UPPER MISSISSIPPI RIVER RESTORATION
FEASIBILITY REPORT
WITH INTEGRATED ENVIRONMENTAL ASSESSMENT

LOWER POOL 4 BIG LAKE
HABITAT REHABILITATION AND ENHANCEMENT PROJECT

POOL 4, UPPER MISSISSIPPI RIVER MILES 760 – 756
BUFFALO COUNTY, WISCONSIN

May 2024

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St. Paul District

Upper Mississippi River Restoration
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EXECUTIVE SUMMARY

This Feasibility Study Report with Integrated Environmental Assessment investigates the feasibility of alternative measures to address problems and opportunities associated with the Lower Pool 4 Big Lake Habitat Rehabilitation and Enhancement project (Project), which is part of the Upper Mississippi River Restoration (UMRR) Program. The study area includes Indian Slough which connects to Big Lake which is a backwater lake on the Mississippi River in Lower Pool 4 near Wabasha, Minnesota.

The project lies within the Upper Mississippi River National Wildlife and Fish Refuge (Refuge) established by Congress to provide a refuge and breeding place for migratory birds, wild birds, game animals, fur-bearing animals, fish and other aquatic animal life and, the conservation of wild flowers and aquatic plants.

The Big Lake area has experienced loss and degradation of islands and floodplain forest habitat, due to erosional forces such as wind and waves. Invasive species such as reed canary grass and flowering rush have also presented problems for the Big Lake area. Declining floodplain forests, dominated by a single age class, are unable to naturally regenerate due to invasive herbaceous cover and inundation frequency and duration. Degradation and changes to flow and depth diversity throughout the study area due to island loss and sediment deposition effect native fish and mussels. Island dissection and distributary channel formation along Indian and Catfish Sloughs add to the loss of habitat.

The objectives of the project are to:

1. Protect, enhance, restore, or create naturally regenerating, resilient, and diverse bottomland forest habitats.
2. Maintain a balance of coverage and relative abundance of native emergent, rooted floating leaved, and submergent aquatic vegetation communities.
3. Protect, enhance, restore, or create flowing channel habitats.
4. Protect, enhance, restore, or create backwater habitats.

The Project Delivery Team (PDT) identified a variety of measures that could be taken to achieve project objectives, including dredging, island construction, island restoration, and flow modifying structures. The measures were combined in various logical combinations to form alternative project plans.

The Recommended Plan, shown in Figure ES-1, would include access and overwintering dredging, four island features, a sediment deflector, four shoreline stabilization features, six rock closures, and nonstructural forest management actions. The Recommended Plan addresses all project objectives and would be 100% Federally funded. The St. Paul's Operations Division,

Channels and Harbors (C&H) is willing to contribute granular material for the Recommended Plan, as material reuse for environmental purposes is compliant with beneficial use. The granular material will come from the Teepeeota Point dredge material placement site. C&H forecasting contribution assumes $24-25 per cubic yard for beneficial use of the sand in accordance with federal Standard dredge material management calculations. This contribution is estimated to be $7,305,000 to be paid toward construction of the Big Lake HREP and is not included in the Project first cost. The project first cost estimate is $44,679,000, with a 147 average annual habitat unit gain, and annual average cost per annual average habitat unit of $11,680.

The U.S. Fish and Wildlife Service (USFWS) is the Project Sponsor. The USFWS will be responsible for operation and maintenance actions associated with the Recommended Plan. The estimated annual O&M for the Recommended Plan is $15,753. The O&M responsibilities of the Sponsor will be addressed in the proposed draft Memorandum of Agreement for the Project.

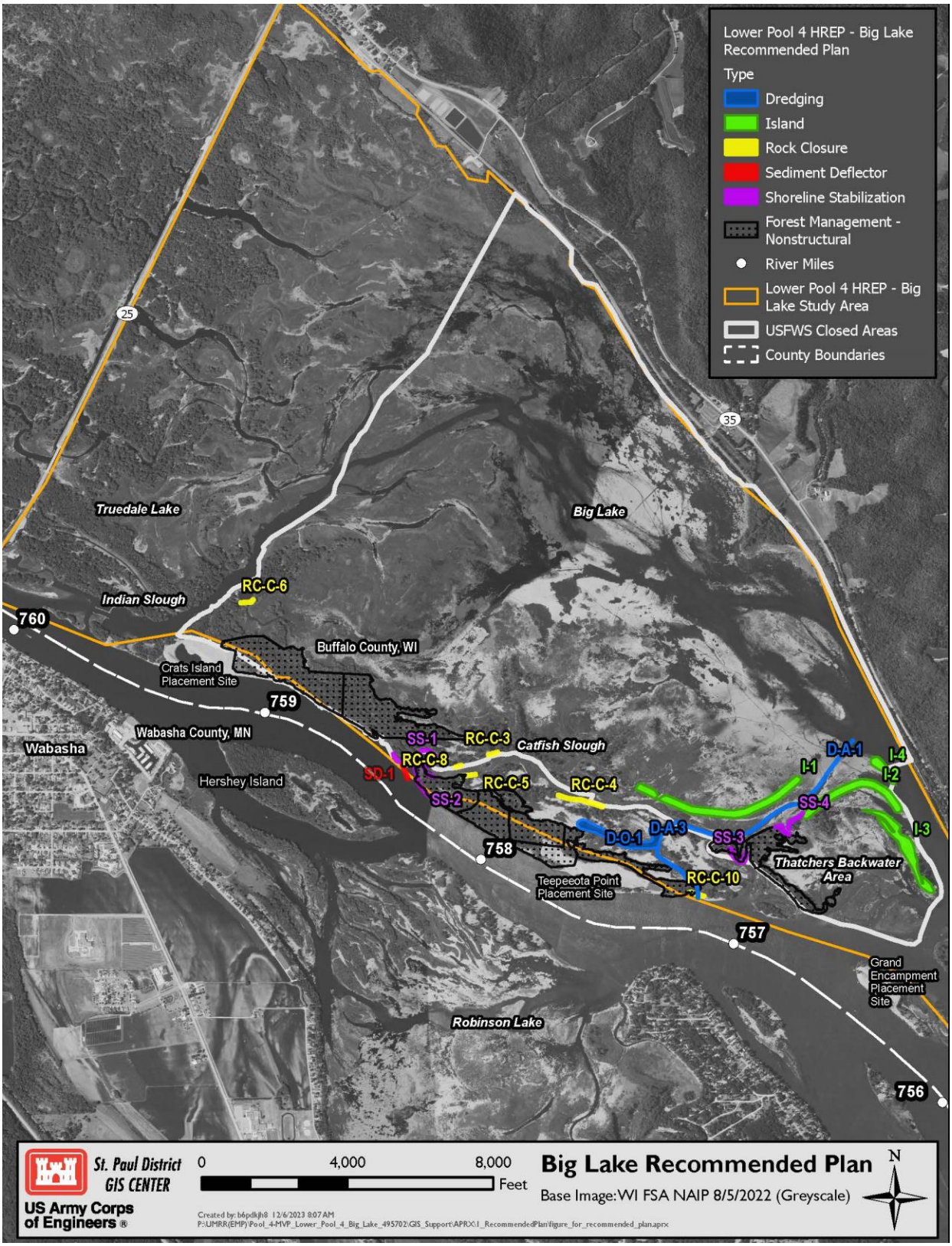

Figure ES-1. Lower Pool 4 Big Lake HREP Recommended Plan

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List of Tables

List of Figures

List of Photos

Appendices

ACRONYMS

Average Annual Habitat Unit	**AAHU**	Long Term Resource Monitoring	**LTRM**
Area of Potential Effect	**APE**	Integrated Feasibility Report with Integrated Environmental Assessment	**IFR/EA**
Cost Effectiveness & Incremental Cost Analyses	**CE/ICA**	USACE, Mississippi Valley Division	**MVD**
Climate and Economic Justice Screening Tool	**CEJST**	National Economic Development	**NED**
Council on Environmental Quality	**CEQ**	North American Vertical Datum of 1988	**NAVD 88**
Code of Federal Regulations	**CFR**	National Environmental Policy Act	**NEPA**
Cubic Yards	**CY**	National Ecosystem Restoration	**NER**
Department of Natural Resources	**DNR**	National Register of Historic Places	**NRHP**
St. Paul District	**District**	Operation and Maintenance	**O&M**
Access Dredging	**D-A**	Other Social Effects	**OSE**
Overwintering Dredging	**D-O**	Plans & Specifications	**P&S**
Dissolved Oxygen	**DO**	Principles and Guidelines	**P&G**
Engineer Circular	**EC**	Project Delivery Team	**PDT**
Environmental Justice	**EJ**	Public Law	**PL**
Environmental Protection Agency	**EPA**	Rock closure - complete	**RC-C**
Executive Order	**EO**	Reed canary grass	**RCG**
Environmental Operating Principles	**EOP**	Regional ECONomic System	**RECONS**
Engineer Regulation	**ER**	Regional Economic Development	**RED**
Endangered Species Act	**ESA**	Upper Mississippi River National Wildlife and Fish Refuge	**Refuge**
Environmental Quality	**EQ**	River Mile	**RM**
Flow Frequency Study	**FFS**	River Resources Action Team	**RRAT**
Forest management	**FM**	River Resources Action Team – Technical Section	**RRAT-Tech**
Fiscal Year	**FY**	River Resources Coordinating Team	**RRCT**
Fish and Wildlife Coordination Act	**FWCA**	River Resources Forum	**RRF**
Fish and Wildlife Interagency Committee	**FWIC**	State Historic Preservation Office	**SHPO**
Fish and Wildlife Work Group	**FWWG**	Sediment deflector	**SD**
Future Without Project	**FWOP**	Shoreline stabilization	**SS**
Finding of No Significant Impact	**FONSI**	Thin layer placement	**TLP**
Federal Register	**FR**	Total Suspended Solids	**TSS**
Habitat Evaluation Procedures	**HEP**	U.S. Army Corps of Engineers	**USACE**
Habitat Needs Assessment-II	**HNA-II**	Upper Mississippi River	**UMR**
Habitat Rehabilitation and Enhancement Project	**HREP**	Upper Mississippi River Restoration	**UMRR**
Habitat Suitability Index	**HSI**	Upper Mississippi River System	**UMRS**
Habitat Unit	**HU**	U.S. Fish and Wildlife Service	**USFWS**
Hazardous, Toxic, and Radioactive Waste	**HTRW**	Water Resources Development Act	**WRDA**
Islands	**I**		
Lock and Dam	**L/D**		

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1. INTRODUCTION

1.1 Authority and Project Selection

The Upper Mississippi River Restoration (UMRR) program was authorized by Section 1103 of the Water Resources Development Act (WRDA) of 1986 (Public Law (PL) 99-662), as amended (33 U.S.C. 652(e)). The UMRR program is composed of two elements: (1) plan, construct, and evaluate measures for fish and wildlife habitat improvement through Habitat Rehabilitation and Enhancement Projects (HREPs), and (2) monitor the natural resources of the river system through the Long-Term Resource Monitoring element. It is a regional program that includes the U.S. Army Corps of Engineers (USACE) St. Paul, Rock Island, and St. Louis Districts. Additional information on the program authority can be found at: https://www.mvr.usace.army.mil/Missions/Environmental-Stewardship/Upper-Mississippi-River-Restoration/Key-Documents/. Section 509 of WRDA 1999 provides the U.S. Army Corps of Engineers (USACE) with the authority to plan, design, and construct HREPs and is the authority under which this study is being conducted.

Interagency groups in each of the Districts identify, prioritize, and select the HREPs. Field managers from the interagency groups determine the areas that have degraded aquatic, wetland, and bottomland forest habitats and which UMRR authorized objectives are priority for the area. After considering resource needs and deficiencies pool by pool, the Fish and Wildlife Work Group (FWWG) and the River Resources Forum (RRF) supported and recommended the Project to the UMRR Coordinating Committee for endorsement and transmittal to the Mississippi Valley Division (MVD). MVD approved the Lower Pool 4 Fact Sheet in October 2020.

1.2 Agency Participants and Coordination

Participants in the planning of the Project included St. Paul District staff, Sponsor, and Project partners. Under Federal regulations governing the implementation of National Environmental Policy Act (NEPA), U.S. Fish and Wildlife Service (USFWS) is a cooperating agency. Development of this Integrated Feasibility Report with Integrated Environmental Assessment (IFR/EA) was actively coordinated with the participants during team meetings, phone conversations, and on-site visits to the study area.

U.S. Army Corps of Engineers, St. Paul District (District). The District is responsible for Project management and coordination with the Sponsor, Project partners, and other affected agencies. The District will submit the IFR/EA, program funds, finalize Plans & Specifications (P&S), complete all NEPA requirements, advertise and award a construction contract, and perform construction contract supervision and administration. In accordance with Section 906(e) of WRDA 1986 (33 USC 2283(e)), the first cost of the project will be 100% Federal because the project will be located on national wildlife refuge lands.

Sponsor. U.S. Fish and Wildlife Service is the Sponsor. Operation and maintenance (O&M) is the responsibility of Sponsor in accordance with 33 U.S.C. § 652(e)(7)(A)). The O&M responsibilities of the Sponsor will be addressed in the proposed draft Memorandum of Agreement for the Project (Appendix K, Memorandum of Agreement with the US Fish and Wildlife Service).

The study area is located on land managed by the Upper Mississippi River National Wildlife and Fish Refuge - Winona District. USFWS will determine whether the 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 O&M responsibilities. The Regional Director will also determine, based on the facts and recommendations contain herein, whether the final integrated Feasibility Report and EA meets the USFWS's obligation under NEPA, the Fish and Wildlife Coordination Act (FWCA) of 1965, the Endangered Species Act of 1973, the Migratory Bird Treaty Act of 1918, and the Bald Eagle Protection Act of 1940. The USFWS has been a cooperating agency in the preparation of this EA and has been integral in the decision-making process for the Feasibility Report.

Before any work is commenced under a construction contract, USACE will obtain a Special Use Permit from the Refuge Manager for each construction contract. This permit will be included in the technical specification package and be part of the contract documents.

Partners. Wisconsin Department of Natural Resources (DNR) and Minnesota DNR participated in the planning process and the development of alternatives, during monthly interagency team meetings, phone conversations, and on-site visits to the study area. Decisions to be made by the State of Wisconsin include archeological and cultural impacts review and a no-rise certification. The State of Wisconsin has been a partnering agency in the decision-making process for the Feasibility Report. The State of Minnesota has also been a partnering agency, but no work is proposed within the State boundary.

1.3 Study Purpose and Scope

The District proposes to rehabilitate and enhance the Project area through construction of measures that will maintain, enhance, and restore quality habitat for native and desirable plant, animal, and fish species and maintain, enhance, restore, and emulate natural river processes, structures, and functions for a resilient and sustainable ecosystem.

The purpose of this Integrated Feasibility Report (IFR) and Environmental Assessment (EA), including the Finding of No Significant Impact (FONSI), is to evaluate the proposal for the Project within the UMRR program. The IFR/EA meets USACE planning guidance and meets NEPA requirements. USACE developed this report with the USFWS serving as the Federal project partner. This report provides planning, engineering, and sufficient construction details of the Recommended Plan to allow for final design and construction to proceed subsequent to document approval.

The purpose of the main report is to summarize the multidisciplinary efforts of USACE, USFWS, WI DNR and MN DNR that led to the study recommendation. USACE organized the report to follow a general problem-solving format:

- Review existing conditions and anticipated future conditions;
- Identify project goals and objectives;
- Formulate restoration alternatives to address the objectives;
- Identify costs and benefits of the restoration alternatives;
- Compare the alternatives on the costs and benefits;
- Recommend a single restoration plan for implementation; and
- Present a detailed analysis on the plan.

The detailed analysis includes considerations of design, construction, operations, and maintenance; a detailed cost estimate; a monitoring plan to gage restoration performance; real

estate requirements; environmental effects; and a detailed schedule for implementation. Supporting documentation is provided in the appendices of this report.

The study is consistent with agency goals and was planned for the benefit of resident and migratory birds, fish, and other wildlife.

1.4 Study Area

The entire Lower Pool 4 study area encompasses approximately 8,276 acres of open backwater, meandered side-channel, main channel border, and island formations from Highway 25 (Nelson Dike) at Wabasha, Minnesota to Lock and Dam No. 4 (L/D 4) near Alma, Wisconsin.

The Lower Pool 4 Big Lake study area is on the left descending bank of the main channel of the Mississippi River from river miles (RM) 759.5 and 756.6 (see Figure 1). Land ownership within the study area is a patchwork of both USACE and USFWS with all being managed as part of the Upper Mississippi River National Wildlife and Fish Refuge (Refuge).

Established in 1924, the Refuge encompasses more than 244,500 acres across 261 miles of the river valley from Wabasha, MN, to Rock Island, IL (USFWS, 2019). The Refuge is divided into four districts: Winona (in which this study area is located), LaCrosse, McGregor, and Savanna Districts.

Created as a refuge for fish, wildlife, and plants and a breeding place for migratory birds, the Refuge encompasses one of the largest blocks of floodplain habitat in the lower 48 states. Bordered by steep wooded bluffs that rise 100 to 600 feet above the river valley, the Mississippi River corridor and refuge offer scenic beauty and uniquely productive fish and wildlife habitat. Refuge habitat includes broad pools, islands, braided channels, extensive bottomland forest, floodplain marshes and occasional sand prairie. These habitats are critical to mammals, waterfowl, songbirds and raptors, amphibians, and reptiles.

A portion of the study areas is located within the Refuge's Big Lake Closed Area (Figure 1). A closed area is characterized as an area that is closed to all migratory bird hunting, closed to all other hunting and trapping from March 16 until the day after the close of the State of Wisconsin duck hunting season, except for wild turkey hunting. There is also a Voluntary Avoidance October 15 to the end of the State of Wisconsin duck hunting season. Watercraft should use designated travel corridors.

Pool 4 is part of the Upper Mississippi River (UMR). It was created in 1935 by the completion of L/D 4. Pool 4 is 44.2 miles long, extending from RM 752.7 to 796.9. Lake Pepin is a large river lake, that comprises most of Pool 4, extending over 22 miles from RM 763.5 to about 786.0. The valley of Lower Pool 4 varies in width from about 1 mile at L/D 4 to about 3 miles at Wabasha, Minnesota and in Lake Pepin. The bluffs are steep on both sides and highly dissected, with a maximum relief of around 700 feet. The navigation channel parallels the Minnesota shoreline from Reads Landing to just south of Wabasha. From there it angles gradually across the valley through Lower Pool 4 and parallels the Wisconsin shoreline at a point just north of L/D 4.

The Mississippi River at L/D 4 drains an area of approximately 57,100 square miles. The drainage basin above L/D 4 includes large portions of Minnesota and Wisconsin, and a small portion of South Dakota and Iowa. Early summer (June) discharges at L/D 4 generally range from 25,000 to 50,000 cubic feet per second (cfs). By late summer, discharges usually decrease to 15,000 to 35,000 cfs. Winter low flows are generally in the range if 15,000 to 20,000 cfs.

The lower portion of the Pool 4, between L/D 4 and Lake Pepin, is dominated by floodplain features created by the Chippewa River and its delta.

The USACE is authorized to maintain a 9-foot navigation channel on the Mississippi River. Authority for continued operation and maintenance of the Mississippi River 9-Foot Channel project is provided in the Rivers and Harbors Acts of 1930 and 1932. There are three dredged material placement sites located in the vicinity of the Lower Pool 4 Big Lake study area, Crats Islands, Teepeeota Point and Grand Encampment (shown in Figure 1).

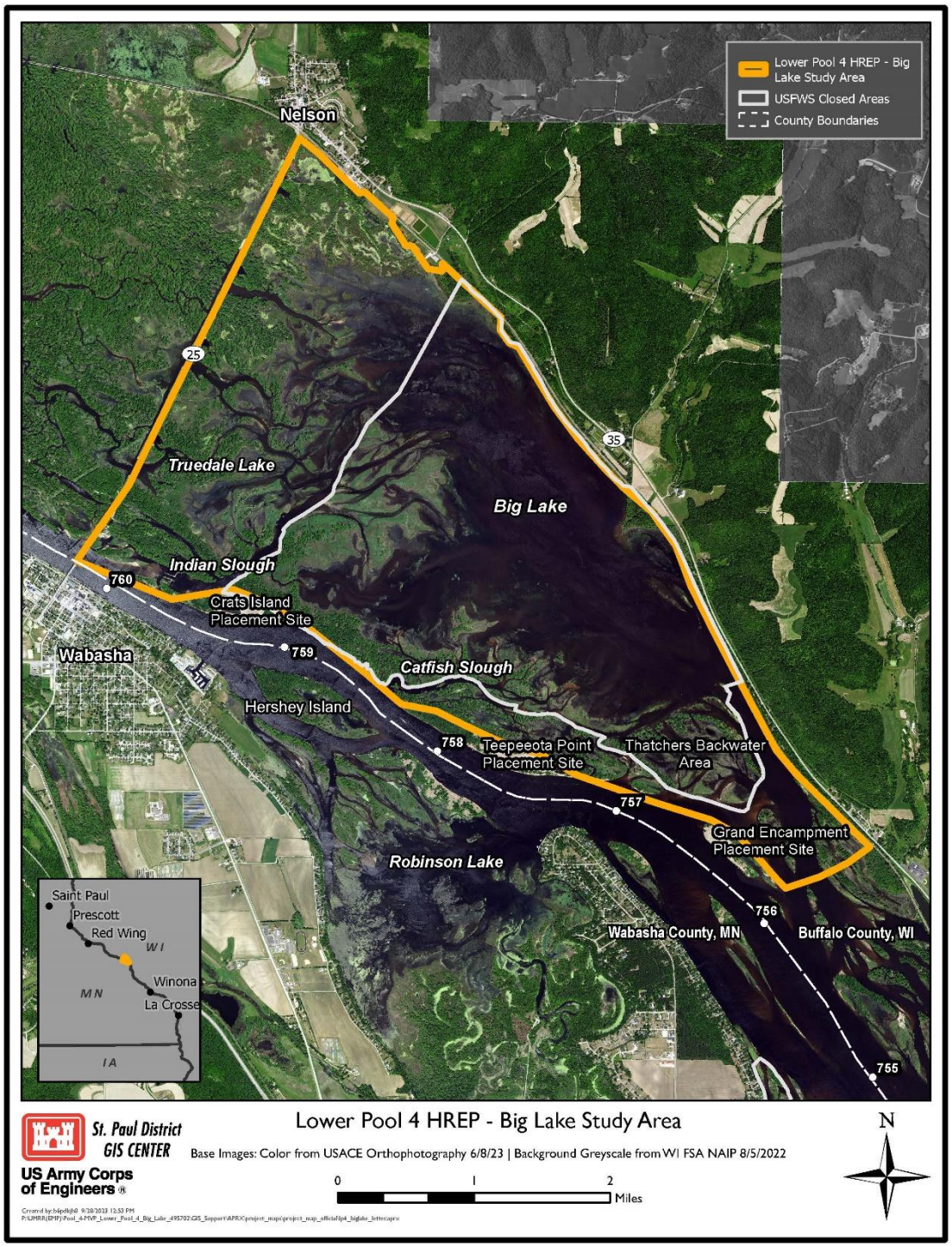

Figure 1. Big Lake Study Area

1.5 Prior Reports, Existing Water Projects, and Ongoing Programs

Table 1 summarizes prior reports, existing water projects, and ongoing programs which provided valuable information, experience, or guidance in the planning of the Project.

Table 1. Prior Reports, Projects, and Programs

Year	Study/Report/Environmental Document Title	Project Relevance
2022	Lower Pool 4 Dredged Material Management Plan	Long-term plan for managing dredged material from Lower Pool 4.
2020	Head of Lake Pepin Mississippi River Upper Pool 4 Pierce County Islands	Project in Red Wing, MN. Lessons learned were incorporated into this study.
2018	Upper Mississippi River Restoration Habitat Rehabilitation and Enhancement Projects Pools 4 through 9 2018 Site Inspection Report	Document includes site inspections of Indian Slough and Peterson Lake.
2018	Habitat Needs Assessment II	Document used in informing the planning objectives, measures, and desired future habitat conditions.
2011	Indian Slough Habitat Rehabilitation and Enhancement Project, Project Evaluation Report	Lessons learned from this project were used during the plan formulation for this study.
2011	Peterson Lake Habitat Rehabilitation and Enhancement Project, Project Evaluation Report	Lessons learned from this project were used during the plan formulation for this study.
2004	Environmental Pool Plans	Study used during formulation of problems, objectives, desired future habitat conditions and potential measures for the study.

2. NEED FOR AND OBJECTIVES OF ACTION

This section describes the development of Project objectives, including the assessment of resource significance of the Project area, consideration of the goals and recommendations of overarching programs identification of problems and opportunities, and identification of constraints and considerations. For planning purposes, the period of analysis was established as 50 years starting in 2027. The period of analysis is the period of time an alternative would have significant beneficial effects.

2.1 Resource Significance

Resource significance is considered from a public, institutional, and technical standpoint, as described in ER 1105-2-100. These three categories are used to determine if the ecosystem within the Project area is significant enough to warrant Federal investment.

1. **Institutional Recognition:** Institutional recognition means the importance of an environmental resource is acknowledged in the laws, adopted plans and other policy statements of public agencies, tribes, or private groups. Congress designated the UMRS as both a "…nationally significant ecosystem and a nationally significant navigation system…" in Section

1103 of the WRDA 1986. Institutional significance of the UMR is demonstrated in a number of region-specific laws and policies including the UMR National Wildlife and Fish Refuge Comprehensive Conservation Plan of 2006, the UMR Wild Life and Fish Refuge Act of 1924, and the Migratory Bird Conservation Act of 1929.

Congress established the Refuge in 1924 (PL 68-268) to provide a refuge and breeding place for migratory birds, wild birds, game animals, fur-bearing animals, fish and other aquatic animal life and, the conservation of wild flowers and aquatic plants. In addition to Congress, many other governmental entities and agencies as well as non-profit and private organizations have recognized the significance of the Refuge.

Backwater habitats on the UMR have been recognized as a significant resource by a number of public agencies and other institutions. The Izaak Walton League and a number of other organizations recognized the importance of the UMR and convinced Congress to preserve a large section of the floodplain in 1924 through the acquisition of land formation of a refuge for wildlife and fish (later become the Upper Mississippi River National Wildlife and Fish Refuge). In 1986, U.S. congress designated the UMR system as both a "… nationally significant ecosystem and a nationally significant navigation system…" in Section 1103 of the WRDA 1986. The UMR Conservation Committee recognized the importance of the floodplain forest, sigh, and wildlife of the river. Institutional recognition is also documented through the following acts: Clean Water Act, Fish and Wildlife Conservations Act of 1980, Fish and Wildlife Coordination Act, and the National Wildlife Refuge Systems Biological Integrity, Diversity, and Environmental Health Policy.

2. Technical Recognition: Technical recognition means the resource qualifies as significant based on scientific knowledge or judgment of critical resource characteristics. Scarcity, representativeness, status and trends, connectivity, limiting habitat, and biodiversity describe technical significance. Differences across geographical areas and spatial scales may determine whether a resource is significant. The UMRR study area encompasses a globally significant flyway used by more than 326 species of birds and as a home for at least 260 species of fish, 37 species of mussels, 47 species of reptiles and amphibians, and 50 species of mammals, including a number of rare and endangered species. The Upper Mississippi River Floodplain Wetlands are designated as a Ramsar Wetland of International Importance (Secritariat of the Conservation on Wetlands, 2020) and the Upper Mississippi River National Wildlife Refuge has been designated as an Important Bird Area (National Audubon Society).

Pool 4 is a trend pool within the Long-Term Resource Monitoring (LTRM) Program of the broader UMRR Program. As such, Pool 4 has a long-term data set (over 30 years) of intensive, annual surveys of aquatic vegetation, fisheries, water quality and other resources. The Environmental Pool Plan for Pools 1-10 documents the desired future habitat conditions for Pool 4, which includes improving terrestrial habitat by increasing the quality and diversity of floodplain forest, along with improvements to aquatic habitat. The documents above describing Institutional Recognition helps to outline the resource significance specific to the Big Lake HREP.

3. Public Significance: Public recognition means some segment of the general public recognizes the importance of an environmental resource, as evidenced by people engaged in activities reflecting an interest or concern for that resource. The public recognizes the UMR as a nationally, regionally, and locally significant resource. Some of the public services the Mississippi River provides include aesthetics, recreation, science, education, history, raw

materials, and flood regulation. In general, the services identified show the wide range of uses from the river, which extended beyond the ecological health of the UMR, and directly relate to public welfare and long-term ecological health of the region. Non-profit and private organizations recognize the significance of the resources in UMRR study areas through actively engaging in UMRR implementation or serving as nonfederal cost-share sponsors of habitat projects.

