and most of the river bottom in the area will level off to a relatively uniform shallow water depth, leading to reduced habitat diversity. Without the project it is also projected that the Capoli Slough secondary channel would continue to lose definition, with more diffuse river flows and a reduced ability to flush sediments.

9.3.2.6 Biological Productivity

The proposed project would have temporary minor adverse effects on biological productivity resulting from disturbance caused by construction activities. However, project measures would lead to a substantial positive effect on the overall long-term biological productivity in Capoli Slough. The existing high biological productivity would be maintained and increased as a more diverse and abundant aquatic vegetation community develops. Although the total area of aquatic habitat would be less, the shoreline interface and associated littoral areas would increase, which are highly productive relative to open water. This would contribute to macroinvertebrate species diversity and community structure and function. This, coupled with other habitat improvements in the project area, could also lead to greater vertebrate productivity, especially shorebirds, waterfowl, and aquatic mammals. The increased productivity levels would be especially pronounced when comparing with- and without-project conditions.

9.3.2.7 Surface Water Quality

During construction, there would be a minor negative effect on water quality in the project area. Dredging activities and the placement of fill to construct the proposed measures would result in localized increases in suspended sediment and turbidity. However, the coarseness of the material used to construct the island bases would reduce the amount of resuspension of this material.

Minimal risk is associated with contaminants becoming resuspended in the water column from dredging activities. The general sediment quality in Pool 9 is described in Section 3. Sediment analysis of the fine-grained material used for fill has shown it to be fairly clean (Attachment 8). No organic hits were above the Ontario Ministry of the Environment's lowest effects level guidelines for sediment. However, some results were above the lowest effects level guidelines for manganese, nickel, ammonia and total organic carbon, but those results are not unusual for the Upper Mississippi River.

The increase in aquatic vegetation following completion of the project could lead to an increase in denitrification of surface water. However, the project would also reduce water exchange in the area, which could have the opposite effect. Because of these and other complications of the nitrogen cycle, it is difficult to predict whether the proposed project would have a measurable effect on the nitrogen budget of the project area. If the effect is measurable, it would likely be minor.

9.3.2.8 Aquatic and Terrestrial Organisms

As described earlier, the project would have short-term adverse effects and long-term beneficial effects on most aquatic and terrestrial species that inhabit the area, especially waterfowl and fish. In addition to these effects, the placement of rock and sand to construct the channel measures would cover substrate and the associated benthic organisms that have limited mobility. Island construction activities could potentially impact benthic organisms by burying, crushing or physical removal by dredging. Access channel dredging would remove benthic organisms. Benthos taxa of particular concern include mussels; potential project effects are addressed in the biological assessment (Attachment 7). As a result of coordination with the USFWS and other resource agencies, a mussel impact minimization plan would be developed. Among other things, provisions of the plan include specific routes (for access dredging) that avoid high-density mussel areas. Implementation of the plan would also minimize impacts on associated species. Thus impacts on mussels and other benthos would be temporary and benthic organisms would recolonize the dredge cuts.

Increased activity and noise would disturb fish and wildlife in the immediate project area during construction. Species that are mobile would relocate to a different area during construction. However, this disruption would be temporary, and no permanent effects would likely occur.

Over the long-term, the proposed project would benefit aquatic and terrestrial organisms through improvements to habitat. These habitat improvements are especially pronounced when comparing future-with to future without-project conditions. The creation and protection of terrestrial habitat (in the forms of islands) and associated vegetation would incur numerous benefits to a wide variety of wildlife species including roosting habitat for raptors, migration and nesting habitat for neotropical migrants and nesting habitat for turtles. Fur-bearing mammals would also benefit from newly created and protection of existing floodplain forests. The creation of shallow water zones (in the form of mudflats) would provide marsh habitat for marsh and water birds such as grebes (*Aechmophorus* spp.), white pelicans (*Pelecanus onocrotalus*), double crested cormorants (*Phalacrocorax auritus*), bitterns, herons, egrets, terns, and shorebirds. The proposed habitat dredging would also create deeper backwater areas (greater than 3 feet) that would provide better overwintering habitat in Capoli Slough for backwater fish species. In addition, deeper pool areas that provide bathymetric diversity are within protected areas provided by new islands, which would promote winter temperatures more favorable to bluegill. Improvements to water quality and greater aquatic habitat diversity (associated with dredging and creation of shoreline) would promote use by benthic macroinvertebrates.

9.3.2.9 Threatened and Endangered Species

The only federally listed species with suitable habitat in the project area for the Capoli Slough HREP is the Higgins eye (*Lampsilis higginsii*); therefore, no direct or secondary positive or adverse effects to other federally listed species are expected. Additional background information on *L. higginsii* can be obtained from the 2008 Biological Assessment (Attachment 7).

In general, island construction activities within Capoli Slough could potentially impact *L. higginsii* by burying, crushing or physical removal by dredging. Mussels living in proposed island feature footprints would be buried by material and likely killed. Mussels in areas to be dredged for access would be crushed or removed and also likely killed. *L. higginsii* may be impacted by both island (and island feature) construction and access dredging. Although dredging covers a smaller footprint than islands and island measures, it poses a greater potential direct impact to *L. higginsii* because it would be done along the margins of more favorable mussel habitat. However, the areas dredged for access would be available for recolonization by *L. higginsii* once project construction has been completed.

During mussel surveys from 1995 to 2009, Higgins eye distribution within the Capoli Slough island complex was limited to the main channel border and within Capoli Slough proper, generally in water depths greater than 3 feet and in nonvegetated areas. Impacts on the species are anticipated primarily where access dredging footprints are located within these areas. After several revisions of the project, construction methods,

and the development of an Impact Minimization and Evaluation Plan that includes relocating individual Higgins eye, the total estimated take to the species was 37 killed and 217 harassed. However, it is anticipated that Higgins eye (and other mussels) would recolonize the footprint after construction is complete. Based on these factors, the USFWS determined that the proposed project would not jeopardize continued existence of the species, and an Incidental Take Statement was issued to the Corps for the project (Attachment 7).

Wisconsin State-listed species that occur within the Capoli Slough HREP are washboard (*Megalonaias nervosa*), round pigtoe (*Pleurobema sintoxia*), monkeyface (*Quadrula metanevra*), wartyback (*Quadrula nodulata*), rock pocketbook (*Arcidens confragosus*), and yellow and slough sandshells (*Lampsilis teres*). During mussel surveys from 1995 to 2009 (Attachment 7), the distribution of these species was mostly limited to the main channel border and within Capoli Slough proper, generally in water depths greater than 3 feet and in nonvegetated areas. Like Higgins eye, impacts on Wisconsin-protected mussels are anticipated at areas of access dredging.

Over the long-term, positive impacts to native mussels including Higgins eye are expected as aquatic habitat is improved by preventing the loss of the Capoli Slough island/wetland complex and restoring eroded islands to reduce wind fetch and diversify water velocities. Without the project, it is estimated that remaining islands would be lost and most of the river bottom in the area leveled off to a relatively uniform shallow water depth, with diffuse river flows. Also, the Capoli Slough secondary channel would continue to lose definition, with reduced sediment flushing flows. These conditions are likely to be less hospitable to native mussels. The project would likely maintain and potentially improve the quality of mussel habitat. Albeit difficult to quantify, construction of the island complex might have long-term beneficial effects on native mussels from improved mussel and host fish habitat conditions.

9.3.2.10 Other Natural Resource Effects

Improved habitat and water quality as a result of the recommended alternative are expected to have de minimis effects on other natural resource components such as groundwater and water supply. For instance, improved quality of surface water with a connection to groundwater would have a corresponding effect on the latter. Determining the level of these effects is difficult, but it is anticipated that that they would not rise to the level of even a minor effect.

9.3.3 CULTURAL RESOURCE EFFECTS

All the existing island shorelines within the project area were surveyed in 1994 (Boszhardt 1995). Three archaeological sites were identified: 47CR578, 47CR579 and

47CR580. Subsequent Phase II testing determined that historic sites 47CR578 and 47CR580 were not eligible for the NRHP. Site 47CR579, with precontact and historic components, is eligible for the NRHP. No historic shipwrecks or navigation features (e.g., wing dams) are recorded in the project area.

All three of the archaeological sites are situated on natural levees with elevations that are above 620 feet msl 1912 adjusted, the normal pool elevation. Former landforms within the greater Capoli Slough island complex below elevations of 620 feet msl 1912 adjusted are no longer extant: they have succumbed to erosion and inundation since the construction of Lock and Dam 9 in 1937. These now submerged former islands lie beneath approximately 1 to 3 feet of water. A series of geologic bore holes were completed across the project area. In three instances, bore holes identified plant matter (e.g., sticks, roots, fibers) and shells at various depths. Two of these holes are upstream and along the backside of the natural levee containing site 47CR579. The other is immediately southwest of the natural levee harboring site 47CR578. While not conclusive, these borings may indicate submerged or deeply buried archaeological sites or simply the land surface prior to inundation.

The various structures (e.g., rock mounds, mud flats, access dredging) would not impact the three archaeological sites. No construction activities would take place on existing islands where the archaeological sites are located. Conversely, the construction of rock mounds adjacent to the existing islands harboring the archaeological sites would prevent additional erosion and thereby protect the sites. None of the project structures are situated over bore holes that contained organic material. Other project structures are located in areas that were historically side channels or wetlands and would not adversely impact cultural resources that may possibly be submerged. In other areas, the structures and intended results (e.g., sediment infilling) would protect the lake bottom by preventing scouring and additional lake bottom erosion.

9.4 OTHER ACTION ALTERNATIVES

Other action alternatives would have similar types of causal factors and effects on the parameters listed in table 9-1 as the recommended plan but would differ in level of magnitude. The extent of these effects would largely depend on the number and size of the different components or constructed measures and the anticipated changes to land cover types (table 7-3). These measures would affect the resulting acreages of land cover types, which may be used as a surrogate for determining the level of natural resource effect. As most of the action alternatives have fewer components than the recommended alternative, they would have less impact on the listed parameters. Alternative A, the minimum project, would have the fewest amount of impacts, both beneficial and adverse (table 9-2 and table 7-3). However, alternatives E5 and E6 had several more measures than the recommended alternative and, therefore, would have greater effects. None of the alternatives would have impacts falling into the “significant” category.

For socioeconomic factors, the other action alternatives would result in minor short-term adverse effects on noise level and aesthetic values but beneficial effects on employment. However, business activities associated with increased recreational opportunities would experience long-term benefits. For natural resource factors, minor adverse effects on air and surface water quality, wetlands, aquatic habitat, and biological productivity would be short-term. Over the long term, most of these same factors would experience substantial beneficial effects.

9.5 CUMULATIVE EFFECTS

Cumulative effects as they relate to the proposed action when added to other past, present, and reasonably foreseeable future actions were evaluated for Pool 9 in its entirety rather than limited to the project area. Cumulative effects evaluation for all of Pool 9 is appropriate because of the strong relation between the configuration of project components (e.g., island-building, habitat dredging) and their effects (e.g., decreased wind fetch) to water levels, which are most closely managed at the pool scale (see section 4.3.2 – Pool Regulation). In addition, plans identifying common habitat goals and objectives for each pool of the Upper Mississippi River have been developed by stakeholders (River Resources Forum 2004). A description of conditions for Pool 9 is provided in section 3 – Assessment of Existing Resources.

The temporal limit for considering cumulative effects was identified as a 50-year period that begins when EMP was authorized (1986). This period was also targeted because it is anticipated that most of the ecological benefits associated with the proposed project would be achieved within 20 to 25 years.

Several EMP and Operation & Maintenance (O&M) projects in Pool 9 have either been constructed or are in the process of being constructed. In addition, several new projects are early in the planning process. In all, approximately 10,000 acres of floodplain habitat would be affected with implementation of all past, existing, and potential projects in Pool 9 (Table 9-2). Additional planned activities in Pool 9 include the continued operation and maintenance of the 9-Foot Channel, commercial traffic, public use, commercial and residential development, agricultural practices and watershed management, and habitat restoration projects. The most immediate future project in Pool 9 is the Harpers Slough HREP (an island rehabilitation project similar to Capoli Slough) that may be implemented in the next 3 to 6 years under the EMP. Other major factors that will affect the Pool 9 environment include hydrologic and hydraulic processes in an altered environment, point and nonpoint source pollution, and exotic species.

In addition to the above EMP projects, growing season water level drawdowns are being considered for Pool 9 to stimulate and restore aquatic vegetation. Other ecological restoration projects are also being proposed as part of the Upper Mississippi River National Wildlife and Fish Refuge, Comprehensive Conservation Plan and the Navigation Ecosystem Sustainability Program.

The proposed Capoli Slough EMP project alone would likely have minor additional cumulative ecological effects in Pool 9, none of which would be adverse. However, in conjunction with other ecological restoration and island reconstruction projects, Pool 9 would likely experience a significant cumulative increase in aquatic vegetation and habitat quality and diversity. Also, while Capoli Slough EMP alone would likely have a negligible effect on the nitrogen budget within the lower Pool 9 area, the cumulative effect of the proposed project with other similar projects on the Upper Mississippi River basin could be a decrease in the export of nitrate to the Gulf of Mexico.

Table 9-3
Past, Existing, and Potential Future Ecological Restoration Projects in Pool 9

Project	**Year construction completed/proposed for construction**	**Acres affected (est)**
Blackhawk Park	1990	282
Cold Springs	1994	35
Lansing Big Lake	1996	100
Bank Stabilization	1999	200
Pool 9 Island	1995	321
Pool Slough	2006	52
Small scale drawdown	1997	25
Hummingbird Slough	2002	297
Conway Lake [a]	2017	561
Lake Winneshiek [a]	2018	6,000
Harpers Slough [a]	2016	2,200
Total		**10,073**

[a] currently in the planning phase; actual construction dates may change.

The majority of the nitrogen load to the Upper Mississippi River is derived from upland anthropogenic sources and the river itself primarily acts as a conduit for nitrogen. However, natural bacterial processes occurring in the river have a minor de-nitrification effect on water before it is released to the Gulf of Mexico. The combination of HREP projects could lead to a reduction in the extent of the hypoxic zone.

The cumulative effects of EMP projects are being monitored and reported through the LTRMP (U.S. Geological Survey 1999; Johnson and Hagerty 2008). Status and trends are summarized and provided in a Report to Congress every 6 years. The indexes of primary interest involve water quality, aquatic vegetation, hydrology, sedimentation and habitat diversity, and land cover types and land use.

10. SUMMARY OF PLAN ACCOMPLISHMENTS

The recommended plan would substantially improve and maintain habitat conditions over a large portion of lower Pool 9. The habitat improvements, while focusing on improving conditions for migratory waterfowl within the Upper Mississippi River National Wildlife and Fish Refuge, would also improve habitat for a variety of other fish and wildlife such as shorebirds, wading birds, aquatic mammals, terrestrial wildlife, turtles, lacustrine and lotic fish, and mussels**.**

The recommended plan would reduce the mean weighted wind fetch from baseline conditions of 7,500 and future without conditions of 9,400 feet to 3,300 feet with Alternative E4 (Table 7-4). The Environmental Design Handbook (2006) provides a guideline for planning island layout of less than 3,500 feet fetch for water depths of 2 feet. The E4 alternative would meet this design guideline. Also table 7-4 and Appendix 9 show a substantial reduction in sediment suspension probability from baseline of 69 percent and from future without conditions of 79 percent to 36 percent with Alternative E4.

The project would protect, restore and/or create about 49 acres of islands, compared to the 70 acres of islands that were present in the Capoli Slough area shortly after inundation in 1940. The islands recommended for construction would protect about 2,035 acres of shallow and deep aquatic habitat from wave action, thereby decreasing sediment resuspension, increasing photic depth, increasing aquatic plant growth and diversity, and preventing uprooting. Acreage of rooted floating aquatic and emergent vegetation would be maintained at 220 to 240 acres compared to the future without-project conditions, where the vegetation is estimated to disappear. Acreage of submersed aquatic vegetation is expected to approximately double from baseline conditions to around 1,200 acres.

Vegetation beds in the form of submersed or rooted aquatic vegetation have higher values for bluegill life requisites relative to open water. These areas are expected to expand substantially in comparison to future without-project conditions. The proposed habitat dredging would also create deeper backwater areas that would provide better overwintering habitat in Capoli Slough for backwater fish species. In addition, deeper pool areas that provide bathymetric diversity are within protected areas that could promote winter temperatures more favorable to bluegill. This type of habitat is of critical importance in the project area where overwintering habitat is almost nonexistent due to the loss of islands. The existing Habitat Suitability Index (HSI) value for bluegill is 0.37 and, in the future, these conditions would continue to degrade without project measures with HIS decreasing to 0.13 over a 50-year period. However, the protections provided from new islands, increased aquatic vegetation, and habitat dredging for overwinter refuge areas would increase HSI to 0.65 for bluegill over this same period.

Substantial habitat benefits to shorebirds and wading birds are expected to accrue due to the creation of about 30,000 linear feet of sandy shoreline and at least one emergent wetland/mudflat totaling about 5 acres. The sand berms, pads and passing

lanes of the islands would also provide a substantial amount of area available for turtle nesting.

Project measures would also provide long-term benefits to waterfowl using aquatic areas bordering islands. Specifically, the increased aquatic vegetation extent and diversity and restoration of island complexes affording protection from prevailing winds and disturbance would contribute to an increase in the value of the project area as waterfowl migration habitat. This is evidenced by diving duck HSIs, which would increase from 0.43 to 0.60 if the recommended plan is implemented.

The 49 acres of islands protected or created would provide habitat for terrestrial and semi-aquatic species of wildlife. This type of habitat is nearly nonexistent in the areas where the islands would be constructed.

The islands would help maintain approximately 41 acres of Capoli Slough secondary channel, which would contribute to aquatic habitat diversity in this area, primarily for riverine fish species and mussels. The cobble liners would also increase aquatic habitat diversity in this secondary channel. The HSI for smallmouth bass is predicted to decline from the existing 0.52 to 0.45 for the future without action. The HSI would increase to 0.61 for smallmouth bass with construction of the project measures.

The project would contribute significantly to the cumulative long-term habitat restoration goals for lower Pool 9 The Habitat Needs Assessment (U.S. Army Corps of Engineers, 2000) identified Pool 9 as having approximately 21,000 acres of contiguous impounded area and contiguous floodplain shallow aquatic area (the geomorphic habitat types predominant in lower Pool 9, including the project area). The Habitat Needs Assessment indicated that for lower Pool 9 the present need is to increase island habitat by 638 acres and contiguous floodplain shallow aquatic area by 4,200 acres. The protection/creation of 49 acres of islands, habitat improvement in the 821-acre Capoli Slough complex, and reduction in sediment suspension on an additional 1,214 acres would contribute toward meeting this long-term goal.

