US Army Corps of Engineers®
St. Paul District

Mississippi River Upper Pool 4
Section 1122
Pierce County Islands Head of Lake Pepin Backwater Complex
Feasibility Report and Integrated Environmental Assessment

Mississippi River: Mile 785-790

St. Paul District

Project Sponsor: Wisconsin Department of Natural Resources

April 2020

EXECUTIVE SUMMARY

This Feasibility Study Report with Integrated Environmental Assessment investigates the feasibility of alternative measures to address problems and opportunities associated with the Mississippi River Upper Pool 4 Pierce County Islands Head of Lake Pepin project (Project). The study area includes a backwater complex of the Mississippi River, located downriver of Red Wing, MN and across from Bay City, WI.

The Project lies within the Pierce County Islands Wildlife Management Area, established by the State of Wisconsin to provide habitat for migratory waterfowl, waterbirds, fish, and other wildlife species, as well as to provide educational and recreational opportunities to the public.

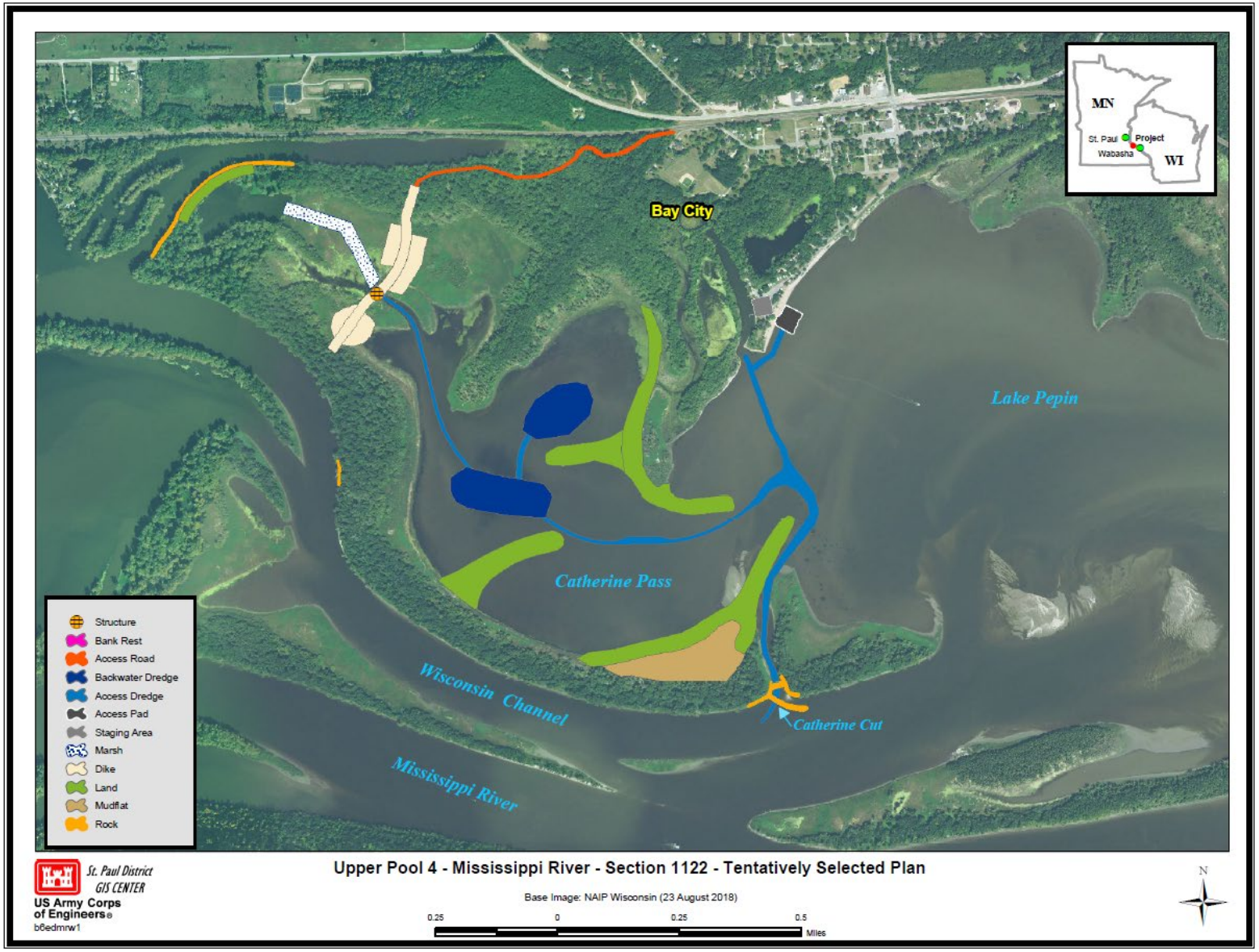
The habitat conditions in the study area have declined due to a number of factors, including high flows (including record levels in 2019), increased turbidity, loss of depth diversity, and loss of aquatic vegetation.

The objectives of the project are to:

1. Increase the health, diversity, and acreage of emergent and floating leafed aquatic vegetation.
2. Increase the health, diversity, and acreage of submerged aquatic vegetation.
3. Improve and increase the quantity and quality of wetland habitat for backwater waterfowl species.
4. Protect existing shoreline habitat and increase the linear feet of sheltered bank and associated littoral habitat for use by marsh and water birds, shorebirds, aquatic mammals, amphibians, and reptiles.
5. Improve and increase the overall health and quantity of floodplain forest.
6. Improve or maintain the quantity and quality of habitat for riverine aquatic species.
7. Increase the quantity and quality of backwater fish habitat.