2.2 Overarching Program Documents

The following section documents overarching objectives, plans, goals and objectives for the program and the Big Lake study. These were used in the planning of this study.

2.2.1 Upper Mississippi River System (UMRS) Ecosystem Restoration Objectives

Formal planning for UMRS ecosystem management and restoration has been an ongoing process that was institutionalized in the 1970s with a Comprehensive Master Plan completed by the Upper Mississippi River Basin Commission in 1982. The UMRR program was authorized in 1986 and has since gone through several project planning cycles to develop regional ecosystem restoration needs and priorities. Reach Planning processes led to the identification of high priority areas for restoration of natural river processes (as required by Section 8004 of WRDA 2007) and provided context for formulating project measures, defining performance measures, and designing monitoring plans. Goals and objectives for the condition of the river ecosystem are central to river management and are linked to other elements of the framework. The overarching UMRS Ecosystem Goal is to conserve, restore, and maintain the ecological structure and function of the UMRS.

2.2.2 Environmental Pool Plans

The FWWG/FWIC created Pool Plans in January of 2004/September of 2002 that established common habitat goals and objectives for Pools 1-10/11-22 of the UMR. The following general resource problems for Pool 4 are taken directly from the report Environmental Pool Plans, Mississippi River Pools 1-10 (USACE, 2004) followed by specific proposed actions for the Study Area.

2.2.3 Habitat Needs Assessment-II

To address the UMRR program's vision statement of a healthier and more resilient UMR ecosystem that sustains the river's multiple uses, the program developed a suite of 12 indicators in the Habitat Needs Assessment-II (HNA-II) that quantify aspects of ecosystem health and resilience, reflect the ability of large floodplain river ecosystems to adapt and respond to disturbances, and represent ecosystem-based management objectives developed for the UMRS (USACE, 2011). To identify habitat needs for the UMRS, the HNA-II effort compared individual indicators to the conditions desired by the management agencies of the UMRR program. An assessment of current conditions using both quantitative data analysis and qualitative management perspectives was performed at two spatial scales: navigation pool and clusters of navigation pools that shared similar ecological attributes. The UMRR program can use the information provided in the HNA-II to achieve the program's goals and individual HREPs more effectively (McCain, Schmuecker, & De Jager, 2018).

Pool 4 is part of the upper impounded area of the UMRS, as identified by the River Teams, and has the following desired future conditions:

- Improve function and diversity of aquatic habitat types by improving quality, depth and distribution of lotic and lentic habitats.
- Maintain and enhance aquatic vegetation diversity.

- Maintain and enhance floodplain vegetation diversity, including hard-mast trees.
- Restore floodplain topographic diversity and diversify inundation periods.

2.2.4 USFWS and Upper Mississippi River National Wildlife and Fish Refuge Goals and Objectives

U.S. Fish and Wildlife Service and National Wildlife Refuge System have broad goals and objectives that are provided by legislation that guides the management of the National Wildlife Refuge System including the National Wildlife Refuge System Administration Act of 1966 and the National Wildlife Refuge System Improvement Act of 1977 16 U.S.C 668dd to 66ee (Refuge Administration Act). These define the Refuge System and authorizes the Secretary of the Interior to permit any use of a refuge provided such use is compatible with the major purposes for which the refuge was established. The landmark National Wildlife Refuge System Improvement Act, passed by Congress in 1997, prepared the way for a renewed vision for the future of the refuge system whereby:

- Wildlife comes first.
- Refuges are cornerstones for biodiversity and ecosystem-level conservation.
- Lands and waters of the System are biologically healthy.

The refuge has identified several Refuge Priority Resources of Concern that are relevant to the Lower Pool 4 study area: native invertebrate pollinators, cerulean warbler, prothonotary warbler, transient neotropical migrant passerines, tree-roosting bats, midwestern wooded swamps and floodplains, dabbling duck guild, black tern, tundra swan, secretive marsh birds, canvasbacks, lesser scaup, limnophilic native mussels, limnophilic native fish, fluvial-dependent native mussels, migratory fluvial-dependent native fish.

The refuge provided specific objectives that address Refuge Priority Resources of Concern relevant to the Lower Pool 4 project. The refuge-specific objectives were reviewed and they aided in the development of the Lower Pool 4 Big Lake project objectives; the Lower Pool 4 Big Lake Project Objectives can be found in section 2.4 of this report.
USFWS and Refuge goals and objectives are included in their entirety in Appendix A, Correspondence and Coordination.

2.3 Problems and Opportunities

USACE's planning process starts with identifying problems and associated opportunities within the geographic scope of the study area. From the list of problems and opportunities, and in collaboration with agency partners, USACE drafts specific objectives for the project. USACE determines the success of the project planning by the fulfillment of the objectives through identified measures. The following documents the major problems within the study area.

The construction of L/D 4 in the mid-1930s and its operation to maintain a minimum pool elevation for navigation, submerged the floodplain throughout Pool 4, increasing the size of the lake, expanding secondary channels and deteriorating existing floodplain islands of the project area. The Chippewa River also enters the main channel 4 miles upstream of the project area. During below-bankfull flow conditions, Big Lake receives inflows from the Main Channel on the western side of the lake through Indian Slough and Catfish Slough. During above-bankfull conditions/small flood events the natural levee between Big Lake and the Main Channel are overtopped.

As with the majority of the UMR, sedimentation of the backwaters is an ongoing issue. This

study area is greatly influenced by the input of material (sand) from the Chippewa River which enters Pool 4 on the left descending bank at the base of Lake Pepin (RM 763.5).

Big Lake has lost much of its island complex to wind and wave erosion. The few remaining islands that served as a barrier between the lower portion of the lake and Catfish Slough have been degraded and/or eliminated over the past several years. Floodplain forest habitat associated with these islands has also been lost. Additionally, sedimentation has made Catfish Slough nearly impassable by all but the most specialized boats.

Aquatic backwater habitats in Lower Pool 4 are threatened by continual sedimentation which reduces their depth and converts them other habitats such as reed canary grass meadows. Aquatic backwater habitat that can support overwintering by fish such as bluegill, largemouth bass and yellow perch is relatively limited in and below Big Lake. Discharge into Big Lake via Indian and Catfish Sloughs results in relatively high current velocities and the inability of the water column to thermally stratify. There are pockets of potentially suitable overwintering habitats (e.g., Big Lake, Thatchers backwater area), however these areas appear to be filling with sediment which decreases their depth, and they are becoming characterized by increasing flow velocities as a result of higher amounts of discharge resulting from expansion of secondary and tertiary channel widths. The habitat below Big Lake is primarily an array of side channels. While this area provides aquatic backwater habitat, their extent is relatively limited and there are no larger, extensive areas of aquatic backwater habitat.

Without active management, floodplain forests within the study area are likely to continue to degrade. The diversity of overstory tree species has declined from historic levels and is likely to continue to do so. Forest health has also been negatively impacted due to the effects of forest pests and diseases, and likely the chronic physiological stress associated with alterations to hydrology. On higher elevation sites, the prevalence of reed canary grass (RCG) (*Phalaris arundinacea*) and other non-woody competition throughout the management area will continue to preclude successful natural regeneration from the species that are still present on or near the site. Even if RCG were not present, it is not certain whether standard tree planting techniques alone would lead to a successful outcome due to changes in the hydrologic regime at the site, primarily at lower elevations relative to mean pool. For example, higher impact restoration techniques such as alterations in topographic diversity may ultimately be required to ensure the long-term sustainability of healthy floodplain forest attributes.

A variety of physical, chemical, and biological stressors have individually and cumulatively affected the quantity and quality of habitat for biota. Specifically, without the implementation of active site restoration measures, the following conditions are likely to occur at the Lower Pool 4 study area: increased coverage and dominance of RCG; increased loss of tree and other native plant species diversity; increased loss of forest structural and age class diversity; increased loss of forested land cover; increase in floodplain forest habitat fragmentation; decrease in floodplain forest habitat connectivity; decrease in amount of floodplain forest interior habitat; increase in cumulative adverse impacts on forest-dependent wildlife species; increase in cumulative adverse impacts on local aesthetic and cultural resources; increase in cumulative adverse impacts on ecosystem services (e.g., improvements to water quality).

Problems

Based on the assessment of the problems within the study area, the following problem statements were developed.

a. Loss of island and floodplain forest habitat due to erosional forces (e.g., wind, wave, ice, river current).
    i. Example: Loss of islands separating Big Lake and Catfish Slough.
b. Expansion of invasive species.
    i. Examples: Reed canary grass (RCG) and flowering rush.
c. Declining single age floodplain forest that is unable to naturally regenerate due to invasive herbaceous cover and inundation frequency and duration.
    i. Examples: RCG replacement of forest in the Upper Big Lake/Indian Slough areas.
d. Degradation and changes to flow and depth diversity throughout the study area used by native fish and mussels, due to island loss and sediment deposition.
    i. Example: Catfish Slough.

Opportunities

Within the study area, there are opportunities for additional beneficial outcomes beyond solving the above stated problems. The following opportunities were identified for this study:

a. Reduce human disturbance to waterbirds in Big Lake by restoring and enhancing barrier islands and floodplain forests between Catfish Slough and Big Lake.

b. Increase walk-in access for recreational users where feasible.

c. Create or restore other important habitats, for example sand flats, mud flats (also referred to as emergent wetlands), isolated wetlands, and mussel habitats in support of achieving primary objectives or when it does not substantially detract from these objectives.

d. Use channel maintenance material for construction of features.

e. Use Long Term Resource Monitoring (LTRM) expertise and data throughout the process, from design criteria through monitoring plan development.

2.4 Project Goal and Objectives

Based on the identified problems affecting the Project's natural resources and considering the management goals of the cooperating agencies, the Project goal is to maintain, enhance, and create habitat suitable for native and desirable, aquatic and terrestrial flora and fauna. The objectives identified to meet these goals over the period of analysis are to:

- Protect, enhance, restore, or create naturally regenerating, resilient, and diverse bottomland forest habitats.
- Maintain a balance of coverage and relative abundance of native emergent, rooted floating leaved, and submergent aquatic vegetation communities.
- Protect, enhance, restore, or create flowing channel habitats.
- Protect, enhance, restore, or create backwater habitats.

2.5 Planning Constraints and Considerations

The following constraints were included in plan formulation:

1. Institutional constraints: Avoid or minimize impacts to flood stages and navigation.
    - Restoration measures should not increase flood heights or adversely affect private property or infrastructure.
    - Restoration measures should not impact the Federally-authorized navigation channel within the Mississippi River.
2. Environmental constraints: Construct measures consistent with Federal, state, and local laws. Compliance and coordination under NEPA emphasize the importance of environmental impacts to be minimized and avoided, as much as possible. Therefore, the following constraints are considered when analyzing alternatives:
    - Avoid impacts to threatened and endangered species.
    - Restrictive work periods and locations (Refuge closed area, eagle nesting, etc.).
    - Avoid impacts to sensitive species' habitat.
    - Avoid adverse impacts to cultural resources.
    - Avoid actions that would introduce, promote, or spread invasive species.

In addition to institutional and environmental constraints, there are also considerations that are considered throughout the planning process. Specific considerations used for this study are as follows:

- Restoration measures should be designed to minimize O&M for the sponsor.
- Avoid impacting powerline if measures would be constructed within the right of way.

2.6 Future Without Project Condition

The Future Without Project (FWOP) condition is the forecasted condition of the study area for the next 50 years (2027-2077) assuming no significant action is taken to address the resource problems identified above. More detail on existing conditions can be found throughout section 6 of this report.

Based on the information discussed above, without action, the floodplain forest habitat and the aquatic habitat in the study area is expected to continue to degrade. Further sedimentation would result in the general loss of depth and conversion of deeper backwater habitat to shallow water and sandbar habitat throughout the project area, but especially in deltaic areas of Big Lake. This would result in a continued loss of important habitat for migratory waterfowl that use Big Lake during spring and fall migration. Sedimentation and erosion may result in the expansion of wetlands in some areas, or changes in wetland from one type to another, as a result of areas becoming shallower and experiencing changes in vegetation type. Wet floodplain forest island areas will likely continue to erode.

3. PLAN FORMULATION

Plan formulation for the Lower Pool 4 Big Lake HREP has been conducted in accordance with the six-step planning process described in *Economic and Environmental Principles and Guidelines for Water and Related Land Resources Implementation Studies* (1983) and the *Planning Guidance Notebook* (Engineer Regulations (ER) 1105-2-100). The six steps in the iterative plan formulation process are: 1) Specify the water and related land resources problems

and opportunities of the study area; 2) Inventory and forecast existing conditions; 3) Formulate alternative plans; 4) Evaluate alternative plans; 5) Compare alternative plans; and 6) Select a plan.

This chapter documents the measures that were developed and the alternatives that we developed from the measures.

3.1 Management Measures

A management measure is a feature (such as a structural element that requires construction or assembly on-site) or an activity (a nonstructural action) that can be combined with other management measures to form alternative plans. Management measures were developed to address study area problems, meet study objectives, and to capitalize upon study area opportunities. Management measures were derived from a variety of sources including prior studies, the NEPA public scoping process, and the multidisciplinary, interagency Project Delivery Team (PDT). These measures have been implemented successfully throughout the UMR and are based on the *Upper Mississippi River Restoration Program – Environmental Design Handbook* (December 2012) and lessons learned from other large river ecosystem restoration projects including those designed and constructed in the Upper Mississippi River Restoration program. A general description of management measures developed for this study are described below.

3.1.1 Non-Structural Measures

Forest Management - Nonstructural

Forest management could be accomplished by several types of actions including timber stand improvement, woody invasive control, underplanting, invasive species control (i.e., RCG), and planting/seeding (Photo 1).

Photo 1

Photo 1. Example of tree planting.

3.1.2 Structural Measures

Forest Management (FM) - Thin Layer Placement (TLP)

Thin layer placement is a structural forest management technique that would be accomplished

by placement of dredged material to raise the terrestrial elevation, to create more forest area while burying invasive species such as RCG. An increase in elevation would reduce the annual duration of inundation for the raised areas, benefiting desirable tree species that are less flood tolerant to grow.

Island Restoration/Creation

Island restoration and/or island creation could serve a variety of habitat purposes in the study area. Islands protect shallow areas from wind driven wave action and erosion, which in turn can reduce turbidity, protect existing aquatic vegetation, and improve conditions for the growth of aquatic vegetation in other shallow areas. Islands can provide bottomland forest habitat, and their creation increases habitat diversity and provides habitat niches that have been lost in Lower Pool 4 Big Lake. Islands typically include erosion protection methods to ensure the islands are stable over the project life (riprap end protection, groins, and vanes). Additional details on design assumptions of groins and vanes can be found in Appendix E. Borrow material to construct island features would come from several potential sources including overwintering and or access dredging measures and the existing 9-foot navigation temporary dredge placement sites in the project vicinity (specifically, Teepeeota Point dredged material placement site) as beneficial use of the material. An example of island creation on the UMR, during construction, is shown in Photo 2.

Photo 2. Example of island creation.

Shoreline Stabilization (SS)

Shoreline stabilization could be accomplished for this project through placement of riprap placed directly on existing grade. This measure would reduce erosion on existing shorelines and provide habitat for aquatic organisms. An example of shoreline stabilization using riprap is shown in Photo 3.

Photo 3. Example of shoreline stabilization using riprap.

Sediment Deflector (SD)

The sediment deflector would reduce sediment entering the project area. This would be constructed of riprap and connect to shoreline stabilization measures. Photo 4 shows what a sediment deflector could look like.

Photo 4. Example of sediment deflector.

Closure Structures

Complete closures or partial closures are structural measures designed to control or reduce flow in existing secondary channels (Photo 5). By reducing flows, closure structures can also reduce suspended sediment load into the secondary channel. Closure structures are generally constructed with rock, although design concepts involving the incorporation of woody material have been used. Usually, these structures are designed with a top elevation near the bankfull event so that seasonal hydraulic connectivity is maintained. Some of these structures include a low flow notch and are termed partial closure structures. While acceptable in terms of regulations, local support of a closure structure can depend on its location and the design; for example, a complete closure can close off an area whereas a partial closure would still allow for channel flows and boater access.

Photo 5. Example of closure structure.

Dredging

Dredging is split into two types: Overwintering and Access. All dredged material would be used for construction of other measures (i.e., islands). Dredging can be accomplished by mechanical (Photo 6) or hydraulic means.

- **Overwintering Dredging (D-O):** The lack of depth diversity and aquatic habitat structure in the Lower Pool 4 Big Lake area limits the value of the area for some types of fish. Dredging would reverse the effects of past sedimentation could be implemented at critical locations for restored and increased depth diversity, enhanced aquatic structure, and improved water quality.
- **Access Dredging (D-A):** Dredging for access is completed for the construction contractor. This is typically completed on an as needed basis but must be included in the plan for constructability. Dredge depths for access is six feet from Low Control Pool (LCP) for barge draft. There would be minimal ancillary habitat benefits associated with access dredging.

Photo 6. Example of mechanical dredging.

Table 2 documents the specific measures (measure type and measure name) that were developed for this study as well as assumptions about how the measures work together. No measures were screened from consideration, all were carried forward.

Table 2. Management Measures with Assumptions and Dependencies

Measure Type	Measure Name	Measure Assumptions and Dependencies
Island	I-1	
	I-2	Measure to be included with any action alternative and would provide minimum habitat benefits.
	I-3	
	I-4	
	I-5	
	I-6	
	I-7	D-A-5 required for constructability.
Shoreline Stabilization	SS-1	Measure to be included with any action alternative and would provide minimum habitat benefits. Dependent on SS-2 and combined with SD-1.
	SS-2	Measure to be included with any action alternative and would provide minimum habitat benefits. Dependent on SS-1 and combined with SD-1.
	SS-3	
	SS-4	Measure to be included with any action alternative and would provide minimum habitat benefits.
Rock Closures*	RC-C-2	
	RC-C-3	
	RC-C-4	Measure to be included with any action alternative and would provide minimum habitat benefits.
	RC-C-5	Measure to be included with any action alternative and would provide minimum habitat benefits.
	RC-C-6	Measure to preserve existing overwintering site in Big Lake.
	RC-C-7	D-A-2 required for constructability.
	RC-C-8	
	RC-C-10	Measure to be included with any action alternative and would provide minimum habitat benefits.
Dredging	D-A-1	Measure to be included with any action alternative and would provide ancillary habitat benefits.
	D-A-2	Measure to be included with any action alternative and would provide minimum ancillary habitat benefits.
	D-A-3	Measure to be included with any action alternative and would provide ancillary habitat benefits.
	D-A-4	
	D-A-5	
	D-O-1	
	D-O-3	
Forest Management	FM Nonstructural	Measure to be included with any action alternative and would provide minimum habitat benefits.
	FM - TLP	
Sediment Deflector	SD-1	Measure to be included with any action alternative and would provide minimum habitat benefits. Dependent on SS-1 and SS-2.

*Rock Closures are all considered complete closures (RC-C) for measure and alternative development. Additional design will be completed to determine if a complete or partial closure is most appropriate during Plans and Specifications.

3.2 Development of Alternatives

Alternative plans are different combinations of various sizes and scales of measures that would

contribute to attaining the planning objectives. Alternative plans are developed from the measures. In general, a measure may stand alone as an alternative that can be implemented independently or in combination with other measures.

The alternative plans for this study were developed through a multi-step process. The following documents the steps the PDT used in the development of the alternatives.

1. Review of historic images: Historic images were used to site specific measures, where islands and floodplain forest habitat has been lost and mimic channels and sloughs that were once present.
2. Review of available data: Numerous sources of data were used in the development of siting of specific measures and the development of alternatives. These sources include bathymetry, topobathy, forest inventory, LTRM data, land cover, and waterfowl surveys.
3. Review flood stage impacts: The next step was to ensure the alternatives would not have flood stage impacts (i.e., comply with No-Rise). Per Wisconsin guidelines - “The regional flood profile and changes to that profile caused by development in the floodplain, as determined by the hydraulic model, shall be calculated to the nearest 0.01 foot” – the resulting WSEs must be exported from the model by rounding to the nearest hundredth of a foot. This analysis compared existing to proposed conditions to ensure the proposed alternatives met the Wisconsin definition of no-rise. This was an iterative modeling effort that included many adjustments to size, elevation, and location of features to meet this constraint.
4. Largest alternative: Once the flood stage analysis was complete the largest alternative was determined. The largest alternative includes all the restoration measures and would provide the greatest habitat benefits.
5. Smallest alternative: Once the largest alternative was set the PDT developed the smallest alternative. This alternative includes the key measures that should be considered to be part of any action alternative and would provide minimum habitat benefits.
6. Full array of alternatives: Once the largest and smallest alternatives were developed the PDT developed a range of alternatives that would provide different types and levels of habitat benefits.

The alternatives were developed in a logical manner, and the PDT considered access and constructability when developing the alternatives. **Error! Reference source not found.** shows the measures that are included in each of the alternatives, a Y indicates it is included, gray indicates it is not included. Figures of all alternatives along with a brief description are provided below (see Figure 2 - Figure 11).

Table 3. Measures Included in Each Alternative

Type	Name	Alt1	Alt2	Alt3	Alt4	Alt5	Alt6	Alt7	Alt8	Alt9	Alt10
Island	I-1			Y	Y	Y	Y	Y	Y	Y	Y
	I-2		Y	Y	Y	Y	Y	Y	Y	Y	Y
	I-3			Y	Y	Y	Y	Y	Y	Y	Y
	I-4				Y	Y	Y	Y	Y	Y	Y
	I-5									Y	Y
	I-6									Y	Y
	I-7									Y	Y
Shoreline Stabilization	SS-1		Y	Y	Y	Y	Y	Y	Y	Y	Y
	SS-2		Y	Y	Y	Y	Y	Y	Y	Y	Y
	SS-3			Y	Y	Y	Y	Y	Y	Y	Y
	SS-4		Y	Y	Y	Y	Y	Y	Y	Y	Y
Rock Closure	RC-C-2							Y		Y	Y
	RC-C-3				Y	Y	Y	Y	Y	Y	Y
	RC-C-4		Y	Y	Y	Y	Y	Y	Y	Y	Y
	RC-C-5		Y	Y	Y	Y	Y	Y	Y	Y	Y
	RC-C-6					Y	Y		Y		Y
	RC-C-7								Y		Y
	RC-C-8				Y	Y	Y	Y	Y	Y	Y
	RC-C-10		Y	Y	Y	Y	Y	Y	Y	Y	Y
Dredging	D-A-1		Y	Y	Y	Y	Y	Y	Y	Y	Y
	D-A-2								Y		Y
	D-A-3		Y	Y	Y	Y	Y	Y	Y	Y	Y
	D-A-4									Y	Y
	D-A-5									Y	Y
	D-O-1			Y	Y	Y	Y	Y	Y	Y	Y
	D-O-3								Y		Y
Forest Management	FM-Nonstruct.		Y	Y	Y	Y	Y	Y	Y	Y	Y
	FM-TLP					Y	Y		Y		Y
Sediment Deflector	SD-1		Y	Y	Y	Y	Y	Y	Y	Y	Y

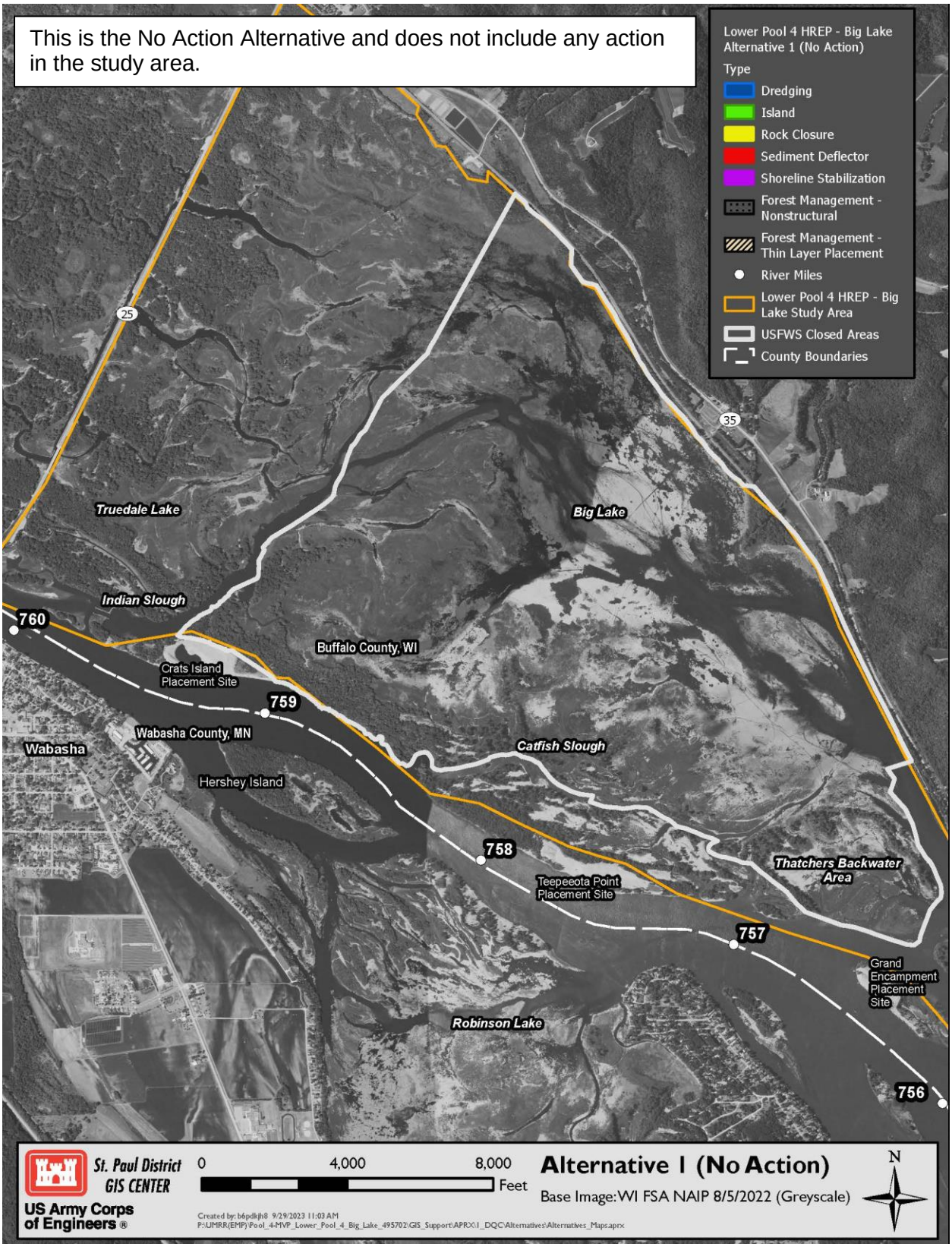

Figure 2. Alternative 1 – No Action.