The goal of the project that was established early in the planning process was: **"Prevent the further loss and expand the 820-acre Capoli Slough island/wetland complex and improve habitat quality and diversity within the complex."** Seven planning objectives were established at the beginning of the study to meet this goal and Table 10-1 summarizes how the recommended project meets or does not meet the planning objectives. The desired areal extents listed in the planning objectives were only partially met for emergent and floating aquatic vegetation, islands, and deepwater overwintering fish habitat.

Table 10-1. Project Objectives and Accomplishments.

Project Objectives	Met/Not Met	Discussion
Objective 1: Maintain/increase the acreage (339 acres) of emergent and floating-leafed aquatic vegetation.	Partially Met	The project would maintain 229 acres of emergent aquatic vegetation and floating-leafed vegetation, which is predicted to be eliminated without project implementation. With the increased protection and creation of emergent wetland area, these areas would increase, but the restoration of 38 acres of islands would displace some of the existing aquatic vegetated areas and offset this gain.
Objective 2: Maintain/increase the acreage of submersed aquatic vegetation in Capoli Slough and surrounding area	Met	The project would approximately double the number of acres of submersed aquatic vegetation to approximately 1,200 acres.
Objective 3: Within the Capoli Slough complex, maintain Capoli Slough (41 acres) as a well-defined, self-maintaining running slough habitat and restore similar habitat where possible**.**	Met	The islands would help maintain around 41 acres of Capoli Slough secondary channel, which would contribute to aquatic habitat diversity in this area, primarily for riverine fish species and mussels. The cobble liners would also increase aquatic habitat diversity in this secondary channel.
Objective 4: Maintain protected wetlands and aquatic areas (600 acres) within the Capoli Slough complex.	Met	The islands would provide protected wetlands and aquatic area in the 600 acres. Over 300,000 feet of sandy shoreline would be created for shorebirds and wading birds.
Objective 5: Maintain existing islands and increase the acreage of island habitat (120 acres).	Partially Met	The project would protect, restore and/or create approximately 49 acres of islands. Narrow islands and rock mounds were used to achieve most of the benefits of islands while reducing costs.
Objective 6: Provide turtle nesting habitat (3 acres) within or near the Capoli Slough complex.	Met	Restoration of islands would provide migratory and resident bird nesting habitat. The sand berms, pads and passing lanes of the islands would provide at least 3 acres of area available for turtle nesting.
Objective 7: Enhance and/or develop protected off-channel lacustrine fisheries habitat within the Capoli Slough complex, including 10 acres of deepwater (greater than 4 feet) habitat meeting winter water quality criteria for overwintering fish habitat.	Met	The islands would provide protected wetlands and aquatic area in the 780 acres Capoli Slough project site. The proposed habitat dredging would also create 10 acres of deeper backwater areas that would provide overwintering habitat in Capoli Slough for backwater fish species.

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11. OPERATION, MAINTENANCE, REPAIR, REHABILITATION, AND REPLACEMENT

11.1 GENERAL

Upon completion of construction, the USFWS would accept responsibility for the project in accordance with Section 107(b) of the Water Resources Development Act of 1992, 33 U.S.C. § 652(e)(7)(A). The operation, maintenance, repair, rehabilitation, and replacement (OMRR&R) responsibilities of the USFWS are addressed in the proposed Memorandum of Agreement for the project (Attachment 10 Memorandum of Agreement between the United States Fish and Wildlife Service and the Department of the Army). Corps will develop an Operation and Maintenance Manual for the project and will provide the manual to USFWS at project completion and turnover. The MOA shall remain in effect for a period of no more than 50 years after initiation of construction of the project. Specific operation and maintenance requirements would be defined in project (OMRR&R) manuals, which would be prepared by the Corps of Engineers and coordinated with the USFWS.

11.2 OPERATION

No specific operational requirements are associated with any of the project measures that would be the responsibility of the USFWS. The USFWS would be required to conduct periodic inspections and submit reports of inspection activities and MRR&R performed.

11.3 MAINTENANCE

The USFWS would perform maintenance on Capoli Slough project measures as necessary for them to remain functional. The Corps would be responsible for excessive damage caused by a catastrophic event such as a large flood, which would be covered under the Major Rehabilitation provision contained in the proposed Memorandum of Agreement.

The present value and estimated average annual OMRR&R costs for the USFWS are shown in table 11-1. The present and average annual costs are shown in August 2010 price levels, with a Federal discount rate of 4 1/8 percent. More detailed information can be found in Attachment 2, including the breakdown on facilities repair, mainly rock

repair, rehabilitation, and replacement. The facilities repair, rehabilitation, and replacement could occur in one event or over several events.

Not all project measures will require maintenance. Table 11-2 categorizes project measures as to the expected level of OMRR&R. Critical measures are those that must be maintained for structural integrity or for the feature to provide the majority of habitat benefits for which it was designed. Noncritical measures are those where minor changes are acceptable and the need for maintenance would be considered on a case-by-case basis. Dynamic measures are those where river forces would be allowed to shape the measures with no future maintenance anticipated.

Table 11-1
Present Value and Average Annual Operation, Maintenance, Repair, Rehabilitation, and Replacement Costs - USFWS

Feature	O&M Cycle	Present Value	Average Annual Cost
A1. Periodic Inspections (first 5 years)	1 year	$35,490	$1,688
A2. Periodic Inspections (year 7, 9, 11)	2 years	$8,359	$397
A3. Periodic Inspections (every 5 years starting in year 15)	5 years	$9,554	$454
B. Annual Inspections	1 year	$42,060	$2,000
C. Facilities Repair	10 year	$106,068	$5,044
Total OMRR&R		$201,531	$9,583

Table 11-2
Maintenance, Repair, Rehabilitation, and Replacement Cost Categorization of Major Project Measures

Critical – Must be Maintained or Repaired

Rock sill tie-in points with islands
Rock end protection
Rock vane tie-in points with island
Major damage to rock sills
Major damage to rock wedges and mounds

Noncritical – Maintained or Repaired if Determined Necessary

Individual vanes
Island shorelines
Minor damage to rock sills, mounds, and wedges
Major damage to sand/fine portion of rock wedge narrow islands

Dynamic – No maintenance

Emergent wetlands/mudflats
Sand pads and passing lanes
Access channels
Borrow sites/habitat dredging
Cobble liners

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12. PROJECT PERFORMANCE EVALUATION AND ADAPTIVE MANAGEMENT

Adaptive management (AM) is a structured process of learning by doing and adapting based on what is learned. AM is a process that promotes flexible decision making and implementation that can be adapted as outcomes from management actions become better understood. Careful monitoring of outcomes advances scientific understanding and helps adjust policies or operations as part of an iterative learning process.

Section 2039 of WRDA 2007 requires that when conducting a feasibility study for ecosystem restoration that the recommended project includes a plan for monitoring the success of the ecosystem restoration. The monitoring plan shall include a description of the monitoring activities, the criteria for success, and the estimated cost and duration of the monitoring as well as specify that monitoring will continue until such time as the Secretary determines that the success criteria have been met. Project performance evaluation was designed to directly measure the degree of attainment of the project objectives. Table 12-1 summarizes the overall monitoring approach used for UMRS-EMP projects. Table 12-2 summarizes the timelines to meet the objectives and the performance criteria used to determine success. The timeline for most of the performance criteria was set at 5 years post-construction to allow the features to stabilize and/or aquatic plants to respond. Mussel and fish response are likely to take 10 years or more to meet the performance criteria. For instances, monitoring at other HREPs has shown it takes 5 to 7 years for an overwintering population to become established to the point where multiple year classes are present and Catch Per Unit Effort(CPUE) begins to stabilize (Janvrin 2011). Therefore, project performance monitoring takes this into account by setting the targets as a 4-year averaged CPUE to be met by year 10 post-project.

Table 12-3 summarizes the specific monitoring that would be conducted for the recommended Capoli Slough project. Biological response monitoring would also be completed on the project (table 12-4). The Wisconsin DNR has been collecting pre-project fish data since 2007. The fisheries in lower Pool 9 were sampled using random stratified and fixed site electrofishing runs in early November each year when temperatures were at or below 10 degrees C. Fish begin moving to their overwintering sites when temperatures fall below 10 degrees C. A summary of the results of these pre-project data as provided in Janvrin 2011 is contained in Attachment 12 Supporting Data. The Wisconsin DNR plans to repeat the sampling post-project to evaluate the response of the fisheries to the proposed Capoli Slough project.

Mussel surveys were also completed pre-project, and the results are contained in Attachment 7 Mussels. Post-project surveys would be completed 5 and 10 years after

construction. A relocation plan would be developed and coordinated. Annual reporting by January 31 in accordance with the USFWS's 2009 Biological Opinion would also be completed.

An Evaluation Report would be prepared after 10 years of monitoring to summarize the project history and the effectiveness of the project in meeting stated restoration objectives. Another reason for preparing this report is adaptive management, to derive lessons learned from the project experience for application to future restoration projects and river management.

Table 12-1
UMRS-EMP Monitoring and Performance Evaluation Matrix

Type of Activity	Purpose	Responsible Agency	Implementing Agency	Funding Source	Remarks
Problem Analysis	System-wide problem definition. Evaluate planning assumptions.	USGS	USGS (Upper Midwest Environmental Science Center - UMESC)	LTRM	Lead into pre-project monitoring; define desired conditions for plan formulation.
Pre-project Monitoring	Identify and define problems at specific sites.	Sponsor	Sponsor	Sponsor	Should attempt to begin defining baseline.
Baseline Monitoring	Establish baselines for performance evaluation.	Corps	Field stations or sponsors thru Cooperative Agreements, or Corps.*	HREP	Should be over several years to reconcile perturbations.
Data Collection for Design	1. Identify project objectives. 2. Design of project. 3. Develop Performance Evaluation Plan.	Corps	Corps	HREP	After fact sheet. Data may aid in defining baseline.
Construction Monitoring	Assure permit conditions met.	Corps	Corps	HREP	
Performance Evaluation Monitoring	Determine success of projects.	Corps	Field stations or sponsors thru Cooperative Agreements, sponsor thru O&M**, or Corps.*	HREP	After construction.
Analysis of Biological Responses to Projects	1. Determine critical impact levels, cause-effect relationships, and long-term losses of significant habitat.	USGS	USGS (UMESC)	LTRM	Biological Response Study tasks beyond scope of Performance Evaluation, Problem Analysis, and Trend Analysis.
	2. Demonstrate success or response of biota.	Corps	Corps/USGS (UMESC)/Others	HREP	

*Choice depends on logistics. When done by the States under a Cooperative Agreement, the role of the UMESC will be to: (1) advise and assist in assuring QA/QC consistency, (2) review and comment on reasonableness of cost estimates, and (3) be the financial manager. If a private firm or State is funded by contract, coordination with the UMESC is required to assure QA/QC consistency.

**Some limited reporting of information for some projects (e.g., waterfowl management areas) could be furnished by onsite personnel as part of O&M.

Table 12-2
Timeline and Performance Criteria for the Objectives

Objectives	Timeline - Post Construction	Performance Criteria
Objective 1: Maintain/increase the acreage (339 acres) of emergent and floating-leafed aquatic vegetation.	5-10 years	Spatial extent - 229 acres Maintain native species diversity
Objective 2: Maintain/increase the acreage of submersed aquatic vegetation in Capoli Slough and surrounding area	5-10 years	Average secchi transparency greater than 0.8m during growing season Spatial extent - 1,000 – 1,500 acres Maintain native species diversity
Objective 3: Within the Capoli Slough complex, maintain Capoli Slough (41 acres) as a well-defined, self-maintaining running slough habitat and restore similar habitat where possible**.**	5 years - physical response 10 years - mussel response	Physical – 41 acres * Maintain - cross-sectional area (width*depth), sinuosity (slough length/straight distance length), water surface facet slope *Substrate – extent of rock/gravel -1 acre Mussels *Density - 3.5/m^2 hot zone, 2.5/m^2 Capoli *Higgins eye density – 0.02/m^2 *Species richness – 19
Objective 4: Maintain protected wetlands and aquatic areas (600 acres) within the Capoli Slough complex.	5 years	Spatial extent - 600 acres
Objective 5: Maintain existing islands and increase the acreage of island habitat (120 acres).	5 years	Spatial extent - 49 acres
Objective 6: Provide turtle nesting habitat (3 acres) within or near the Capoli Slough complex.	5 years	Spatial extent - 3 acres
Objective 7: Enhance and/or develop protected off-channel lacustrine fisheries habitat within the Capoli Slough complex, including 10 acres of deepwater (greater than 4 feet) habitat meeting winter water quality criteria for overwintering fish habitat.	2 years – physical and water quality 5 years vegetation 10 years fish	Spatial extent deepwater (greater than 4 feet) – 10 acres Winter Water Quality * DO greater than 3 mg/l * water Temperatures 4 C^0 over 35 percent of area 2 to 4 C^0 over 30 percent of the area 0 to 2 C^0 over 35 percent of the area * Current velocities less than 0.3 cm over 80 percent of area Vegetation * 40 to 60 percent of area during summer Fish * Electro-fishing catch per unit effort of age1 plus fish in overwintering area greater than 150/hour

Table 12-3
Post Construction Monitoring for Capoli Slough HREP

Project Objective	Enhancement Measure	Unit of Measure	Measurement Plan	Monitoring Interval	Projected Cost/effort
Objectives 1and 2: Maintain/increase the acreage (339 acres) of emergent, floating-leafed and submersed aquatic vegetation.	Islands, mudflats	Acres, Aquatic Plants percent cover and species.	Islands (visual and aerial). Emergent vegetation	Aquatic vegetation – every 5 years.	$10,000
Objective 3: Within the Capoli Slough complex, maintain Capoli Slough (41 acres) as a well-defined, self-maintaining running slough habitat and restore similar habitat where possible**.**	Islands, cobble liners	Island acres, current velocity (ft/sec), bathymetry (feet), cross-sectional area (width*depth), sinuosity (slough length/straight distance length), water surface facet slope	Islands (visual and aerial). Slough Hydraulics, Dimension, Profile, & Pattern	Current velocity, bathymetry - 5, 10, 20 years post construction	$20,000
Objective 4: Maintain protected wetlands and aquatic areas (600 acres) within the Capoli Slough complex.	Islands, mudflats	Current velocity (ft/sec), Emergent, floating leaf, SAV % cover and species.	Emergent, floating leaf, and SAV, Current velocity	Emergent, floating leaf, and SAV vegetation – every 5 years	Covered in cost for Obj. 1.
Objective 5: Maintain existing islands and increase the acreage of island habitat (120 acres).	Islands	Acres	Islands (visual and aerial).	5, 10, 20 years post construction	Covered in cost for Obj. 1.
Objective 6: Provide turtle nesting habitat (3 acres) within or near the Capoli Slough complex.	Islands, pads, passing lanes	Acres	Islands (visual and aerial).	Every 5 years	Covered in cost for Obj. 1.
Objective 7: Enhance and/or develop protected off-channel lacustrine fisheries habitat within the Capoli Slough complex, including 10 acres of deepwater (greater than 4 feet) habitat meeting winter water quality criteria for overwintering fish habitat.	Fine material borrow, habitat dredging	Bathymetry (feet), current velocity (ft/sec), dissolved oxygen (mg/l), temperature (^{0}C)	Current velocity, bathymetry, winter water quality monitoring	Bathymetry – every 10 years. Other parameters 2, 5, 10, 20 years post construction	Bathymetry - Covered in cost for Obj. 2. WQ - $5,000

Table 12-4
Post Construction Biological Response Monitoring for Capoli Slough

Performance Evaluation Objective for Biological Response	Measurement Plan	Unit of Measure	Monitoring Interval	Projected Cost/effort
1.Evaluate fish use of the Capoli Slough complex as overwintering habitat	Fall electrofishing runs fixed and stratified random	Catch Per Unit of Effort (#/HR) of age 1 plus black crappie (>4"), bluegill (>3") and largemouth bass (>4")	Annual for first 5 years, periodically thereafter.	WDNR
2.Evaluate the assumption that Higgins eye and other native mussels will re-colonize the dredged access channels	Quantitative stratified random quadrats	Mussel density, species richness, presence of Higgins eye pearlymussel	5 and 10 years post construction	$35,000
3.Evaluate the long-term impacts from the project on Higgins eye and other native mussels within the Capoli Slough secondary channel	Quantitative stratified random quadrats	Mussel density, species richness , presence of Higgins eye pearlymussel	5 and 10 years post construction	Covered in cost for Obj. 2.
4. Annual reporting to the USFWS concerning implementation of Reasonable and Prudent measures and conservation measure	Annual summary report	None	1,2,3 during construction 5 and 10 years post construction	$2,000

13. COST ESTIMATE

The total project cost (fully funded) for the select plan is estimated to be $9,371,400 as summarized in table 13-1. This cost does not include prior allocations of $805,700 for general planning and design. For budget purposes, the Fully Funded - Indexed for Construction in 2012 – 2013 cost estimate is $10,093,700. A detailed cost estimate is contained in attachment 2.

Table 13-1
Summary of Recommended Plan Costs*

Construction	$8,095,000
Planning, Engineering and Design	$1,443,700
Construction Management	$555,000
Total	$10,093,700

* August 2010 price levels

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14. REAL ESTATE REQUIREMENTS

This EMP project is located in Pool 9 of the Upper Mississippi River in Crawford County. This direct Federal project will be constructed entirely on lands owned by the United States of America. Additionally, the navigational servitude applies to any work performed within the river. The project is located on lands that are administered by the USFWS and are managed by the USFWS as part of the Upper Mississippi River National Wildlife and Fish Refuge. No additional real estate interest in any lands will be necessary to complete this project.

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15. SCHEDULE FOR DESIGN AND CONSTRUCTION

A schedule for review and approval, major work tasks, and project construction is shown below. This schedule assumes the availability of funds to prepare plans and specifications and undertake construction will not be limiting.