The Project Delivery Team (PDT) identified a variety of measures that could be taken to achieve project objectives, including peninsulas (also referred to as islands), water level management structures, overwintering dredged areas, access dredging, and shoreline protection. The measures were combined in various logical combinations to form alternative project plans.

The Tentatively Selected Plan, shown in Figure ES-1, would address the majority of the Project objectives and improve habitat conditions in Catherine Pass. Project features include four peninsulas, refuge dredging, a water level management dike with a water control structure, an access road, two backwater dredged areas, three areas of shoreline protection, a mudflat, access dredging, and a partial closure. The Tentatively Selected Plan would be cost-shared using a combination of federal funds (O&M and Section 1122) and non-Federal sponsor funds (Wisconsin Department of Natural Resources). The preliminary cost estimate is $24.4 million, with a 286 average annual habitat unit gain, and a cost of $2,780 per average annual habitat unit. It is estimated that the project would take 5 years to construct.



Executive Figure 1. Upper Pool 4, Section 1122 – Tentatively Selected Plan

FEASIBILITY REPORT AND INTEGRATED ENVIRONMENTAL ASSESSMENT

UPPER POOL 4 – SECTION 1122

MISSISSIPPI RIVER

PIERCE COUNTY, WISCONSIN

Table of Contents

List of Tables

List of Figures

Appendices

1 INTRODUCTION

1.1 Study Authority

This study was initiated under Section 204 of the Water Resources Development Act (WRDA) of 1992, as amended. Section 204 provides authority for the U.S. Army Corps of Engineers (Corps) to restore, protect, and create aquatic and wetland habitats in connection with construction or maintenance dredging of an authorized Federal navigation project. Section 204 is one of a number of existing authorities in the Continuing Authorities Program (CAP), which gives the Corps authority to plan, design, and construct a project without specific project authorization by Congress. The Federal cost for individual Section 204 projects is limited by statute to $10 million. This cost limit refers to the incremental cost over the Federal Standard. The Federal Standard (or Base Plan) is the least costly plan which accomplishes the disposal of dredged material from a navigation project, consistent with sound engineering practices and environmental standards.

The general purpose of this program is for:

"(1) Sediment Use.- (A) Sediment from Federal water resources projects. For sediment obtained through or used in the construction, operation, or maintenance of an authorized Federal water resources project, including a project authorized for flood control, the Secretary shall develop, at Federal expense, regional sediment management plans and carry out projects at locations identified in plans developed under this section, or identified jointly by the non-Federal interest and the Secretary, for use in the construction, repair, modification, or rehabilitation of projects associated with Federal water resources projects for purposes listed in paragraph (3). …(3) Purposes for Sediment Use in Projects. (A) to reduce storm damage to property; (B) to protect, restore, and create aquatic and ecologically related habitats, including wetlands; and (C) to transport and place suitable sediment for the purposes of improving environmental conditions…" (33 U.S. Code § 2326(a)).

In accordance with this authority, the Planning Phase of the project is developed at 100% Federal expense. The Design and Implementation Phase of the project is cost shared 65% Federal and 35% non-Federal. The non-Federal sponsor must provide all lands required for the project and is responsible for 100 percent of the operation and maintenance, repairs, replacements, and rehabilitations (OMRR&R) of the completed project. The non-Federal sponsor must either have taxing authority, or demonstrate the ability to fund the project and fund the OMRR&R in perpetuity.

1.1.1 Selection as a Section 1122 Pilot Study

While the Planning Phase was developed according to the Section 204 authority, during this phase the study was selected as a Section 1122 Pilot Study in December of 2018. Section 1122 of the WRDA of 2016 required the Corps to establish a pilot program to recommend ten projects for the beneficial use of dredged material. Out of almost 100 proposals received, the Corps selected this study as 1 in 10 nationally to be part of the pilot program. Projects were selected as having a high likelihood of delivering environmental, economic, and social benefits described in the proposals, and exhibit geographic diversity.

Section 1122 funding is designated to cover the incremental costs above the Federal Standard for the additional transportation and placement costs of material dredged from the navigation channel. The cost-share information in this document details the funding breakdown under the Section 1122 authority (detailed in Section 4.6).

As a Pilot Study, the Corps is able to accomplish things that would not have been possible with existing programs and authorities. In Pool 4, because of physical, social, and regulatory constraints, all of the dredged material has to be removed from the channel and either stored permanently at an upland site or used beneficially. Beneficial use within the river valley is preferred, however it is often cost prohibitive to transport dredge material from the dredge cut to the reach where habitat restoration is needed; the 1122 program provides the funds to overcome these cost constraints.

1.2 Study Purpose and Scope

The US Army Corps of Engineers (Corps), St. Paul District (District) is proposing to restore, protect, and create aquatic and wetland habitats in connection with construction or maintenance dredging of authorized projects under Section 1122 of WRDA 2016. The project area is located in Upper Pool 4 of the Mississippi River and is known as the Pierce County Islands Head of Lake Pepin Backwater Complex.