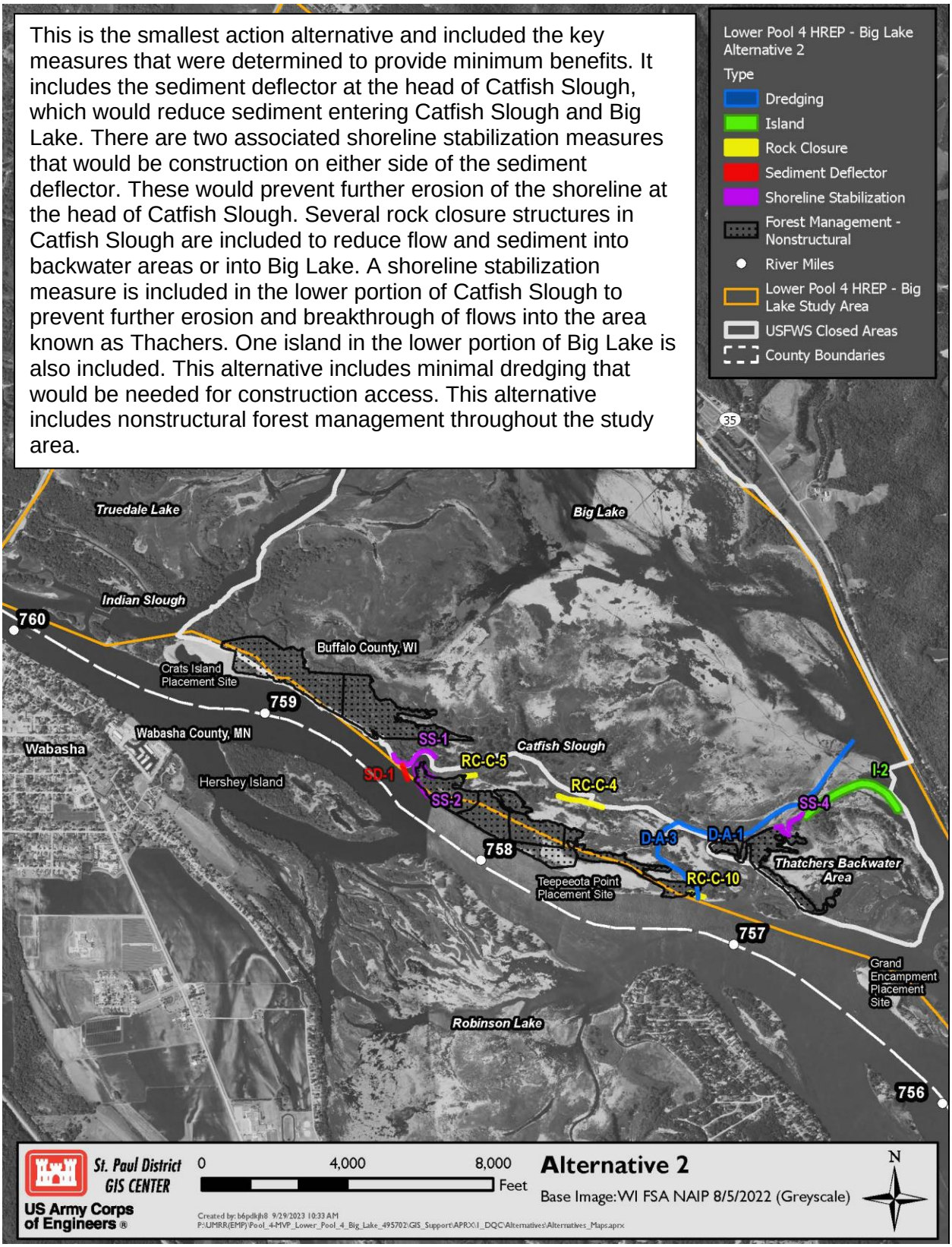

Figure 3. Alternative 2.

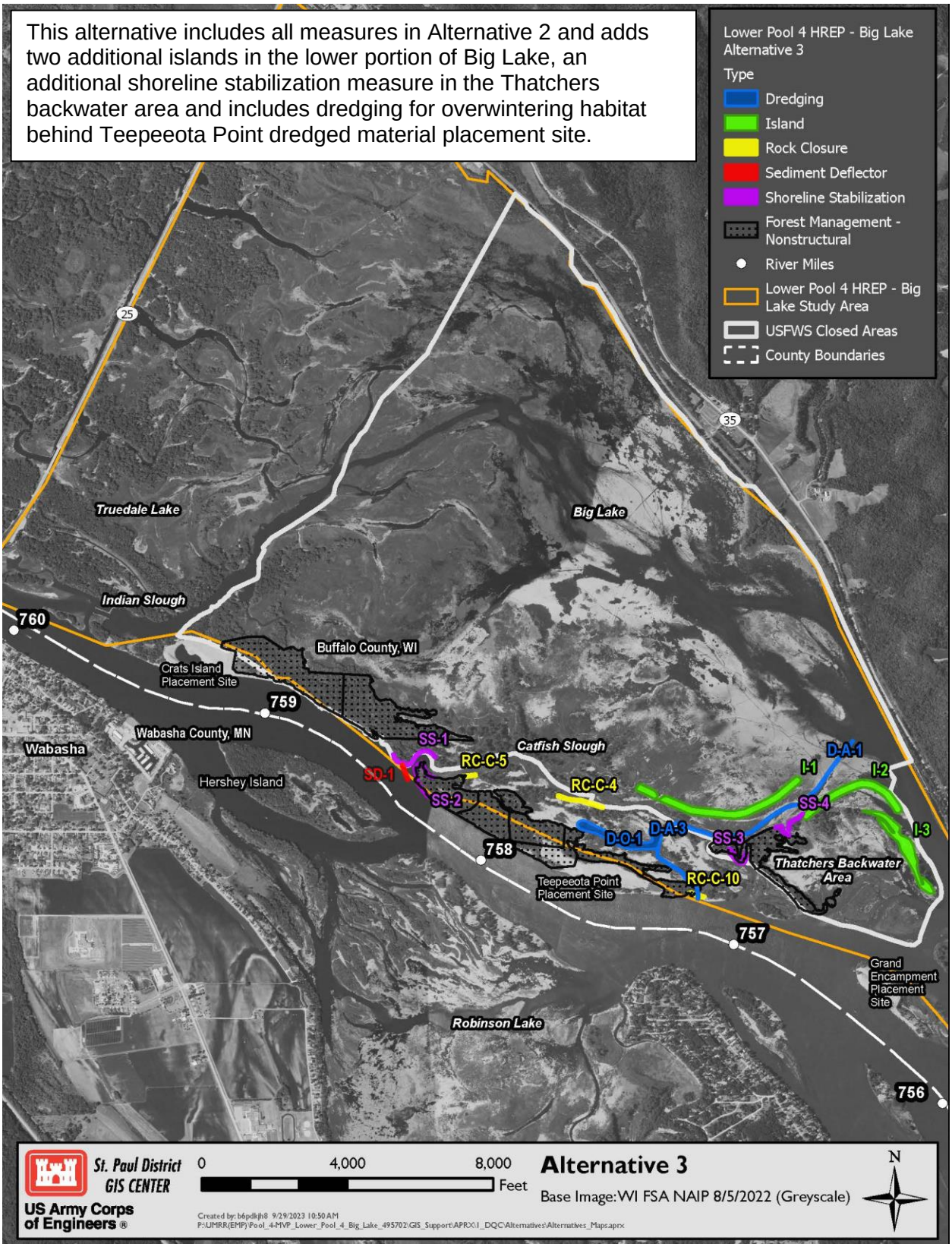

Figure 4. Alternative 3.

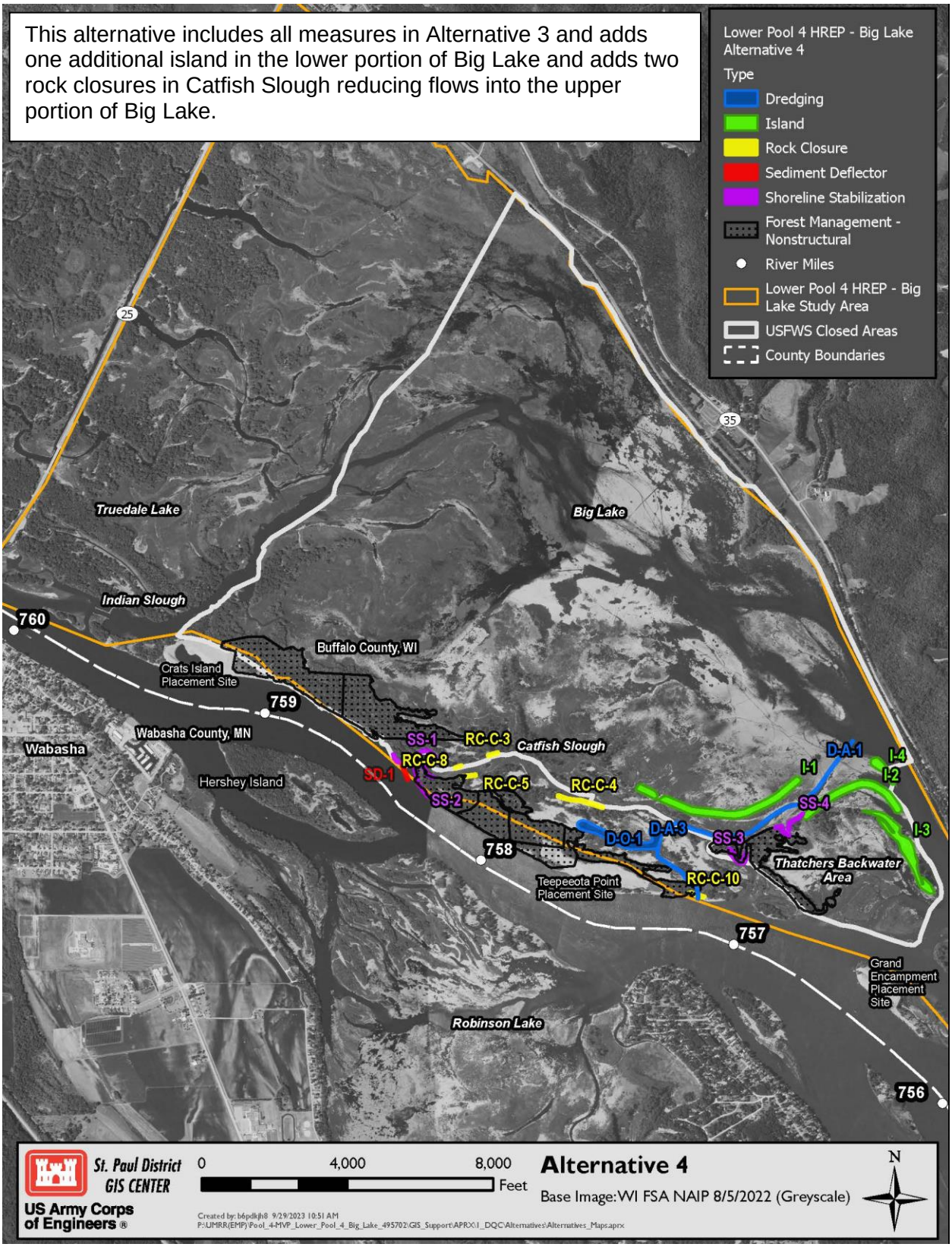

Figure 5. Alternative 4.

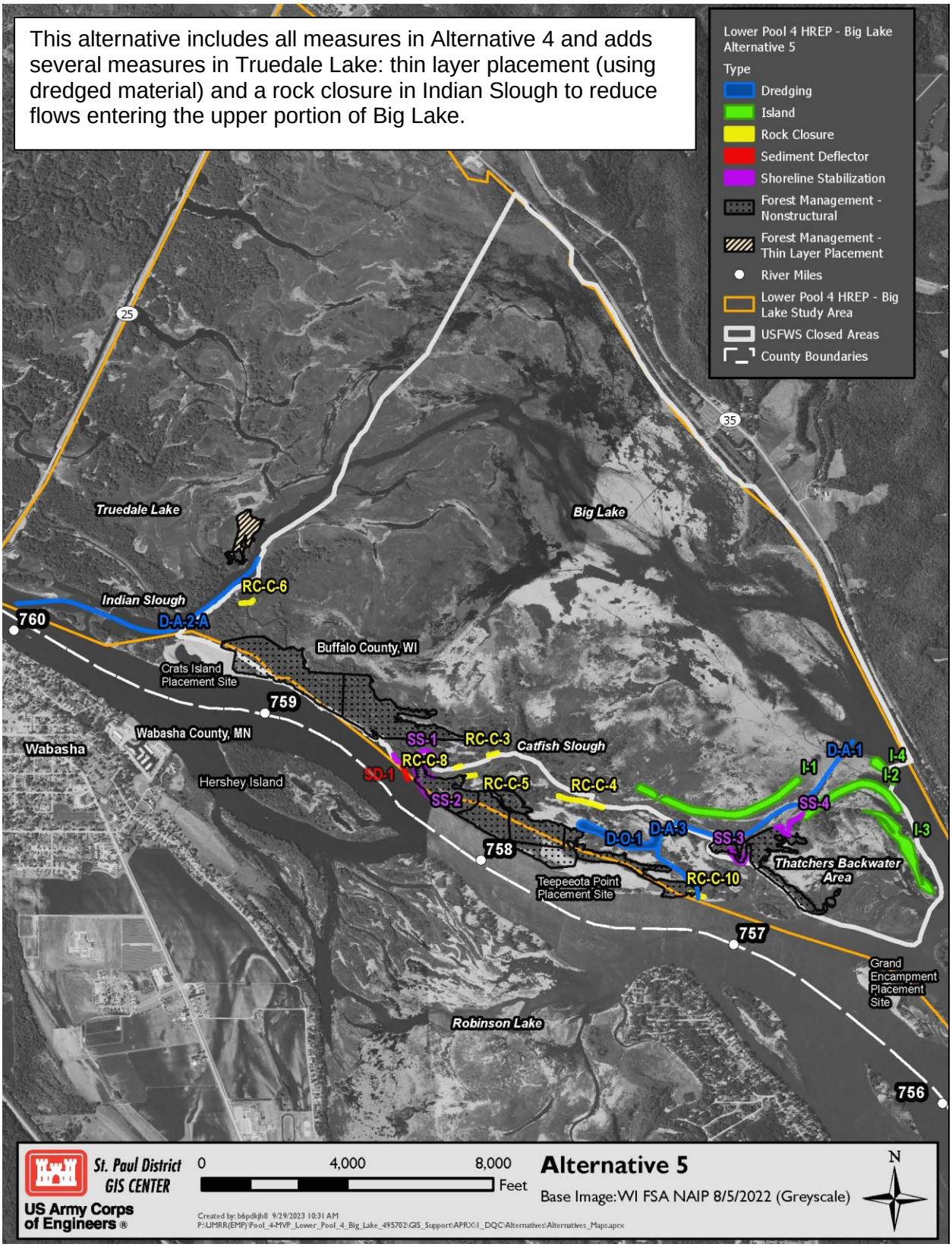

Figure 6. Alternative 5.

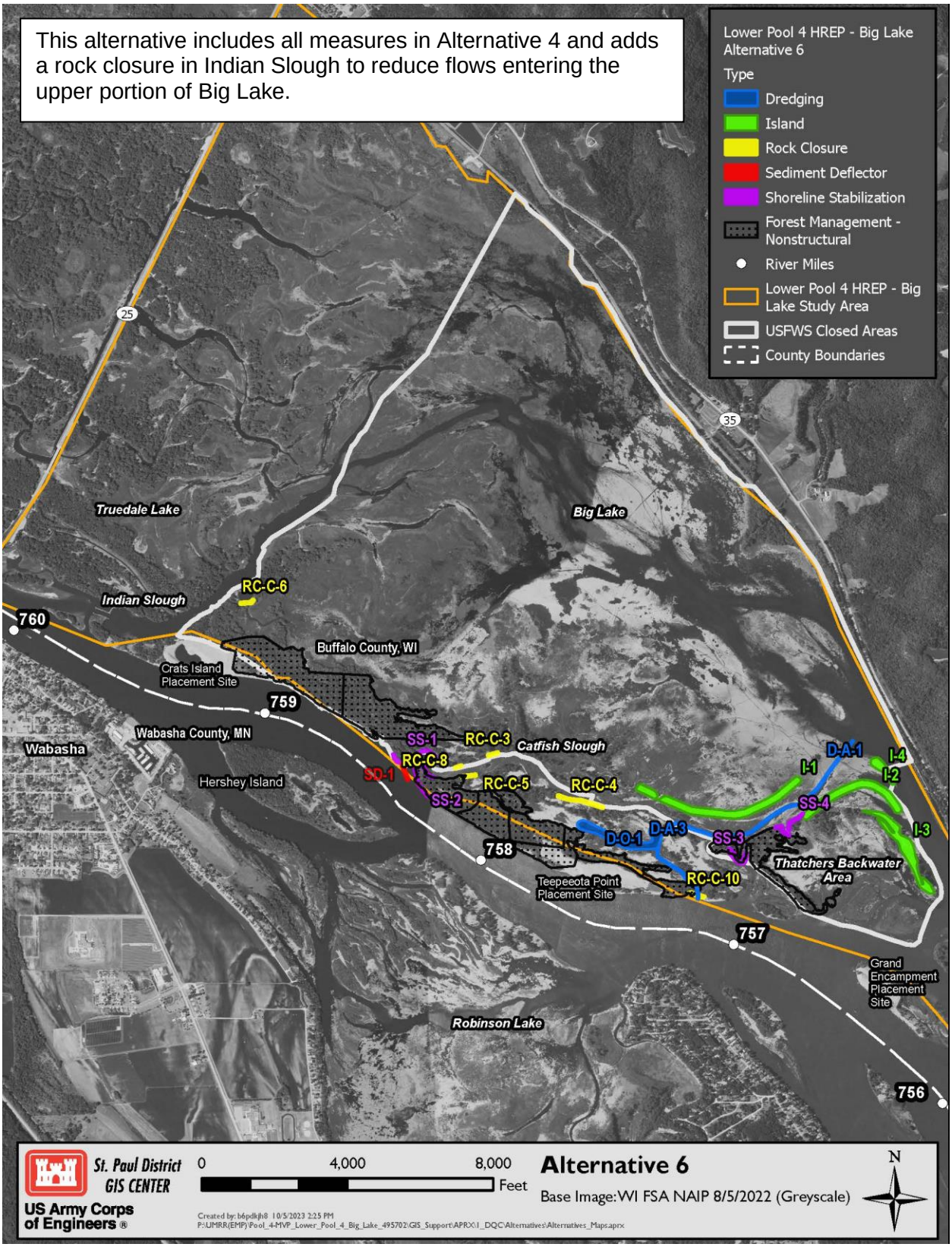

Figure 7. Alternative 6.

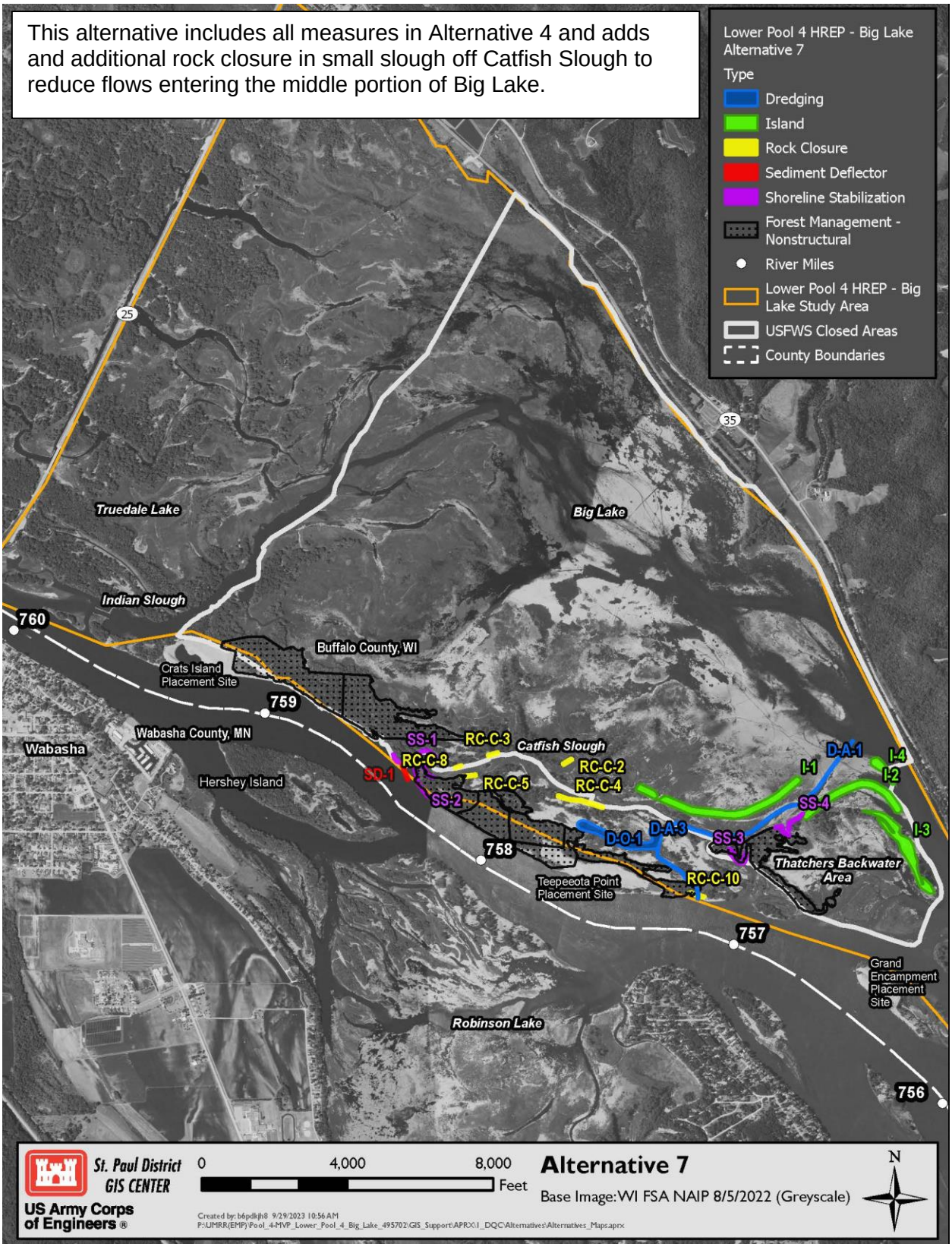

Figure 8. Alternative 7.

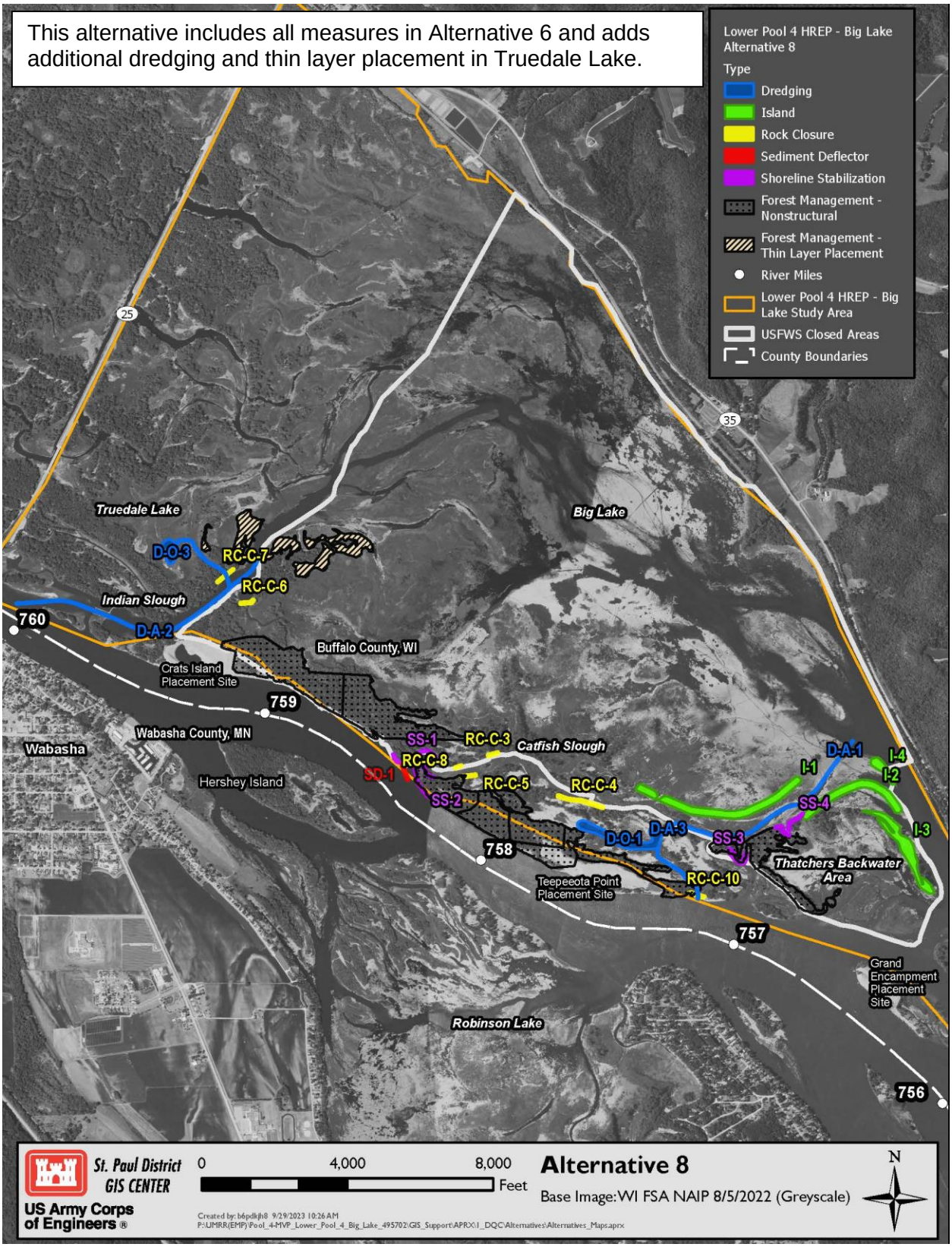

Figure 9. Alternative 8.

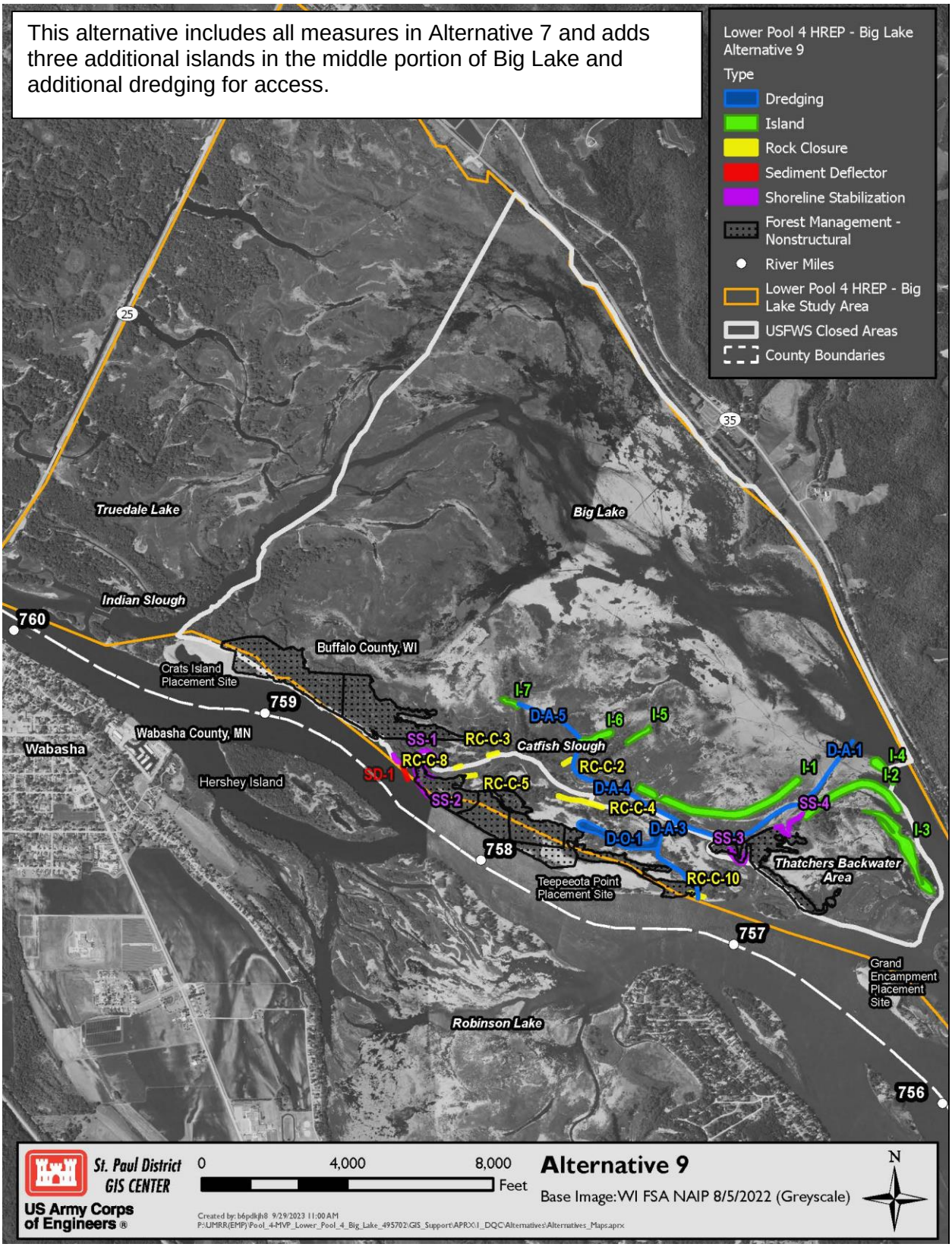

Figure 10. Alternative 9.