Requirement	Scheduled Date
Submit draft Definite Project Report to Mississippi Valley Division, U.S. Army Corps of Engineers	Feb 2011
Submit final Definite Project Report to Mississippi Valley Division, U.S. Army Corps of Engineers	May 2011
Obtain construction approval from Mississippi Valley Division, U.S. Army Corps of Engineers	May 2011
Begin plans and specifications Stages 1 and 2	May 2011
Complete plans and specifications Stage 1	July 2011
Advertise for bids (budget dependent)	Aug 2011
Award contract	Sept 2011
Complete construction	Dec 2012
Complete Plans and Specifications Stage 2	Apr 2012
Advertise for bids (budget dependent)	Nov 2012
Award contract	Jan 2013
Complete construction	Dec 2013

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16. IMPLEMENTATION RESPONSIBILITIES

The responsibility for plan implementation and construction falls to the Corps of Engineers as the lead Federal agency. After construction of the project, project operation and maintenance would be required for measures of the project as discussed previously in Section 11 (OMRR&R) of this report. The USFWS would be responsible for operation and maintenance of the project.

Should rehabilitation that exceeds the annual maintenance requirements be necessary (as a result of a specific storm or flood event) for those portions of the Capoli Slough project located on the refuge, a mutual decision between the participating agencies would be made whether to rehabilitate the damaged portions of the project. If rehabilitated, the Federal share of rehabilitation would be the responsibility of the Corps of Engineers.

Performance evaluation, which includes monitoring of physical/chemical conditions and some limited biological parameters, would be a Corps of Engineers responsibility, as outlined in Section 12 of this report.

Attachment 10 contains a draft copy of the formal agreement that would be entered into by the Corps of Engineers and the USFWS before implementation of the project. This Memorandum of Agreement (MOA) formally establishes the relationships between the Department of the Army (DOA), represented by the Corps of Engineers, and the USFWS in constructing, operating, and maintaining the implemented measures of the Capoli Slough project. This MOA is used in lieu of a separate List of Items of Cooperation normally used in Specifically Authorized and Cost Shared projects because:

1. This project is 100 percent federally funded (per Section 906(e) of WRDA 1986) because it is taking place on a National Wildlife Refuge.

2. The project has no local sponsor because the project is 100 percent federally funded.

3. O&M is also a 100 percent Federal cost when the project is located on Federal lands, and, therefore, per Section 107(b) of WRDA 1992, O&M costs shall be borne by the Federal agency that is responsible for fish and wildlife management activities on such lands (here, the USFWS).

DOA will develop an Operation and Maintenance Manual for the project and will provide the manual to USFWS at project completion and turnover. The MOA shall remain in effect for a period of no more than 50 years after initiation of construction of the project.

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17. COORDINATION, PUBLIC VIEWS, AND COMMENTS

The planning for the Capoli Slough project has been an interagency effort involving the St. Paul District, the USFWS, and the Wisconsin and Iowa DNRs. Interagency meetings and site visits were held on a periodic basis throughout the study phase. In addition to the meetings, informal coordination took place on an as-needed basis to address specific problems, issues, and ideas. Formal Section 7 Consultation in accordance with the Endangered Species Act, 16 U.S.C. § 1536, was completed to address impacts to the endangered mussel, Higgins eye (see attachment 7).

A Problem Appraisal Report was completed for the project in April 2001. This report addressed the existing conditions and habitat problems in the project area, identified habitat goals and objectives, and identified alternatives to be studied in detail that would address the habitat goals and objectives.

A public meeting was held in Lansing, Iowa on December 6, 2001, to discuss the project and obtain public input on the planning process. The meeting was attended by 17 private citizens and by representatives of the Federal and State resource management agencies involved in the project.

See attachment 1 for pertinent coordination. Comments on the Preliminary Draft DPR by the partner agencies and the Corps responses are also included in attachment 1. The draft DPR/EA was sent to congressional interests; Federal, State, and local agencies; special interest groups; interested citizens; and others as listed in attachment 1. Comments on the Draft DPR from the public and agencies are attached to this Final Main Report. The USWFS supports the recommended plan and has provided a preliminary letter of intent to assume operation, repair, rehabilitation, and replacement (see USFWS letter dated March 21, 2011) based on the Draft DPR and Integrated EA. The USFWS Regional Director, in his letter on the Final DPR, will include the certification of support for operation, repair, rehabilitation, and replacement and the MOA in Appendix 10 will be signed by USACE and USFWS.

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18. CONCLUSIONS

The Capoli Slough Habitat Rehabilitation and Enhancement Project provides the opportunity to restore habitat for fish, migratory birds, and other forms of fish and wildlife indigenous to the Upper Mississippi River. The loss of islands, a decline in aquatic vegetation, and changes in bathymetry have substantially reduced the value of the project area to fish and wildlife. With no action, these changes are expected to continue, resulting in further degradation of habitat values.

A number of measures are aimed at correcting existing habitat problems and improving habitat conditions. The stabilization of remaining islands and the construction of additional islands will substantially improve conditions for the growth of emergent and submersed aquatic plants, increase the amount of protected areas, improve other habitat parameters for diving and dabbling ducks, and improve overall habitat diversity and quality in the project area. The islands will also serve, to a certain degree, to protect the existing vegetation and natural island areas by reducing northerly and southerly wind and wave action. The islands and associated habitats will provide improved habitat conditions for a wide variety of wildlife ranging from shorebirds to mammals to neotropical songbirds.

The lack of overwintering fish habitat has been identified by natural resource agencies as an important factor to overall fish habitat quality in lower Pool 9. Protecting existing and increasing deepwater habitats with low current velocities so that they provide suitable overwintering habitat for Centrarchids and other quiet-water fish species will improve overall fish habitat quality.

Protecting existing and constructing new islands along the deeper water secondary channel portion of the study area would maintain and enhance riverine fish and mussel habitat. The proposed project would preserve baseline cover types and will provide a defined self-maintaining channel with coarser substrates, high recruitment of woody debris (as cover), and lower turbidities.

The habitat benefits that would be gained by the Upper Mississippi River System from implementation of the project justify expenditure of public funds for preparation of plans and specifications and for construction.

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19. RECOMMENDATION

The recommended plan is Alternative E4 with Habitat Dredging B and Wetland K and creation of riffle pool structure in Capoli Slough. The recommended plan includes Islands A, B, C, D, E/E1,F, G, K L; Rock sills A and D; Rock Mound I; Habitat Dredging A and B; Wetland K; and two cobble liners.

Because the project is located on national wildlife refuge lands, project costs would be 100-percent Federal in accordance with Section 906 (e) of Public Law 99-662, 33 U.S.C. § 2283(e). The estimated cost of the project at current price levels is $10,093,700 (including sunk general design costs of $805,700). Upon project completion, the USFWS would responsible for Operation, Maintenance, Repair, Rehabilitation, and Replacement at an estimated cost at current price levels of $201,531. The recommended plan also includes an adaptive monitoring program at an estimated cost at current price levels of $180,000.

The study area covers 2,035 acres. The expected outputs include 229 acres of emergent and floating leaf aquatic vegetation; 1,000 to 1,500 acres of submerged vegetation; 49 acres of islands, including 3 acres of turtle nesting habitat; 41 acres of self sustaining diverse running slough; 10 acres of deepwater overwintering fish habitat; and 30,000 linear feet of sandy shoreline suitable for use by shorebirds and wading birds. The recommended plan will contribute 519.7 average annual habitat units over the 50-year period of analysis to the National Environmental Quality Account at an average annual cost of $838 per average annual habitat unit.

I have weighed the accomplishments to be obtained from the Capoli Slough project against its cost and have considered the alternatives, impacts, and scope of the proposed project. In my judgment, the cost the project is a justified expenditure of Federal funds. Therefore, I recommend that the Capoli Slough project for habitat restoration and enhancement in Pool 9 of the Upper Mississippi River be approved for construction.

The recommendations contained herein reflect the information available at this time and current departmental policies governing formulation of individual projects under the continuing authorities Environmental Management Program. They do not reflect program and budgeting priorities inherent in the formulation of a national Civil Works continuing authorities program nor the perspective of higher review levels.

Michael S. Price
Colonel, Corps of Engineers
District Engineer

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CAPOLI SLOUGH HABITAT REHABILITATION AND ENHANCEMENT PROJECT
POOL 9, MISSISSIPPI RIVER, WISCONSIN

Regional Planning and Environment Division North
Environmental and GIS Branch

FINDING OF NO SIGNIFICANT IMPACT

In accordance with the National Environmental Policy Act, Endangered Species Act, Clean Water Act, National Historic Preservation Act, Executive Orders, and other environmental laws and regulations, the St. Paul District, Corps of Engineers, has assessed the environmental impacts of the following project.

CAPOLI SLOUGH HABITAT REHABILITATION AND ENHANCEMENT PROJECT
POOL 9, MISSISSIPPI RIVER, WISCONSIN

The Upper Mississippi River System Environmental Management Program (UMRS-EMP) in Section 1103 of the 1986 Water Resources Development Act (WRDA), as amended in WRDA 1999 (Public Law 106-53), 33 U.S.C. § 652, authorizes the planning, construction, and evaluation of fish and wildlife habitat rehabilitation and enhancement projects (known as HREPs) on the UMRS.

A total of 23 alternatives, including the no action alternative, were evaluated in detail. The proposed project alternative, at a cost of around $10 million, includes restoration of 9 islands and protection of 10 existing barrier islands (49 acres total), creation of deep-water overwintering fish habitat, and a riffle/pool complex. Preservation and restoration of critical barrier island habitat in lower Pool 9 would reduce wind fetch and create more favorable conditions for aquatic vegetation. The purpose of the project is to maintain and improve fish habitat and resting and feeding habitat for migratory birds in 2,035 acres in lower Pool 9.

An integrated Definite Project Report and Environmental Assessment and 404(b) Evaluation was prepared and sent out for agency and public review. A public meeting was held to solicit input. There are no unresolved issues resulting from this review.

This Finding of No Significant Impact is based on the following factors: the proposed project would have long-term beneficial impacts on the aquatic environment and fishery resources; short-term minor adverse impacts on the aquatic and terrestrial environment from construction activities; minor beneficial impacts on the economic and social environment; and minor adverse impacts to the endangered Higgins eye.

FINDING OF NO SIGNIFICANT IMPACT (cont.)

CAPOLI SLOUGH HABITAT REHABILITATION AND ENHANCEMENT PROJECT
POOL 9, MISSISSIPPI RIVER, WISCONSIN

The environmental review process indicates that the proposed action does not constitute a major Federal action significantly affecting the quality of the human environment. Therefore, an environmental impact statement will not be prepared.

14 June 2011
Date

Michael J. Price
Colonel, Corps of Engineers
District Engineer

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COMMENTS ON DRAFT DEFINITE PROJECT REPORT AND INTEGRATED ENVIRONMENTAL ASSESSMENT

NEWS RELEASE

U.S. ARMY CORPS OF ENGINEERS **BUILDING STRONG®**

ST. PAUL DISTRICT
Feb. 23, 2011
MVP-PA-2010-009
Shannon Bauer: 651-290-5108, 612-840-9453, shannon.l.bauer@usace.army.mil
Mark Davidson: 651-290-5201, 651-261-6769, mark.d.davidson@usace.army.mil
Patrick Moes: 651-290-5202, 651-366-7539, patrick.n.moes@usace.army.mil

Draft report for Capoli Slough island building/restoration project available for public review and comment

ST. PAUL, Minn. – The U.S. Army Corps of Engineers, St. Paul District, is proposing to construct nine new islands and protect 10 existing islands in Capoli Slough, which is located on the Wisconsin side of the Upper Mississippi River in lower Pool 9 near Lansing, Iowa.

The project would include protecting or restoring around 49 acres of island habitat and creating 10 acres of overwintering habitat for bluegills and other fish species, which would contribute to enhancing the aquatic diversity in this 2,000 acre study area. The Capoli Slough complex has been declining in size since the creation of the lock and dam system on the Upper Mississippi river and currently only 11 acres of islands remain. Project construction would begin in 2012 and be completed by 2014. Estimated cost is $10 million.

The St. Paul District prepared a draft Definite Project Report and Integrated Environmental Assessment for the project, and it is available for public review and comments until March 18. A copy of these documents can be obtained by visiting a local library or by visiting the district website at: http://www.mvp.usace.army.mil/environment/default.asp?pageid=124. Comments on the report can be submitted to the District Engineer, St. Paul District, U.S. Army Corps of Engineers, 180 E. Fifth St., Ste. 700, St. Paul, MN 55101-1678.

The public is also invited to attend an informational meeting concerning the project's anticipated activities and schedule. The meeting will be held Monday, March 7, from 6:30-8:30 p.m. at the Kerndt Brother's Community Center, located at 391 Main St. in Lansing, Iowa.

For more information in regards to the draft report and environmental assessment, contact Dennis Anderson, the Corps' environmental specialist for the project, at 651-290-5272.

The U.S. Army Corps of Engineers, St. Paul District, serves the American public in the areas of environmental enhancement, navigation, flood damage reduction, water and wetlands regulation, recreation sites and disaster response. It contributes around $175 million to the five-state district economy. The 700 employees work at more than 40 sites in five upper-Midwest states. For more information, see www.mvp.usace.army.mil.

-30-

Public Meeting
Capoli Slough and Harpers Slough
Habitat Rehabilitation and Enhancement Projects
Lansing, Iowa
March 7, 2011, 6:30-8:30 pm

Name	Address (for mailing list)	Affiliation (if any)
Mark Franckus	[redacted]	
Chris Meyer		
Bob Meyer		
Tim Yager		
BYRON CLEMENT		
Doug Smith		
Greg Fiedler		
MARK SCHNEIDER		
Richard De		2146
Jesse Waymiller		5215
Jim Barry		

Public Meeting
Capoli Slough and Harpers Slough
Habitat Rehabilitation and Enhancement Projects
Lansing, Iowa
March 7, 2011, 6:30-8:30 pm

Name	Address (for mailing list)	Affiliation (if any)
William H Howe	[redacted]	
GLEN WENDEL		
Stanley W. Hagerich		
Sharonne Baylor		
Mark Clements		
DARRIN MELLAS		
William Hubbard		
Bob Kurtt		
Bob Black		
Marty Brennan		
Jerry Boardman		

Public Meeting
Capoli Slough and Harpers Slough
Habitat Rehabilitation and Enhancement Projects
Lansing, Iowa
March 7, 2011, 6:30-8:30 pm

Name	Address (for mailing list)	Affiliation (if any)
LARRY KNUTSON	[redacted]	
Lon Flick Box 84		
John Verdon		
LARRY Shamme		
Allan Kirchner		
Bob HENKEL		
Russ Quackenbush		
Brian Pottorff		
Jay Clark		
RYAN DIEHL		
DON TORAN		

Public Meeting
Capoli Slough and Harpers Slough
Habitat Rehabilitation and Enhancement Projects
Lansing, Iowa
March 7, 2011, 6:30-8:30 pm

Name	Address (for mailing list)	Affiliation (if any)
Todd Lansing	[redacted]	
Bill Nation		
Earl Meeter		

March 7, 2011 Public Meeting

U.S. ARMY CORPS OF ENGINEERS **BUILDING STRONG®**

ST. PAUL DISTRICT
March 7, 2011

Draft report for Capoli Slough Habitat and Rehabilitation Project Public review and comment

Comments Received at March 7, 2011 Capoli HREP Public Meeting:

1. Citizen A: Maintain scour (location on NW side of project) to keep channel deeper. Use seed islands to trap sediment.
   Response: The access channel was realigned and a seed island added to address this concern.

2. Bill Howell: Don't just focus on Higgins eye mussels. Look at all other mussels, especially state-listed threatened and endangered species.
   Response by Dennis Anderson: We considered all mussel species in project planning.

3. John Vernon, Friends of Pool 9: His Board is very supportive of the Capoli project. He expect it to improve fishing.

4. Citizen B: Pool 9 Islands project experienced island erosion, rock wearing. Will this happen at Capoli?
   Response by Dennis Anderson: Capoli islands will be much more protected with rock mounds and rock sills.

5. Citizen C: Why didn't "they" save these islands 30 years ago?
   Response by COE/FWS: Better awareness of need for ecosystem protection and restoration now than 30 years ago. EMP is 25 years old and focuses on ecosystem restoration.

6. Citizen D: Thief Island will disappear soon. Boat landing at Genoa? Has been a concern for 12 years. Dairyland Power started erosion by tying off barges there.
   Response: Not project related.

7. Citizen E: Rock berm. Why is there a 50' strip of water between the rock and the island.
   Response by Tim Yager: Purpose of project is to create emergent aquatic vegetation habitat.

8. Citizen E: Need willows to protect island.
   Response: Two rows of willows would be planted along the shorelines.

9. Citizen F: Is there a drawdown planned for Pool 9 in 2011? Opposed to a drawdown. Too many weeds. Recreational impacts.
   Response by Jeff DeZellar: No drawdown is planned for Pool 9. WLMTF is discussing future drawdowns in Pool 8 and/or Pool 3. Funding for planning and implementation is a major challenge. Very aware of recreational access issues e.g. 2010 Pool 6 drawdown challenges. Public input will be sought for any proposed drawdowns.

State of Wisconsin
DEPARTMENT OF NATURAL RESOURCES
101 S. Webster Street
Box 7921
Madison WI 53707-7921

Scott Walker, Governor
Cathy Stepp, Secretary
Telephone 608-266-2621
FAX 608-267-3579
TTY Access via relay - 711

June 3, 2011

Colonel Michael J. Price
Dept. of the Army, St. Paul District, Corps of Engineers
180 5th Street East, Suite 700
St. Paul, MN 55101-1678

Subject: Capoli Slough, Habitat Rehabilitation and Enhancement Project

Dear Colonel Price:

This letter conveys the Wisconsin Department of Natural Resources' support for construction of the Capoli Slough Habitat Rehabilitation and Enhancement Project, Pool 9, Upper Mississippi River. This project will be constructed under authority of the Environmental Management Plan as described by Section 509 of the Water Resources Development Act of 1999.

The combination of restoration features identified in the Definite Project Report will greatly benefit a variety of Mississippi River fish and wildlife. Water quality certification will be done separately for each stage of construction following completion of the draft plans and specifications for project features located in Wisconsin waters.

I look forward to completion of the Capoli Slough Habitat Rehabilitation and Enhancement Project and the benefits it will provide to the Upper Mississippi River System.