This Feasibility Study Report with integrated Environmental Assessment (EA) provides a concise study overview of the plan formulation process that has been followed to create viable alternatives and ultimately identify the recommended plan for the Upper Pool 4 Pierce County Islands Head of Lake Pepin Section 1122 Feasibility Study. This report was prepared to comply with the National Environmental Policy Act of 1969. Upon completion, this report will provide planning, engineering and construction details of the recommended restoration plan to allow final design and construction to proceed subsequent to the approval of the plan. The project scope includes habitat improvement measures within and immediately around the head of Lake Pepin. Implementation of these measures in this area will directly benefit the entire Upper Pool 4 ecosystem.

1.3 Agency Participants and Coordination

The non-Federal sponsor is the Wisconsin Department of Natural Resources (WDNR). The Corps received a letter of interest dated December 31, 2015 from the Lake Pepin Legacy Alliance and Audubon Minnesota requesting that the Corps of Engineers perform a study to determine the feasibility of restoring aquatic habitat through the creation of islands in Upper Pool 4. Funding for the study under the authority of the Beneficial Use of Dredged Material Program (Section 204 of the Water Resources Development Act of 1992, as amended) was made available in 2016. The Federal Interest Determination was approved by the Mississippi Valley Division on August 17, 2016 and the Feasibility phase of the effort started in 2017. In a letter dated March 1, 2017 the Wisconsin Department of Natural Resources stated its interest in pursuing the feasibility study and also its interest in being the non-Federal sponsor.

Participants in the planning for the Upper Pool 4 study included the WDNR, Lake Pepin Legacy Alliance, and the Corps. These agencies were involved in project planning because the study area is located within the State of Wisconsin and the Mississippi River. Under federal regulations governing the implementation of NEPA, WDNR is a cooperating agency.

The following individuals played an active role in the planning of the project.

U.S. ARMY CORPS OF ENGINEERS		
Name	Discipline	Contribution
Tom Novak	Project Manager	Project Manager
Angela Deen	Lead Planner	Study Manager, Plan Formulation
Steve Clark	Biologist	Environmental/HEP
Kacie Opat	Hydraulics	Hydrology/Hydraulics

Dan Mielke	Hydraulics	Hydrology/Hydraulics
Jon Hendrickson	Hydraulics	Technical Lead
Garrett Blomstrand	Hydrology	Climate Change
Jeff McGrath	Economist	Economics
Greg Wachman	Engineer	Geotechnical
Jennie Tyrell	Engineer	Cost & Specs
Adam Rasmussen	Engineer	Cost & Specs
Christine Moss	Engineer	Civil/Layout
Andrew Weber	Engineer	Civil/Layout
Brad Perkl	Archaeologist	Cultural Resources
Scott Baker	Civil Engineer	Construction
Zach Kimmel	Channel Maint. Coordinator	Channel Maintenance
Pete Crary	Real Estate	Real Estate
Steven Taylor	Engineer	Structural
Colin Riddick	Geotechnical	Borings
Mike Walker	Cartographer	GIS
WISCONSIN DEPARTMENT OF NATURAL RESOURCES		
Kurt Rasmussen		
Brenda Kelly		
LAKE PEPIN LEGACY ALLIANCE		
Rylee Main	Executive Director	
Mac Becco	Communications Director	
MINNESOTA DEPARTMENT OF NATURAL RESOURCES		
Dan Dieterman		
Megan Moore		

1.4 Study Area

The study area is located near the head of Lake Pepin in Upper Pool 4 of the Mississippi River (Figure 1). Pool 4 is an impoundment of the Mississippi River resulting from the construction of Lock and Dam 4 in 1935 as part of the navigation channel project. Pool 4 is 44.2 miles long, extending from Red Wing, Minnesota at River Mile 797 to Alma, Wisconsin at River Mile 753.

Lake Pepin, a large river lake, is entirely contained within Pool 4 of the Upper Mississippi River (UMR). The average or typical elevation in Upper Lake Pepin is about 668.5 feet (NAVD 1988) based on the average discharge at Lock and Dam (LD) 4 and according to Lake City gauge records from 1972 to present (U.S. Army Corps of Engineers, 2001). Note that all elevations given in this report are in the NAVD 88 datum. Presently, Lake Pepin stretches over 22 miles, extending from river mile 786 to 763.5 and averaging 1.7 miles wide. The average depth of the lake is 21 feet and the maximum depth is 60 feet, though water depths throughout much of Upper Lake Pepin are less than five feet. Lake Pepin forms the boundary between Minnesota and Wisconsin and covers 29,000 acres.

The Canadian Pacific Railway runs adjacent to the river on the Minnesota side, while Burlington Northern – Santa Fe runs on the Wisconsin side. The area also hosts two National Scenic Byways adjacent to the river: Wisconsin State Highway 35 and U.S. Route 61.

Within Upper Pool 4, the 6,500 acre Pierce County Islands Head of Pepin Backwater Complex extends from RM 784 – 792 and includes backwater lakes, sloughs, flowing channels, and islands. Almost 1,000 acres are designated as the Pierce County Islands Wildlife Management Area. A portion of the Pierce County Islands Head of Pepin Backwater Complex (Wildlife Refuge Subunit) is designated as a “no-entry waterfowl refuge except trapping, gun deer and muzzleloader deer” from September 1 to December 31. No person may hunt lands and waters within the boundary of the refuge or enter the land within the refuge boundary for any reason unless such areas are posted as open with department signs or except to trap, hunt deer during the open seasons, or except for the retrieval of legally killed or crippled game in posted retrieval zones (WDNR, 2020).