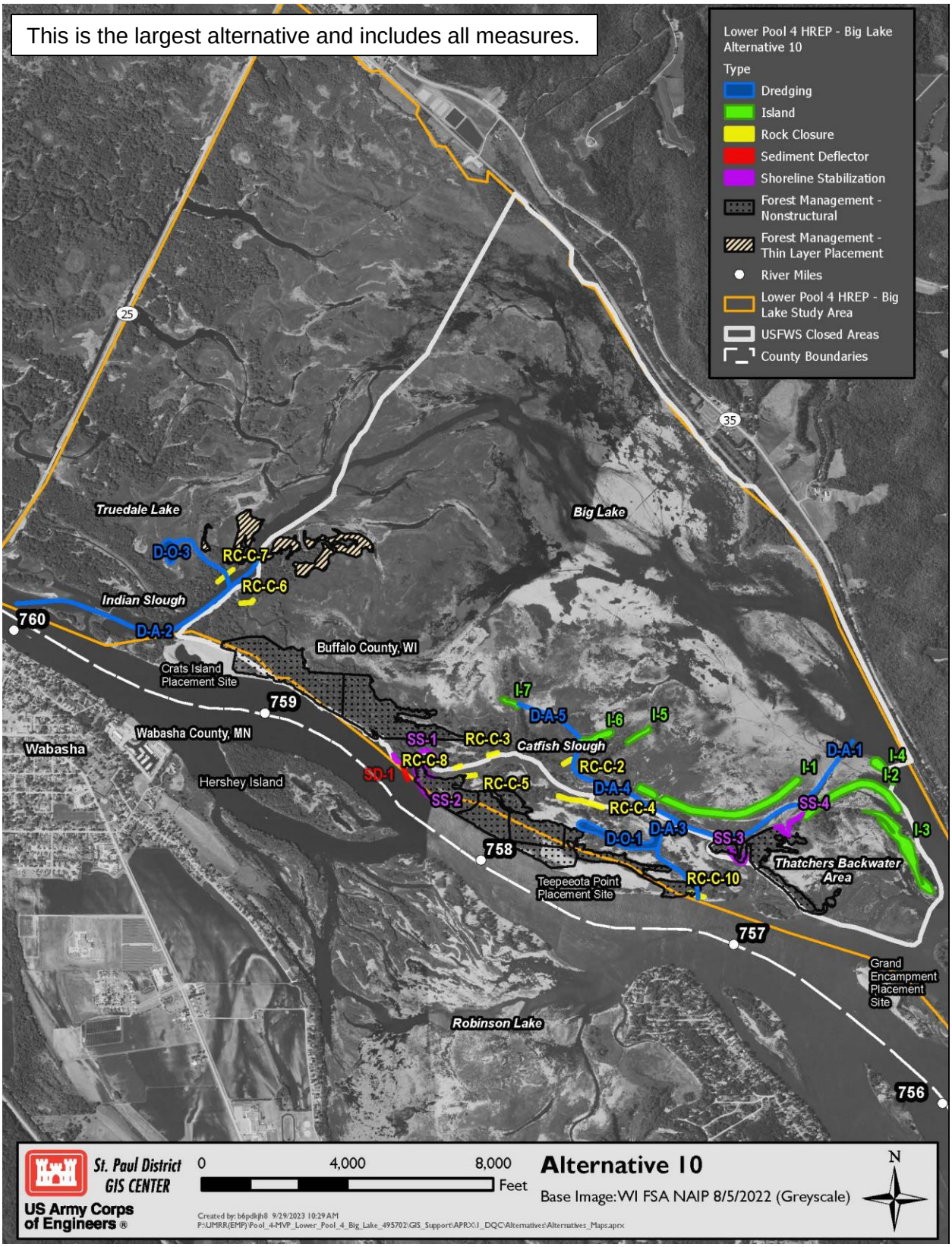

Figure 11. Alternative 10.

4. EVALUATION AND COMPARISON OF ALTERNATIVES

4.1 Evaluation of Alternatives

This section documents the process used to determine the habitat benefits and estimated costs for each alternative. The benefits and costs were used in the evaluation and comparison of alternatives.

4.1.1 Habitat Benefits Analysis

This assessment includes a summary of the existing biological conditions used in the evaluation, as well as a forecast for future conditions under the No Action Alternative and each potential Project alternative. The evaluation was conducted by a multi-agency team that included representatives from the District, Sponsor, and Project partners. Aquatic and floodplain benefits were quantified using the Habitat Evaluation Procedures (HEP; (USFWS, 1980)), a habitat-based evaluation methodology used in project planning. The procedure documents the quality and quantity of available habitat for selected wildlife species. The HEP assumes that habitat for selected wildlife species can be described by a Habitat Suitability Index (HSI). This index value (from 0.0 to 1.0) is multiplied by the area of applicable habitat to obtain Habitat Units (HUs).

Changes in HUs will occur as a habitat matures naturally or is influenced by development. These changes influence the cumulative HUs derived over the period of analysis (50 years). HUs are calculated for select target years and annualized using the IWR Planning Suite II tool annualizer over the period of analysis to derive a net Average Annual Habitat Unit (AAHU) quantity. By using target years, AAHUs were annualized using a linear interpolation approach, essentially drawing a straight line between target years, and then calculating the area under the curve for the resulting planning horizon benefit curve. Resulting net AAHUs are used as the output measurement to compare alternatives for the proposed Project.

The PDT used three USACE-approved [per Engineer Circular (EC) 1105-2-412] habitat evaluation methodologies in their analyses:

1. Upper Mississippi River System Floodplain Forest Habitat Model (hereafter the Floodplain Forest Model)
2. Modification of the Habitat Suitability Index Model for the Bluegill (Lepomis macrochirus) for Winter Conditions for Upper Mississippi River Backwater Habitats Migratory Habitat Model for the Diving Ducks using the Upper Mississippi River (hereafter the diving duck model)

A summary of the habitat analysis is provided in Table 4. Summaries of the average annual habitat units for each alternative can be found in Table 5. Complete documentation of the habitat benefits analysis is provided in Appendix C, Habitat Benefits Evaluation. As mentioned in Appendix C, a specific modeling effort was not done to evaluate benefits to flowing channel habitat. However, the rock features included in project alternatives will provide habitat to aquatic biota, including some that are habitat specialists seeking rock rapids habitat. Consideration will be given in design to optimizing these rock features to provide habitat to riverine species (e.g., various species of redhorse, sucker and sturgeon).

Table 4. Habitat Types and Areas Evaluated for the Big Lake Study

Habitat Type	Evaluation Area	Area (acres)	Habitat Suitability Index Model
Bottomland Forest	Island Features	34.8	Floodplain Forest Model
	Thin Layer Placement	21.3	Floodplain Forest Model
	Non-Structural Improvement	158.4	Floodplain Forest Model
Backwater Fisheries	D-O-1	27.3	Bluegill Overwintering Model
	D-O-3	36.9	Bluegill Overwintering Model
	Big Lake Overwintering Site	77.2	Bluegill Overwintering Model
	Thatchers backwater area	104.3	Bluegill Overwintering Model
Aquatic Submergent Vegetation	Diving Duck Evaluation Area	100	Diving Duck Model

Table 5. Annualized AAHUs By Alternative

Alternative	Forest Model AAHUs	Duck Model AAHUs	Bluegill Model AAHUs	Total AAHUs
Alt1	0	0	0	0
Alt2	37.4	56.1	15.4	108.9
Alt3	45.3	56.1	15.4	116.8
Alt4	46.2	56.1	27.5	129.8
Alt5	49.1	56.1	44.6	149.8
Alt6	46.2	56.1	44.6	146.9
Alt7	46.2	56.1	27.5	129.8
Alt8	57	56.1	53.7	166.8
Alt9	48.5	56.1	27.5	132.1
Alt10	59.3	56.1	53.7	169.1

4.1.2 Cost Estimates

Cost estimates for alternative comparison were prepared using October 2022 (Fiscal Year (FY) 2023) price levels; annualized costs include construction costs, contingency costs, adaptive management costs and O&M costs. It is assumed that USACE Channels and Harbors would contribute Federal Standard cost share for material used from Teepeeota Point dredged material placement site. Project measures are on the Refuge, and therefore federal lands. These lands are currently managed for ecological benefit to wildlife and land use would not be altered in the most-likely future condition or in the with-project condition, but rather restored and enhanced. Consequently, there are no lands and damages, relocation, or economic opportunity costs, in accordance with the IWR Report 93-R-12, *NED Cost Manual*, that may result in different plan selection.

Table 6 shows the estimated cost of Project alternatives as of completion of the habitat analysis and for use in the comparison of alternatives, prior to selection, refinement, and developing a full cost estimate of the Recommended Plan.

Table 6. Alternative Cost Estimates

Alternative	Estimated Construction Cost	Contingency	PED[1]	S&A[2]	Project First Cost
1	$0	$0	$0	$0	$0
2	$13,067,000	$3,708,000	$4,051,000	$1,960,000	$22,786,000
3	$17,819,000	$5,119,000	$5,524,000	$2,673,000	$31,135,000
4	$19,439,000	$5,592,000	$6,026,000	$2,916,000	$33,974,000
5	$20,523,000	$5,902,000	$6,362,000	$3,078,000	$35,865,000
6	$19,553,000	$5,627,000	$6,062,000	$2,933,000	$34,175,000
7	$19,554,000	$5,627,000	$6,062,000	$2,933,000	$34,176,000
8	$25,050,000	$7,232,000	$7,766,000	$3,758,000	$43,806,000
9	$22,104,000	$6,385,000	$6,852,000	$3,316,000	$38,657,000
10	$27,920,000	$8,086,000	$8,655,000	$4,188,000	$48,849,000

[1] PED – Preconstruction Engineering and Design, 31% of construction cost.
[2] S&A – Supervision & Administration, 15% of construction cost.
Note – all numbers have been rounded, estimates are Class 4.

Table 7 presents annualized investment costs, including interest during construction (IDC), based on the FY 2023 discount rate of 2.5% and a 50-year period of analysis, annual operations and maintenance (O&M) costs, annual monitoring and adaptive management (M&AM) costs, and the total annual cost. Interest During Construction (IDC) was calculated using mid-year compounding based on a 2-year period of construction and FY 2023 discount rate of 2.5%. Both IDC and the annualization was completed in IWR Planning Suite II annualizer tool.

Table 7: Annualized Costs

Alternative	Project First Cost	Interest During Construction[1]	Total Investment Cost	Average Annual Investment Cost	Annual O&M Cost	Annual M&AM Cost[2]	Total Average Annual Cost
1	$0	$0	$0	$0	$0	$0	$0
2	$22,786,000	$328,700	$23,114,700	$814,980	$13,700	$23,700	$852,300
3	$31,135,000	$448,300	$31,583,300	$1,113,600	$17,000	$32,400	$1,162,900
4	$33,974,000	$489,000	$34,462,000	$1,215,000	$18.700	$35,300	$1,269,100
5	$35,865,000	$516,300	$36,381,300	$1,282,700	$18,700	$37,300	$1,338,700
6	$34,175,000	$491,900	$34,666,900	$1,222,300	$18,700	$35,500	$1,276,500
7	$34,176,000	$491,900	$34,667,900	$1,222,300	$18,700	$35,500	$1,276,500
8	$43,806,000	$630,200	$44,436,000	$1,566,700	$18,900	$45,500	$1,631,100
9	$38,657,000	$556,100	$39,213,000	$1,382,600	$19,400	$40,200	$1,442,200
10	$48,849,000	$702,400	$49,551,400	$1,747,000	$19,300	$50,800	$1,817,200

[1] IDC was calculated based on a 2 year period of construction and FY 23 discount rate of 2.5%.
[2] Monitoring & Adaptive Management (M&AM) was calculated using a total of 4%.

4.2 Cost Effectiveness Incremental Cost Analysis

IWR Planning was used to complete a Cost Effective and Incremental Cost Analysis (CE/ICA) for the 10 alternatives (including the No Action Alternative), using the AAHUs and annualized costs described in this section. The CE/ICA is used when project benefits are not measured in dollars and is used to ensure the least cost alternative is identified for each possible level of environmental output, and the maximum level of output is identified for any level of investment.

Cost Effectiveness evaluation is used to identify the least costly solution to achieve a range of project benefits; the Incremental Cost Analysis identifies the subset of cost-effective alternative that are superior financial investments, called “Best Buys,” through analysis of the preliminary incremental costs. Best Buys are the alternatives that are the most efficient at producing the output variable or provide the greatest increase in AAHUs for the least increase in preliminary cost. The first Best Buy is the most efficient alternative, producing output at the lowest incremental cost per incremental unit. If a higher level of output is desired than what is provided by the first Best Buy, the second Best Buy is the most efficient plan for producing additional output, and so on.

Figure 12 and Table 8 show the alternatives differentiated by cost effectiveness. From this list of ten alternatives, two non cost effective alternatives, three cost effective alternatives and five Best Buy alternatives were identified.

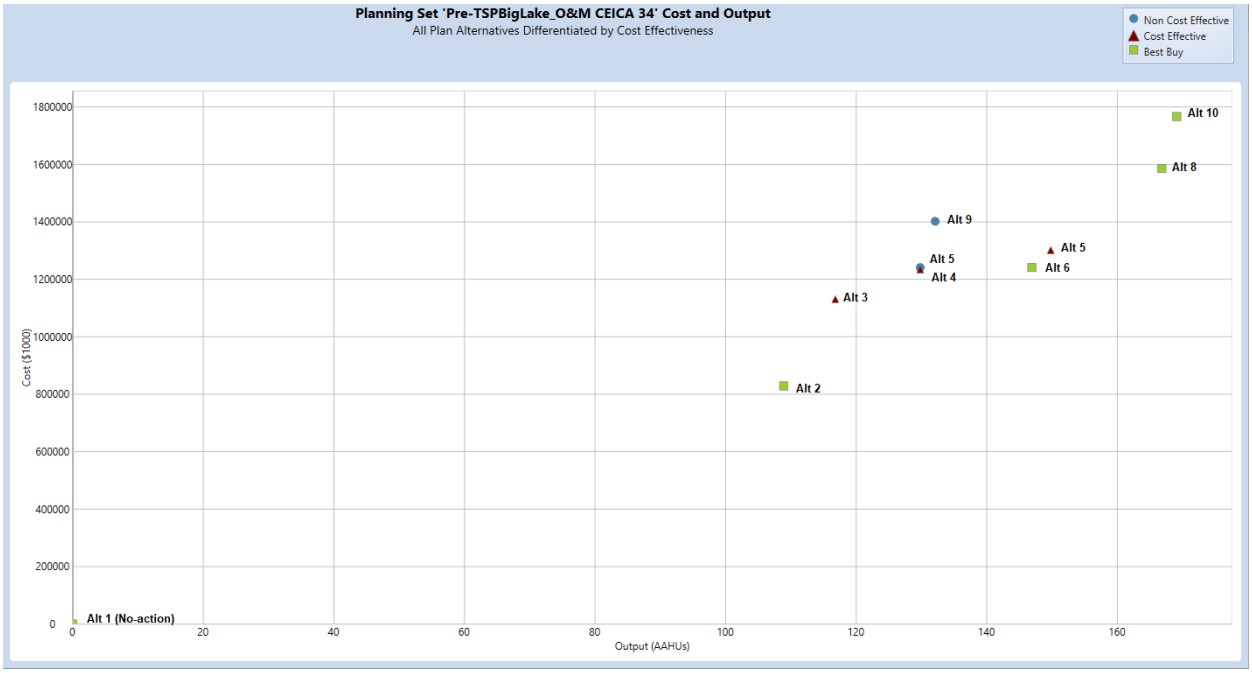

Figure 12. Alternative Plans Differentiated by Cost Effectiveness

Table 8. Alternatives Cost Effectiveness

Alternative	Net AAHUs	Project First Costs	Average Annual Cost	Average Annual Cost / AAHU	Cost Effectiveness
Alt 1 No Action	0	$0	$0	NA	Best Buy
Alt 2	109	$22,786,000	$814,980	$7,480	Best Buy
Alt 3	117	$31,135,000	$1,113,564	$9,530	Cost Effective
Alt 4	130	$33,974,000	$1,215,064	$9,360	Cost Effective
Alt 5	150	$35,865,000	$1,282,733	$8,560	Cost Effective
Alt 6	147	$34,175,000	$1,222,287	$8,320	Best Buy
Alt 7	130	$34,176,000	$1,222,323	$9,420	Non-Cost Effective
Alt 8	167	$43,806,000	$1,566,733	$9,390	Best Buy
Alt 9	132	$38,657,000	$1,382,576	$10,470	Non -Cost Effective
Alt 10	169	$48,849,000	$1,747,085	$10,330	Best Buy

The four Best Buy alternatives were analyzed to determine which had the lowest incremental cost for each additional increment of output.**Error! Reference source not found.** Figure 13 and Table 9 presents the Best Buy alternatives' differentiated by incremental cost and incremental benefit. Note that Alternative 1 (No Action) is not shown on the figure, it would appear at 0 on the X and Y axis.

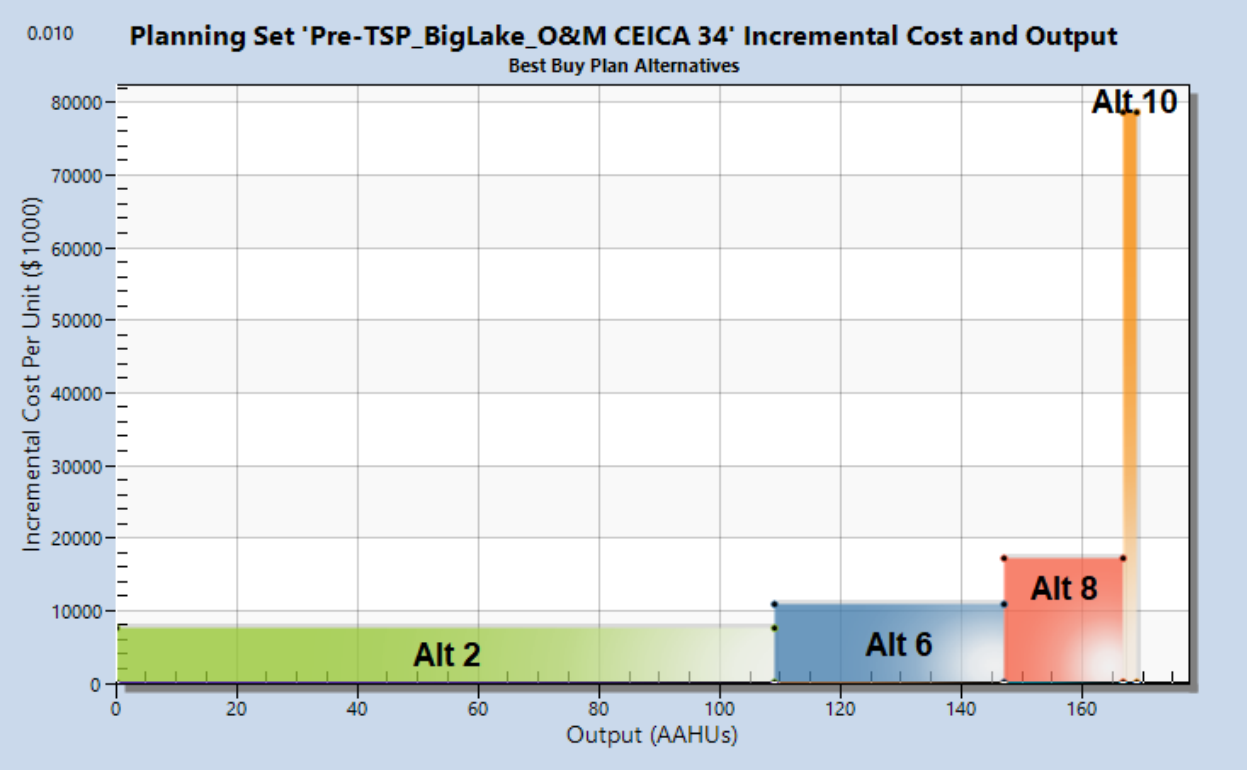

Figure 13. Best Buy Alternatives Differentiated by Incremental Cost & Incremental Benefit

Table 9. Best Buy Alternatives Incremental Cost per Incremental Output

Alternative	Output (AAHUs)[1]	Average Annual Cost	Average Annual /AHHU	Incremental Cost	Incremental Output (AAHUs)	Incremental Cost per Incremental Output
1	0	$0	$0	$0	0	$0
2	109	$852,338	$7,827	$852,338	109	$7,827
6	147	$1,276,499	$8,689	$424,161	38	$11,162
8	167	$1,631,161	$9,779	$354,662	20	$17,822
10	169	$1,817,165	$10,746	$186,004	2	$80,871

[1] Numbers have been rounded.

After reviewing the results of the CE/ICA analysis, all non-cost effective and cost-effective alternatives were screened from further consideration. Non-cost effective alternatives were screened from further consideration simply because they are not cost effective compared to the other alternatives. The cost-effective alternatives were also screened from further consideration. While these alternatives were cost effective, they were not the most cost effective nor did they give the greatest increase in outputs for the least increase in cost. The screened alternatives include Alternative 3, 4, 5, 7, and 9. The Best Buy alternatives were retained for further consideration and are further discussed in the following sections.

4.3 Comparison of Best Buy Alternatives

The final array of alternatives include Alternative 1, 2, 6, 8, and 10, all of which are Best Buy alternatives.

The Best Buy alternatives provide the information necessary to make well-informed decisions regarding the desired scale of features. Progressing through the increasing levels of output for the alternatives helps determine whether the increase in output is worth in additional cost. As long as decision makers consider a level of output to be “worth it”, subsequent levels of output are considered. When a level of output is determined to be “not worth it”, then subsequent levels of output will also likely be “not worth it”. Identification of such break points can be subjective. For this study, break points were identified between each of the Best Buy alternatives. The following documents the accomplishments of the Best Buy alternatives.

Alternative 1 (No Action) would not provide any habitat gains and no federal dollars would be expended.

Alternative 2 is the smallest action alternative and would provide minimal restoration benefits throughout the study area and include one island feature (8 acres), three rock closure structures in Catfish Slough that would benefit 132 acres of backwater habitat, and a sediment deflector with associated shoreline stabilization at the head of Catfish Slough that would benefit 100 acres of aquatic vegetation. This alternative would also improve 159 acres of bottomland forest habitat throughout the study area. This alternative would also further prevent shoreline erosion and breakthrough flows in the lower portion of Catfish Slough. This alternative would yield 109 AAHU at an average annual cost of $7,827. The incremental benefit compared to Alternative 1 would be 109 AAHU and the incremental cost per incremental AAHU would be $7,827. It was determined that the incremental cost was worth the incremental benefit compared to Alternative 1. This alternative would marginally meet the project objectives, there are additional alternatives that should be considered to ensure the objectives could be further accomplished with additional investment.

Alternative 6 would provide restoration benefits throughout the study area and include four island features (29 acres), five rock closure structures in Catfish Slough and one closure in Indian Slough that would benefit 209 acres of backwater habitat, a sediment deflector at the head of Catfish Slough with associated shoreline stabilization that would benefit 100 acres of aquatic vegetation, and overwintering dredging that would benefit 27 acres of backwater habitat behind Teepeeota Point dredged material placement site. This alternative would also improve 159 acres of bottomland forest habitat throughout the study area. This alternative would also further prevent shoreline erosion and breakthrough flows in the lower portion of Catfish Slough. This alternative would yield 147 AAHU at an average cost of $8,689. The incremental benefit compared to Alternative 2 would be 38 AAHU and the incremental cost per incremental AAHU would be $11,162. It was determined that the incremental cost was worth the incremental benefit compared to Alternative 2. This alternative would best meet the project objectives for a reasonable cost.

Alternative 8 would provide restoration benefits throughout the study area and include four island features (29 acres), six rock closure structures in Catfish Slough and two rock closures in Indian Slough that would benefit 246 acres of backwater habitat, a sediment deflector at the head of Catfish Slough and associated shoreline stabilization that would benefit 100 acres of aquatic vegetation, and overwintering dredging behind Teepeeota Point dredged material placement site and in Truedale that would benefit 64 acres of backwater habitat. This alternative would improve 159 acres of bottomland forest habitat throughout the study area and an additional 21 acres of forest through thin player placement. This alternative would also further prevent shoreline erosion and breakthrough flows in the lower portion of Catfish Slough. This alternative would yield 167 AAHU at an average cost of $9,779. The incremental benefit compared to Alternative 6 would be 20 AAHU and the incremental cost would per incremental AAHU be $17,822. It was determined that the additional cost was not worth the additional benefit.

Alternative 10 is the largest action alternative and would provide restoration benefits throughout the study area and include seven island feature (35 acres), six rock closure structures in Catfish Slough and two rock closures in Indian Slough that would benefit 246 acres of backwater habitat, a sediment deflector at the head of Catfish Slough that would benefit 100 acres of aquatic vegetation, and overwintering dredging behind Teepeeota Point dredged material placement site and in Truedale that would benefit 64 acres of backwater habitat. This alternative would improve 159 acres of bottomland forest habitat throughout the study area and an additional 21 acres of forest through thin player placement. This alternative would yield 169 AAHU at an average cost of $10,746. The incremental benefit compared to Alternative 8 would be 2 AAHU and the incremental cost would be $80,871. It was determined that the additional cost was not worth the additional benefit.

4.3.1 Ability to Meet Project Objectives

The following table (Table 10) documents the Best Buy alternatives and how each met or didn't meet the project objectives. High was used to describe when the measures significantly contributed to meeting the objective, moderate was used to describe alternatives when the objective was met but other alternatives provided additional habitat benefits, none was used to describe where the objective was not met.

Table 10. Best Buy Alternatives Ability to Meet Project Objectives

Alternatives	Protect, enhance, restore, or create naturally regenerating, resilient, and diverse bottomland forest habitats.	Maintain a balance of coverage and relative abundance of native emergent, rooted floating leaved, and submergent aquatic vegetation communities.	Protect, enhance, restore, or create flowing channel habitats.	Protect, enhance, restore, or create backwater habitats.
1	None	None	None	None
2	Moderate – would improve ~8 acres of bottomland forest on new islands and 159 acres of forest management.	High – would maintain 100+acres of aquatic vegetation throughout the study area.	Moderate – would incorporate shoreline stabilization to minimize erosion and widening of secondary channels.	Moderate - would improve two backwater areas with construction of closure structures and island I-2 (island protects backwater habitat).
6	Moderate – would improve ~29 acres of bottomland forest on new islands and 159 acres of forest management.	High – would maintain 100+acres of aquatic vegetation throughout the study area.	Moderate – would incorporate shoreline stabilization to minimize erosion and widening of secondary channels.	High – would improve three backwater areas with construction of closure structures and backwater dredging, as well as island I-2.
8	High – would improve ~29 acres of bottomland forest on new islands, 21 acres through tin layer placement, and 159 acres of forest management.	High – would maintain 100+acres of aquatic vegetation throughout the study area.	Moderate – would incorporate shoreline stabilization to minimize erosion and widening of secondary channels.	High – would improve four backwater areas with construction of closures structures and backwater dredging, as well as island I-2.
10	High – would improve ~35 acres of bottomland forest on new islands, 21 acres through tin layer placement and 159 acres of forest management.	High – would maintain 100+acres of aquatic vegetation throughout the study area.	Moderate – would incorporate shoreline stabilization to minimize erosion and widening of secondary channels.	High – would improve four backwater areas with construction of closure structures and backwater dredging, as well as island I-2.

4.3.2 Principles and Guidelines Criteria

Evaluation of the final array of alternatives was also based on the Economic and Environmental Principles and Guidelines (P&G) For Water and Related Land Resources Implementation. The P&G criteria include:

- **Completeness** is the extent to which a given alternative plan provides and accounts for all necessary investments or other actions to ensure the realization of the planned effects. This may require relating the plan to other types of public or private plans if the other plans are crucial to realization of the contributions to the objective.
- **Effectiveness** is the extent to which an alternative plan alleviates the specified problems and achieves the specified opportunities.
- **Efficiency** is the extent to which an alternative plan is the most cost- effective means of alleviating the specified problems and realizing the specified opportunities, consistent with protecting the Nation's environment.
- **Acceptability** is the extent to which the alternative plans are acceptable in terms of applicable laws, regulations, and public policies. Acceptability can also consider the sponsor, partners, and public acceptance of the alternative.

The study team gave each alternative a qualitative metric (high/moderate/low) related to the P&G criteria. High signifies the metric was met considerably. Moderate indicates the metric was moderately met. Low indicates the metric was minimally or not met. Table 11 documents the evaluation of the best buy alternatives using the P&G criteria.