Sincerely,

Cathy Stepp
Secretary

c: Tom Melius , Regional Director, USFWS
Kevin Forester, Complex Manager, USFWS
Jeff Janvrin, Wisconsin DNR, La Crosse
Dennis Anderson, Corps of Engineers, St. Paul Island District

State of Wisconsin
DEPARTMENT OF NATURAL RESOURCES
La Crosse Service Center
3550 Mormon Coulee Road
La Crosse WI 54601

Scott Walker, Governor
Cathy Stepp, Secretary
Scott Humrickhouse, Regional Director
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WISCONSIN
DEPT. OF NATURAL RESOURCES

March 23, 2011

Mr. Dennis Anderson
Environmental and GIS Branch
U.S. Army Corps of Engineers, St. Paul District
180 Fifth Street East, Suite 700
St. Paul MN 55101-1678

Subject: Capoli Slough EMP Habitat Rehabilitation and Enhancement Project, Draft DPR

Dear Mr. Anderson:

We have completed review of the Capoli Slough Habitat Rehabilitation and Enhancement Project (HREP), Draft Definite Project Report (DPR) and Integrated Environmental Assessment, dated February 2011. We support the majority of proposed features of the selected plan with the exception of reducing the size of habitat dredging area B.

Habitat Dredging A and B are both needed, in their entirety, to meet objectives for protected off channel fisheries habitat (overwintering habitat). Additional factors not included in the habitat assessment models, and therefore not captured in the incremental analysis, justify the inclusion of both A and B in the selected plan.

The overwintering habitat objective and initial conceptual plan were developed in the early 2000's. The objective was developed without the insight of an existing centrarchid overwintering sites inventory. Since then, the Wisconsin and Iowa DNR's conducted a multi-year inventory of overwintering sites in Pools 4 – 11. The DPR correctly summarizes the findings for Pool 9, stating that between rivers miles 648 – 661 there are only 2 sites; a poor quality site at Capoli and the high quality site at Cold Springs. This documents the scarcity of this unique habitat type in the lower 13 miles of Pool 9. Maintaining and enhancing overwintering habitat at Capoli is consistent with other project objectives and clearly needed in this section of the river.

Winter water quality monitoring over the past 10 years at completed HREP's has documented the influence eddies have on the quality of overwintering habitat and radio telemetry studies at 2 HREPs documented winter habitat use in response to eddies. Results of the radio tracking study showed centrarchids avoided areas where eddies were present. The dropping of Island K1 appears to have resulted in a larger proportion of the island interior being influenced by eddy flow (unfortunately, no model run was done to verify if Island K1 would have reduced the influence of eddy flow). Modeled eddy flow within the interior of the islands was one reason habitat dredging B was added to function as an overwintering complex in conjunction with A.

The stated physical criteria for overwintering habitat at Capoli include meeting winter water velocities of 0.3 cm/sec and DO > 3mg/l. The Hydraulic Appendix states the modeled velocity vectors within the island interior are less than 1.2 cm/sec. This, along with a figure illustrating the vectors, indicates habitat dredging A will have velocities up to 4 times greater than design criteria for overwintering habitat when river discharge is 30,000 cfs. Monitoring at other HREPs shows it is likely the eddy will be present at lower river discharges, although it's potential influence may be less. This information also indicates habitat dredging B should meet the velocity criteria, however, given the location of habitat dredging B, the area may occasionally have DO < 3 mg/l. The

combination of habitat dredging A and B provides for a gradient of overwintering habitat conditions over a wide range of river discharge conditions. Therefore, both A and B must be completed to fully meet overwintering habitat objectives and will require either sizing wetland K to accommodate the amount of material to be dredged from both areas or the addition of emergent wetland A to accommodate the material.

We concur with the recommendation to not construct Islands H and J at this time. However, the DPR must document the planning team's concerns about the small mouth bass model and wind fetch models lacking sensitivity to detect the benefits these islands would provide for mussels and other riverine species. The team recommended adaptively assessing the selected plan by monitoring habitat and channel conditions in Capoli Slough to determine if objectives were being met. This included the recommendation of implementing these features in the future by incorporating them into later stages of Capoli Slough HREP construction, or as part of other construction activities in Pool 9, if monitoring indicates the islands were needed.

Following are additional comments on the report:

4.4 – Estimated future habitat conditions: Add discussion of estimated future conditions of fish and mussel habitat conditions.

6.3.7 – Isolated wetlands: The Wisconsin DNR still supports the creation of isolated wetlands in the Capoli Slough complex for the benefits this habitat type would provide for a variety of wildlife. Revise as follows, "However, there was a concern raised by some members of the planning team that…"

7.3.3 Alternative C - Habitat Benefits: Add description of Islands K and K1 influence on reducing velocities and benefits to prolonging the life of existing overwintering habitat.

8.9.1 Sources of Material – Sand: The granular borrow source area(s) need better delineation of the borrow source area and a that it meets a P200 < 10% before dredging occurs.

8.9.2 Random Fill – Remove reference to granular material as a source for random fill. This will provide for additional capacity within island cross-sections for material dredged from Habitat Dredging A and B if the capacity is not needed for access dredging.

Wisconsin water quality certification for the project should be requested following completion of draft plans and specifications for the project. We look forward to the completion of the Capoli Slough Definite Project Report and construction of the project. Please contact Jeff Janvrin at 608-785-9005 or jeff.janvrin@Wisconsin.gov, if you have questions regarding our comments.

Sincerely,

Ron Benjamin
Mississippi River Fisheries Supervisor

cc: Kevin Forester, US. FWS, Winona
Tim Yager, US FWS, McGregor
Sharrone Baylor, US FWS, Winona
Pam Thiel, US FWS, La Crosse Fish and Wildlife Conservation Office
Mike Griffin, Iowa DNR
Scott Gritters, Iowa DNR
Phil Delphey, US FWS, Twin Cities Ecological Services

DEPARTMENT OF THE ARMY
ST. PAUL DISTRICT, CORPS OF ENGINEERS
180 FIFTH STREET EAST, SUITE 700
ST. PAUL MN 55101-1678

June 7, 2011

REPLY TO
ATTENTION OF

Regional Planning and Environment Division North

Mr. Ronald Benjamin
Mississippi River Fisheries Supervisor
Wisconsin Department of Natural Resources
La Crosse Service Center
3550 Mormon Coulee Road
La Crosse, Wisconsin 54601

Dear Mr. Benjamin:

The Corps of Engineers has received the Wisconsin Department of Natural Resources (WDNR) comments in a letter dated March 23, 2011, on the February 2011 draft Definite Project Report and Integrated Environmental Assessment (DPR) for the proposed Capoli Slough Habitat Rehabilitation and Enhancement Project. The project proposes to construct islands, deepwater areas, mudflats, and other habitat features to benefit fish and wildlife within Pool 9 of the Mississippi River, Crawford County, Wisconsin. We appreciate WDNR's general support of most of the features of the recommended plan of Alternative E4 with Habitat Dredging B, Emergent Wetland K, and riffle structures. A summary of the WDNR's comments and our responses are below.

WDNR General Comments:

We support the majority of proposed features of the selected plan with the exception of reducing the size of habitat dredging area B. Habitat Dredging A and B are both needed, in their entirety, to meet objectives for protected off channel fisheries habitat (overwintering habitat). Additional factors not included in the habitat assessment models, and therefore not captured in the incremental analysis, justify the inclusion of both A and B in the selected plan

Response: We understand the WDNR's position, but believe that the project as recommended would include Habitat Dredging A and B, which would provide the desired habitat benefits in a cost effective fashion. Habitat dredging B would be listed as a first priority, but based on a quantity balance for the need for fine material for topsoil and emergent wetland creation we believe that both Habitat Dredging A and B would be necessary.

We concur with the recommendation to not construct Islands H and J at this time. However, the DPR must document the planning team's concerns about the smallmouth bass model and wind fetch models lacking sensitivity to detect the benefits these islands would provide for mussels and other riverine species. The team recommended adaptively assessing the selected plan by monitoring habitat and channel conditions in Capoli Slough to determine if objectives

were being met. This included the recommendation of implementing these features in the future by incorporating them into later stages of Capoli Slough HREP construction or as part of other construction activities in Pool 9, if monitoring indicates the islands were needed.

Response: EMP is an adaptive program. With Conway, Harpers, and Winneshiek Habitat Rehabilitation and Enhancement Projects in various stages of planning and construction, it is likely that we will be constructing projects in Pool 9 over the next several years. There will be ample opportunities to evaluate and adaptively manage the Capoli Slough project area, which may include the future additions of Islands H and J and/or additional habitat dredging.

WDNR Specific Comments:

4.4 - Estimated future habitat conditions: Add discussion of estimated future conditions of fish and mussel habitat conditions.

Response: We have added a discussion of those conditions.

6.3.7 - Isolated wetlands: The Wisconsin DNR still supports the creation of isolated wetlands in the Capoli Slough complex for the benefits this habitat type would provide for a variety of wildlife. Revise as follows, "However, there was a concern raised by some members of the planning team that ..."

Response: We have added the recommended wording.

7.3.3 Alternative C - Habitat Benefits: Add description of Islands K and Kl influence on reducing velocities and benefits to prolonging the life of existing overwintering habitat.

Response: We have added that discussion.

8.9.1 Sources of Material - Sand: The granular borrow source area(s) need better delineation of the borrow source area and that it meets a P200 < 10% before dredging occurs.

Response: The percent fines criterion has been added. Additional borings will be taken during plans and specifications, and the borrow area will be clearly defined.

8.9.2 Random Fill - Remove reference to granular material as a source for random fill. This will provide for additional capacity within island cross-sections for material dredged from Habitat Dredging A and B if the capacity is not needed for access dredging.

Response: We have added that habitat dredging material is the preferred source of random fill, above the access dredging quantities. However, we will leave granular fill as an option for random fill to achieve the most cost effective bid.

Wisconsin water quality certification for the project should be requested following completion of draft plans and specifications for the project.

Response: We will apply for Water Quality Certification during plans and specifications.

The Corps is pleased that the WDNR has indicated its interest for the proposed project, and we look forward to our continued partnership with the U.S. Fish and Wildlife Service and State agencies on implementing, if funded, this beneficial project. If you have any questions or comments, please contact Dennis Anderson at (651) 290-5272, dennis.d.anderson@usace.army.mil, or at the address above.

Sincerely,

Terry J. Birkenstock
Deputy Chief, Regional Planning and
Environment Division North

United States Department of the Interior

U.S FISH AND WILDLIFE SERVICE
Upper Mississippi River National Wildlife and Fish Refuge
51 E. Fourth Street - Room 101
Winona, Minnesota 55987

IN REPLY REFER TO:

March 21, 2011

Mr. Dennis Anderson
Environmental and GIS Branch
US Army Corps of Engineers, St. Paul District
180 Fifth Street East, Suite 700
St. Paul, MN 55101-1678

Dear Mr. Anderson,

Thank you for the opportunity to review and comment on the Capoli Slough HREP draft Definite Project Report and Integrated Environmental Assessment (project #114832) dated February 2011. This project will benefit the biological resources of the Upper Mississippi River National Wildlife and Fish Refuge. The US Fish and Wildlife Service supports the recommended plan of Alternative E4 with Habitat Dredging B, Emergent Wetland K, and riffle structures.

The US Fish and Wildlife Service has the following comments regarding the document.

1. Emergent Wetland K: Please revise page 7-13, section 7.6.1 which states that emergent wetlands would be created near Islands A and K. The only required emergent wetland is Emergent Wetland K. The emergent wetland discussion on page 8-5, section 8.3.5, is correct in identifying Emergent Wetland K as the only required emergent wetland; the others are optional areas for excess access channel material disposal.

2. Habitat Dredging B: Clarify Habitat Dredging B requirements on page 8-6, section 8.4. Habitat Dredging B excavation is complete when sufficient quantities have been removed to complete the island fine fill sections and Emergent Wetland K.

3. Access Dredging Material Placement: Consider allowing the Contractor to place excess access dredging material in an island random fill section. If this is allowed, please revise the following paragraphs: 1) page 8-9, section 8.8, last paragraph; and 2) page 8-10, section 8.9.2.

4. Aquatic Vegetation: Page 1-4, section 1.5, first paragraph, discusses the decline in aquatic vegetation over the past few decades. Vegetation has recovered over the last 10 years, and has significantly recovered in the last 5. Revise the paragraph to reflect the project area's vegetation recovery.

5. Invasive Species Management: Page 3-6, section 3.5, last paragraph discusses invasive plants. Revise the last sentence to state, "The USFWS and State resource agencies are actively pursuing methods to control the spread of invasive species on lands they manage."

6. Bald Eagle Nesting: Page 3-10, section 3.7.4, paragraph 3 discusses eagle nesting. Please revise several areas of this paragraph.

   6.1. The paragraph states that "...eagles occasionally nest on the ground or on cliffs..." Remove this reference. Nests on the ground or cliffs in the project area is not a real possibility, except for some very small likelihood that adults may continue to feed eaglets in a nest that has fallen from a tree.

   6.2. Remove the sentence that begins, "They seem to prefer to nest in mature or old growth.." This is too vague and potentially misleading.

   6.3. Remove the sentence, "Nests are usually located in dead or dying hardwood trees." Bald eagles do nest in dead trees, but it is not necessarily typical. For example, Guinn found that the majority of nest trees in his study were in live trees. (Guinn, J. E. 2004. BALD EAGLE NEST SITE SELECTION AND PRODUCTIVITY RELATED TO HABITAT AND HUMAN PRESENCE IN MINNESOTA. Ph.D. Dissertation. North Dakota State University. Fargo, ND. 159 p.)

7. Bald Eagle Nesting: Page 6-2, section 6.2.3.8 references bald eagle nesting seasons. Change "Minnesota" to "Iowa and Wisconsin".

8. Project Objective: Page 10-3, Table 10-1. Remove "waterfowl and" from Objective 6 description. (Note that this objective is labeled incorrectly as "Objective 5".)

9. Memorandum of Agreement: The final Definite Project Report must include a copy of the draft Memorandum of Agreement for the operation, maintenance, and rehabilitation of the project. As funding allows, the US Fish and Wildlife Service will cover operation and maintenance costs as described in the report. The Regional Director's letter on the final Definite Project Report will include the certification of support for operation and maintenance.

These comments have been prepared under the authority of the Fish and Wildlife Coordination Act (16 U.S.C. 661 et seq.), the National Environmental Policy Act of 1969 (42 U.S.C. 4321-4347), the Endangered Species Act of 1973, (16 U.S.C. 1531-1543), as amended, and the U.S. Fish and Wildlife Service's Mitigation Policy.

We are pleased to see this project moving forward, and look forward to our continued partnership with the Corps and state agencies on this beneficial project. If you have any questions or need more information, please contact Ms. Sharonne Baylor, our EMP coordinator, at (507) 494-6207.

Sincerely,

Kevin Foerster
Refuge Manager

cc: Tim Yager, McGregor District Manager
Pam Thiel, La Crosse Fish and Wildlife Conservation Office
Phil Delphey, Twin Cities Ecological Services
Mike Griffin, Iowa DNR
Jeff Janvrin, Wisconsin DNR

DEPARTMENT OF THE ARMY
ST. PAUL DISTRICT, CORPS OF ENGINEERS
180 FIFTH STREET EAST, SUITE 700
ST. PAUL MN 55101-1678

JUNE 7, 2011

REPLY TO
ATTENTION OF

Regional Planning and Environment Division North

Mr. Kevin Foerster, Refuge Manager
Upper Mississippi River National
Wildlife Refuge and Fish Refuge
U.S. Fish and Wildlife Service
51 E. Fourth Street – Room 101
Winona, Minnesota 55987

Dear Mr. Foerster:

The Corps of Engineers has received the U.S. Fish and Wildlife Service (USFWS) comments in a letter dated March 21, 2011, on the February 2011 draft Definite Project Report and Integrated Environmental Assessment (DPR) for the proposed Capoli Slough Habitat Rehabilitation and Enhancement Project (HREP). The project proposes to construct islands, deepwater areas, mudflats, and other habitat features to benefit fish and wildlife within Pool 9 of the Mississippi River, Crawford County, Wisconsin. We appreciate USFWS's support of the recommended plan of Alternative E4 with Habitat Dredging B, Emergent Wetland K, and riffle structures. We concur with your specific comments 1through 8 and have revised the sections in the final DPR accordingly. Our response to comment 9 is below.

USFWS Comment 9:
Memorandum of Agreement: The final Definite Project Report must include a copy of the draft Memorandum of Agreement for the operation, maintenance, and rehabilitation of the project. As funding allows, the US Fish and Wildlife Service will cover operation and maintenance costs as described in the report. The Regional Director's letter on the final Definite Project Report will include the certification of support for operation and maintenance.

Response: The Draft DPR contained a Draft Memorandum of Agreement in appendix 10. The Final DPR will contain a Final Memorandum of Agreement between the Department of the Army and USFWS.

The Corps is pleased that USFWS has indicated its interest in the proposed project, and we look forward to our continued partnership with the USFWS and State agencies on implementing this

beneficial project. If you have any questions or comments, please contact Dennis Anderson at (651) 290-5272, dennis.d.anderson@usace.army.mil, or at the address above.

Sincerely,

Terry J. Birkenstock
Deputy Chief, Regional Planning and
Environment Division North

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 5
77 WEST JACKSON BOULEVARD
CHICAGO, IL 60604-3590

MAR 1 8 2011

REPLY TO THE ATTENTION OF:
E-19J

Dennis Anderson
U.S. Army Corps of Engineers
St. Paul District
180 Fifth Street East, Suite 700
St. Paul, Minnesota 55101-1678

Re: Draft Definite Project Report and Integrated Environmental Assessment - Capoli Slough Habitat Rehabilitation and Enhancement Project, Mississippi River, Crawford County, Wisconsin

Dear Mr. Anderson:

In accordance with our responsibilities under the National Environmental Policy Act, the Council on Environmental Quality's NEPA Implementing Regulations (40 CFR 1500-1508), and Section 309 of the Clean Air Act, we have reviewed the above-mentioned project. The proposed project would protect and/or restore about 49 acres of islands, create about 10 acres of protected deepwater over-wintering habitat for backwater fish species, create 5 acres of mudflats, and create a riffle/pool complex.

General Comments
Part of the project will include cobble liners along several of the restored islands. The sediment load in lower Pool 9 can be significant. With the islands reducing wave action and creating still waters behind the islands, there is the potential for the velocity of the current to slow to the extent that the sediments will settle and begin to cover the cobble liners, negating the habitat benefits associated with the cobble habitat. Will the cobble line require additional or special dredging to remain as cobble habitat?