Pre-impoundment, the Pierce County Islands were a mixture of bottomland forest, permanent and seasonal lakes and forested wetlands, wet meadow and sloughs that conveyed flow seasonally (Figure 2). Impoundment did not greatly affect backwater and off channel areas within the Pierce County Islands Head of Pepin Backwater Complex. This was due to the distance from Lock and Dam 4, which is over 30 miles downstream.

Water depths are variable throughout the area with deepest depths associated with the main channel of the Mississippi River and a larger secondary channel called the Wisconsin channel (Figure 3). Backwater depths are generally shallow and are decreasing over time due to long-term effects of sedimentation. Most of the backwater areas that have adequate depth to provide over winter fish habitat also have too much flow that makes it unsuitable for over wintering centrarchids (WDNR, 2010).

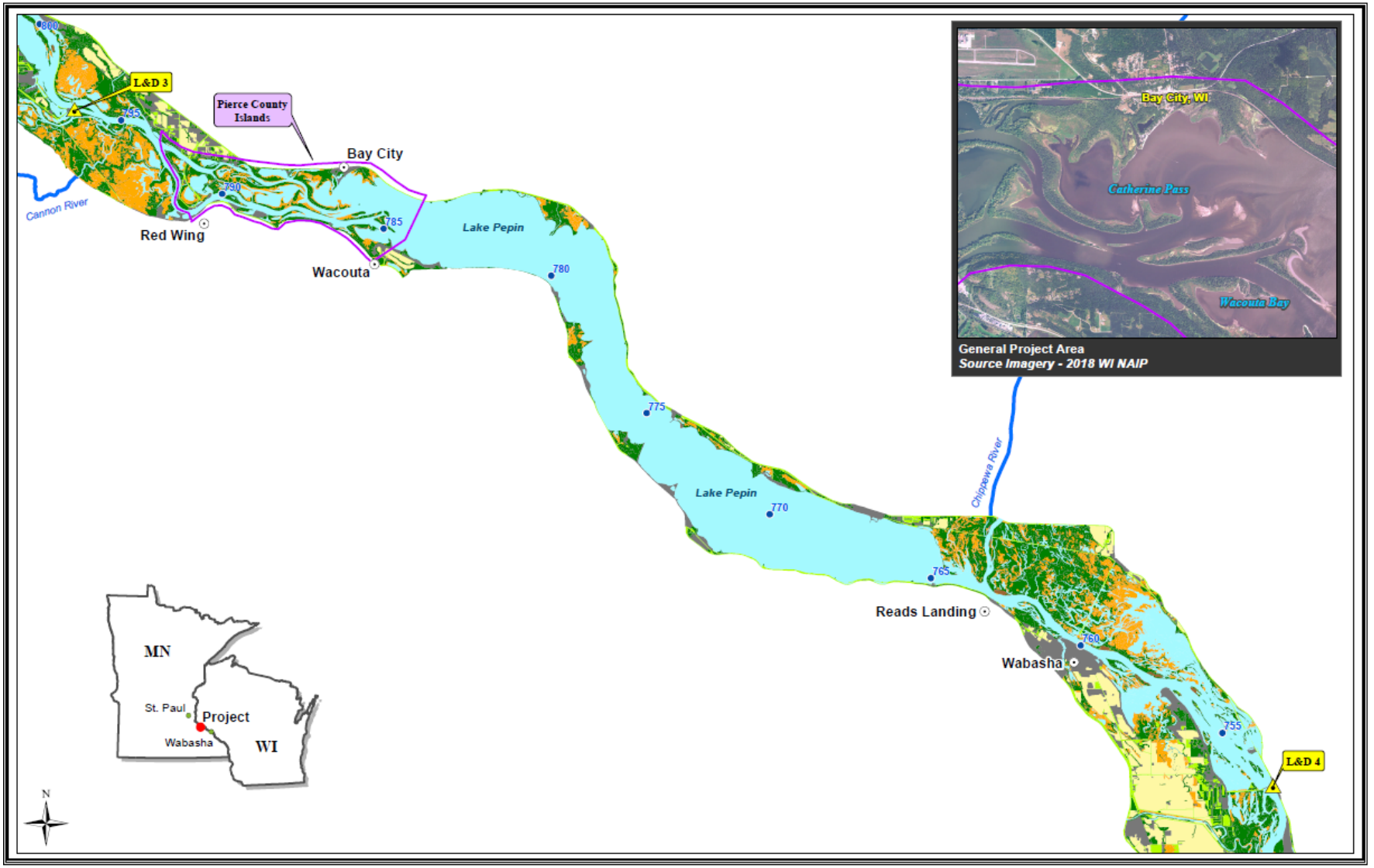


Figure 1: Study Area, Pool 4 of the Mississippi River

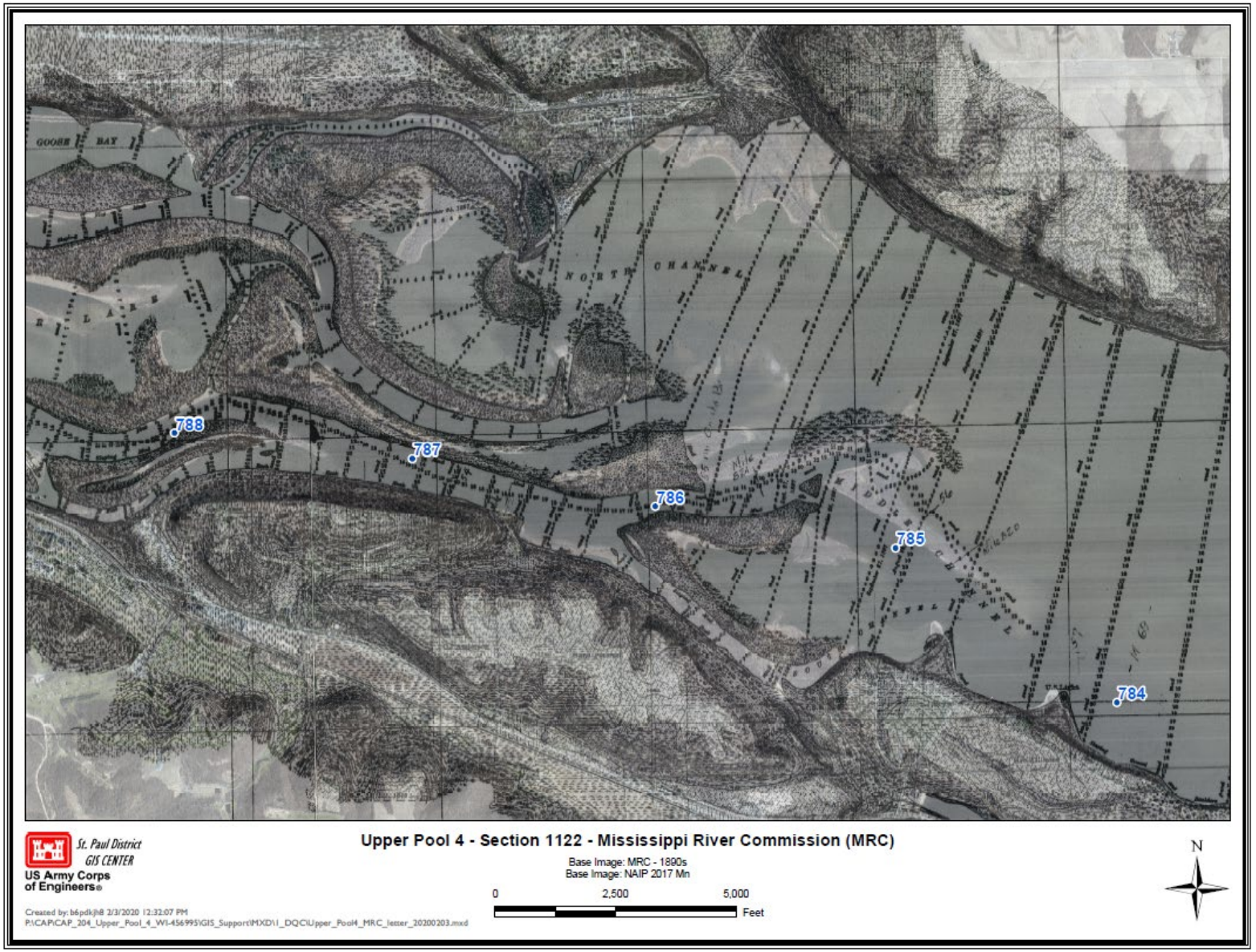


Figure 2: Pre-Impoundment (Mississippi River Commission 1890s Map)