- Completeness – High indicates the alternative is complete and no further investments from others would be needed to achieve the planning objectives. Low indicates that no planning objectives would be met and the alternative is not complete and additional action would be needed.

- Effectiveness – High indicates the alternative addresses the problems within the study area. Moderate indicates the alternative minimally addresses the problems within the study area. Low indicates no problems are addressed within the study area.

- Efficiency – The efficiency metric used the cost per AAHU and project first cost. All alternatives are considered high from a cost/AHHU perspective, as they are all Best Buy alternatives. High indicates the cost /AAHU was considered reasonable, and the project first cost was under $40 million. Low indicates the cost/AAHU was considered reasonable, and the project first cost was over $40 million. $40 million was used as it is the cost threshold for individual projects in the UMRR Program.

- Acceptability - High indicates the alternative is acceptable in terms of laws and regulation and has support from the Sponsor and partners. Moderate indicates the alternative is acceptable in terms of laws and regulation and in minimally acceptable to the Sponsor and partners. Low indicates that the alternative would not be acceptable in terms of laws, regulations and would not be acceptable to the Sponsor, partners, or the public.

Table 11. Evaluation of Best Buy Alternatives Using P&G Criteria

Alternative	Completeness	Effectiveness	Efficiency	Acceptability
1	Low – No action taken and objectives not met.	Low – No restoration action taken, and no problems alleviated.	High - $0/AAHU, project first cost $0	Low – Does not violate any laws/regulations, is not acceptable to sponsor and partners.
2	High – Action taken to address the objectives, no other action needed from others to realize the benefits.	Moderate – Minimally addresses the problems in the lower portion of Big Lake, does not address problems in Truedale Lake area.	High - $7,827/AAHU, project first cost $22,786,000	Moderate - Does not violate any laws/regulations, is minimally acceptable to sponsor and partners.
6	High - Action taken to address the objectives, no other action needed from others to realize the benefits.	High – Problems addressed throughout the Big Lake area, does not address problems in Truedale Lake area.	High - $8,689/AAHU, project first cost $34,175,000	High - Does not violate any laws/regulations, is acceptable to sponsor and partners.
8	High - Action taken to address the objectives, no other action needed from others to realize the benefits.	High – Problems addressed throughout the entire study area.	Low - $9,779/AAHU, project first cost $43,806,000, over the $40 million cost limit	High - Does not violate any laws/regulations, is acceptable to sponsor and partners.
10	High - Action taken to address the objectives, no other action needed from others to realize the benefits.	High – Problems addressed throughout the entire study area.	Low - $10,746/AAHU, project first cost $48,849,000, over the $40 million cost limit	High - Does not violate any laws/regulations, is acceptable to sponsor and partners.

4.3.3 Comprehensive Benefits

USACE is required to comprehensively evaluate and provide a complete accounting consideration, and documentation of the total benefits of alternatives over a full array of benefit categories: National Ecosystem Restoration (NER), Regional Economic Development (RED), Environmental Quality (EQ) and Other Social Effects (OSE) (Assistant Secretary of the Army (Civil Works) Memorandum, SUBJECT: POLICY DIRECTIVE – Comprehensive Documentation of Benefits in Decision Document, 5 January 2021). The final array of alternatives were assessed to determine if they have net benefits in total and in each benefit category.

National Ecosystem Restoration

Single purpose ecosystem restoration projects are evaluated in their net increases in ecosystem value. These contributions are related to National Ecosystem Restoration (NER) benefit category and are defined by increases in the net quantity and/or quality of desired ecosystem

resources. The quantified effects on this account can be shown through the ratio of average annual cost to average annual habitat units. The average annual cost per average annual habitat unit for the Best Buy action alternatives range from approximately $7,830 to $10,750 (FY 2023), The no action alternative does not have any costs or habitat units associated with it and therefore has no impact to NER.

Regional Economic Development

The Regional Economic Development (RED) account registers changes in the distribution of regional economic activity that result from each alternative plan. RED benefits impact a region, not the nation as a whole. For the Lower Pool 4 Big Lake HREP study, the Regional ECONomic System (RECONS) model was used to model regional economic impacts which provides estimates of jobs supported by USACE programs, projects, and activities. RECONS was run for every alternative developed during the project. Economic impact and contribution estimate the change (impact) or existence (contribution) in economic activity (output, labor income, value added, and employment) associated with the new or already occurring economic stimulus to an economy. Gross Regional Product, which is also known as value added, is equal to the sum of employee compensation, proprietor income, other property type income, and indirect business taxes. GRP is also defined as gross industry output (i.e., sales or gross revenues) less the cost of intermediate inputs (i.e., the consumption of goods and services purchased from other US industries or imported). Jobs are defined as the work in which one is engaged; an occupation by which a person earns income. Jobs are presented in full-time equivalents. All Best Buy action alternatives would have a positive impact on the regional economy. Table 12 below describes the Best Buy alternatives and their impacts. Additional information surrounding the RECONS analysis can be found in Appendix I, RECONS.

Table 12. Summary of RED Impact of Best Buy Alternatives

Alternative	Expenditures	Gross Regional Product	Full-time Equivalent Jobs
1	$0	$0	0
2	$22,786,000	$12,042,000	193.8
6	$34,175,000	$18,060,000	290.6
8	$43,806,000	$23,150,000	372.5
10	$48,849,000	$25,815,000	415.4

Environmental Quality

The EQ account displays non-monetary effects on significant natural, cultural resources, and aesthetic resources including the positive and adverse effects of ecosystem restoration plans. For ecosystem restoration projects such as this one, contributions to the EQ account are detailed both through NEPA compliance and through calculation of net ecosystem benefits. Here, NEPA compliance is achieved by integrating an EA into this feasibility report, with a qualitative summary of environmental effects detailed in Table 21 as well as in Section 6 of this report.

The USACE objective in ecosystem restoration is to contribute NER via increases in the net quality and or quantity of desired ecosystem resources. Contributions to NER outputs are increases in the net quality and or quantity of desired ecosystem resources. Cost per AAHU for all alternatives are considered efficient at achieving the ecosystem restoration objectives.

Selecting the NER plan requires consideration of the plan that meets the planning objectives and constraints and reasonably maximizes environmental benefits while passing the test of cost effectiveness and incremental cost analyses, significance of outputs, completeness, effectiveness, efficiency and acceptability. The alternative that reasonably maximizes the benefits in relations to costs and meets the overall study objectives is Alternative 6 and is the NER plan. A calculation of net ecosystem benefits was completed through the use of HEP and HSI models. The quantitative results of the evaluation are discussed above and in Appendix C. The credit for the EQ account is the quantified benefits resulting from the project, which in the case of the NER plan, provides a net gain of 147 AAHUs over the 50-year period of analysis.

Other Social Effects
The Other Social Effects (OSE) account includes urban and community impacts; life, heath, and safety factors; displacement; long-term productivity; and energy requirements and energy conservation. The OSE account addresses plan effects from perspectives that are relevant to the planning process but are not reflected in the other three accounts.

There are no notable life or safety factors that would be affected by any of the action alternatives. Alternative 6 would store additional carbon long term, providing incremental but diffuse socio-economic benefits over the No Action Alternative. The bottomland forest zones could potentially serve as a passive and natural native seed source for adjacent bottomland forest.

There would also be recreational benefits associated with Alternative 6. The Winona District of the Upper Mississippi River National Wildlife and Fish Refuge has previously established recreational usage by the public. Island creation and the creation or enhancement of additional overwintering and floodplain habitat would likely increase fishing, canoeing, boating, and bird watching recreational users traveling to the area, thus positively affecting OSE factors. There would likely be incremental local and possibly regional benefits due to increases in local hotel stays, purchases from local stores (such as bait, tackle, boating and canoe supplies, and food). These benefits cannot be quantified as there are no current USACE baseline data of recreational use of the study area. However, observational data from completed habitat restoration projects in the area support that there would likely be a small, incremental benefits from primary and secondary effects of increased recreation of the study area. For additional information on existing recreational usage, see section 6.4.17.

Comprehensive Benefits Summary
Table 13 provides a summary of benefits for the Best Buy alternatives across the benefit categories. NER was evaluated using cost/AAHU. RED was evaluated using gross regional product, which is also known as value added. EQ was evaluated using the number of restored or enhances acres. OSE was evaluated using incidental recreation benefits. All action alternatives are very similar when comparted across all four accounts. Generally, the larger the project the greater the benefits across the categories. While the accounts were beneficial in the consideration of each alternative, they were not driving factors in the selection of the Recommended Plan.

Table 13. Comprehensive Benefits Summary for Best Buy Alternatives.

Alternative	NER	RED	EQ	OSE
	Average Annual Cost/AAHU	Gross Regional Product, Employment	Acres Restored	Incidental Recreation Benefits
1 – No Action	$0	$0, 0 full-time equivalent jobs	0	Remain as is
2	$7,827	$12,042,000, 193.8 full-time equivalent jobs	408	Positive impact
6	$8,689	$18,060,000, 290.6 full-time equivalent jobs	543	Positive impact
8	$9,779	$23,150,000, 372.5 full-time equivalent jobs	620	Positive impact
10	$10,746	$25,815,000, 415.4 full-time equivalent jobs	625	Positive impact

4.4 Selection of the Recommended Plan

Federal planning for water resources development was conducted in accordance with the U.S. Water Resources Council's P&G.

> "For ecosystem restoration projects, a plan that reasonably maximizes ecosystem restoration benefits compared to costs, consistent with the Federal objective, shall be selected. The selected plan must be shown to be cost effective and justified to achieve the desired level of output. This plan shall be identified as the National Ecosystem Restoration (NER) Plan."

Based on the evaluation and comparison alternatives across the habitat benefits gained compared to costs, the alternatives ability to meet the objectives, the comparison using the P&G criteria, and across all benefit categories, Alternative 6 is the alternative that best meets the project objectives and reasonably maximizes benefits compared to cost. Alternative 6 is recommended as the National Ecosystem Restoration Plan and the Recommended Plan.

5. RECOMMENDED PLAN

5.1 Description of Plan

The following documents the features of the Recommended Plan. Additional details on design assumptions for the Recommended Plan are included in technical appendices. The Recommended Plan is shown on Figure 18, additional images of the Recommended Plan can be found in Appendix L, Plates.

5.1.1 Forest Management – Non-Structural

Forest management would occur along the main channel approximately RM 759 to RM 756.5, near the Crats Island dredged material placement site, along Catfish slough, and near the Teepeeota Point dredged material placement site. Specific actions include timber stand improvement, removal of invasive woody vegetation and grasses, planting and seeding, and planting hard mast trees. The Recommended Plan would include approximately 159 acres of non-structural forest management measures.

5.1.2 Island Creation – Islands (I)

The Recommended Plan includes the restoration/creation of four island features. Island features would be constructed by placing granular material and fine material and include erosion protection methods to ensure the islands are stable over the project life (riprap end protection, groins, and vanes).

- I-1 would be about 12 acres along the downstream end of Catfish Slough north of the Thatchers backwater area towards the Wisconsin shoreline.
- I-2 would be about 8 acres along the north shoreline of the Thatchers backwater area.
- I-3 would be about 8 acres along the right descending bank along the shoreline between Thatchers backwater area and the Wisconsin shoreline.
- I-4 would be a small island, about 2 acres, to the northeast of I-2 in the channel between Thatchers backwater area and the Wisconsin shoreline.

5.1.3 Shoreline Stabilization (SS)

Shoreline stabilization would be accomplished through placement of riprap on existing shorelines. Some of the shoreline stabilization measures include a granular berm topped with fine material to restore the shoreline. The top elevation of the shoreline stabilization measures are designed to match the existing adjacent land. The design of these features do not include excavation of existing shoreline ensuring the existing land is not disturbed. These measures would be constructed with R45 riprap and placed directly on the existing grade.

- SS-1 would be along the left descending bank of the entrance of Catfish Slough (Figure 14) at the main channel of Mississippi River and would include granular fill with riprap to address stabilization along an existing, deep scour hole.
- SS-2 would be along the right descending bank of the entrance of Catfish Slough (Figure 14) at the main channel of Mississippi River and would include granular fill with riprap to address stabilization along an existing, deep scour hole. Figure 14 shows the area just downstream of the Catfish Slough entrance from the main channel. SS-2 would incorporate the area in Figure 15.
- SS-3 would be along the west side of the north shoreline of Thatchers backwater area and would include granular fill with riprap.
- SS-4 would be along the center of the north shoreline of Thatchers backwater area.

Figure 14. Head of Catfish Slough looking southwest towards the main channel of the Mississippi River.

Figure 15. Area along the main channel just south of the head of Catfish Slough, proposed location of SS-2.

5.1.4 Sediment Deflector (SD)

The Sediment Deflector (SD) would be situated at the head of Catfish Slough where it meets the Main Channel. This feature is oriented downstream to prevent sediment from entering Catfish Slough for events less than or equal to the 50% Annual Exceedance Probability (AEP) event. The SD would be constructed at a top elevation of 668.7 feet (50% AEP event at this approximate river mile). The side slope would be 1V:2.5H and top width would be six feet.

5.1.5 Closure Structures – Rock Closures (RC)

Complete closures or partial closures are structural measures designed to control or reduce flow in existing secondary channels. By reducing flows, closure structures can also reduce or deflect suspended sediment.

The Recommended Plan would include six rock closures. These structures are designed with a top width of six feet and a top elevation slightly below the adjacent existing land so that seasonal hydraulic connectivity is maintained. These structures also include shoreline stabilization directly adjacent to the structure to prevent erosion at the tie-in locations. These structures are identified and designed as complete closures (RC-C), however, refinement following the Recommended Plan may result in some or all the closures including a low flow notch to serve as partial closure structures.

- RC-C-3 – A rock closure would be constructed along the north side (left descending bank) of Catfish Slough.
- RC-C-4 – A long rock closure would be constructed on the south side (right descending bank) of Catfish Slough (Figure 16), parallel to D-O-1.
- RC-C-5 – A rock closure would be constructed along the south side (right descending bank) of Catfish Slough at the north entrance to the area that would include overwintering dredging (D-O-1) behind Teepeeota Point dredged material placement site.
- RC-C-6 – A rock closure would be constructed along the south side (right descending bank) of Indian Slough (Figure 17), south of the Truedale backwater area at the northern extent of the refuge Closed Area.
- RC-C-8 – A rock closure would be constructed along the north side (left descending bank) of Catfish Slough nearest SS-1.
- RC-C-10 – A rock closure would be constructed at the main channel entrance for D-A-3 to D-O-1, south of Teepeeota Point dredged material placement site.

Figure 16. Location of proposed RC-C-4.

Figure 17. Location of proposed RC-C-6 in Indian Slough.

5.1.6 Overwintering Dredging (D-O)

Dredging would be implemented to restore and increase depth diversity, particularly depths suitable for overwintering (i.e., greater than 8 ft in depth), to increase aquatic structure, and to improve water quality.

The backwater area between Teepeeota Point dredged material placement site and Catfish Slough (D-O-1) would be dredged for overwintering fish habitat and as a source of material for building other features. Current design and quantity estimates assume side slopes of one foot vertical: four feet horizontal to a bottom elevation of 658.5 feet which is approximately eight feet deep from LCP. Dredge cut size is initially estimated at 6.9 acres, but this size could fluctuate based on material needs for island construction. Depending on drying and material shrinkage, the size of the dredged area could vary somewhat. Size also could fluctuate slightly based on design parameters such as side slopes which will be finalized during the design phase.

5.1.7 Access Dredging (D-A)

Access dredging would be needed to reach Catfish Slough from the main channel of the river. Dredging would also occur in the southern portion of Catfish Slough towards the Wisconsin shoreline to access areas need for island building. Dredging to a depth of six feet from LCP and 40-foot width would be done for the construction access areas throughout the project area.

Current design and quantity estimates assume side slopes of one foot vertical: four feet horizontal to a bottom elevation of 660.5 feet which is approximately six feet deep from LCP and channel bottom width of 40 feet.

- D-A-1 – Access dredging would be completed along Catfish Slough towards the Wisconsin shoreline, parallel to, and providing access for, the island features.
- D-A-3 – Access from the main channel would include access dredging south of Teepeeota Point dredged material placement site to D-O-1 and Catfish Slough.

5.1.8 Design Quantities

A summary of quantities for features in the Recommended Plan is located in Table 14. Shows the Recommended Plan, Alternative 6. The quantities, in cubic yards (CY) and subsequent costs may vary during final design. Additional details of quantities and design can be found in Appendix H, Civil Engineering.

Table 14. Summary of Quantities for the Recommended Plan Measures.

Feature ID	Cut Volume Granular CY	Cut Volume Fines CY	Fill Volume Granular CY	Fill Volume Fines Cu Yards With Shrinkage	Fines Thickness	Underwater Placement Rock Volume CY	Surface Area Acres
Forest Management							159
D-A-1	14,908	6,810					5.4
D-A-3	10,063	0					1.4
D-O-1		49,506					6.9
I-1			104,942	11,163	6"	12,627	15.9
I-2			68,095	7,568	6"	14,188	9.6
I-3			105,677	27,261	18"	1,866	11.2
I-4			36,595	106,399	18"	7,139	4.0
RC-C-3						866	0.35
RC-C-4						2,201	0.68
RC-C-5						480	.19
RC-C-6						629	0.27
RC-C-8						528	0.19
RC-C-10						1,674	0.46
SD-1						11,877	0.65
SS-1			2,114	870		8,430	3.1
SS-2			2,114	1,178		19,674	2.7
SS-3			854	1,877		1,227	2.3
SS-4			0	0		3,468	1.7
Totals	24,971	56,316	320,391	56,316		86,871	225.8

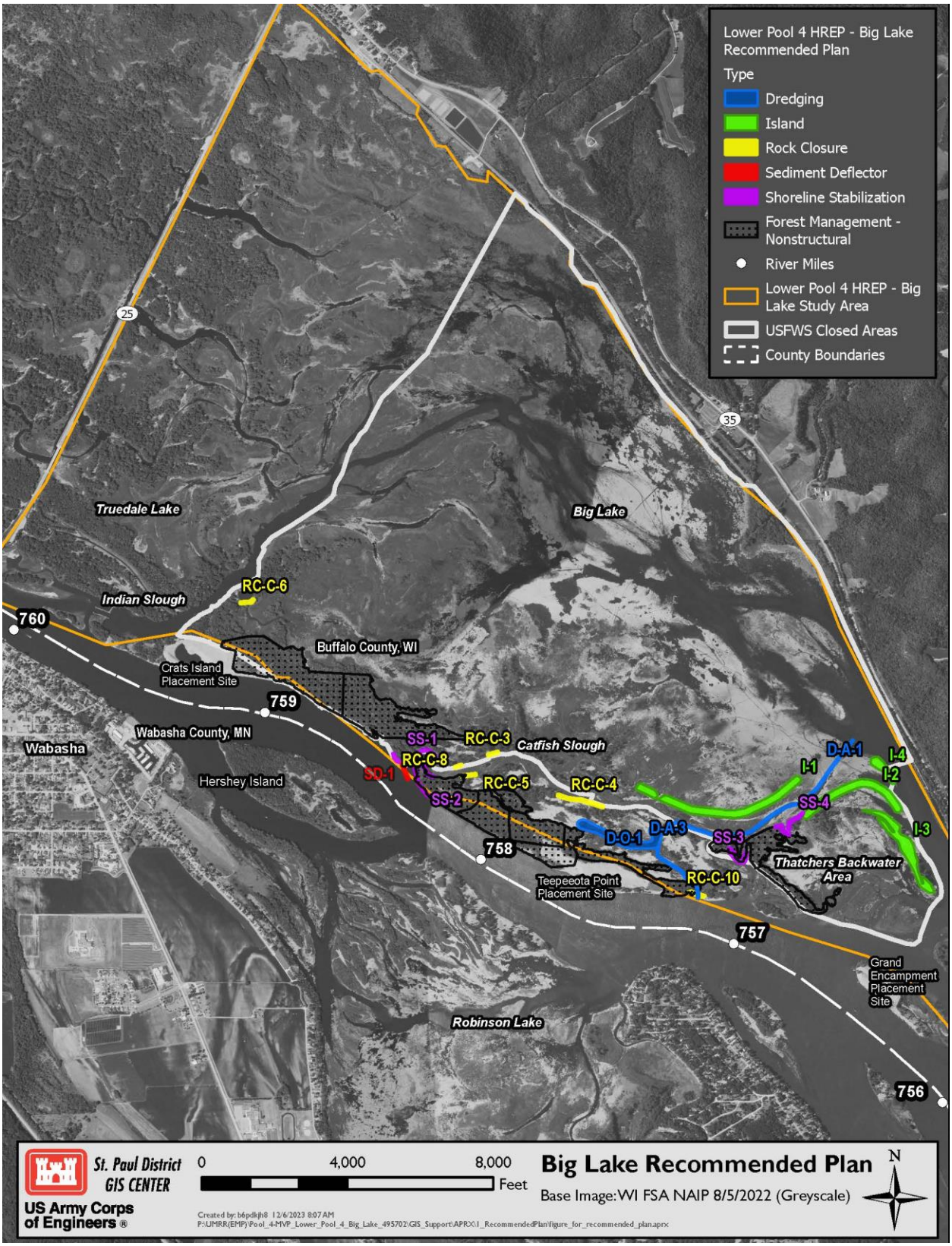

Figure 18. Recommended Plan – Alternative 6

5.2 Cost Estimates

The Project first cost is presented in Table 15 below. A full description of the cost estimate, including all related elements, can be found in Appendix F, Cost Engineering.

The St. Paul's Operations Division, Channels and Harbors (C&H) is willing to contribute granular material for Alternative 6, as material reuse for environmental purposes is compliant with beneficial use. The granular material will come from the Teepeeota Point dredge material placement site. C&H forecasting contribution assumes $24-25 per cubic yard for beneficial use of the sand in accordance with federal Standard dredge material management calculations. This contribution is estimated to be $7,305,000 to be paid toward construction of the Big Lake HREP and is not included in the Project first cost.

Table 15. Project Design and Construction Cost Estimates (October 2023 – FY 2024 Price Level)

Account	Measure	Project First
01	Lands and Damages	$3,750
06	Fish and Wildlife Facilities	$29,560,000
30	Planning, Engineering and Design	$9,770,000
31	Construction Management	$5,345,000
	Project Cost Estimates	$44,679,000

Costs were annualized using the FY24 discount rate of 2.75% and a 50 year period of analysis. IDC was computed using a 3 year period of construction and 2.75% (FY24) discount rate. The annualized costs and AAHUs were used to calculate a total annual cost per average annual habitat unit (Table 16). The total annual cost per habitat unit is $11,680. The costs used for analysis purposes include project first costs, IDC, and annualized O&M, adaptive management, and monitoring costs. Adaptive Management and Monitoring costs are within the total construction cost value.

Table 16. Total Annual Cost per Average Annual Habitat Unit

Analysis Element	Total
Construction Cost ($)	$44,679,000
IDC ($)	$1,238,000
Project Investment Costs ($)	$45,917,000
Annual Investment Cost ($)	$1,701,000
Annual O&M ($)	$15,753
Total Annual Costs ($)	$1,717,000
AAHUs	147
Total Annual Cost/AAHU ($)	$11,680

Costs for post-construction evaluation are provided in Appendix F, Cost Engineering. Performance monitoring and adaptive management are funded by the Project. Monitoring to support Long-Term Performance Reporting starts following completion of performance monitoring and adaptive management (approximately 10 years), if implemented, except for water quality monitoring. Long-term performance reporting is a UMRR Program cost and not included in the Lower Pool 4 Big Lake HREP cost estimate.

5.3 Design Considerations

The following items are being tracked by the PDT and will be completed or considered during PED.

- Collect geotechnical borings at islands and other land features.
- Refine lateral displacement and settlement assumptions affecting the granular material quantity.
- Refine shrinkage factor assumption affecting the fine material quantity.
- Refine lateral displacement and settlement assumptions using 2023 geotechnical boring results.
- Collect topographic information to be used for any feature and quantity refinement.
- Refine positioning of features such as islands and shoreline stabilization features to fit into the existing conditions topography.
- Refine island top elevations and fine thicknesses.
- Refine top elevations of rock closures (all assumed to be completely closed during feasibility).
- Refine Shoreline Stabilization 1 and 2 (SS-1 and 2) extent based on hydraulic model velocities.
- Refine shoreline stabilization feature typical cross sections.
    - Consider the inclusion of lotic (riverine) habitat features such as spawning reefs or other features that might benefit lotic fish and mussels by utilizing rock, cobble, or gravel material.
- Refine access dredging centerline based on existing conditions and construction needs.
    - Refine access dredge invert to coincide with specific LCP at project features. The current civil design uses 660.5 which was generalized to the entire study area.
    - Consider including passing lanes to increase construction efficiency.
- Refine overwintering area typical section, footprint and positioning.
    - Refine overwintering dredge invert to coincide with specific LCP at project features. The current civil design uses 658.5 which was generalized to the entire study area.
    - Consider refining overwintering design to also provide additional habitat for species of greatest conservation need and the refuge priority resources of concern.
    - Consider shallow side slopes and/or a bench at a shallower depth to create a greater amount of shallow, vegetated aquatic habitat.
    - Consider the inclusion of habitat features such as spawning reefs within dredged areas by utilizing rock, cobble, or gravel material.
    - Consider including brush and large woody debris to provide coarse structural cover within the dredged areas.
    - Consider undulating bottom topography of dredged areas as well as undulating perimeter boundaries to create bathymetric diversity.

5.4 Construction Considerations and Considerations

How features are constructed is generally left to the discretion of the contractor. The contractor is responsible for providing the finished product (the structures as designed) in a manner best suited to their operation, and without causing environmental damage.

The contractor would be allowed to use available technologies, so long as they are able to meet all the other conditions, including applicable Federal and State permits and State Water Quality Certification.

Generally, a balance must be struck to provide reasonable access for the construction while minimizing the environmental disturbances associated with the dredging and construction. Contractors are allowed to request alternate access routes. These requests would be evaluated on a case-by-case basis for approval and may require additional environmental review.

The complete project duration is assumed to be three years.

The USACE is required to apply for and obtain a Special Use Permit for each construction contract.

The following construction restrictions would be applied in the construction of the project features.

- **USFWS Closed Area** – No work can be completed within the USFWS Closed Area between October 15th and the close the Wisconsin duck season.
- **Tree Clearing** – Any tree clearing necessary to construct the Recommended Plan, would be limited to 1 November to 31 March. This would avoid potential impacts to bat roosting trees during their active season.
- **Bald Eagles –** The contractor will be required to maintain a buffer of at least 660 feet between construction activities and any active nest during the period generally from January 15 through June 15. Complete bald eagle work restrictions and construction specifications will be developed during the plans & specifications by the Refuge.
- **Clean Water Act Requirements –** Contractor must comply with requirements of NWP 27 and associated Section 401 Water Quality Certification." NWP 27 has its own requirements in addition to those in the associated 401, both national and regional requirements (e.g., related to restoration in areas of temporary discharges).
- **Endangered Species** – Work can not affect federally listed species if such species are encountered.

5.5 Real Estate Considerations

All lands required for the Project are owned by the United States of America and managed by USACE and USFWS. The subject properties within the study area will be managed as part of Upper Mississippi River National Wildlife and Fish Refuge (Refuge). For this Project, the Sponsor is the U.S. Fish and Wildlife Service. Acquisition of land rights, condemnation proceedings, or the Unform Act according to 49 CFR Part 24, will not be applied to this project.

The granular and fine placement materials for the project are anticipated to come from the access dredging and overwintering dredging and the Teepeeota Point dredged material placement site.

Access to the Project will be by water. Boat ramps in the Project vicinity are public boat ramps, which the contractor may use. The Contractor will need to abide by local boat ramp usage regulations. See Appendix G, Real Estate Plan, for additional details.

5.6 Operation and Maintenance Responsibilities

O&M is the responsibility of the Sponsor (USFWS) in accordance with Section 107(b) of WRDA 1992, Public Law 102-580. O&M of UMRR HREPs is similar to that undertaken by the Sponsor in day-to-day management of boat ramps, wildlife management areas, and other public use

areas. The purpose of assigning O&M costs to the Project Sponsor is to ensure commitment and accountability. HREPs are designed and constructed to operate for 50 years with proper maintenance. Upon completion of the construction as determined by the District Engineer, the Sponsor shall operate and maintain the Project as defined in this IFR/EA; 100 percent of all costs associated with the O&M of the Project will be borne by the Sponsor.

This Project was designed to reduce overall operation costs and ensure low annual maintenance requirements. There are no operational requirements for this Project. Maintenance will include periodic inspections and periodic replacement of riprap. Maintenance requirements would be further detailed in the Project's O&M manual published after construction completion and preparation of as-built drawings, and prior to transferring the Project to the Sponsor.