This project is essentially being constructed to restore island and backwater habitat that has been lost due to wave action and the islands being overly-wet with limited opportunities to dry out. The information provided is not clear how the new islands will be protected from future erosion.

The restoration project is proposed for 820 acres within the 2,035-acre study area. The EA would benefit from a summary of the vetting process that resulted in the preferred alternative - when the project was identified and debated by the Fish and Wildlife Workgroup and the River Resources Forum.

Reviewing the historic aerial photographs, it appears there was an extensive complex of islands closer to Lock and Dam 9, river miles 658 - 648. Acknowledging that this EA analyzes the proposed action, the restoration of Capoli Slough, is there any evidence that any of these islands still exist below the surface? If so, what measures might help stabilize these islands?

Section 1.5 – Resource Problems/Opportunities
Constant water levels and the wave action have resulted in the degradation and loss of the island habitat. Will these conditions remain a problem in the future? Unless periodic drawdowns are integrated into the project, the loss of the restored islands could continue after project completion.

Section 4.2 – Historically Documented Changes in Habitat Condition
The aerial photographs from 1929 show the area of both Capoli and Ferry Sloughs. These areas had a large land component and less open water areas. The elevation of vegetated areas was 613 feet, which is seven feet below current water levels (the current elevation of Pool 9 is 620 ft.). During the first eight years after the closure of the Lock and Dam 9, pool drawdowns were conducted. Water levels were allowed to drop to 617.5 feet, which provided some habitat stabilization. However, this activity was discontinued after the eighth year of operation. We recommend the U.S. Army Corps of Engineers (USACE) discuss what efforts or changes in authority would be required to allow the water levels to be drawn down to previous levels on a regular basis, allowing for compaction of soils and island stabilization. Additionally, the analysis would benefit from a discussion focused on the effects of changes in hydrology in the system, particularly water depth causing island soils to be almost continually wet and allowing wave action to have adverse effects.

Objective 3, maintain and restore well-defined running slough habitats, is intended to provide habitat for species in the Upper Mississippi River and diversity of species. The discussion indicates that running sloughs can be valuable habitat for mussels. A discussion focused on the recently-listed endangered mussel species, the sheepnose and the spectacle case, would be useful, especially whether the project area has historically provided habitat for these species and could provide habitat as a result of the proposed project.

Objective 5 recommends preservation of existing islands as well as an increase in acreage of island habitat. The Environmental Assessment should indicate whether a drawdown to water levels of 617.5 ft. or lower could enhance the potential to preserve and enhance the islands and their habitat.

If you have any questions, please do not hesitate to contact me or Kathleen Kowal of my staff at (312) 353-5206 or via email at kowal.kathleen@epa.gov, or Bill Franz, Upper Mississippi River at (312) 886-7500 or via email at franz.william@epa.gov.

Sincerely,

Kenneth A. Westlake, Chief
NEPA Implementation Section
Office of Enforcement and Compliance Assurance

DEPARTMENT OF THE ARMY
ST. PAUL DISTRICT, CORPS OF ENGINEERS
SIBLEY SQUARE AT MEARS PARK
190 FIFTH STREET EAST, SUITE 401
ST. PAUL MN 55101-1638

June 7, 2011

Regional Planning and Environment Division North

SUBJECT: E-19J, EPA Comments on the Draft Definite Project Report and Integrated Environmental Assessment for the Capoli Slough Habitat Rehabilitation and Enhancement Project, Pool 9, Mississippi River, Crawford County, Wisconsin

Mr. Kenneth A. Westlake
Chief, NEPA Implementation Section
Office of Enforcement and Compliance Assurance
USEPA, Region 5
77 West Jackson Boulevard
Chicago, Illinois 60604-3590

Dear Mr. Westlake:

The Corps of Engineers has received the Environmental Protection Agency's (EPA) comments on the draft Definite Project Report and Integrated Environmental Assessment (DPR) for the proposed Capoli Slough Habitat Rehabilitation and Enhancement Project (HREP). The project proposes to construct islands, deepwater areas, mudflats, and other habitat features to benefit fish and wildlife within Pool 9 of the Mississippi River, Crawford County, Wisconsin. We appreciate EPA's comments, which are summarized below, and provide our responses in accordance with the National Environmental Policy Act of 1969 (42 U.S.C. 4321-4347) and other authorities.

GENERAL COMMENTS

1. Newly-created and existing islands will create "still" areas where velocities are reduced, contributing to sedimentation. Over time, proposed cobble liners in such areas will be buried by sediments, thus negating habitat benefits. Will additional dredging be needed?

Response: The Corps does not anticipate any additional dredging to maintain hydraulic diversity associated with the proposed cobble liners. Two structures, located about 200 feet apart, are proposed at strategic locations within Capoli Slough proper, close to where the secondary channel connects with the main channel (see Plate 8 of the draft DPR). Existing and proposed islands will help maintain the morphology of the secondary channel and enhance associated flows. No other features are proposed that would cause velocities in the slough proper area to be reduced. The cobble liner is expected to be self- maintaining (i.e., scour conditions). Thus, the habitat benefits associated with this hydraulic diversity will be sustained through the life of the project. A similar structure near the upstream part of this same channel has been in place for decades (prior to locks and dams) and has created a scour hole over 8 feet deep as shown in the 1998 bathymetric survey (Figure 1).

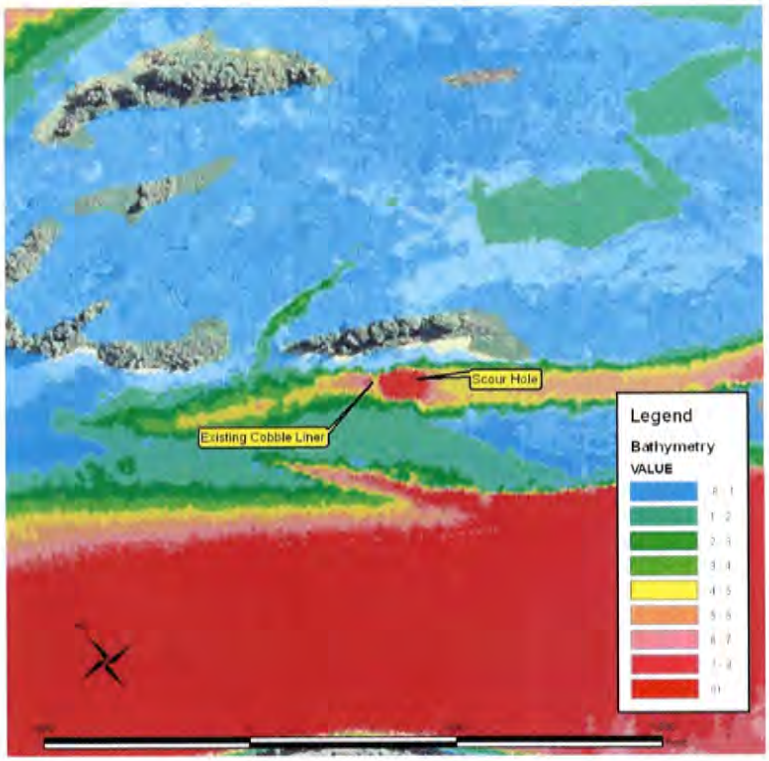


Figure 1. Existing cobble liner in Capoli Slough proper and associated bathymetry.

2. Provide information on how new islands will be protected from future erosion.

Response: Minimizing shoreline erosion and stabilizing banks of new and existing islands have been considered throughout the planning process. Section 6.2.4 (Bank Protection) of the DPR briefly discusses traditional protection features the Corps has experience using on other HREP projects in the Upper Mississippi River (namely, vanes, groins, rock layers on the bank or rock mounds). Section 6.3.2 (Islands) references the Engineering and Design Handbook that discusses recommendations for elevation, width, side slopes, topsoil and vegetation. These recommendations have been developed with consideration to minimizing bank erosion. A comprehensive approach to addressing bank erosion considers, among other things, island location and configuration, bank exposure, and effects of wind-generated wave action. The latter is a primary driver of erosion and is discussed in detail in Attachment 9 (Wind and Wave Appendix). In addition, design criteria have been developed specifically for shoreline protection features as discussed in Attachment 5 (Hydraulic Appendix). Structures planned for the project fall into two general categories: rock (mounds or vanes) and vegetative.

3. The Environmental Assessment would benefit from a summary of the vetting process involving debate by the Fish and Wildlife Workgroup and the River Resources Forum.

Response: Section 2.2 of the DPR discusses how the Fish and Wildlife Work Group and the River Resources Forum were involved in the development of the initial conceptual plan and sequencing and selection of Capoli Slough project for study. Section 7 of the DPR

(Development and Evaluation of Alternatives) discusses some of the various conceptual features considered during the planning process and includes the desired future habitat conditions of the area as identified by the interagency Fish and Wildlife Work Group of the River Resources Forum. In an effort to maintain brevity of the document, further details of the vetting process have not been included. The Corps is in the process of obtaining endorsement from the River Resources Forum.

4. Historically, an extensive complex of islands existed between river miles 648and 658. Do remnants of these islands still exist and, if so, what measures might help stabilize these islands?

Response: Bathymetric survey data indicate that island remnants exist in this reach of the river. Because this area is outside the Capoli Slough HREP, there will be no direct effects to minimizing erosion to these downstream islands and it is not addressed in the DPR. However, the proposed project may have minor benefits by reducing wind fetch from the northwest direction. The Corps is currently in the planning phase for the Harper's Slough HREP. We have also identified the Lake Winneshiek HREP as a future project for consideration. Both of these projects are within the area identified and would have features similar to those of the Capoli Slough HREP (i.e., new islands, mudflats, and deepwater areas) to help minimize erosion and stabilize existing islands. Final planning and implementation of these projects is subject to funding.

SPECIFIC COMMENTS

1. Section 1.5 – Resource Problems/Opportunities. Will constant water levels and wave action remain a problem for island habitat losses? Unless periodic drawdowns are integrated into the project, the loss of the restored islands could continue after project completion

Response: Constant water levels and wave action will continue to be an erosion problem, especially for islands in Pool 9 with high exposure to wind fetch that lack protection features. Proposed newly created islands of this project have been designed with this in mind and should remain stable whether or not periodic drawdowns occur. The Corps has observed this in other HREP projects, most notably, the Pool 8 islands. However, the Corps also recognizes the value of periodic drawdowns in Pool 9 to promote aquatic and emergent vegetation that can help stabilize existing islands and provide other environmental benefits. While water level management in Pool 9 (including summer drawdowns) is not integrated into the proposed project, it is being evaluated (along with Pools 5 and 8) as part of a more systemic evaluation under the Navigation and Ecosystem Sustainability Program (NESP). Our experience with drawdowns in other pools has required a significant planning effort that, if integrated with the Capoli Slough HREP, would jeopardize its timely implementation.

2. Section 4.2 – Historically Documented Changes in Habitat Condition. The Corps should discuss what efforts or changes in authority would be required to allow the water levels to be drawn down to previous levels on a regular basis. Additionally, the analysis should discuss the effects of changes in hydrology in the system, particularly water depth causing island soils to be almost continually wet.

Response: Currently, the Corps is not authorized to implement regular drawdowns for ecosystem benefits on a regular basis. This initiative is being examined as part of NESP, which has been authorized for planning, but not for implementation. Past drawdowns have been conducted on an experimental or one-time basis, which has required considerable planning and deviations from the Corps water control plan for maintaining conditions for the 9-foot navigation channel. A change to this plan would likely trigger additional analysis (including impacts to listed mussels). An analysis of the changed hydrology of the system (as compared to a system of regular drawdowns) would not change proposed project features.

3. Objective 3 – Maintain and restore well defined running slough habitats. A discussion on the recently [proposed] listed endangered sheepnose and spectacle case mussels would be useful.

Response: A proposed rule to list these species was issued on January 19, 2011, though the species have not been officially listed. In addition to the Higgins' eye pearlymussel, a species list provided by the Fish and Wildlife Service identifies sheepnose mussel as a candidate species. However, recent mussel surveys within the project area indicated that neither sheepnose nor spectacle case were present (see Attachment 7 of the DPR - Mussel Results and Coordination). Moreover, throughout Pool 9, neither of these species has been recorded (D. Kelner, pers. comm. 2011). For this reason, we have determined there would be no effect to these species.

4. Objective 5 – Preservation of existing islands and an increase in acreage of island habitat. The EA should indicate whether a drawdown to water levels of 617.5 feet or lower could enhance the potential to meet this objective.

Response: Drawdown is outside the scope of the proposed project.

The Corps is pleased that the EPA has indicated its interest for the proposed project. If you have any questions or comments, please contact Dennis Anderson at (651) 290-5272, dennis.d.anderson@usace.army.mil, or at the address above.

Sincerely,

Terry J. Birkenstock
Deputy Chief, Regional Planning and
Environment Division North

From: Kelly, Jerry - DOT
To: Anderson, Dennis D MVP
Subject: Environmental Assessment for Project #114832, Capoli Slough
Date: Thursday, February 24, 2011 1:41:29 PM

Dennis,
Thank you for forwarding the Environmental Assessment for Project #114832, Capoli Slough Habitat Rehabilitation, for review by the WisDOT Bureau of Aeronautics (BOA). The project area is not within 5 miles or on a flight path of a Wisconsin public use airport. Consequently, BOA does not have comments on your proposed project. If you have any questions, please contact me.

Jerry Kelly
Environmental Review Specialist
WisDOT Bureau of Aeronautics
4802 Sheboygan Ave., Room 701
Madison, Wisconsin 53707
(608) 266-2934
jerry.kelly@dot.wi.gov

W. J. Burke & Associates
PLANNING & DEVELOPMENT CONSULTANT

P.O. Box 399
Lansing, Iowa 52151
Phone -Fax: ~~319~~ 563-538-4159
wjbplan@~~reconnect~~.com
MCHS!

Reply to Capoli Slough EMP Environmental Assessment

March 17, 2011

Terry J. Birkenstock
Chief, Environmental and GIS Branch
Dept. Of the Army, COE
180 Fifth St. East, Suite 700
St. Paul, MN 55101-1678

Dear Mr. Birkenstock and other project authorities:

This letter is being submitted pursuant to the public input offered for the above referenced project. I apologize for the late submittal; however, this information has only recently been made available for inspection and comment.

In general, this project is needed in lower Pool 9 and is supported by the general public in this area. As background, I am one of the founding members of the Friends of Pool 9 and am an Iowa member of the Mississippi River Citizens Committee, and have been involved with enjoying and planning for our Mississippi River corridor resource for many years.

I would like to provide the following input:

1. The environmental assessment would be more complete if it noted the nationally significant Capoli Bluff historic site directly adjacent to the project area on west side of river channel at mile 658.

2. Reference is made on page 9-15, Table 9-3, of a **Conway Lake** project being in the planning phase. This proposed project is not supported locally and has received consistent opposition when talked about locally. When asked who came up with this project, the authorities proposing this project reported at public meetings that a single individual came up with the idea, that being a now retired DNR biologist. The public that enjoys this unique, wild area opposes the dramatic engineered changes being "planned" for this sensitive environment. There are currently three active eagle nests within this project area and likely more by 2017. Proposed changes will permit motorized water craft to enter (speed into) this small lake from nearby Lansing; the area needs some areas not accessible by motorized water craft-jet-skis would also find their way into this nearby water body from your new dredged channel. The public wants to maintain some areas

of quiet and solitude on our river, particularly areas that can be walked into much of the year. I and others have submitted formal objections to this proposed project, and this letter is an additional formal objection to the project as endorsed by the Capoli Slough project environmental analysis. The river clearly needs more island projects in the open flowage areas, and its assume the Lake Winneshiek and Harpers Slough projects would fit this category of higher priority which the general public will support. If the COE has any information on this Capoli Project different from the concerns expressed above I would like to request this information in writing since this project is now in the public "planning phase". Releasing "draft" plans soon before implementation is no longer legal or appropriate.

Thank you.

Sincerely,

William J. Burke AICP

From:	Davidson, Mark D MVP
To:	"Peter & Jean Smith"
Cc:	Anderson, Dennis D MVP
Subject:	RE: Capoli Slough Project - new and old Island protection (UNCLASSIFIED)
Date:	Wednesday, March 02, 2011 3:23:13 PM

Classification: UNCLASSIFIED
Caveats: NONE

Mr. Smith - thanks for your comments.

Mark Davidson

-----Original Message-----
From: Peter & Jean Smith [mailto:jptsmith@centurytel.net]
Sent: Wednesday, March 02, 2011 3:02 PM
To: Davidson, Mark D MVP
Subject: Capoli Slough Project - new and old Island protection

My only comment on the project slated for 2012 - 2014 is that the Corps of Engineers should consider postponing the work until 2014 or 2015.

The Federal Government needs to reduce spending particularly with expensive lower priority projects. Ten million dollars is a big price tag. The Corps of Engineers, along with all government agencies, have to be serious about helping to reduce the deficit. Thanks for the opportunity to comment.