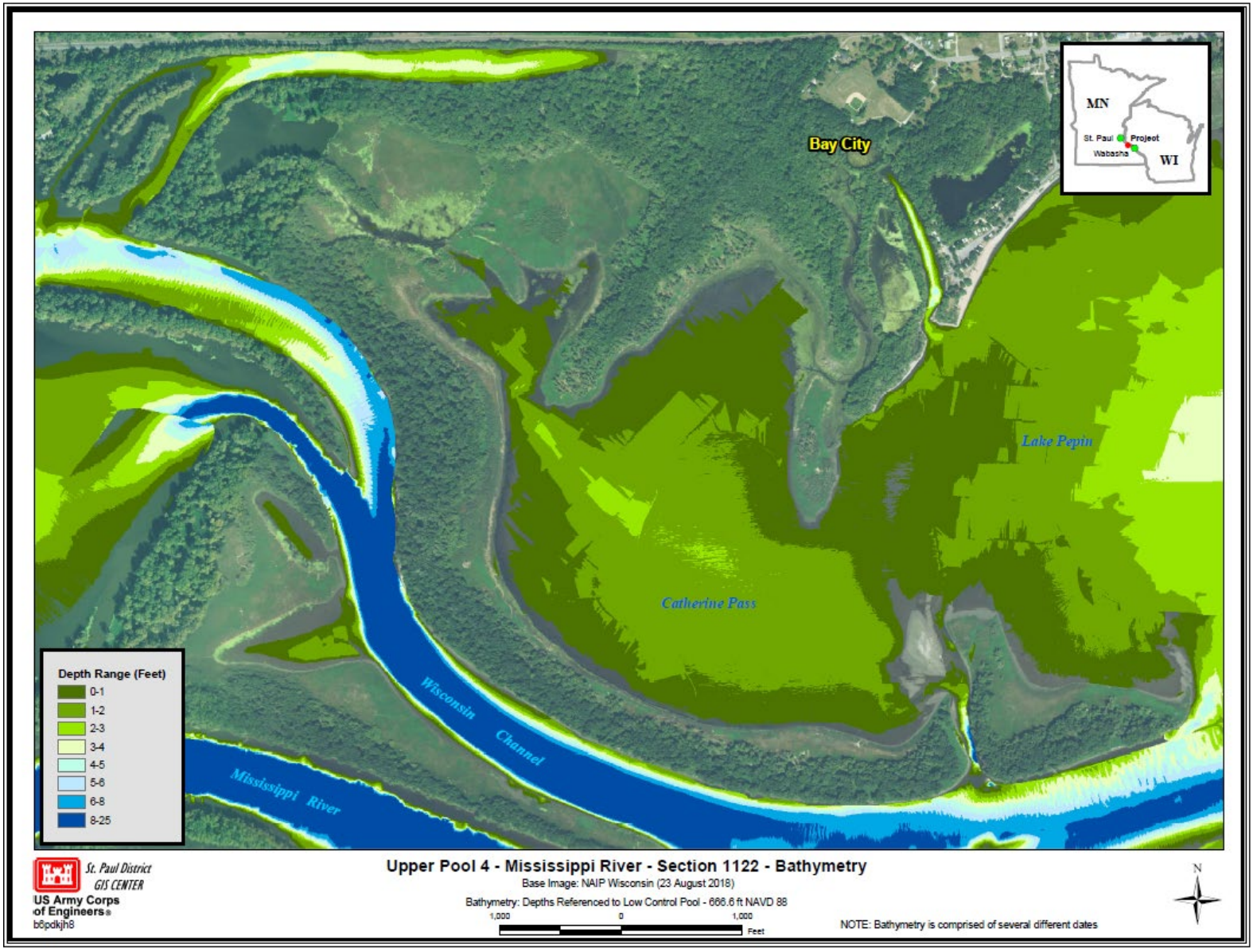


Figure 3: Bathymetry in the Study Area

1.5 Existing and Current Studies, Reports, and Water Resources Projects

Table 1 highlights the existing Corps projects in Pool 4. Of particular application to this study is the Great River Environmental Action Team Study. This 9-volume report, completed in 1980, documents the results of the 5-year Great River Environmental Action Team study for the St. Paul District reach of the Mississippi River (including the head of navigation in Minneapolis Minnesota, downstream to Guttenberg, Iowa). The report contained numerous recommendations for improved management of the river, the most important of which was a 40-year plan for dredged material placement for all of the historic dredging locations in the St. Paul District. Many of the study's recommendations have been implemented. Of particular application to this study is GREAT I which states – "A plan should be developed to use the river's sediment transport capability to cause necessary dredging requirements to occur near long-term placement sites as environmentally and economically feasible."

Table 1: Corps Projects in the Pool 4 Area

Project Name	Year
Nine Foot Navigation Channel Project Environmental Impact Statement	1974
Great River Environmental Action Team Study (Great I)	1980
Channel Maintenance Management Plan and EIS	1996
Channel management Study Pool 3/Upper Pool 4	2001
Environmental Pool Plans Mississippi River Pools 1-10	2004
Upper Mississippi River Environmental Design Handbook	2012
Identifying, Planning and Financing Beneficial Use Projects using Dredged Material	2007
Biological Opinion for the Operation and Maintenance of the 9-Foot Navigation Channel on the Upper Mississippi River System Report	2000
Higgins eye mussel reintroduction activities in Pool 4	2003-10

1.6 Resource Significance

Federal Economic and Environmental Principles and Guidelines for Water and Related Land Resources Implementation Studies (Water Resources Council 1983) (P&G) and Corps planning guidance Engineer Regulation (ER) 1105-2-100 determine the criteria for the significance of resources (USACE 2000).

Protecting and restoring significant resources are in the national interest because of the scarcity of these resources. For ecosystem restoration projects, monetary and non-monetary values also quantify and qualify the resource significance. The resource's contribution to the nation's economy determines monetary value (e.g., a lake with waterfowl encourages bird-watching tour businesses) whereas technical, institutional, or public recognition of the ecological, cultural, and aesthetic attributes determines non-monetary value (e.g., a lake serves as a historic site with cultural significance).

ER 1105-2-100, paragraph 2-4m(1) describes these three forms of significance determining non-monetary value:

"Significance of resources and effects will be derived from institutional, public or technical recognition. Institutional recognition of a resource or effect means its importance is recognized and acknowledged in the laws, plans and policies of government and private groups. Technical recognition of a resource or an effect is based upon scientific or other technical criteria that establishes its significance. Public recognition means some segment of the general public considers the resource or effect to be important. Public recognition may be manifest in controversy, support or opposition expressed in any number of formal or informal ways. The scientific community and natural resources management agencies recognize the technical significance of resources."