O&M considerations may extend outside of the typical 50-year period of analysis, as the Sponsor is expected to maintain the HREP as outlined in the Memorandum of Agreement (MOA). Rehabilitation cannot be accurately measured during P&S or construction phases. Rehabilitation is the reconstructive work that significantly exceeds the annual O&M requirements and is needed as a result of major storms or flood events. Table 17 lists the major O&M components, their associated frequencies, and costs.

Table 17. O&M Responsibilities

O&M	Frequency	Annual Cost
Periodic Inspection	Occurs bi-annually for years 1-10, then every 5 years for years 10-50.	$4,045
Stone Feature Maintenance	Assumes approximately 20% replacement over the 50-year life of the feature.	$11,708
Total O&M Costs		$15,753

5.7 Monitoring and Adaptive Management

The project performance assessment would allow measurement of differences from baseline conditions for key biological factors. This should allow a quantitative determination of improvement and assessment of whether features are functioning as intended. Adaptive management could potentially include repeated site prep and vegetation control measures, replanting of trees, or stabilization or repair of island features; adjustment in elevation of rock closing structures or the sediment deflector; and potentially additional dredging. Monitoring and adaptive management may extend for up to ten years following project completion and would be mostly Federally funded with some work contributions from state resource agencies as state budget and work planning allows. Monitoring activities to evaluate each of the project's goals and objectives are described in Appendix J, Monitoring and Adaptive Management, along with any documentation or adjustments required for underperforming features through adaptive management.

For budgeting purposes, the approximate overall cost for monitoring is set at 1% of total cost, or $368,000 over the 10-year monitoring period. Similarly, a budget for adaptive management is set at 3% of construction cost, which is about $1.1 million. The actual adaptive management cost may be higher or lower.

USACE would be responsible for determining ecological success for the ecosystem restoration

projects it constructs and would draft the final performance evaluation report (PER). USACE would also be responsible for vegetation monitoring and data analysis.

USFWS would be responsible for periodically inspecting the partial closure and documenting any inspection findings. If collected by the USFWS for their own Refuge purposes, bird monitoring and data analysis would be provided to USACE with a write-up of the bird monitoring methods and results for incorporation into the PER.

Additional information on post construction evaluation can be found Appendix J, Monitoring and Adaptive Management.

5.8 Implementation Schedule

The schedule for feasibility study completion, design, and construction is documented in Table 18. Design and construction will be initiated pending funding.

Table 18. Project Implementation Schedule

Event	Scheduled Date
Public Review of Draft Report	October 2023
Submit Final IFR/EA to MVD, USACE	May 2024
Approved Final IFR/EA from MVD, USACE	August 2024
Initiate Design (Plans and Specifications)	July 2024
Complete Design (Plans and Specifications)	October 2025
Initiate Construction	2027
Complete All Construction Stages	2029

5.9 Risk and Uncertainty

Areas of risk and uncertainty have been analyzed and were defined so that decisions could be made regarding the reliability of estimated benefits and the costs of alternative plans. Risk is defined as the probability or likelihood for an outcome. Uncertainty refers to the likelihood that an outcome results from a lack of knowledge about critical elements or processes that then contributes to risk or natural variability in the same elements or processes.

The PDT worked to manage risk in developing measures by expanding on and referencing successful similar work completed by previous HREPs, the Design Handbook, and utilizing data from LTRM. The PDT used that experience and information to identify possible risks and decrease uncertainty in plan formulation. No measures in the Recommended Plan are believed to be burdened by significant risk or uncertainty regarding the eventual success of the proposed measures. Significant risk would be avoided by proper design, appropriate selection, and correct seasonal timing of applications.

Risks identified for the Recommended Plan include:

- Cultural surveys: cultural surveys of the Recommended Plan have been performed. The cultural report stated that no additional archaeological sites were identified and that the Project area is comprised of soils with a low potential of containing intact cultural deposits.
- Construction of some features may need to occur in high-water conditions: high water

conditions can be unpredictable, but generally occur each spring. Constructing features in high-water conditions would need flexibility. If high-water occurs in the fall, it could present an opportunity for construction of certain features. This item could impact construction and will be reviewed during the design and implementation phase.

- Design includes assumption for shrinkage factor (fine material): actual material shrinkage could result in more or less material needed than planned. Design assumptions will be updated when more information is available. The current shrinkage factor assumption for fine material is conservative and based on geotechnical borings at dredging locations and past project observations.
- Design includes assumptions for settlement and lateral displacement (granular material): actual material settlement and displacement could result in more or less material needed than planned. Design assumptions will be updated when more information is available. The current assumption for estimated settlement and displacement are conservative and based on past project observations. Geotechnical borings at islands locations are scheduled to be collected in August/September 2023.
- Civil site surveys: preliminary civil designs are developed with existing topographic information (LiDAR). Topographic surveys would help inform the design and will be done once the project reaches that design phase.

6. ENVIRONMENTAL EFFECTS

This chapter identifies the existing conditions of the resources for the Big Lake HREP study area and describes the environmental consequences of the alternatives considered compared to the No-Action Without Project condition. The depth of analysis of the alternatives corresponds to the scope and magnitude of the potential environmental impact. This chapter provides the basis for the comparison of alternatives and describes the probable consequences (impacts and effects) of each alternative on the selected environmental resources.

The Recommended Plan (Alternative 6) and the No-Action Alternative are the primary actions evaluated and discussed in this section. As discussed above, other alternatives were also considered and screened, with Alternatives 2, 6, 8 and 10 constituting the final array of alternatives. All features included in alternatives smaller than Alternative 6 are analyzed as part of Alternative 6, below. Alternatives 8 and 10 include all features of Alternative 6 as well as additional features generally consisting of up to 3 additional islands in the middle part of Big Lake, additional rock closures in the middle portion of Big Lake and at Truedale Lake, an additional area of overwintering dredging and forest management thin layer placement at Truedale Lake, and associated access dredging for construction of those features. These other alternatives would generally have similar adverse effects to those described here for the Recommended Plan. The main differences are the expanded location of the adverse effects to include additional features in the middle of Big Lake and at Truedale Lake. With these alternatives, there would be an increase in magnitude of long term beneficial effects; and increase in magnitude and duration of short term adverse effects generally proportional to the increase in features/size among alternatives. There would also be addition of forestry management thin layer placement with these larger alternatives. Additionally, slight shifts in design parameters based on material needs with Alternative 6 (e.g., dredging footprint area for Dredge Cut D-O-1) would not appreciably change the effects analysis. Because there are no unresolved resource conflicts associated with Alternative 6 compared to the larger alternatives that include all features of Alternative 6, the additional features are not specifically analyzed below.

6.1 Short-Term Construction Effects

Construction of the Recommended Plan is expected to take about three construction seasons, potentially from 2027 thru 2029. Construction would generally occur from June through October 15. Construction equipment would need to be removed outside of this period. Access to the project area is likely to be done via the water. No staging on land outside of the project area is expected. Construction equipment would likely involve typical equipment such as barges, earth moving equipment, and hydraulic or mechanical dredging equipment. Fill materials such as sand and fines would come from on-site or adjacent dredged material placement sites. Rock would come from a near-by quarry.

6.2 Resource History and Current Management of the Study Area.

The project area is within the Winona District of Upper Mississippi River National Wildlife and Fish Refuge which was established in 1924. It is managed to meet the Refuge mission and priorities which include the protection of fish and wildlife resources and their associated habitats. As discussed above, a portion of the study areas is located within the Refuge's Big Lake Closed Area. There is also an annual Voluntary Avoidance period from October 15 to the end of the State of Wisconsin duck hunting season. The project area does include a previous HREP (Indian Sough HREP) that was constructed in the 1990s to reduce course sediment loading to the upper end of Big Lake.

6.3 Resources Not Evaluated in Detail

The PDT considered relevant environmental resources that would potentially be impacted by the proposed alternatives and eliminated resources that were not in the area of potential effect (APE) or would not be impacted by any of the alternatives from further evaluation. These resources include:

- Geology
- Wild and Scenic Rivers (there are no designated wild and scenic rivers in or near the study area)
- Mineral and Energy Resources
- Soils (No prime or unique soils in the study area)

The PDT focused on information gathered from the study area and the APE, which are documented below.

6.4 Relevant Resources

The PDT evaluated relevant resources in the Project area and assessed existing and Future Without Project (FWOP) conditions. Under NEPA, the FWOP (considered to be the No Action alternative) is necessary to provide a reference point, enabling a comparison of environmental effects of the action alternatives. The PDT focused its evaluation on resources potentially affected by the alternatives. This section briefly describes the following resources' current condition.

6.4.1 Hydrology and Hydraulics

Existing Conditions

According to the L/D 4 Water Control Manual (WCM) (USACE, 2004), the dam has 6 roller gates and 22 tainter gates which are adjusted to maintain pool elevations at either the Wabasha, MN (RM 760.5) control point (primary control) or the dam (secondary control) for

discharges less than 89,000 cfs based on the operating plan. The original operating plan (established in 1937) allowed a drawdown of 4 feet at the dam. It was soon learned however that this drawdown impacted navigation and it was reduced to 2.5 feet in 1943. Then, in 1960 it was further reduced to 1.5 feet to maintain a more stable pool elevation. Finally, this was modified further in 1971 to allow only a 0.5-foot drawdown. The minimum pool elevations or low control pool (LCP) elevations for the existing operating plan are 666.1 (North American Vertical Datum of 1988 (NAVD 88)) at the lock, and 666.6 (NAVD 88) at the Wabasha control point. The pool is in secondary control when discharges are between 27,000 and 89,000 cfs. When river discharges decline to 27,000 cfs, regulation of the pool shifts to primary control. For discharges exceeding 89,000 cfs, the gates at the lock are raised above the water surface and open river conditions are in effect (i.e., the dam is considered out of control). The WSE at points upstream of the dam rises and falls with river discharge and the range of fluctuation is greater the father upstream from the dam one progresses. Since the project area is in the lower pool and near a control point, the WSE do not fluctuate significantly as compared to other locations in this pool.

The Annual Exceedance Probability (AEP) WSEs were adopted from the Flow Frequency Study (FFS) (USACE, 2004) for the Wabasha, MN gage (RM 760.4) and the project area (RM 657.38) (Table 19). The AEP WSE values are reported in the National Geodetic Vertical Datum of 1929 datum within the FFS and then converted to the project datum of NAVD 1988.

Table 19. AEP Events at Wabasha, MN according to the Upper Mississippi River FFS

Annual Exceedance Probability	Discharge at Wabasha, MN from FFS 2004 (cubic feet per second)	WSE at Wabasha, MN (RM 760.4) from FFS 2004 (feet - NAVD 88)	WSE at Project Area (RM 757.38) from FFS 2004 (feet - NAVD 88)
50.0%	82,000	670.8	668.9
20.0%	120,000	673.0	671.3
10.0%	146,000	674.4	672.8
4.0%	179,000	676.0	674.6
2.0%	204,000	677.1	675.8
1.0%	230,000	678.2	676.9
0.5%	255,000	679.3	678.0
0.2%	290,000	680.7	679.4

Impacts of the No Action Alternative
The No Action Alternative would have no effect on hydraulic or hydrologic conditions, including flood stage levels, in the study area.

Impacts of the Recommended Plan
Floodplain management guidelines require a flood stage impacts analysis (or no-rise analysis) for any project involving construction of features within the existing 1/100 Annual Exceedance Probability (AEP) event floodplain. The details of the flood stage impact analysis can be found in Appendix E, Climate Change, Hydrology and Hydraulics.

The State of Wisconsin interprets Federal Emergency Management Agency's (FEMA) no-rise requirement by requiring existing conditions and proposed conditions hydraulic model output to be reported to the hundredth of a foot with the impact assesses by subtracting the existing conditions result from the proposed conditions result (NR 116.07(4)(f)). Essentially, this means

that the flood stage impacts difference must be less than 0.005 feet. When completing the flood stage impacts analysis for a project involving construction of features within the existing 1/100 AEP event floodplain, the state guidelines take precedence. Wisconsin DNR administers and enforces the State's floodplain management regulations.

The flood stage impacts analysis was an iterative process to ensure the proposed project does not result in flood stage impacts as defined by state guidelines. To meet these guidelines, the project required reductions in island heights and extents/sizes. The results of the flood stage impact analysis show that the features of all alternatives considered, including the Recommended Plan, meet the FEMA no-rise requirements as defined by the Wisconsin DNR. These results will be provided to the Wisconsin DNR for review during the project's design phase.

Additionally, inclusion of rock closure structures alters project area hydraulics during seasonal low flow conditions by reducing inflow to downstream backwater areas. As a result, closing structures reduce inflow, increase residence time, and favorably alter water quality conditions for the benefit of aquatic habitat in those adjacent backwater areas. These benefits are wrapped into the discussion below when describing habitat benefits and beneficial effects of the project on aquatic habitat and fisheries.

6.4.2 Climate Change

Existing Conditions
Climate factors that pose the greatest risk to the project features are flood duration and frequency due to their effects on the days of inundation during the growing season for bottomland forest and to overwintering fish habitat during the winter months. A climate change assessment was done for this project in accordance with Engineering Construction Bulletin (ECB) No. 2018-14 (USACE, 2022a) and is included in Appendix E (Climate Change, Hydrology and Hydraulics). Available climate change literature suggests a warmer and wetter climate in the future. There are statistically significant increasing trends in projected flow data analyzed specific to this study area. As flow increases, bottomland forest habitat may be inundated more often. There is also evidence that temperatures are increasing in the study area which may negatively affect water quality and aquatic habitat.

Impacts of the No Action Alternative
In addition to fluctuations in climate, flow and water surface elevation can be influenced by long-term geomorphic change and changes to lock and dam operating plans. Discharge can be influenced by changes in upstream water storage due to dam construction, or changes in land-use. These other factors make it difficult to determine the role of climate change in affecting the hydrologic signal at the project scale.

Impacts of the Recommended Plan
Within the Upper Mississippi River Region climate change poses a potential risk to ecosystems due to the likelihood of the region experiencing shifts in the flow regime and increases in temperature in the future. Projects, like the Lower Pool 4 HREP will serve to offset some of this risk by improving water quality and diversifying habitat. Additional discussion related to Climate Change considerations are included in Appendix E.

6.4.3 Land Use

Existing Conditions

Pre 1800s: Prior to Europeans moving into the Midwest, Indigenous communities gathered, hunted, fished, and lived in the Upper Mississippi River valley, including areas of the Refuge (Figure 19).

Early-mid 1800s-1930s: Substantial land-use changes occurred following European settlement, primarily in the form of conversion of native prairie and wetland into agricultural use. Historic maps and aerial imagery of the study area reveal this trend in the landscape. In the early 1800's the United States negotiated treaties with the Dakota/Ho-Chunk Bands with the goal of their removal to allow for greater European settlement. In the early 1800's, due to starvation, disease, and crop failure, and with deception on the part of the United States, Dakota and Ho-Chunk signed over significant swaths of lands. In the decades following the ceding of lands, forests were cleared for use as steamboat fuel, to make pasture for grazing and haying, and for other human uses at a significant rate not seen prior to the European land use practices.

1930s-Today: The federal government acquired land for construction of the locks and dams and to accommodate the flooding that would occur due to damming. Lands were also acquired for the Refuge. The transfer of land from private to federal ownership led to the reestablishment of forest and other habitats on lands that had been grazed and cropped. The construction of the dams flooded areas that had previously been only seasonally flooded, shifting habitats to wetter types. Many areas that had been forest, shrub, or wet meadow became aquatic shallow, deep or open water wetlands. Land use in the area is regulated according to guidelines for the USFWS Refuge.

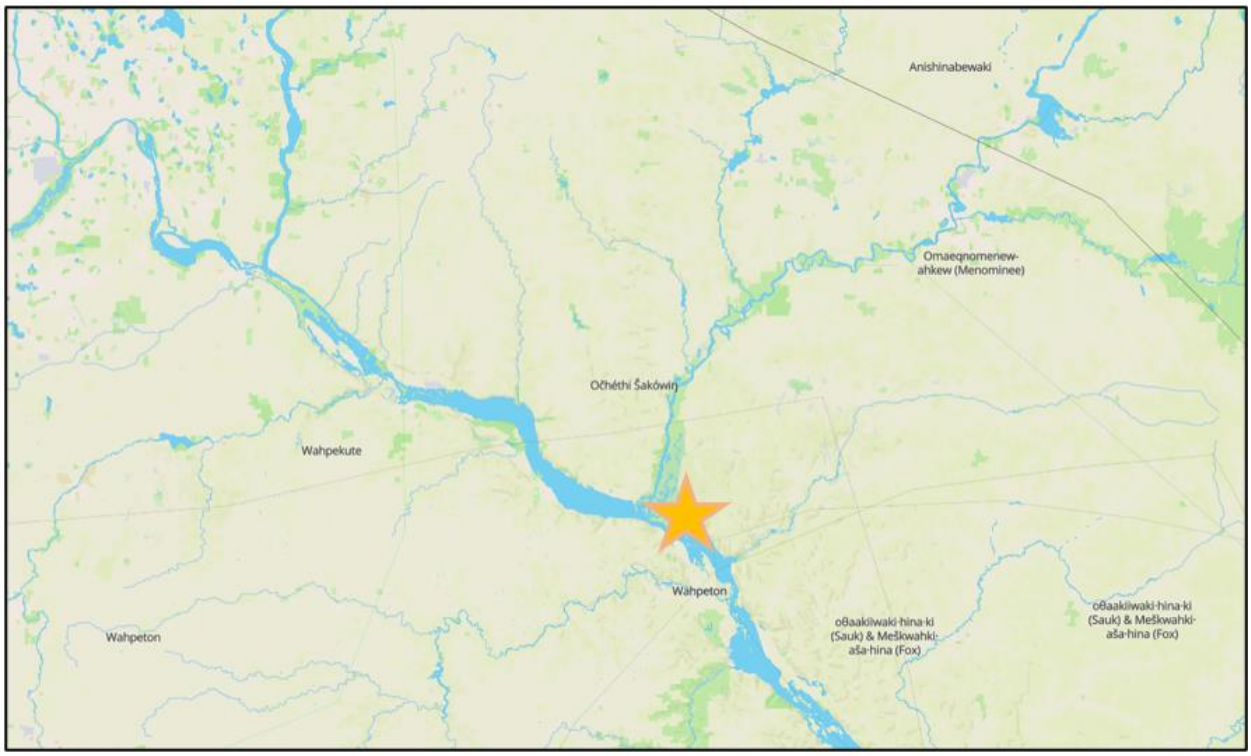

Figure 19 . Approximate Indigenous territories before European settlement, location of Big Lake noted with orange star (https://native-land.ca/).

Impacts of the No Action Alternative

It is likely that land use changes would continue throughout the Upper Mississippi River under the future without project condition.

Impacts of the Recommended Plan
The Recommended Plan would not result in any changes to land use in the project area. Some of the land types would change, but the area would continue to be managed and used for fish and wildlife resource protection.

6.4.4 Water Quality

Existing Conditions
Lower Pool 4 is an assortment of vegetated secondary channels and backwaters that has markedly greater water clarity and lower turbidity levels compared to Upper Pool 4 due to the settling of suspended material in Lake Pepin, located between Upper Pool 4 and Lower Pool 4. This increased light penetration has allowed aquatic macrophytes to increase dissolved oxygen (DO) concentration and slow current velocity during peak density. The flow regime of the Chippewa River influences a large area of lower Pool 4 with its highly stained, low conductivity water (Burdis, 1997).

The general water chemistry of lower Pool 4 is considered adequate to maintain most aquatic life. The Wisconsin DNR includes Lake Pepin as a 303(d)-listed impaired water for total phosphorus. Because of the nutrient enrichment and longer hydraulic retention times, Lake Pepin has algal blooms during low flow conditions that can cause significant temporal swings in DO, particularly in isolated sloughs and backwater lakes. Otherwise, the DO content of the water remains high year-round and above levels required to sustain a quality fishery. The UMRR Program's LTRM element has a fixed water quality monitoring site at river mile 757.2 near the downstream end of Big Lake. Data collected since 1993 shows DO levels consistently above 6 mg/l and turbidity levels usually below 15 NTU. The Wisconsin DNR has included the Mississippi River in the project reach on the 2022 303(d) list of impaired waters for total phosphorus, PFOS and PCBs in fish tissue and mercury (Wisconsin DNR, 2022). The Minnesota Pollution Control Agency has included the Mississippi River in the project reach on the 2022 303(d) list of impaired waters for sulfate, aluminum, mercury, and PCBs in fish tissue (Minnesota Pollution Control Agency (MPCA), 2022). Decreases in discharge, water elevation and total suspended solids (TSS) during the period 2005 through 2011 drove changes in the submergent macrophyte and fish communities in both Upper and Lower Pool 4. Lower Pool 4 exhibited a 29% increase in frequency of submergent vegetation during this period and the upper pool showed a 36% increase, with even greater increases in the backwaters (Popp, Burdis, Delain, & Moore, 2014).

Impacts of the No Action Alternative
While there are efforts underway to improve water quality in the project area, including Total Maximum Daily Load (TMDL) studies, no major changes to water quality are expected under the no action alternative.

Impacts of the Recommended Plan
The Recommended Plan would have temporary, short-term adverse impacts to water quality by increasing turbidity in the project area where construction, excavation and material transport occur. There could also be the potential for oil spills from construction equipment; however, Best Management Practices (BMPs), as required by Section 404 or 401 water quality requirements, would be used to minimize impacts to water quality during construction (please see Appendix B

for additional discussion on compliance with Section 404 and 401). Broad scale water quality effects to the Mississippi River are expected to be negligible post-project. Localized improvements in water quality would occur, due to project features, particularly in targeted backwater areas. Following construction, the Recommended Plan would not result in any meaningful change in the downstream transport of suspended sediment, or resuspension of fine material in the project area.

6.4.5 Soils

Existing Conditions
The Big Lake project is founded on fluvial valley fill, in the Chippewa River Delta. The delta soils are dominated by fluvial sands. Low energy back waters that have formed from both the Chippewa Delta and the lock and dam inundation, now allow fine grained silt and clay sediments to deposit in layers above the Chippewa Delta sands.

No Action (Future Without Project Conditions)
No major impacts to soils would be expected.

Impacts of the Recommended Plan
The Recommended Plan would result in the restoration and creation of island features as outlined above. In these areas, a combination of sands and fines would be placed to elevations above low water conditions for the growth and development of diverse bottomland forest. Materials for island creation would come from identified dredging locations, as well as use of sand obtained from maintenance of the authorized nine-foot channel navigation project. Collectively these actions provide beneficial improvements to habitat. Outside of these areas for material acquisition and island creation, the Recommended Plan would not have any effect on soils or topography.

6.4.6 Hazardous Toxic Radioactive Waste (HTRW)

Existing Conditions
A Phase I HTRW analysis was conducted in 2023, in accordance with ER-1165-2-132, Water Resource Policies and Authorities HTRW Guidance for Civil Works Projects. Based on the desktop search and on-site inspection, this assessment revealed that there were no recognized environmental conditions. See Attachment D-2 of Appendix D, Geotechnical & Sediment Quality Analysis for additional information.

Impacts of the No Action Alternative
No major impacts to HTRW conditions would be expected.

Impacts of the Recommended Plan
No major impacts to HTRW conditions would be expected.

6.4.7 River Substrate and Contaminants

Existing Conditions
Sediment quality is generally good in lower Pool 4. 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 typically dominates sloughs, while finer silt and clay materials are found in boat harbors and marshy backwater areas.

Results of the 2013-2019 main channel contaminant surveys (Appendix D - Geotechnical & Sediment Quality Analysis) shows that the material in Pool 4 is fairly clean sand.

The USACE is conducting soil sampling and chemical characterization of river sediments in potential dredge cuts in the Big Lake project area later in 2023. Based on the project location below Lake Pepin and proximity to areas that might serve as a source of potential contamination, the risk of contamination of river sediments in the project area is low. It's very unlikely that contaminant levels would approach levels that would preclude use of the sediment as proposed with the Recommended Plan. Results of contaminant testing will be coordinated with natural resources partners to verify any concerns with contaminant levels.

Impacts of the No Action Alternative
No changes to river floodplain substrates would occur under the No Action Alternative. No major changes to sediment quality is expected under the No Action Alternative.

Impacts of the Recommended Plan
Construction of the Recommended Plan would result in some minor displacement of sediment and soils due to dredging and material placement where features are being constructed. Such terrestrial areas would be managed for desirable vegetation, while areas dredged would eventually stabilize. Any impacts would generally be minor and not have substantial adverse effects on natural resources. The risk of contamination of river sediments at this location is low. Additional sediment testing later in 2023 will verify contaminant levels and confirm the material can be used for the purpose proposed under the Recommended Plan. Borrow material from existing dredged material placement sites in the project area (Teepeeota) would be clean.

6.4.8 Air Quality

Existing Conditions
The U.S. Environmental Protection Agency is required by the Clean Air Act to establish air quality standards that primarily protect human health. These National Ambient Air Quality Standards (NAAQS) regulate six major air contaminants across the U.S. When an area meets criteria for each of the six contaminants, it is called an "attainment area" for the contaminant; those areas that do not meet the criteria are called "nonattainment areas." Buffalo County is classified as an attainment area for each of the six contaminants and is therefore not a region of impaired ambient air quality (EPA, 2023). This designation means that the project area has relatively few air pollution sources of concern.

Impacts of the No Action Alternative
Without construction of the project and the operation of heavy equipment in the area, the No-Action Alternative would have no impacts to air quality.

Impacts of the Recommended Plan
The operation of heavy equipment, such as dump trucks, backhoes and excavators, during construction would temporarily increase vehicle emissions and slightly degrade air quality in the immediate vicinity of the project area. However, impacts would be short-term and negligible due to the short construction timeframe (a few months each of two to three years). To minimize air emissions, the USACE requires contractors to meet or exceed all federal, state and local air resource requirements. Given the close proximity of material sources, air pollution should be minimized.

6.4.9 Aquatic Habitat

Existing Conditions
Lower Pool 4 supports a high quality fishery resource with both abundance and diversity of biota. Relatively high water clarity results in high light penetration and resulting growth submergent and emergent vegetation. Wild celery (submergent) and wild rice (emergent) grow in dense stands throughout the project area, providing abundant food sources to waterfowl and littoral habitat for fish. Conversely, high sedimentation rates has resulted in loss of backwater depth, as well as increased delta formation in Big Lake and loss of depth in sloughs and side channels. This has resulted in a loss of physical space for fish, particularly during critical seasonal periods.

Impacts of the No Action Alternative
Aquatic habitat is expected to continue to decline under the no-action alternative (the HEP analysis, however, shows static habitat quality over the project life for bluegills, as the modeling is not sensitive enough to depict this minor decline).

Further sedimentation would result in the general loss of depth and conversion of deeper backwater habitat to shallow water and sandbar habitat throughout the project area, but especially in deltaic areas of Big Lake. This would result in a continued loss of wild celery and associated habitat important for migratory waterfowl that use Big Lake during spring and fall migration. Some of the areas would convert to wild rice or shallow sand and sandbar habitat.

Impacts of the Recommended Plan
During construction of the Recommended Plan there would be minor adverse effects to aquatic habitat, mostly due to sediment resuspension. There would also be a long-term reduction in available aquatic habitat as a result of constructing about 29 acres of island habitat. However, this island habitat was historically islands or terrestrial habitat. The Recommended Plan is helping restore that lost habitat. There would be a negligible impact to aquatic habitat downstream of the project area as a result of preventing sediment loading to Big Lake. About eight to nine acres of aquatic area will be disturbed by access dredging. Some areas, particularly in upper Catfish Slough, will fill in with sand and sediment over time and return to baseline conditions. Other areas with access dredging in lower Catfish Slough and Big Lake may remain shallow enough it will likely revegetate with wild celery and other submerged vegetation.

With altered hydraulics in the project area from island construction and various closing structures, there is some risk that wild rice abundance could change. Wild rice tends to be sensitive to changing environmental conditions. This risk appears to be low, but there is the possibility density and occurrence could change as a result of altered conditions. Reductions in wild rice would likely be replaced with additional wild rice where conditions allow.

In total and in the long term, the project features are designed to substantially benefit aquatic habitat. Project features, including backwater dredging and rock closure structures, will benefit aquatic habitat by increasing physical space and improving water quality during seasonal low flow periods, particularly including winter when backwater habitat is critical for overwinter survival of many fish species. Similar habitat projects have seen substantial increases in seasonal fish use in areas targeted, with such areas becoming critical overwintering habitat for several miles within a given pool. The project would result in substantial long-term beneficial

effects to the remaining aquatic habitat available (see Appendix C, Habitat Evaluation and Quantification for additional discussion of aquatic benefits).