Pete Smith
N3511 Sun Valley Rd.
La Crosse, WI 54601

Classification: UNCLASSIFIED
Caveats: NONE

Iowa Department of Transportation
800 Lincoln Way, Ames, Iowa 50010
515-239-1364
Fax: 515-817-6635

March 15, 2011

Dennis Anderson
Fishery Biologist
U.S. Army Corps of Engineers, St. Paul District
180 5th Street East, Suite 700
St. Paul, MN 55101-1638

RE: Capoli Slough Habitat Rehabilitation and Enhancement Project

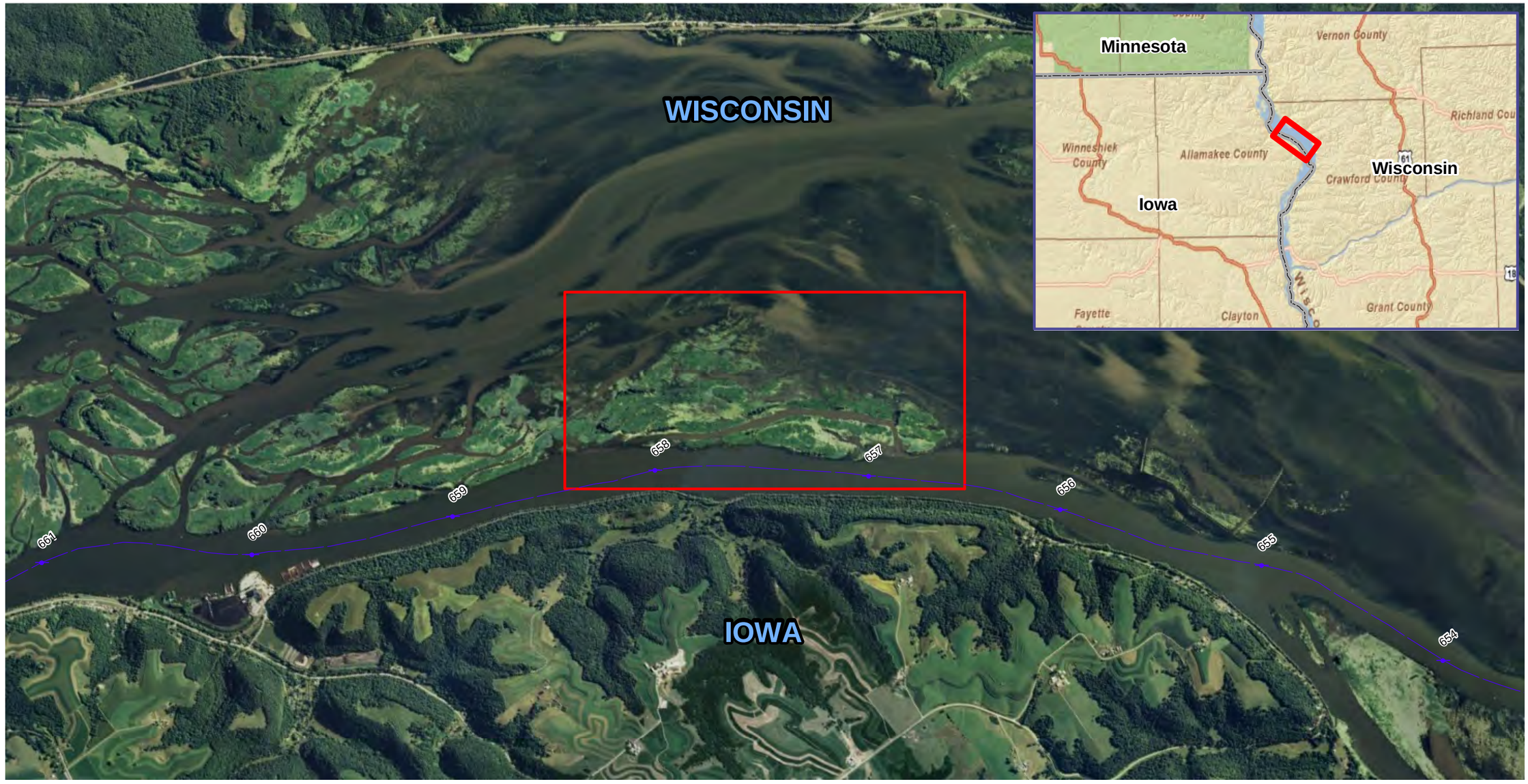
Dear Mr. Anderson,

The Iowa Department of Transportation would like to thank you for the opportunity to provide comment on the Capoli Slough Habitat Rehabilitation and Enhancement Project. The Department reviewed the project documents and has no comments.

Sincerely,

DeeAnn L. Newell
NEPA Section Leader
Iowa Department of Transportation

cc: file



Pool 9 - Capoli Slough - Location Map - Mississippi River

St. Paul District
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US Army Corps of Engineers®

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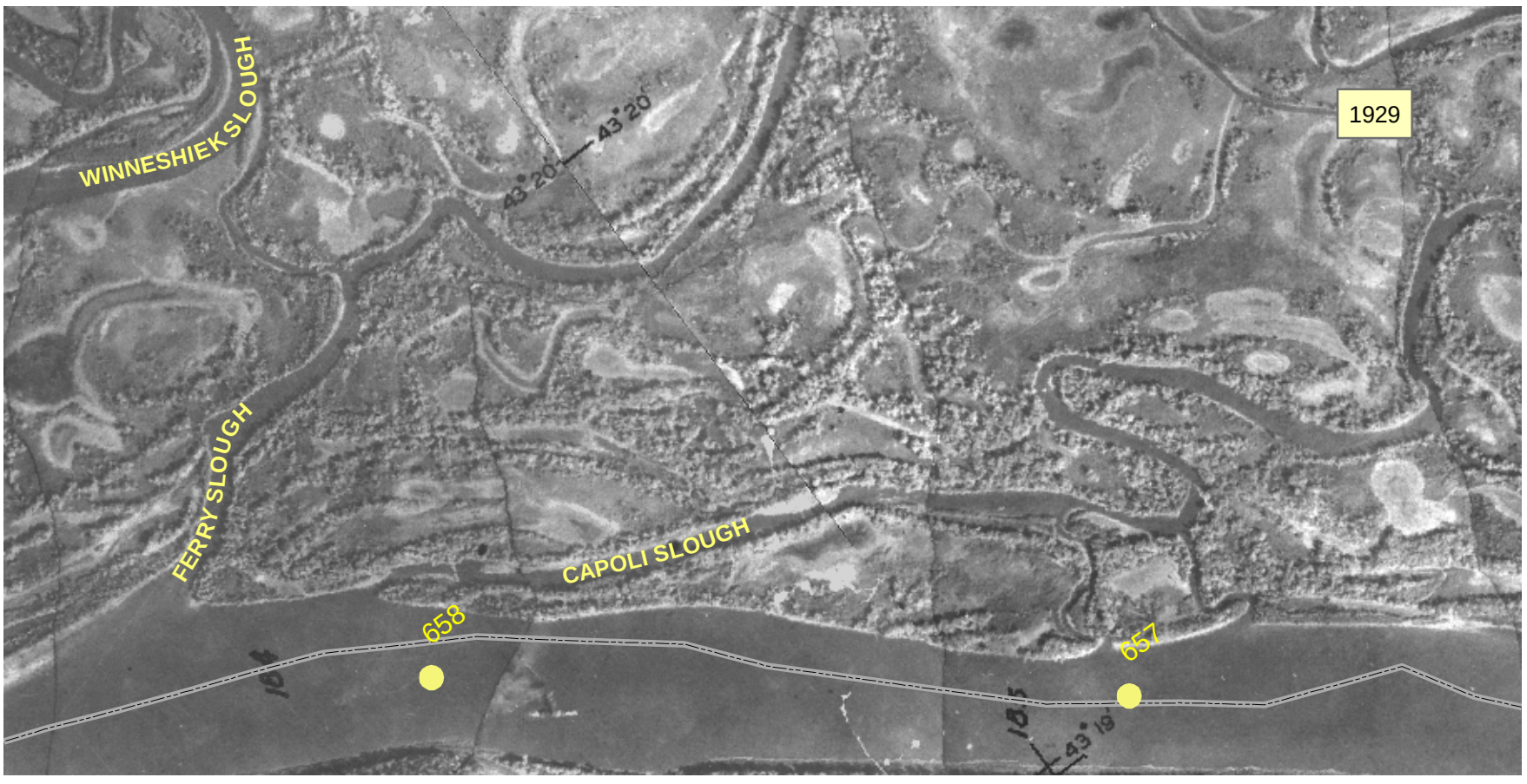
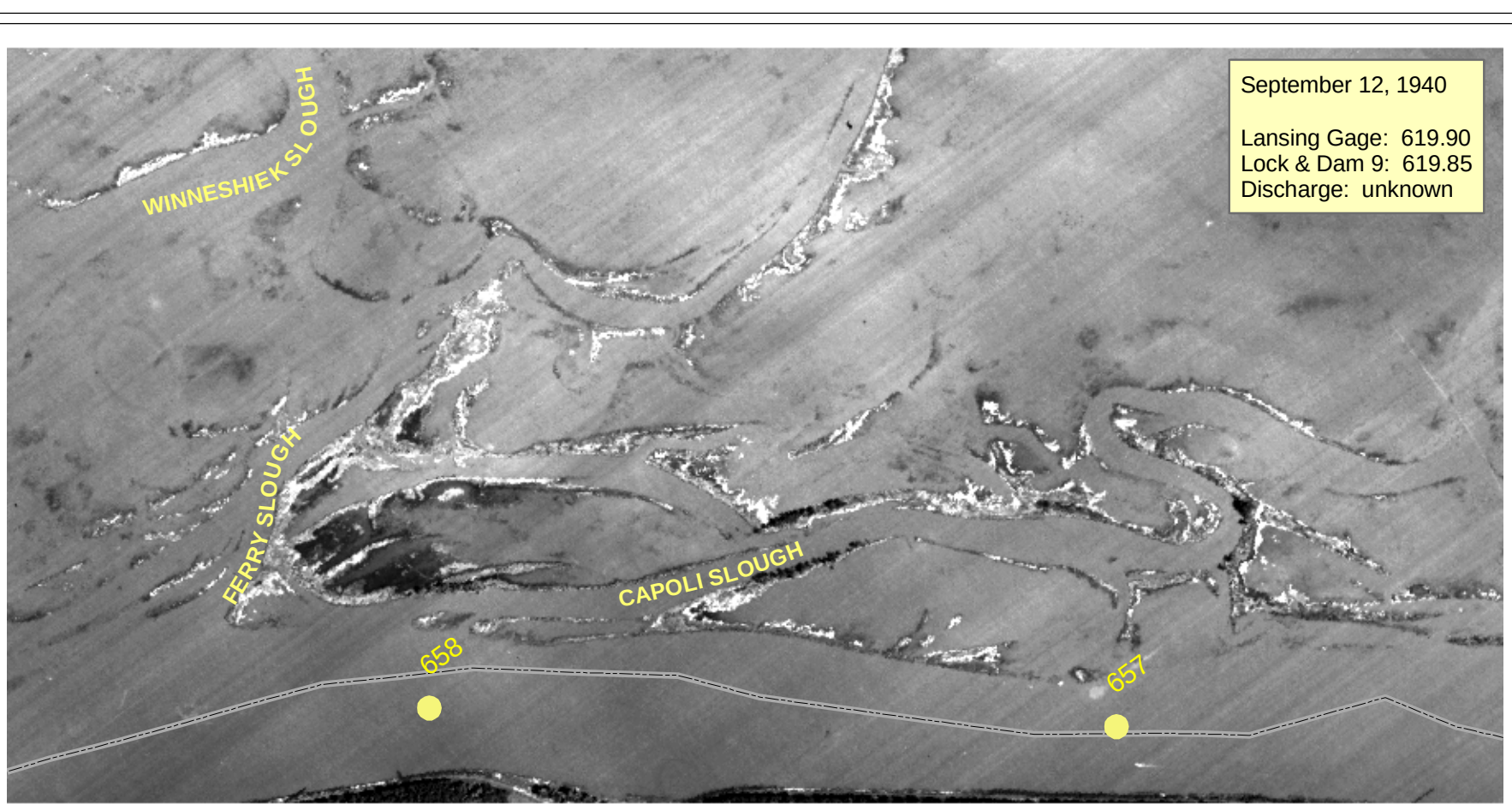
Photo Base: 2008 NAIP - Wisconsin

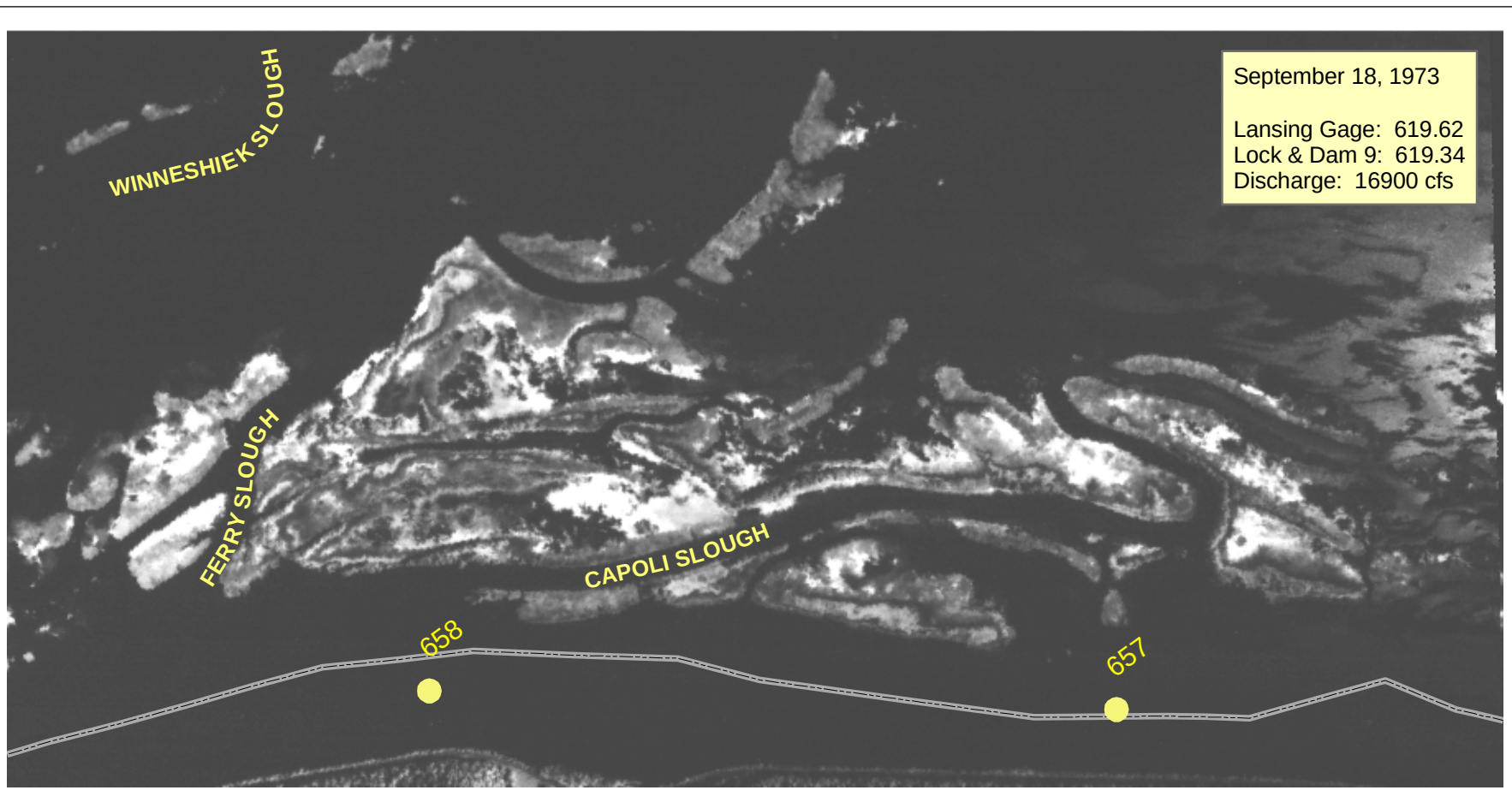
0.5 0 0.5 1 Miles

N

Plate 1







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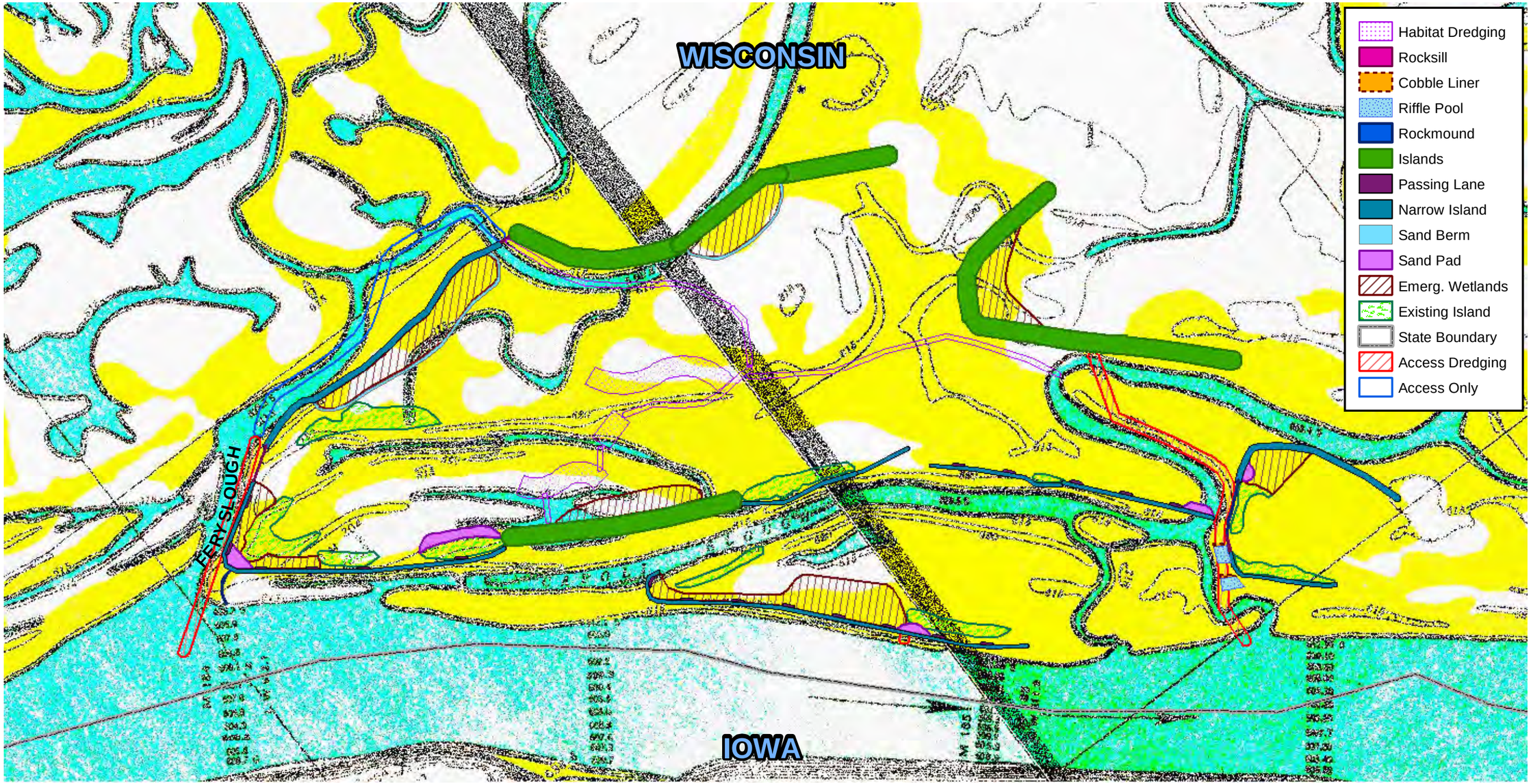
Pool 9 - Capoli Slough - 1929, 1940, 1973