1.6.1 Institutional Recognition

Backwater habitats on the Upper Mississippi River (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 and formation of a refuge for wildlife and fish (later became 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 Upper Mississippi River Floodplain Wetlands are designated as a Ramsar Wetland of International Importance as well as a Globally Important Bird Area. The National Research Council's Committee on Restoration of Aquatic Ecosystems targeted the Upper Mississippi River for restoration as one of only three large river-floodplain ecosystems so designated. The Upper Mississippi River Basin Association is an advocate for restoration of habitat on the Upper Mississippi River. In addition, the Upper Mississippi River Conservation Committee (UMRCC) recognized the importance of the floodplain forest, fish, 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.

1.6.2 Public Recognition

The public recognizes the Upper Mississippi River, including Pool 4, 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 extend beyond the ecological health of the UMR, and directly relate to public welfare and long-term ecological health of the region. The UMR Basin Association is an advocate for habitat restoration on the UMR. The UMRCC, made up of resource professionals, is also a strong advocate for habitat restoration on the river. The UMRCC also recognized the importance of the floodplain forest for fish and wildlife of the UMR in the report, Upper Mississippi and Illinois River Floodplain Forest (Urich et. al, 2002). American Rivers, a nongovernmental organization dedicated to protecting and restoring healthy, natural rivers, listed the Mississippi River in America's Top Ten Endangered Rivers for 2004. The River was a "special mention" on the 2011 list.

1.6.3 Technical Recognition

Numerous scientific analyses and long-term evaluations of the UMR have documented its significant ecological resources. Since the early 1900s, researchers, government agencies, and private groups have studied the larger river system and proposed ecosystem restoration in the

UMR. Resource agencies view the resources in Pool 4 as significant. Pool 4 is a trend pool and has been extensively surveyed through the Long Term Resource Monitoring (LTRM) element of the Upper Mississippi River Restoration (UMRR) Program. Additionally, 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.

2 PROBLEM IDENTIFICATION

The river ecosystem in Upper Pool 4 has been significantly affected by sedimentation and degraded water quality associated with high suspended sediment concentrations, originating mainly from fine sediment inputs via the Minnesota, Cannon, and Vermillion Rivers. Although relatively minor in comparison, shoreline erosion due to recreational boat traffic also affects habitat conditions.

Sedimentation has contributed to a loss in water depth within the backwater areas and isolated wetlands above Lake Pepin as well as a loss in aquatic vegetation.

The effects of wind wave action, large recreational boat wakes, and non-native fish activity are exacerbating sediment resuspension, continuing to limit light penetration and growth of aquatic vegetation.

Concerns over habitat deficiencies in Upper Pool 4 include reduced habitat diversity and quality, lack of aquatic vegetation and invertebrates, and reduced abundance of fish and wildlife. Deep, protected aquatic habitat that would serve as habitat for centrarchid fish and associated species is lacking in both backwaters and within large shallow open water areas of Upper Lake Pepin. Specifically, the major concerns are as follows:

- Continued sedimentation and sediment re-suspension.
- Changes in floodplain connectivity due to island erosion.
- The lack of emergent and submerged aquatic vegetation.
- Lack of protected wetlands and aquatic areas.
- Degradation of habitat for migrating waterfowl and other species.
- Loss of bathymetric diversity.

2.1 Factors Influencing Habitat Change

A number of factors have been identified that are believed to be influencing habitat changes in Upper Pool 4. Many of these factors are synergistic, combining to affect the physical, chemical, and biological environment.

2.1.1 Increased Sedimentation & Turbidity

In Upper Pool 4, sedimentation and sediment re-suspension is a major concern. The Minnesota River is a major source of sedimentation, despite entering farther upstream in Pool 2. Lake Pepin acts as a natural sediment trap, with much of the sediment settling throughout the length of the lake. The Total Suspended Solids (TSS) concentration entering Lake Pepin has a long term average of about 46 mg/L compared to the 8 mg/L concentration downstream of the lake (MPCA, 2015).

Turbidity in this reach of the river began increasing in the early 1920s as the Twin Cities metropolitan area grew and agricultural use of the Minnesota River Basin increased. Sediment cores from Lake Pepin have shown that the sediment load to Lake Pepin doubled between the 1930s and the 1960s and has stabilized at that level, although the source of the sediment has

shifted from farm fields to increased erosion of stream banks and bluffs (Engstrom et al., 2009). Sediment core data shows that the volume of Lake Pepin has been reduced by 17% since 1830 as a result of sediment loading (Engstrom et al., 2009).

Total Suspended Solids can have an adverse effect on Submerged Aquatic Vegetation (SAV). In a study published by the Minnesota Pollution Control Agency in January 2015, monitoring data showed that SAV growth increased when TSS levels fell below 32 mg/L. Based on LTRM data, SAV growth increased in Upper Pool 4 when TSS concentrations decreased. When turbidity is low, this allows sufficient light penetration to support the growth of SAV.

2.1.2 Shallow Depths & Increased Connectivity

The PDT explored available data to determine what factors have the greatest influence on turbidity, water clarity, and limitations to aquatic plant growth and high quality habitat. Shallow water depth and increased connectivity were identified as the factors that limit habitat the most in the project area. Shallow water depths result in more wind-driven wave action resuspension of fine sediment; in shallow areas a small amount of wind can produce wave action that will resuspend sediment in the entire area. Greater connectivity to flowing channels can allow turbid inflows into backwater areas. In the Catherine Pass area, sediment-laden water from the Wisconsin Channel enters through Catherine Cut (Figure 4). There are three additional areas where cuts have formed, which could further increase connectivity into this backwater area.