6.4.10 Wetlands

Existing Conditions
The Corps' definition of wetlands is, "areas that are inundated or saturated by surface or ground water at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions." While a full, detailed wetland delineation has not been conducted for the project area, it is apparent from site visits and aerial imagery that much of the project area supports aquatic vegetation. Wetland vegetation is present on and around the edge of existing islands. Existing islands are low in elevation and partially or entirely inundated yearly during high water periods. Almost the entire area that isn't terrestrial contains submergent or emergent aquatic vegetation.

Impacts of the No Action Alternative
The no-action alternative is not expected to result in substantial changes to wetlands over the project life. Sedimentation and erosion may result in the expansion of wetlands, or changes in wetland from one type to another, as a result of areas becoming shallower and experiencing changes in vegetation type. Wet bottomland forest island areas will likely continue to erode. But substantial gains or losses in wetlands is unlikely.

Impacts of the Recommended Plan
Table 14 describes the fill properties of each feature. The Recommended Plan will result in the permanent placement of fill materials (e.g., sand, fines and rock) on a total of 33.0 acres of river bottom and floodplain. Under the Recommended Plan, an estimated 29.4 acres of wetlands would be affected by island placement. An additional 3.5 acres will be affected through rock placement for closure structures, shoreline stabilization and the sediment deflector. Note that the sediment deflector (SD-1, fill area of 0.6 acres, Table 11) occurs in deeper sections of main channel border habitat and is feature placed in areas that may not be defined as wetland. All of the fill for the Recommended Plan will be below the Ordinary High-Water Mark of 670.2ft elevation.

Wetlands could be affected through dredging of about 7 acres of backwater habitat, and 8.2 acres of access dredging. Backwater habitat dredging could be as deep as eight feet deep and would reflect a more historical reference condition. Also, shallow aquatic areas could be made deeper via access dredging. However, the access dredge channels would be 4-6 feet deep and would likely revegetate with submerged aquatic vegetation where such vegetation currently exists. Of these areas that would be wetland, areas with rock placement are areas that would be lost. These actions and associated effects are anticipated to be minimal, and will improve habitat and restore a historical reference condition (shortly after lock and dam implementation), including historical islands, as well as historical hydrology and sediment transport for the project area. For example, eroding islands and shallow aquatic areas would be restored to islands with wet bottomland forest. These areas of created islands would be in areas where islands were historically present. Similarly, backwater inflow and outflow will be regulated to better match historical conditions. These features work collectively to restore the area to similar historical reference condition.

The new bottomland forest islands would be constructed at elevations ranging between 668.5 and 669.5 NAVD88, or roughly 2.2 to 3.2 feet above Low Control Pool (LCP) in the project area.

These elevations would be inundated approximately 2-3 weeks of the growing season. Even when not inundated, top elevations will be close to river levels, resulting in relatively wet soils for broader periods of the year. Ultimately, these designs and resulting periods of inundation would provide similar wetland conditions to historical floodplain forest in this area. These island footprint areas and elevations have been discussed and agreed to with resource agency partners. The size and elevation of features maximizes not only floodplain forest area, but also habitat dredging that produces the material utilized to create the islands.

6.4.11 Fisheries

Existing Conditions
The fishery of Pool 4 is considered productive and diverse. Gamefish, non-game species, and various forage species find habitat that allows for seasonal movements throughout the project area. The LTRM field station, located at Lake City have documented 99 fish species since 1993. From 1993-2022, the predominant gamefish species were bluegill, yellow perch, largemouth bass, black crappie, and smallmouth bass. Additionally, the LTRM program has found emerald shiner, gizzard shad, weed shiner, spotfin shiner, and mimic shiner to be the dominant forage species. The study area has also been found to support fish species that are rare and/or have special designation by either Minnesota or Wisconsin including American eel, black buffalo, blue sucker, crystal darter, goldeye, lake sturgeon, pirate perch, river redhorse, and skipjack herring.

The Big Lake project area contains shallow backwaters, isolated wetlands, and side channel habitat that affords spawning and rearing habitat for a multitude of species during spring and summer. Deeper areas with sufficiently low flow velocities but suitable depths, temperatures, and dissolved oxygen levels are critical because they are locations were many species of fish are able to overwinter. However, most or all backwater habitat in Lower Pool 4 is experiencing a reduction in depth due to sedimentation, increased connectivity with flowing channel habitats because of island dissection and loss, resulting in increased flow velocities. This is a particularly critical concern for backwater overwintering habitat which was historically more abundant in Big Lake, Truedale Slough, and at Thatchers backwater area. For many species, including bluegill, largemouth bass, northern pike and black crappie, quality overwintering areas are now limiting and are mainly found in scattered areas near the northern study area boundary along State Highway 25. A small area within Big Lake, along with a few locations scattered throughout the remainder of Lower Pool 4, also provides these species with some deeper, off-channel winter habitat, that is protected from flow.

Impacts of the No Action Alternative
Conditions for fish in the project area are expected to decline under the no-action alternative. This would be especially true for fish that rely on isolated backwater habitat, mostly as a result of continued sedimentation (loss of depth) and an increase in flow inputs through increasing side channel abundance and size. This loss of habitat is quantified in the HEP analysis and can be found in Appendix C, Habitat Benefits Evaluation.

Impacts of the Recommended Plan
During construction there would be temporary adverse effects to fish in the project area. Disturbance from construction equipment and the resulting sediment resuspension could have brief physiological impacts and reduce feeding efficiency. Fish would likely move away from areas of the most disturbance, and then return when construction is complete. Shallow areas that were historically islands will be returned to this habitat type. These areas are marginal aquatic and fisheries habitat and would be returned to the habitat types they were historically.

More importantly, a wide range of species that rely on backwater habitat for various life stages would markedly benefit through habitat improvements as discussed throughout this report and quantified in Appendix C, Habitat Benefits Evaluation. Backwater area D-O-1 is about 27 acres and will greatly benefit from dredging about 7 acres of area to a depth of eight feet deep. And while not directly quantified, increases in depth in Catfish Slough would also improve conditions and benefit fishes in areas where access dredging is performed.

6.4.12 Aquatic Invertebrates

Existing

Native mussels are an important group of aquatic invertebrates and Pool 4 contains a relatively diverse assemblage with 34 live species presently occurring within the pool with an additional nine species presumed extirpated.

A GPS-tracked mussel skimmer dredge (as described by (Miller, Whiting, & Wilcox, 1989)) was used to survey footprint areas of the Recommended Plan, including island creation sites as well as access and habitat dredge cut locations. A total of 16 transects were sampled (total distance of over 4,700 meters), along with 7 timed searches of 15-60 minutes (285 minutes total search among 7 sites). Across all this effort, a total of only 66 live mussels were collected representing 8 common species. No more than 15 mussels were collected in any location. Transect densities were less than 0.1 mussels per square meter. Mussel densities within timed search areas were 0.2 mussels per meter or less for all sites. These results are indicative of low-quality mussel habitat and it is highly unlikely that any endangered mussel species are present in the project footprint. Table 20 documents the results of the June 2023 survey. The locations of the survey are provided below in Figure 20.

Table 20. Native mussel abundance and species richness in Lower Pool 4 Big Lake HREP footprint mussel surveys, June 2023

		Transect/Timed Search (skimmer dredge transects were sites 1-15, 21; wading timed searches were sites 16-20, 22-23)																							
Species	Common name	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	Total
Amblema plicata	threeridge								WD	3	10	8			WD					WD	2				23
Cyclonaias pustulosa	pimpleback			1			1			1	1										1				5
Fusconaia flava	Wabash pigtoe			1		WD				2	1				WD					WD	WD				4
Lampsilis cardium	plain pocketbook					WD			WD											WD					WD
Lampsilis siliquoidea	fatmucket		FD										WD	WD			2			1	WD				3
Obliquaria reflexa	threehorn wartyback					WD																			WD
Pleurobema sintoxia	round pigtoe						1																		1
Potamilus alatus	pink heelsplitter								WD											WD					WD
Potamilus fragilis	fragile papershell				FD				1								2								3
Pyganodon grandis	giant floater			FD		WD			WD		2	2	WD	WD			4	1	3	5	8				25
Utterbackia imbecillis	paper pondshell										1	1													2
Number live		0	0	2	0	0	2	0	1	6	15	11	0	0	0	0	8	1	3	6	11	0	0	0	66
Live species		0	0	2	0	0	2	0	1	3	5	3	0	0	0	0	3	1	1	2	3	0	0	0	8

FD = fresh dead; WD = weathered dead

Impacts of the No Action Alternative

The No Action Alternative would have no effect on aquatic invertebrates beyond existing conditions.

Impacts of the Recommended Plan

No diverse, abundant, quality mussel assemblages are found in any footprint areas of the project. The Recommended Plan would have a minor effect on mussel species as the project is not intended to improve mussel habitat and low-quality habitat currently exists. Some mussels,

as well as other aquatic invertebrate species would be killed wherever materials are placed to construct project features as well as dredged areas. However, aquatic invertebrates would recolonize impacted aquatic areas after construction is complete. Overall, impacts to mussels would be extremely minor under the Recommended Plan.

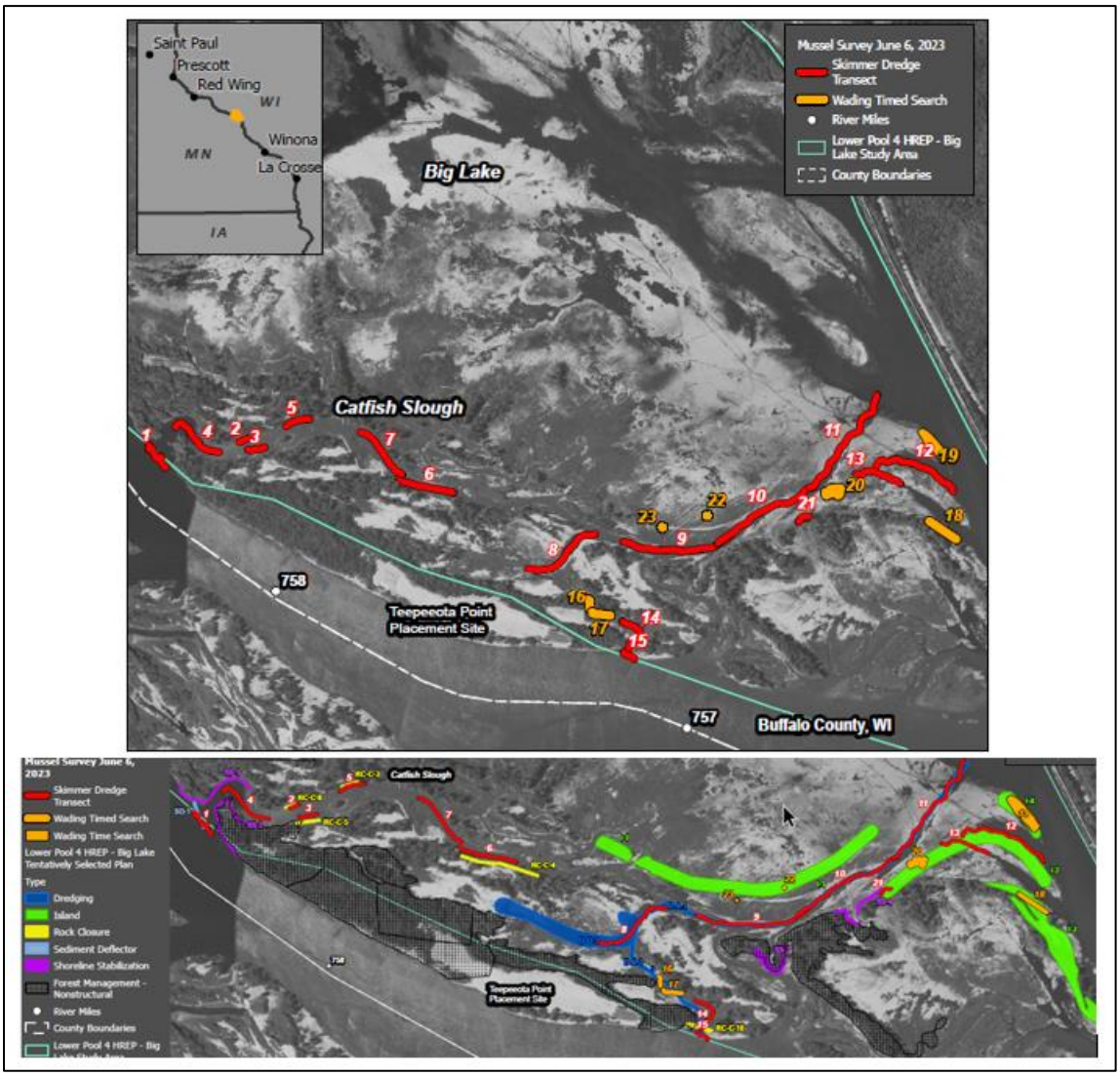

Figure 20. Mussel surveys, including transects and timed wading searches, for the project area, completed in early June of 2023. Top map are general survey locations. The bottom map are those same surveys relative to project features of the Recommended Plan.

6.4.13 Wildlife

Existing Conditions

A variety of mammals inhabit the bottomland forests and wetlands that remain adjacent to Lower Pool 4. These wooded and wetland areas support species muskrat, beaver, river otter cottontail rabbits, red fox, stripped skunks, raccoons, and white tailed deer.

The bottomland forest and shallow aquatic areas in the project area provide essential habitat for

a wide array of birds including waterfowl, songbirds, shorebirds, and raptors. Pool 4 lies within the Mississippi flyway, an important bird migration route that connects Canada to the region surrounding the Gulf of Mexico, and farther south to Central and South America. The UMR floodplain provides critical resting areas and food sources for migratory birds while traveling to northern nesting grounds in the spring and to southern overwintering locations in the fall.

Impacts of the No Action Alternative
Under the No Action Alternative, it is expected that conditions for wildlife would decline slightly. While there could be some new areas of terrestrial habitat form as a result of continued sedimentation, the quality of this new habitat is uncertain, and it is likely that new terrestrial areas could become vegetated with RCG or other invasive species resulting in low quality habitat. Moreover, remaining islands in the project area, particularly lower Big Lake will continue to be lost to erosion. In addition, increased sedimentation in Big Lake could reduce the amount and quality of waterfowl habitat that is critical during the spring and fall migration season. Overall, conditions for wildlife would generally degrade under the No Action condition.

Impacts of the Recommended Plan
The islands/bottomland forest construction, and non-structural forest enhancement would substantially improve the quantity and quality of wildlife habitat in the project area. Wildlife use would increase as trees begin to mature and food production and diversity improve. Critical waterfowl habitat in Big Lake would be much more protected under the Recommended Plan, compared to the No Action alternative. Human disturbance to waterbirds in Big Lake will be reduced by restoring and enhancing barrier islands and floodplain forests between Catfish Slough and Big Lake.

Construction activities may lead to short-term direct and indirect adverse effects to wildlife which could avoid or be displaced during construction. However, the long-term positive impacts of the proposed project features would off-set any short-term or indirect effects caused by construction by providing improved habitat and ecosystem resources for wildlife.

Multiple eagle nests were observed within the project area during site visits in 2022. These nests, and any others found, will be mapped, and documented as active or inactive during PED. USFWS recommends a buffer of at least 660 feet between project activities and active eagle nests. Construction in areas within this buffer of active nests would be scheduled outside of the nesting period (typically occurs between January 15 – June 15) as practicable.

6.4.14 Invasive Species

Existing Conditions
Invasive species currently present within the project area include, but are not limited to, zebra mussels (*Dreissena polymorpha*), RCG, purple loosestrife (*Lythrum salicaria*), flowering rush (*Butomus umbellatus*) and several others. Zebra mussels are currently abundant in lower Pool 4. Mussel survey activities noted a high level of zebra mussel infestation on collected mussels. Similarly, RCG is abundant and thriving in floodplain areas where trees have died off and sunlight penetrates directly to the ground. Flowering rush and purple loosestrife have also been observed in 2023. Flowering rush has received recent attention as the USFWS has employed broad efforts to try and reduce presence and abundance of this species.

Impacts of the No Action Alternative
The No Action Alternative would have no effect on invasive species beyond existing conditions.

Impacts of the Recommended Plan
The Recommended Plan is not anticipated to result in substantial spread of invasive species that are not currently present within the project area. Contractors will be required to clean previously used equipment and watercraft prior to bringing it onto the project site and prior to removing it from the site to prevent the spread of invasive species. Equipment and watercraft are required to be inspected to ensure they are free from soil residuals, plant seeds, foliage, stems and roots, animals and their eggs, as well as residual water. If at any point, equipment or watercraft are found to be contaminated with invasive species, they will immediately be placed on dry land and decontaminated until all invasive species have been removed.

The Recommended Plan includes control and removal of invasive species as a part of TSI features discussed earlier. In addition, active invasive species control will be done to help establish forest plantings to ensure success. Monitoring of invasive species also will be a part of monitoring activities associated with bottomland forest features.

6.4.15 Federally-Listed Species

Section 7 of the ESA generally requires Federal agencies to ensure that any action authorized, funded or carried out by the agencies are not likely to 'jeopardize the continued existence of any endangered species or threatened species or result in the destruction or adverse modification of habitat of such species (16 USC§ 1536(a)(2)). The USFWS's Information Planning and Conservation (IPaC) website was consulted in July 2023 to identify Federally-listed threatened or endangered species, along with experimental and candidate species, known to occur in vicinity of the Big Lake Project Area. Protection of rare and listed species is a central mission responsibility for the refuge, the project sponsor. Project planning to date has been done in collaboration with the refuge in such a way to avoid impacts to such species and will continue to be done through project design and construction, when warranted.

Existing Conditions
The USFWS' Information for Planning and Conservation (IPaC) website was consulted on July 21, 2023, to determine if any proposed, candidate, threatened, or endangered species may occur within the project area. The results indicated that six Federally-listed endangered species, one proposed endangered species, one threatened, and one candidate species may occur within the project area. The species listed as endangered include three freshwater mussels: the Higgins-eye (*Lampsilis higginsii*), sheepnose (*Plethobasus cyphyus*) and spectaclecase (*Cumberlandia monodonta*); one mammal: the northern long-eared bat (*Myotis septentrionalis*); one bird: whooping crane (*Grus americana*)(non-essential experimental population in the project area); and one insect: the rusty patch bumblebee (*Bombus affinis*). The species listed as threatened is the Eastern Massasauga (rattlesnake)(*Sisturus catenatus*). The tricolored bat (*Perimyotis subflavus*) is proposed as endangered, and the monarch butterfly (*Danaus plexippus*) is listed as a candidate species. No critical habitat for any of these species exists in or near the project area.

The Higgins eye is a freshwater mussel of larger rivers where it is usually found in areas with deep water and moderate currents. Its range includes the Upper Mississippi River, the St. Croix River between Minnesota and Wisconsin, the Wisconsin River in Wisconsin, and the lower Rock River between Illinois and Iowa (USFWS, 2023a).

The spectaclecase mussel prefers similar habitats as the Higgins'-eye. Sheepnose also prefers

similar habitat to Higgins Eye.

Extensive mussel surveys conducted in June 2023 (described above) did not collect any endangered mussel species. Moreover, the mussel community overall was poor and not reflective of where endangered mussels would be found.

Suitable habitat for the northern long-eared bat is variable depending on the season and the life stage of the individual. In the summer, these bats often roost under the exfoliating bark of tree species such as maples and ashes within diverse mixed-age and mixed-species tree stands, commonly close to wetlands. In the winter, the northern long-eared bat hibernates in caves and abandoned mines. During periods of migration and foraging, these bats tend to use the “edge habitat” where a transition between two types of vegetation occurs. The northern long-eared bat is relatively widespread, and USFWS lists it as an endangered species because a fungal pathogen causing white-nose syndrome is sharply reducing populations (USFWS, 2023b).

The tricolored bat is a small insectivorous bat that is distinguished by its unique tricolored fur and often appears yellowish to nearly orange. The once common species is wide ranging across the eastern and central United States and portions of southern Canada, Mexico and Central America. During the winter, tricolored bats are often found in caves and abandoned mines, although in the southern United States, where caves are sparse, tricolored bats are often found roosting in road-associated culverts where they exhibit shorter torpor bouts and forage during warm nights. During the spring, summer, and fall, tricolored bats are found in forested habitats where they roost in trees, primarily among leaves of live or recently dead deciduous hardwood trees, but may also be found in Spanish moss, pine trees, and occasionally human structures. Tricolored bats face extinction due primarily to the range-wide impacts of white-nose syndrome, a deadly disease affecting cave-dwelling bats across the continent. White-nose syndrome has caused estimated declines of more than 90 percent in affected tricolored bat colonies across most of the species' range (USFWS, 2023c).

Eastern massasaugas live in wet areas including wet prairies, marshes, fens, sedge meadows, peatlands, and low areas along rivers and lakes. Eastern massasaugas also use adjacent uplands (shrubland, open woodlands, prairie) during part of the year. They often hibernate in crayfish burrows but may also be found under logs and tree roots or in small mammal burrows. Unlike other rattlesnakes, eastern massasaugas hibernate alone.

Whooping cranes may stop within Pool 4 during their spring and fall migration to their summering area in Canada. Whooping cranes within the Project area are part of a non-essential experimental population, which means the population is not essential for the continued existence of the species. However, being that the Project area is within the refuge, this species is treated as threatened under Section 7 of the Endangered Species Act (ESA).

Rusty patched bumble bees live in colonies that include a single queen and several female workers (USFWS, 2023d). The colony produces males and new queens in late summer. Queens are the largest bees in the colony, and workers are the smallest. All rusty patched bumble bees have entirely black heads, but only workers and males have a rusty reddish patch centrally located on the back. Rusty patched bumble bees require nectar and pollen and nesting sites within proximity to food sources (USFWS, 2023e). USFWS notes that Rusty patched bumble bee nests are typically 1 to 4 feet underground in abandoned rodent nests or other mammal burrows and occasionally at the soil surface or aboveground. Habitat areas include prairies, woodlands, marshes, agricultural landscapes, and residential parks and gardens.

During the breeding season, monarchs lay their eggs on their obligate milkweed host plant (primarily Asclepias spp.), and larvae emerge after two to five days. Larvae develop through five larval instars (intervals between molts) over a period of 9 to 18 days, feeding on milkweed and sequestering toxic chemicals (cardenolides) as a defense against predators. The larva then pupates into a chrysalis before emerging 6 to 14 days later as an adult butterfly. There are multiple generations of monarchs produced during the breeding season, with most adult butterflies living approximately two to five weeks; overwintering adults enter reproductive diapause (suspended reproduction) and live six to nine months on their wintering grounds (USFWS, 2023f).

Impacts of the No Action Alternative
The No Action Alternative would not adversely affect listed species.

Impacts of the Recommended Plan
The USACE has determined that the Recommended Plan would have no effect on Federally-listed mussels within the Project area. Extensive mussel surveys conducted within project feature footprint, including access dredging channels, did not collect any Federally-listed mussel species. Mussel communities were poor.

The whooping crane is a species with a non-essential experimental population; however, being that the Project is in the refuge, the species is treated as a threatened species. Pool 4 is a large area with ample stopover habitat for the species. If the construction of the Recommended Plan were to temporarily impact potential stopover habitat, there will be other available habitat within the Project area for the species to use. Based on this information, the USACE has made a no effect determination for the whooping crane under the Recommended Plan.

The USACE has made a no-effect determination for the northern long-eared bat and tricolored bat under the Recommended Plan. At this time, tree removal is not anticipated to take place under the proposed project, and no potential impacts to Northern long-eared bats are anticipated. If tree removal is later deemed necessary, during the Pre-Construction Engineering and Design (PED) phase of the Project, consultation with the USFWS will be completed as appropriate following the most recent ESA requirements for these species.

The USFWS maintains an online map that displayed high and low potential zones for the rusty patched bumble bee (accessed July 2023). Figure 21shows the high and low potential zones encompassing the Project areas. There is a high potential zone on the edge of project features on the east side of the Project area, as well as a high potential zone immediately to the west. A low potential zone means that the area is within the species' maximum dispersal potential from known sites. The species could theoretically be present but is not likely to be present in the low potential areas.

There is extremely low probability that this species is currently found on the project site. At present, the Project area does not provide the prairie habitat that the bee prefers. The terrestrial areas proposed for island restoration on the very edge of the High Potential Zone (Islands IB-2, 3 and 4) are actively eroding, have a surface only a couple feet above low control pool elevation, and experience flooding every spring. Nesting in these areas doesn't appear plausible. Such areas also aren't considered upland grasslands and shrublands assumed to be associated with nests. Overwintering is believed to occur in upland forests and woodlands,

which also doesn't align with the Project area. As such, construction activities are highly unlikely to affect nesting or overwintering areas. There are likely limited plants within project footprint areas that would provide terrestrial food sources, with relatively vast areas outside of project footprints that would remain available. However, no surveys have been done to demonstrate an absence of rusty patch. USACE concludes the project may affect, but is not likely to adversely affect, Rusty Patch bumblebee. USACE has consulted with USFWS on this determination. USFWS concurred with the determination on October 4, 2023 (documentation provided at Appendix A).

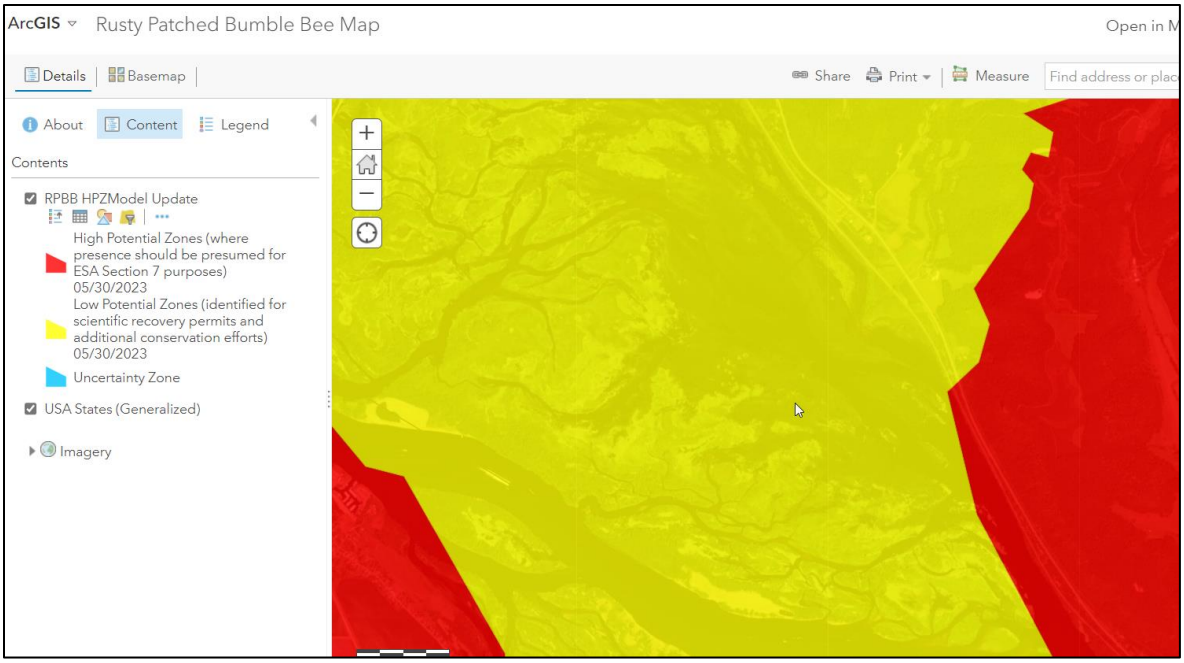

Figure 21. Rusty Patched Bumblebee High Potential and Lower Potential Zones relative the Project area. Query from USFWS July 2023.

The Federally-listed threatened eastern massasauga uses a variety of wetland habitats, including wet meadows, marshes, and bottomland forests. Today, only one viable population is thought to exist in the State and it is located at the confluence of the lower Chippewa and Mississippi River (Chippewa River Bottoms). However, there are no records of the species within the immediate Project area (Brenda Kelly, Wisconsin DNR, pers. comm). The project will have no effect on eastern massasauga. During construction, if any individuals are observed, construction will be halted and the USFWS will be consulted.