0 625 1,250 2,500 3,750 5,000
Feet

Plate 2

N



Pool 9 - Capoli Slough - 1929-1930

1929-1930 Brown Survey Maps

St. Paul District
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800 0 800 1,600 Feet

NOTE: Yellow = Forest
White = Other

Plate 3

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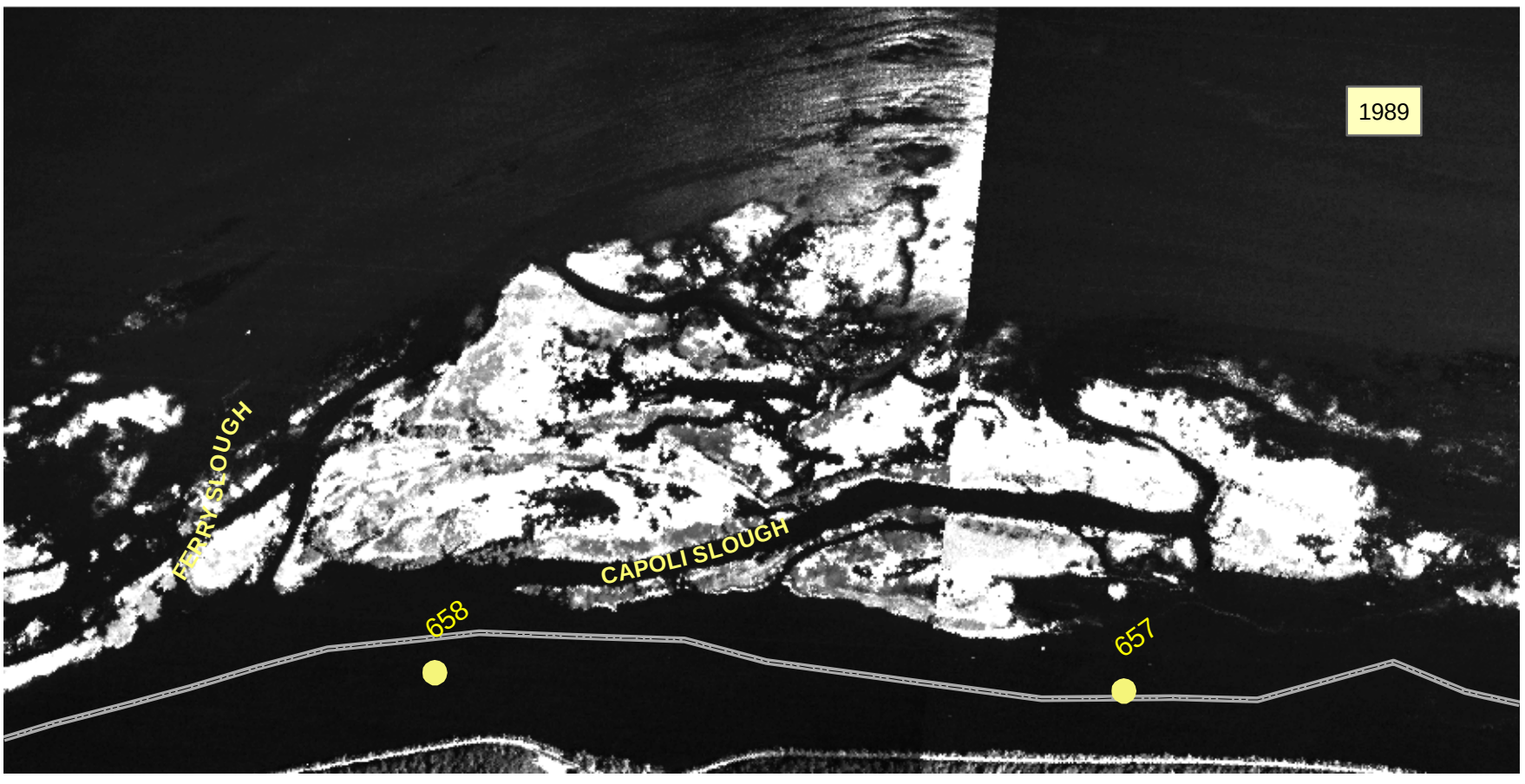

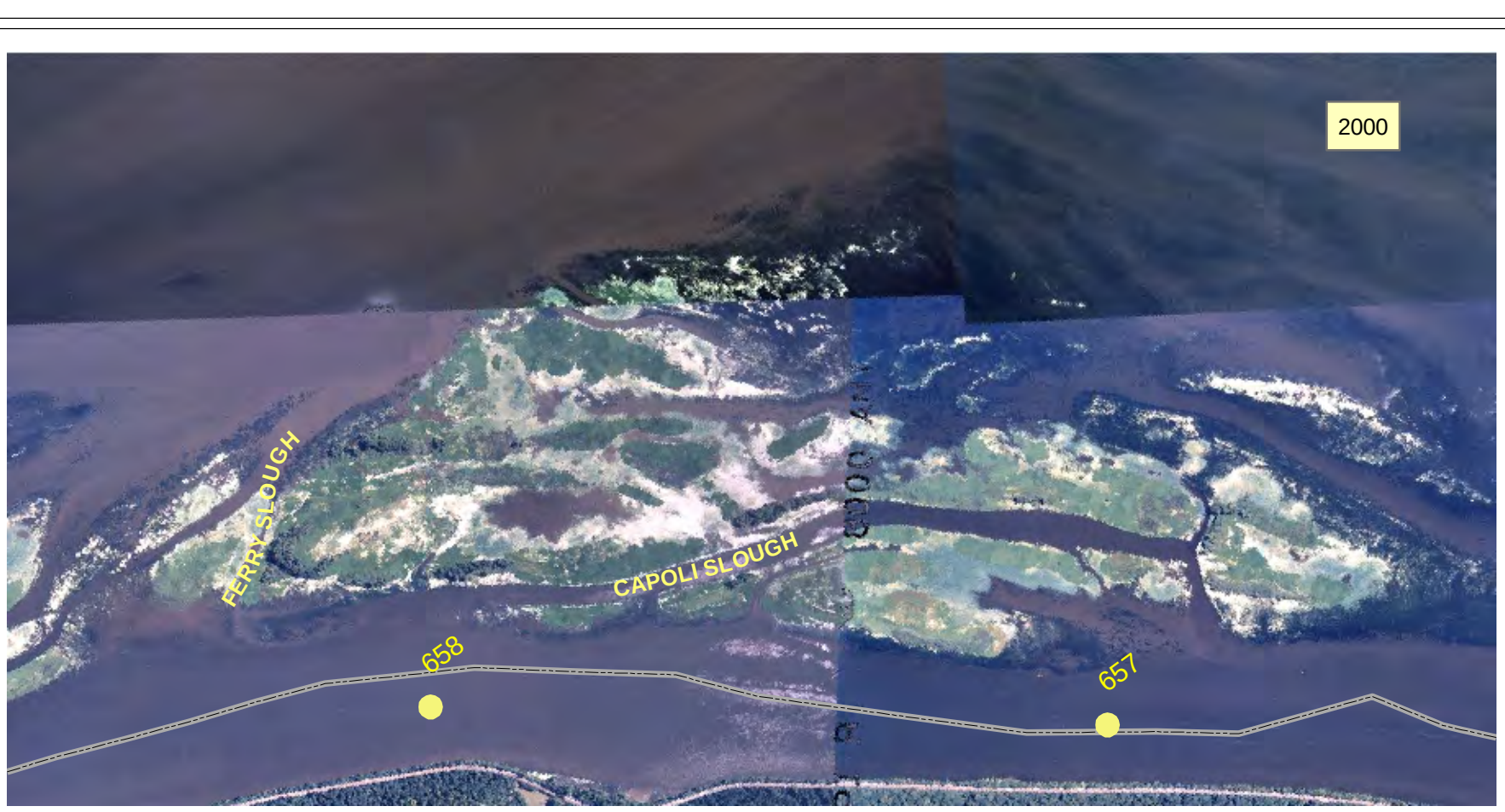

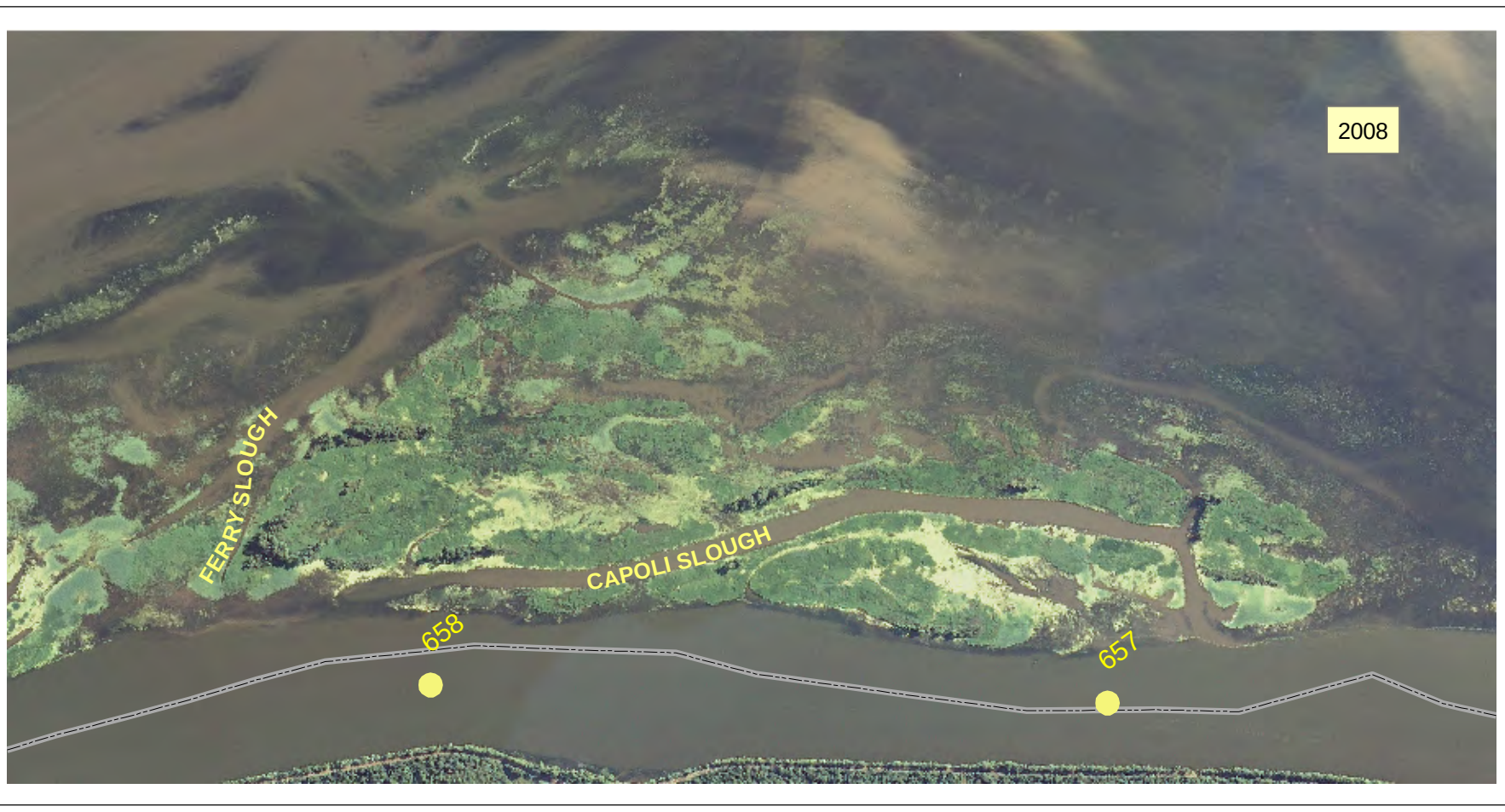

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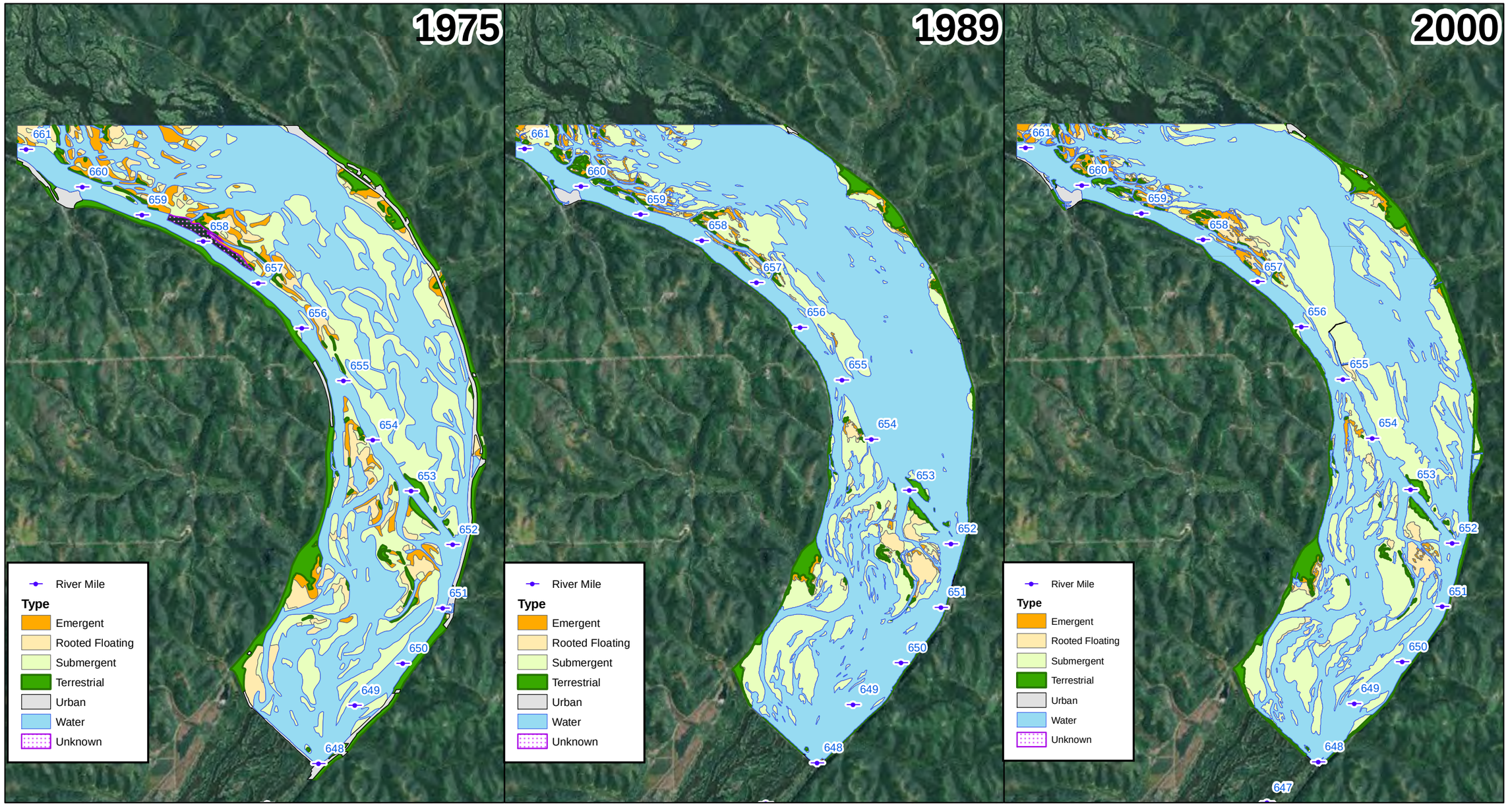
Pool 9 - Capoli Slough - 1989, 2000, 2008

0.5 0 0.5 Miles

Plate 4

N



Lower Pool 9 - Multi Year Vegetation

Photo Base: 2008 USDA Farm Service Agency - Crawford County

1.5 0 1.5 3 Miles

N

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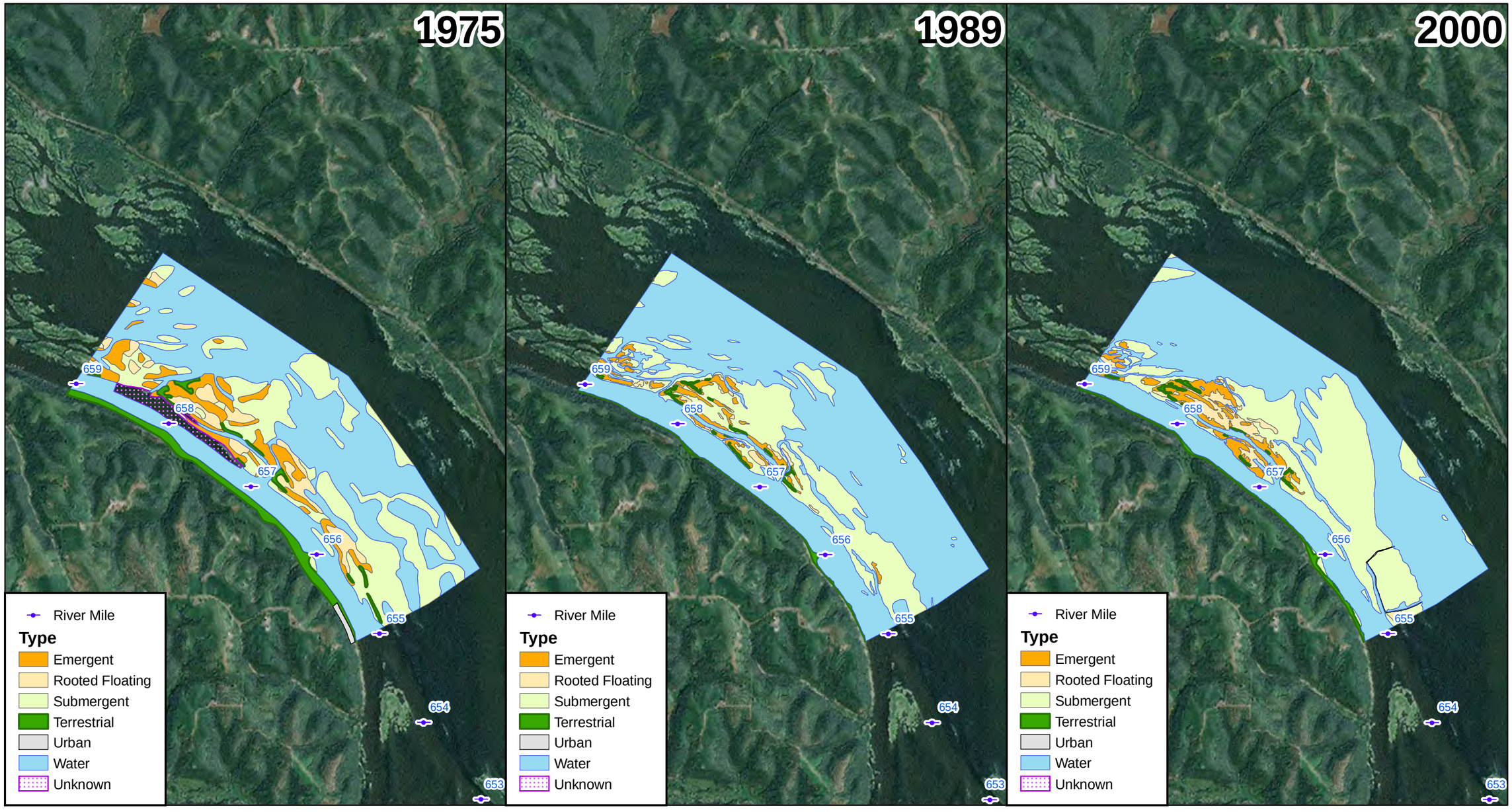
CapoliSloughVegetation_L.mxd MRW 20070130