The monarch butterfly is a candidate species of concern that is found within the Lower Pool 4 Project area. The Recommended Plan is not anticipated to negatively impact local milkweed or other diverse flowering plants that monarchs rely on, as any disturbed terrestrial land within the Project area footprint is predominantly occupied by reed canary grass. Being that the species is mobile, it can avoid any construction activities associated with the implementation of the Recommended Plan. The Recommended Plan is anticipated to have no effect on this candidate species.

6.4.16 Aesthetics

Existing Conditions

The project area is a riverine and backwater environment with a mix of habitat types and associate flora and fauna. The area is used for a wide range of recreational activities and would generally be considered to be scenic.

Impacts of the No Action Alternative
The No Action Alternative will not impact the overall Project area's aesthetic value.

Impacts of the Recommended Plan
The Recommended Plan would result in short-term impacts to aesthetic value within the Project area due to construction activity and the associated construction equipment. In the long-term, aesthetic resources within the Project area may improve slightly because of vegetative plantings, higher quality habitat, and increased wildlife.

6.4.17 Recreation

Existing Conditions
The Project area is heavily used for recreating, especially for fishing, hunting, trapping and boating. This includes use during both summer and winter (outside of Closed Period requirements and recommendations). Four boat ramps are found immediately northeast of Big Lake along the downstream side of State Road 25. Access to Big Lake also occurs from the main channel on the downstream end of the project, as well as Indian Slough and Catfish Slough.

The Winona District of the Refuge, which includes the Big Lake study area along with Pools 5, 5A, and 6, spans 45,000 acres and 50 river miles. Sourced from the Refuge Annual Performance Plan 2017 and Refuge Staff, the district received around 1.1 million recreation visits in 2017. Non-consumptive recreation accounted for about 667,000 visits with residents comprising 76 percent of District visitation.

Impacts of the No Action Alternative
Under the No Action Alternative ecological resources will continue to decline for the reasons listed above. This will impact many recreational aspects of the area, including fishing, bird watching and boating. This decline will lead to less human activity and interest throughout the Project area resulting in an overall minor adverse effect to recreation under the No Action Alternative.

Impacts of the Recommended Plan
Under the Recommended Plan long-term, habitat improvement will increase wildlife and fish populations and diversity. This will, in turn, increase outdoor recreational opportunities including bird watching, fishing, waterfowl hunting, and other water activities, resulting in a minor long-term benefit to recreation. In the short-term, localized construction activities will likely disturb recreation. It is anticipated that the refuge would see a long-term increase in annual visits from both residents and non-residents to the area. Construction may limit fishing and other recreation activities (i.e., canoeing, kayaking, boating) directly where construction is taking place each construction season. Recreation activities could still be completed in adjacent areas in lower Pool 4. Short-term effects will last during the implementation and construction of the Recommended Plan. Overall, these adverse effects would generally be minor and temporary.

6.4.18 Noise

Existing Conditions
The Project area is in the river floodplain of lower Pool 4. While the area would generally be considered quiet, it is adjacent to a railroad and the Great River Road State highway on the Wisconsin side. Island I-4 is about 500 feet from these tracks. Other features are more removed. Sources of noise also include boat navigation on Big Lake, as well as navigation traffic on the adjacent main channel. There are some residencies along Big Lake on the Wisconsin side. However, these residencies are immediately next to the railroad tracks and State highway. There are residencies on the Minnesota side of the river, but they are a much greater distance with river bottomland forest in between, provide buffer to noise.

Impacts of the No Action Alternative
No change in noise levels is anticipated under the No Action Alternative.

Impacts of the Recommended Plan
Project construction would result in temporary increases in noise levels with heavy equipment used in construction. Construction equipment will likely include but not limited to barges, bulldozers, excavators, and dump trucks. Of these, bulldozers are typically the loudest, ranging from 100 – 120 decibels. The closest human use areas will be residents along the Great River Road (State Highway 35), which is roughly 900 to 1,000 feet at the closest locations to the Recommended Plan footprint. The Project area distance to receptor areas should help reduce the sound associated with construction activities. Construction activities will be limited to daytime hours and construction will not be held during typical municipal quiet hours. Increased sound levels associated with construction of the Recommended Plan could temporarily displace some wildlife and decrease recreational use. Noise levels throughout the Project area will return to the normal condition once construction activities cease. Overall, noise conditions for residencies probably wouldn't be substantially different than existing conditions which includes frequent traffic on adjacent rail and highway.

6.4.19 Environmental Justice

Environmental Justice is institutionally significant because of Executive Order 12898 of 1994 (E.O. 12898) and Department of Defense's Strategy on Environmental Justice of 1995, which directs federal agencies to identify and address any disproportionately high adverse human health or environmental effects of federal actions to minority and/or low-income populations, as well as E.O. 14008, 13985 and 13990.

The Executive Order (EO) Revitalizing Our Nation's Commitment to Environmental Justice for All was published in the Federal Register (FR) on April 26, 2023 at 88 FR 25251. The EO outlines the government-wide approach to environmental justice and the requirements to identify, analyze, and address disproportionate and adverse human health and environmental effects of federal actions.

Executive Order (EO) 14096 Revitalizing Our Nation's Commitment to Environmental Justice for All was published in the Federal Register on April 26, 2023 (88 FR 25251). The EO outlines the government-wide approach to environmental justice and the requirements to identify, analyze, and address disproportionate and adverse human health and environmental effects of federal actions.

Existing Conditions
The Council on Environmental Quality (CEQ) guidance on conducting Environmental Justice (EJ) analyses in NEPA documents (CEQ, 1997) and Promising Practices for EJ Methodologies in NEPA Reviews (CEQ, 2016) indicate that a minority population exists where the percentage of minorities in an affected area either exceeds 50 percent or is meaningfully greater than in the general population or other appropriate unit of geographic analysis.

A query of the Project area with the Environmental Protection Agency (EPA) EJ Mapper tool and Climate and Economic Justice Screening Tool (CEJST; CEQ) identifies that the Project area falls within Tract: 55011960300 of Buffalo County, Wisconsin. According to EJScreen, the tract has a low income population of 23% and people of color represent 9% of the population. This compares to all of Buffalo County, Wisconsin, which identifies as 24% low-income and people of color representing 5% of the population. Neither population is greater than 50 percent, nor is the tract low income or minority population meaningfully greater than that of the County. The Corps also evaluated the tract using CEQ's CEJST tool. The tract did not meet any criteria to be considered disadvantaged. The Project area does not contain an EJ population.

Impacts of the No Action Alternative
No major changes in the socioeconomic makeup of the tract, or Buffalo County, is expected in the near future under the No Action Alternative. The No Action Alternative would have no effect on low income or minority populations.

Impacts of the Recommended Plan
Conditions in the Project area do not meet the definition of a disadvantaged community. Moreover, the Recommended Plan would have minimal adverse social effects, and would not have any disproportionate significant adverse effects to any groups or populations living in the Project area.

6.4.20 Cultural Resources

Existing Conditions
Cultural resources are a major component of the UMR valley and are integral, nonrenewable elements of the physical and cultural landscape. Collectively, the archaeological record indicates continual human occupation along the river for approximately 13,000 years. Cultural resources across the Lower Pool 4 locality include precontact habitation sites, human burials, earthworks, and historic farmsteads, shipwrecks, navigation features and standing structures. They are situated across a variety of landforms including terraces, tributary fans, islands, natural levees, side slopes and bluff summits.

Interest in the archaeological record of the UMR valley, including the Lower Pool 4 locality, has been ongoing since the end of the nineteenth century. Early research in the area centered on the contents of burial mounds and who built them, although little information exists from these early burial mound delving activities from the locality. By the early 20th century, most practitioners rejected the popular notion that a race of non-American Indians constructed the mounds and non-scientific investigations gave way to systematic mapping and excavation. Despite an awareness of cultural resources in the pool, no comprehensive pre-impoundment survey was completed prior to construction and subsequent operation of Lock and Dam 4 in 1935. Modern archaeological research within the study area began during the 1970s with highway projects and a Corps sponsored survey of dredged material placement sites. Since the last quarter of the 20th century, numerous cultural resource investigations have been completed

within Pool 4. These include investigations focused on several prominent terraces, literature overviews (e.g., site inventories, geomorphic mapping, shipwreck locations, navigation structures), site predictive modelling, shoreline surveys, shoreline monitoring studies, and project specific site identification and evaluations within the locality.

Despite greater awareness of cultural resources situated within floodplain settings (e.g., deeply buried and submerged sites), few areas within the floodplain portions of the UMR have been subjected to deep site testing. Some cultural resources are experiencing profound effects from inundation, erosion and other forces associated with modern river navigation (e.g., creation of the pool, wave action from motorboats, frequent and prolonged flood events, recreation activities, etc.). Cultural resource practitioners are beginning to understand these complex mechanisms and their influence on cultural resources and are formulating strategies to manage these impacts (e.g., site protection and preservation schemes).

Previous cultural resources investigations in the Lower Pool 4 locality have focused on terraces and uplands where numerous cultural resources are located. Identified cultural resources include precontact habitation sites, burials, burial mounds, historic farmsteads, historic standing structures, and river training structures. Most of the information on cultural resources in this area is obtained from historic documents and maps. Archaeological investigations were completed for the alignment of Wisconsin Trunk Highway 35 between the towns of Nelson and Alma in 1984 and 1988. Portions of a temporary pipeline route for relaying dredged material from Teepeeota Point dredged material placement site to a permanent placement site near the Wabasha Senior High School was surveyed along the terrace on the west side of Robinson Lake in 2007. Portions of a powerline corridor were surveyed in 2018 for installation of power pole structures just north of Trunk Highway 25 and east of the Wabasha-Nelson bridge. Three archaeological sites, 47BF27, 47BF37, and 47BF244 are in the northern portion of the study area, however, no Project feature are in their vicinity and the Project will have no effect on these historic properties.

Impacts of the No Action Alternative
The No Action Alternative would have No Effect to Historic Properties as there are no historic properties within the Project Area.

Impacts of the Recommended Plan
Archaeological and geomorphological investigations were completed across the project area in the Fall of 2023. No cultural resources were identified within the Project footprint and subsurface testing indicated a low potential for intact buried archaeological sites across the Project area. As a result of the archaeological survey and geomorphological testing the USACE has determined that the Project will have No Effect to Historic Properties. In an abundance of caution, a 100-foot buffer will be placed around the known archaeological sites, 47BF27, 47BF37, and 47BF244, in which no work shall occur to ensure that the Project will have No Effect to Historic Properties.

On 24 July 2024, formal letters initiating consultation under Section 106 of the National Historic Preservation Act of 1966, as amended, and its implementing regulation 36 CFR 800 were sent to the Prairie Island Indian Community, Shakopee Mdewakanton Sioux Community, Lower Sioux Community, Upper Sioux Community, Sisseton-Wahpeton Oyate, and Ho-Chunk Nation. On 25 July 2023, the Shakopee Mdewakanton stated they are “not aware of any significant cultural sites in the proposed areas. If or when any additional archaeological work is performed,

please send that information, please avoid any burial/cemetery areas that may be in or very near any proposed work".

On 19 March 2024, letters coordinating the recommended plan were sent to the above-mentioned tribes. No responses were received. The USACE initiated consultation with the Wisconsin State Historic Preservation Office (SHPO) on 19 March 2024. The USACE determined that the Project would have No Effect on Historic Properties and the SHPO concurred with this determination on 26 March 2024. A copy of these letters and responses can be found at the end of Appendix A - Correspondence and Coordination.

6.4.21 Summary of Environmental Consequences.

The Recommended Plan will result in positive long-term benefits to terrestrial habitat, including island and bottomland forests; and improvements or protection of aquatic habitat including emergent and submergent aquatic vegetation, and backwater habitat in an around the Big Lake Project area. The project will restore historical cover types, providing habitat to a greater diversity of species. There would be no effect on any Federally-listed species. Construction of the Project will cause short-term less-than-significant adverse effects to water quality, habitat, fish and wildlife use of the Project area, air quality, noise aesthetics, recreation, and public use. Long-term benefits to habitats will outweigh the short-term impacts. No significant negative social or economic impacts will result. Without having completed the historic properties identification, no historic properties are anticipated to be impacted by the proposed action. Environmental consequences of the proposed action are summarized in Table 21.

Table 21. Environmental Assessment Matrix for the Recommended Plan.

	No-Action Alternative							Recommended Plan						
	BENEFICIAL				ADVERSE			BENEFICIAL				ADVERSE		
PARAMETER	SIGNIFICANT	SUBSTANTIAL	MINOR	NO EFFECT	MINOR	SUBSTANTIAL	SIGNIFICANT	SIGNIFICANT	SUBSTANTIAL	MINOR	NO EFFECT	MINOR	SUBSTANTIAL	SIGNIFICANT
A. Social Effects														
1. Noise Levels				X								T		
2. Aesthetic Values				X								T		
3. Recreational Opportunities					X					X		T		
4. Transportation				X							X			
5. Public Health and Safety				X							X			
6. Community Cohesion (Sense of Unity)				X							X			
7. Community Growth and Development				X							X			
8. Business and Home Relocations				X							X			
9. Existing/Potential Land Use				X							X			
10. Controversy				X							X			
B. Economic Effects														
1. Property Values				X							X			
2. Tax Revenue				X							X			
3. Public Facilities and Services				X							X			
4. Regional Growth				X							X			
5. Employment				X						T				
6. Business Activity				X						T				
7. Farmland/Food Supply				X							X			
8. Commercial Navigation				X						T				
9. Flooding Effects				X							X			
10. Energy Needs and Resources				X							X			
C. Natural Resource Effects														
1. Air Quality				X								T		
2. Terrestrial Habitat						X			X					
3. Wetlands					X				X					
4. Aquatic Habitat						X			X					
5. Habitat Diversity and Interspersion						X			X					
6. Biological Productivity					X					X		T		
7. Surface Water Quality					X					X		T		
8. Water Supply				X							X			
9. Groundwater				X							X			
10. Soils				X							X			
11. Threatened or Endangered Species					X					X		T		
D. Cultural Resource Effects				X							X			

1. Historic Architectural Values				X							X			
2. Prehistoric & Historic Archeological Values				X							X			

T indicates temporary

6.5 **Cumulative Effects**

Cumulative effects, which are effects on the environment that result from the incremental effects of the action when added to the effects of other past, present, and reasonably foreseeable actions regardless of what agency (Federal or non-Federal) or person undertakes such other actions. Cumulative effects can result from individually minor but collectively significant actions taking place over a period of time. Cumulative effects are studied to enable the public, decision–makers, and project proponents to consider the "big picture" effects of a project on the community and the environment.

The 9-foot Navigation Channel is a significant feature of lower Pool 4 and includes extensive past, present and future dredging and dredged material placement activities. The most significant changes to the area generally began with commercial navigation actions of the mid- to late-1800s, with the modern-day environment most greatly shaped by the construction and completion of Lock and Dam 4 in 1935. Activities of commercial navigation, and their associated environmental effects, have been described within other efforts and are incorporated by reference (1996 Channel Maintenance Management Plan and Environmental Impact Statement (USACE, 1996); Lower Pool 4 Dredged Material Management Plan (USACE, 2022b)). There would be little to no cumulative effects to O&M of the 9-Foot Navigation Channel, or commercial traffic, as a result of the proposed action. Similarly, there would be no appreciable affect to commercial and residential development, agricultural practices, point and nonpoint source pollution, and watershed management as a result of this project or past and future UMRR projects and the Navigation and Ecosystem Sustainability Program.

Cumulative Effects of the UMRR Program

Several UMRR and O&M projects in Pool 4 have been constructed, are currently being constructed, or are anticipated for construction in the future. This includes work in lower Pool 4. The scope for cumulative impact assessment is Lower Pool 4.

While the adverse effects of the Recommended Plan alone appear to be minor, when looking at a broader scale the total amount of acres benefited from ecological restoration in lower Pool 4, from this project and similar HREP projects, are beneficial and cumulatively significant. Previous habitat improvement projects have been constructed in Indian Slough (benefiting backwater fisheries and aquatic vegetation in upper Big Lake), Peterson Lake (benefiting aquatic vegetation and backwater fisheries) and the Lock and Dam 4 Embankment (benefiting bottomland forest along the upper embankment; and backwater fisheries in downstream Pool 5). Habitat improvement is also in planning for Robinson Lake immediately to the west of the Project area (similar benefits to those with this project), with additional work also likely in the Buffalo Slough area. These projects collectively include large areas of aquatic and floodplain habitat outside of the main channel in lower Pool 4.

Impacts of No-Action

The density, diversity, and quality of the bottomland forests would continue to decline in lower Pool 4, as is the general pattern throughout the Upper Impounded Reach of the UMRS. The existing silver maple dominated stands would continue to mature with little understory

recruitment. As the trees age and undergo senescence, they would likely be replaced with dense patches of RCG in many areas.

Similarly, backwater fisheries habitat would continue to suffer from sedimentation has been seen throughout the UMR. This habitat loss would likely reduce the numbers and diversity of fish that rely on this habitat in lower Pool 4.

Lastly, aquatic vegetation would continue to shift as a result of sedimentation to middle and lower Big Lake. Loss of depth would shift the aquatic community from submergent vegetation to emergent vegetation and sandbar habitat. This would result in lower waterfowl use and loss of diving duck habitat that is critically important for spring and fall waterfowl migration.

Impacts of the Recommended Plan

The insignificant adverse effects of the Recommended Plan do not meaningfully contribute to those effects of past, present and reasonably foreseeable future projects because these adverse effects are generally temporary and minor (e.g., to water quality, recreation, etc).

The Recommended Plan would create 29 acres of newly forested islands. The Recommended Plan also would improve about 159 acres of bottomland forests in the study area by nonstructural forest improvement measures. These actions would provide tremendous value to bottomland forest habitat in the area. Cumulatively with previous restoration projects, the Recommended Plan would have a substantial beneficial effect on bottomland forest.

The proposed action would benefit about 27 acres of backwater habitat by dredging about 7 acres of area, and benefit over 200 acres of backwater by altering area hydraulics and inflow into backwater areas. Given how backwater habitat has changed and degraded over time in lower Pool 4 and across the UMR, these improvements will provide great value to fish species and communities that rely on this habitat.

Finally, the proposed action would reduce broad sedimentation into lower Big Lake which will maintain existing aquatic vegetation and associated waterfowl use. While the exact acreage is difficult to estimate, it's likely over 100 acres of valuable waterfowl habitat, including that used by migratory diving ducks, will be protected via the project. Without the work proposed here, this habitat could be lost over the next 50 years.

6.6 Compliance with Environmental Laws and Regulations

This document is an integrated environmental assessment. A highlight of compliance with the major environmental laws and regulations follows and is summarized in Table 22Table 22. Discussions with permitting agencies have not indicated any major obstacles with the issuance of permits that would be critical for construction of the project at this time.

Table 22. Relationship of Plans to Environmental Protection Statutes and Other Environmental Requirements.

Federal Laws	Compliance
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	Full
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	Full
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	Full
Wild and Scenic Rivers Act of 1968, as amended	N/A
Farmland Protection Policy Act of 1981	N/A
Executive Orders (E.O.), Memoranda	**Compliance**
Floodplain Management (E.O. 11988)	Full
Safeguarding the Nation from the Impacts of Invasive Species (E.O. 13112)	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 Aug 1976)	Full
Environmental Justice (E.O. 12898)	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.
d. Not Applicable (N/A) - Statute, E.O., or other policy and related regulations not applicable for the current stage of planning.
2 Full compliance to be achieved with the District Engineer's signing of the Finding of No Significant Impact.

6.7 National Environmental Policy Act (NEPA)

The National Environmental Policy Act (NEPA; 42 USC § 4321 et seq.) establishes the broad

national framework for protecting our environment. NEPA's basic policy is to assure proper consideration to the environment prior to undertaking any major federal action. This document has integrated the content required of a NEPA environmental compliance document. A range of alternatives has been presented and the significance of the project's impacts have been evaluated. The document will be distributed to agencies, the public and other interested parties to gather any comments or concerns. If no significant effects to the environment are found during the comment period or moving forward with the project design, a Finding of No Significant Impact (FONSI) will be signed by the St. Paul District commander.

6.8 Endangered Species Act (ESA)

The Endangered Species Act (16 USC § 1531 et seq.) provides for the conservation of threatened and endangered (T&E) plants and animals and the habitats in which they are found. The Corps is required, pursuant to Section 7 of the Act, to consult when its federal action may affect T&E species or designated critical habitat. Unauthorized take is prohibited under Section 9 of the Act. The discussion above in Section 6.4.15 outlines the ESA conclusion for each of the listed species. The Corps determined the proposed project would have no effect on the three species of listed mussels, northern long-eared bat and tricolored bat, eastern massasauga rattlesnake, whooping crane and monarch butterfly. USACE concluded the project "may affect, not likely to adversely affect" rusty patch bumblebee. USACE has consulted with USFWS on this determination. USFWS concurred with the determination on October 4, 2023 (documentation provided at Appendix A).

6.9 Clean Water Act (CWA)

The Clean Water Act (CWA; 33 USC §1251 et seq.) establishes the basic structure for regulating discharges of pollutants into the waters of the United States and regulating quality standards for surface waters. Appendix B discusses how this project will achieve compliance with the CWA. In short, the discharge of dredged or fill material associated with the selected plan has been found to be compliant with the terms and conditions of Nationwide Permit 27 (NWP 27): Aquatic Habitat Restoration, Enhancement, and Established Activities. The Wisconsin Department of Natural Resources is the administering agency for Section 401 water quality certification in the State of Wisconsin. Wisconsin has issued water quality certification for 2021 NWP 27. The selected plan complies with the general NWP conditions, NWP 27 permit and regional conditions, and the Wisconsin DNR's 401 Water Quality Certification conditions. All conditions of NWP 27 will be implemented to minimize adverse impacts to the aquatic environment.

6.10 Fish and Wildlife Coordination Act (FWCA)

The Fish and Wildlife Coordination Act (FWCA; 16 USC 661–667e) requires Federal agencies to coordinate with the USFWS and/or NMFS, as applicable, along with relevant state wildlife agencies, when an activity would modify a waterbody. In compliance with the FWCA, this project has been coordinated extensively with the USFWS (who is also the project sponsor), Wisconsin DNR and Minnesota DNR. These agencies have provided continuous input on all aspects of problem identification, measure identification, alternative development and analysis, and selection of the Recommended Plan. Agencies involvement will continue through development of Plans and Specifications, the entire construction process and post-project evaluation.

6.11 Environmental Operating Principles (EOPs)

The EOPs outline the USACE's role and responsibility to sustainably use and restore our natural resources in a world that is complex and changing. The Recommended Plan meets the

intent of the EOPs. The PDT proactively considered the environmental consequences of the proposed Project, as well as the benefits of the Recommended Plan. The Project would be constructed in compliance with all applicable environmental laws and regulations. In accordance with the EOPs, the District has proposed a Project that supports economic and environmentally sustainable solutions.

6.12 National Historic Preservation Act

The National Historic Preservation Act (NHPA) of 1966, as amended, established national policy for historic preservation and authorized the Secretary of the Interior to expand and maintain a National Register of Historic Places (NRHP). Section 106 specifies that Federal agencies, before approval of any expenditure or before issuance of any license, must consider the effect of the action on any property included in or eligible for the NRHP. Consultation was initiated with the Tribal Historic Preservation Officers on 24 July 2023 (see Section 7.1). Copies of coordination letters are in Appendix A – Correspondence and Coordination. Archaeological and geomorphological investigations were completed across the project area in the Fall of 2023. No cultural resources were identified within the Project footprint and subsurface testing indicated a low potential for intact buried archaeological sites across the Project area. As a result of the archaeological survey and geomorphological testing the USACE has determined that the Project will have No Effect to Historic Properties. In an abundance of caution, a 100-foot buffer will be placed around the known archaeological sites, 47BF27, 47BF37, and 47BF244, in which no work shall occur to ensure that the Project will have No Effect to Historic Properties.

On 24 July 2024, formal letters initiating consultation under Section 106 of the National Historic Preservation Act of 1966, as amended, and its implementing regulation 36 CFR 800 were sent to the Prairie Island Indian Community, Shakopee Mdewakanton Sioux Community, Lower Sioux Community, Upper Sioux Community, Sisseton-Wahpeton Oyate, and Ho-Chunk Nation. On 25 July 2023, the Shakopee Mdewakanton stated they are “not aware of any significant cultural sites in the proposed areas. If or when any additional archaeological work is performed, please send that information, please avoid any burial/cemetery areas that may be in or very near any proposed work”.

On 19 March 2024, letters coordinating the recommended plan were sent to the above-mentioned tribes. No responses were received. The USACE initiated consultation with the Wisconsin State Historic Preservation Office (SHPO) on 19 March 2024. The USACE determined that the Project would have No Effect on Historic Properties and the SHPO concurred with this determination on 26 March 2024.

7. PUBLIC INVOLVEMENT, COORDINATION, AND CONSULTATION

This section documents the coordination that occurred throughout the planning of the Project.

The planning for the Lower Pool 4 Big Lake HREP has been an interagency effort involving the St. Paul District, USFWS, Wisconsin DNR, and Minnesota DNR. Interagency meetings were held monthly throughout the study. Site visits to the Big Lake study area near Wabasha, MN with the interagency PDT were held on 3 June and 29 July 2022. Additional details on coordination are included in Appendix A, Correspondence and Coordination.

7.1 Coordination by Correspondence

USACE sent formal consultation letters under Section 106 of NHPA to the THPO of the Ho-Chunk Nation, Prairie Island Indian Community, Shakopee Mdewakanton Sioux Community,

Lower Sioux Community, Upper Sioux Community, and Sisseton-Wahpeton Oyate on 24 July 2023.

On 19 March 2024, letters coordinating the recommended plan were sent to the above-mentioned tribes. No responses were received. The USACE initiated consultation with the Wisconsin State Historic Preservation Office (SHPO) on 19 March 2024. The USACE determined that the Project would have No Effect on Historic Properties and the SHPO concurred with this determination on 26 March 2024.

7.2 Public Views and Comments

A public scoping meeting was held on 29 August 2022 in Wabasha, MN. Approximately 50 individuals attended the meeting. USACE presented slides on the overall feasibility study, provided handouts, and received input from the public. The presentation was also livestreamed online. A summary of comments and questions was posted on the USACE UMRR website for Lower Pool 4 HREP.

In general, the public is interested in potential work in the study area, as witnessed by the turn out at the public meeting. The public is also interested in additional dredging in Big Lake, putting the needs of the wildlife above the users.

The draft Feasibility Report and integrated Environmental Assessment was released for a 30-day public review and comment period on 12 October 2023 and expired on 17 November 2023. A public meeting was held on 8 November 2023 in Wabasha, MN. USACE presented slides on the overall feasibility study, provided handouts, and received input from the public. No public comments were received on the draft report.

7.3 Views of the Sponsor

USFWS is the Sponsor. O&M is the responsibility of the Sponsor in accordance with 33 U.S.C. § 652(e)(7)(A). The O&M responsibilities of the Sponsor will be addressed in the proposed Memorandum of Agreement for the Project (Appendix K, Memorandum of Agreement).
The USFWS supports the Recommended Plan, a letter of support with comments can be found in Appendix A - Correspondence and Coordination.

8. RECOMMENDATION

The Recommended Plan is Alternative 6, including access and overwintering dredging in the south portion of the study area, four island features, four shoreline stabilization features, six rock closures, a sediment deflector, and nonstructural forest management. The estimated Project first cost of the Recommended Plan is $44,679,000 (October 2023 FY 2024), which includes monitoring costs of $368,000 and adaptive management costs of $1.1M. It is assumed that USACE Channels and Harbors will contribute the Federal Standard cost share for material used from Teepeeota Point dredged material placement site, which is $7,305,000. Alternative 6 addresses all project objectives and would be 100% Federally funded. Upon completion, the Sponsor is responsible for O&M at an estimated annualized cost of $15,753.

The Recommended Plan will contribute 147 average annual habitat units for four habitat types over the 50-year period of analysis.

I have weighed the outputs to be obtained from the full implementation of the Lower Pool 4 Big Lake HREP against its estimated cost and have considered the various alternatives proposed,

impacts identified, and overall scope. The St. Paul District recommends that the Lower Pool 4 Big Lake Project be implemented as generally described in this report.

The recommendations herein reflect the information available at the time and current Department of the Army policies governing the formulation of individual projects. They do not reflect programming and budgeting priorities inherent in the formulation of national Civil Works construction program nor the perspective of higher review levels within the Executive Branch. Consequently, the recommendations may be modified before they are approved for implementing funding. However, prior to approval, the state, Federal agencies and other parties will be advised of any modifications and afforded the opportunity to comment.

Eric Swenson
Colonel, Corps of Engineers
District Commander

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