Plate 5



Pool 9 - Capoli Slough - Vegetation

Photo Base: 2008 USDA Farm Service Agency

1 0 1 2 Miles

N

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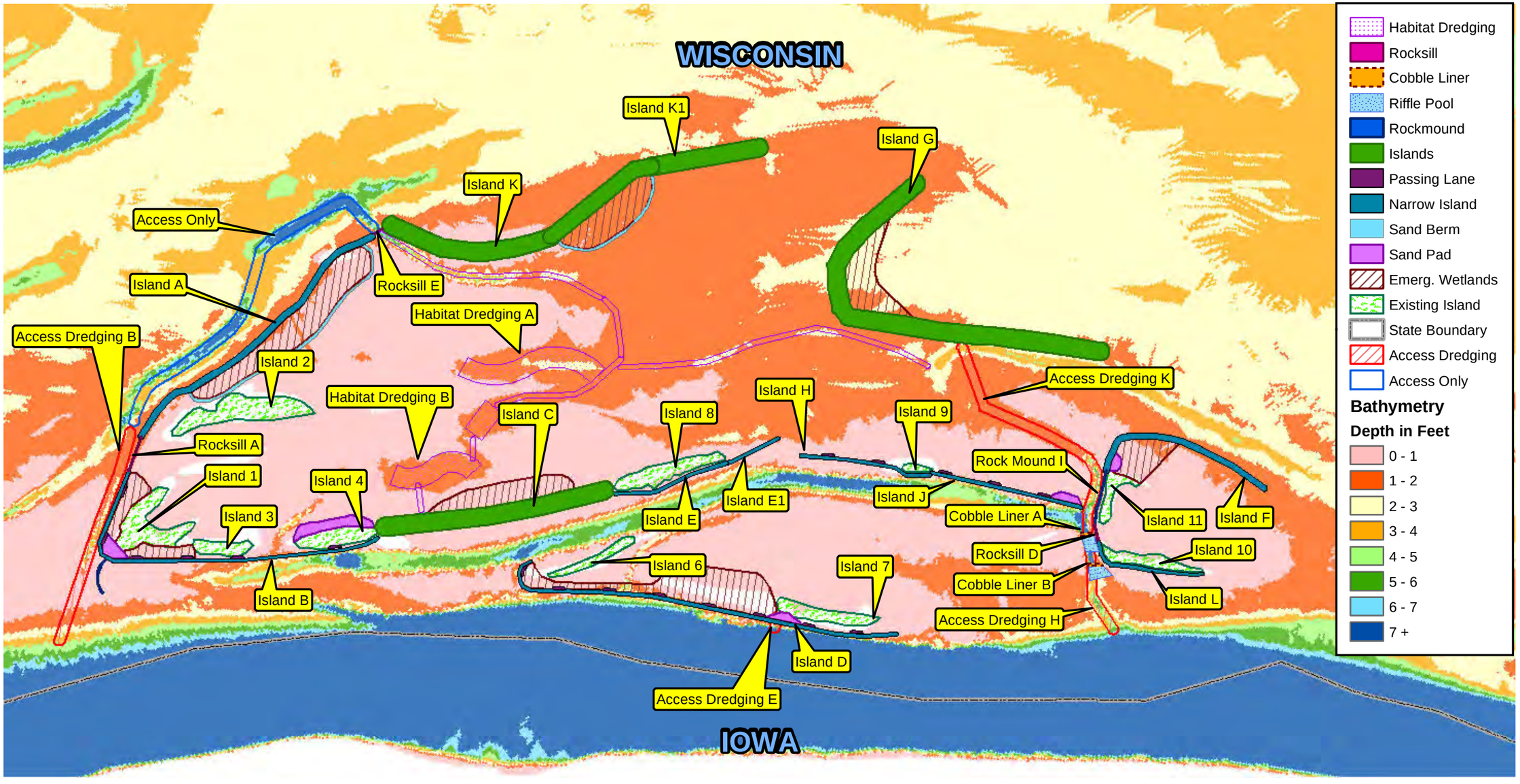
CapoliSloughVegetation_L.mxd MRW 20070130

Plate 6



Pool 9 - Capoli Slough - Revised Layout - 20 October 2010

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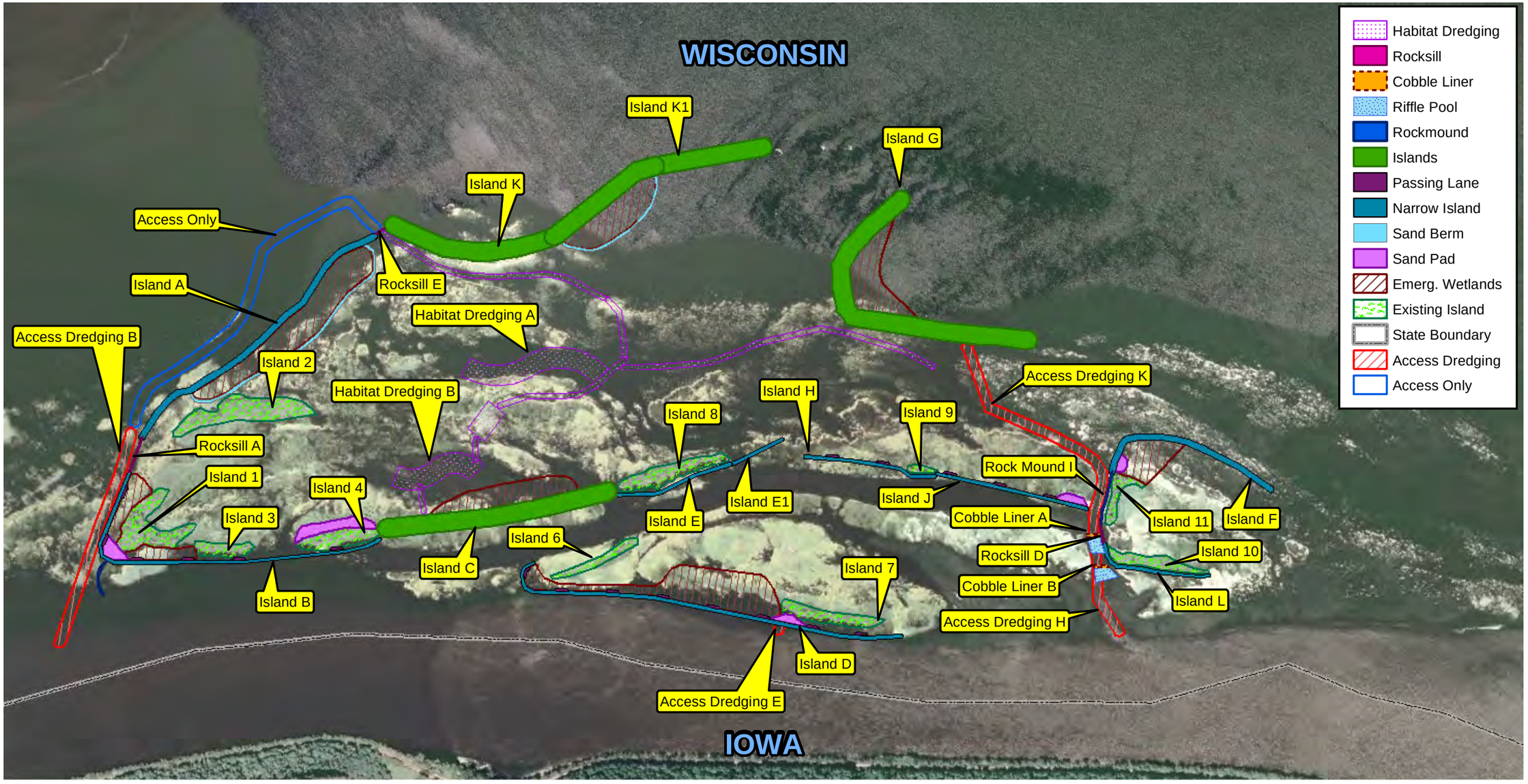
\\mvp-netapp2\GIS\GIS_Projects\pool9\CapoliSlough\MXD\1_Working\CapoliSlough_Revised_20101020.mxd MRW - 20101020

Source: 1998 Bathymetry from UMESC

800 0 800 1,600
Feet

N

Plate 7



Pool 9 - Capoli Slough - All Project Features Evaluated - 23 December 2010

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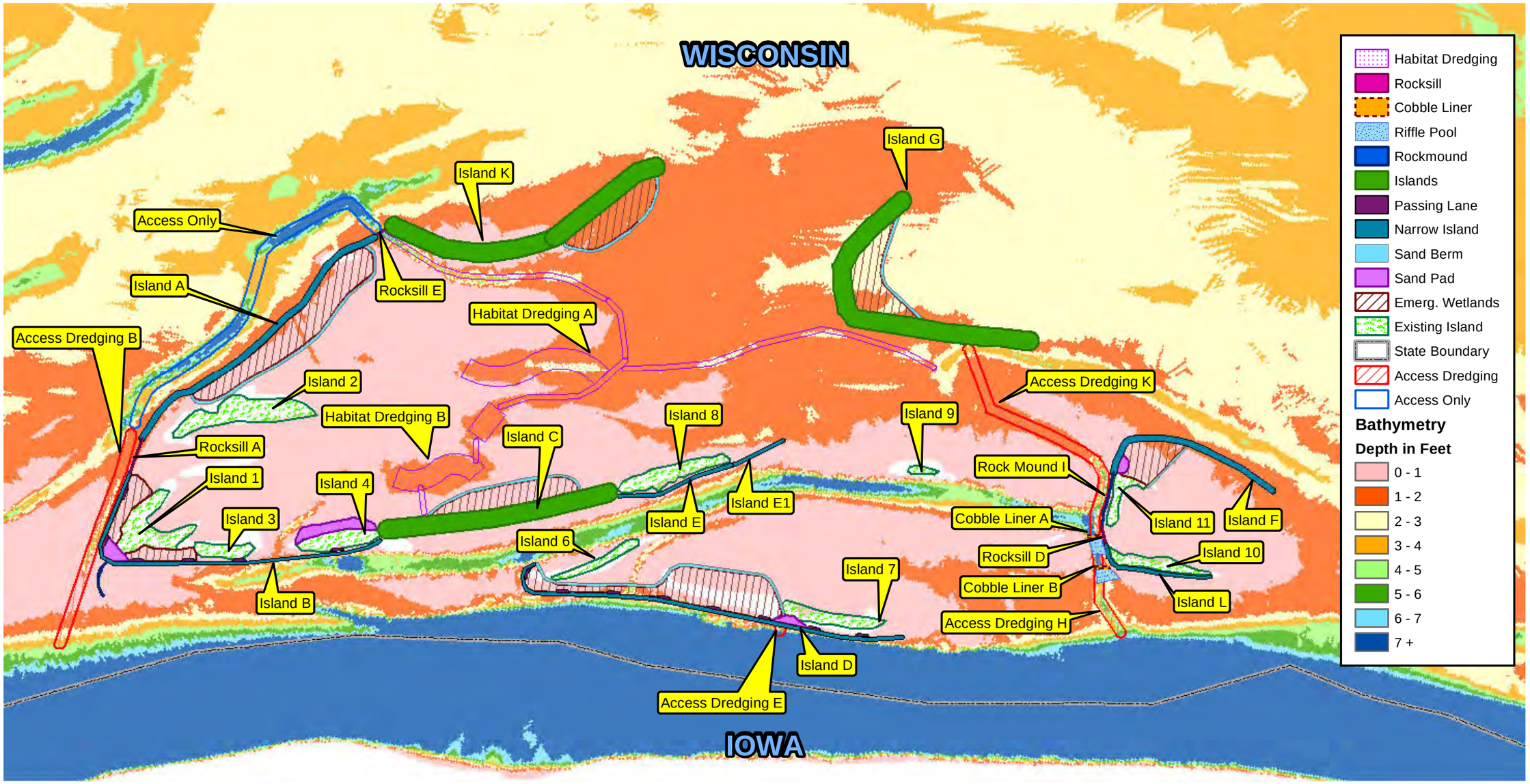
\\mvp-netapp2\GIS\GIS_Projects\pool9\CapoliSlough\MXD\1_Working\CapoliSlough_Revised_20101020_Photobase.mxd MRW - 20101020

Photo Base: 2010 NAIP - Wisconsin

800 0 800 1,600 Feet

N

Plate 8



Pool 9 - Capoli Slough - Recommended Plan - 25 May 2011

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Source: 1998 Bathymetry from UMESC

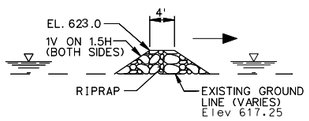
800 0 800 1,600 Feet

N

Plate 9

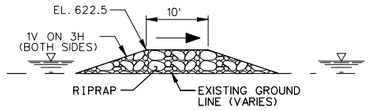
CapoliSlough_RecommendedPlan_20110322_Bathymetry MRW - 20110525

EXPOSED → SHELTERED



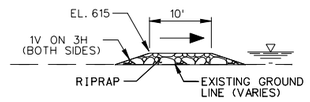
SECTION

ROCK BERM & VANE
ROCK MOUND I & VANES



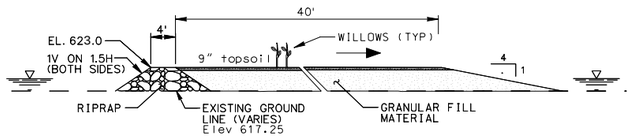
SECTION

ROCK SILL
SILL A,D&E



SECTION

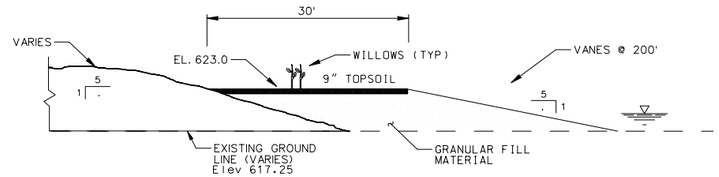
COBBLE LINER
A



SECTION

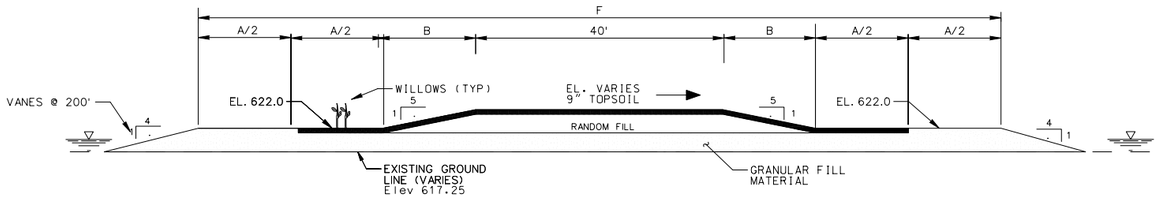
Rock Berm with Narrow Island
(ISLANDS A & F)

Note: Islands B,D & E1 are simular but are 20' in width with 40' wide X 50' long passing lane at 400' intervals. See plan.



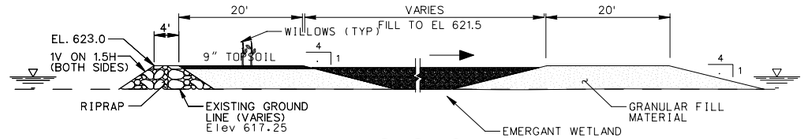
SECTION

ISLAND E & H DESIGN
NARROW ISLAND TIED TO EXISTING
WITH VANES @ 200'



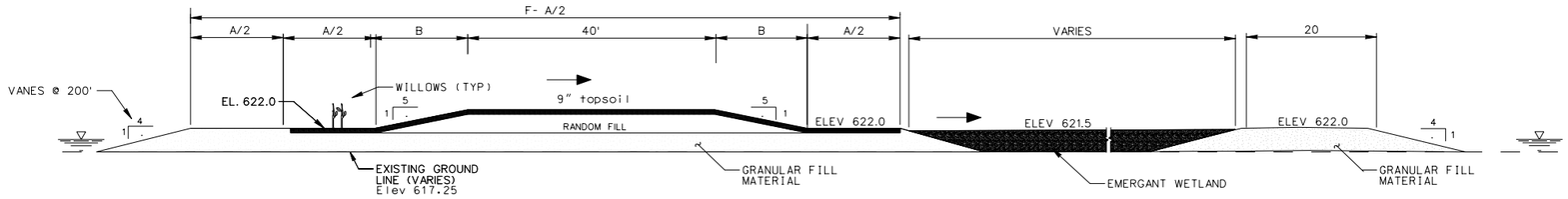
SECTION

TYPE A ISLAND DESIGN
ISLANDS C, G & K



SECTION

ROCK MOUND & SPLIT NARROW ISLAND
(EMERGANT WETLAND OPTION)



SECTION

TYPE A ISLAND DESIGN
(WITH EMERGANT WETLAND OPTION)

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ANSI D

MISSISSIPPI RIVER
CAPOLI SLOUGH ISLANDS

ISLAND SECTIONS
TYPICAL SECTIONS

PLATE 10

auto_lime