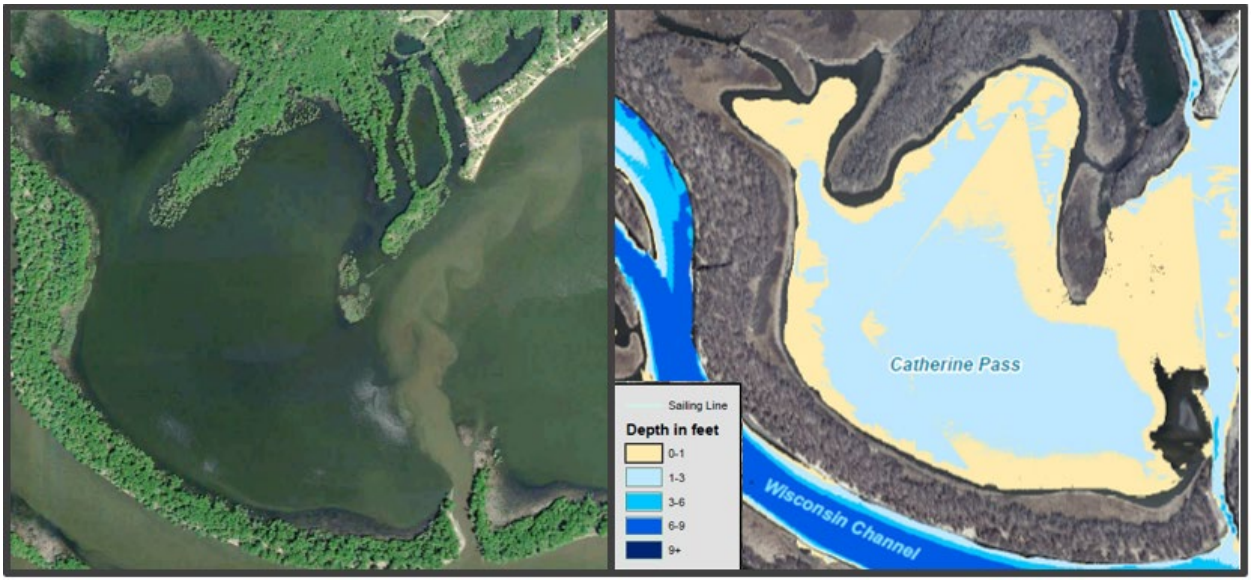


Figure 4: Sediment Inflows and Shallow Depths in Catherine Pass

Given this understanding of the system and the factors that are driving and influencing turbidity and habitat conditions, the PDT focused on formulating features that would reduce connectivity with turbid inflows, reduce wind fetch, and increase backwater depth. Each of these components have been used in similar projects in the past to incrementally improve aquatic habitat conditions. However, when combined as groups of features they have greater synergistic impacts as part of a complete project. Also, these feature types are often combined as dependent groups of features for constructability reasons; in one simple example, material dredged for increased depths must be placed somewhere, and can be used to construct islands or other features to further improve habitat.

2.1.3 Climate Change

Engineering and Construction Bulletin No. 2018-14 (USACE 2018) provides guidance for incorporating climate change information in hydrologic analyses in accordance with Corps overarching climate change adaptation policy. It calls for a qualitative analysis and provides links to online tools that can be used in this qualitative analysis. The goal of a qualitative analysis of potential climate threats and impacts to Corps hydrology-related projects and operations is to describe the observed present and possible future climate threats, vulnerabilities, and impacts specific to the study goals or engineering designs. This includes consideration of both past (observed) changes as well as potential future (projected) changes to relevant climatic and hydrologic variables. For additional details on the climate change analysis completed for this study please see Appendix H – Hydrology and Hydraulics.

The U.S. Global Research Program completed its Third National Climate Assessment in 2014. It states:

> *"[I]n the Upper Midwest extreme heat, heavy downpours, and flooding will affect infrastructure, health, agriculture, forestry, transportation, air and water quality, and more. Climate change will tend to amplify existing risks climate poses to people, ecosystems, and infrastructure. Direct effects will include increased heat stress, flooding, drought, and late spring freezes. Climate change also alters pests and disease prevalence, competition from non-native or opportunistic native species, ecosystem disturbances, land-use change, landscape fragmentation, atmospheric and watershed pollutants, and economic shocks such as crop failures, reduced yields, or toxic blooms of algae due to extreme weather events. These added stresses, together with the direct effects of climate change, are projected to alter ecosystem and socioeconomic patterns and processes in ways that most people in the region would consider detrimental."*

A qualitative climate assessment is included to inform the overall project about how climate change may affect parameters important to ecosystem restoration projects in Upper Pool 4 of the Mississippi River near Bay City, WI.

The study area, similar to other parts of the Upper Mississippi River, has experienced an overall increase in flow. It is likely that the trends detected within observed streamflows in the Upper Mississippi River Basin are at least in part driven by changes in land use and climate. Based on LTRM data obtained in Pool 4, water temperature has significantly increased over the years (Moore et al. 2019). Water discharge has increased significantly over time, and since 1936, the average annual Water Surface Elevation (WSEL) at the Lake City, MN gage has increased one foot (depicted by the trend line in Figure 5. It is important to note that the most recent year (2019) is now considered the flood of record by volume.

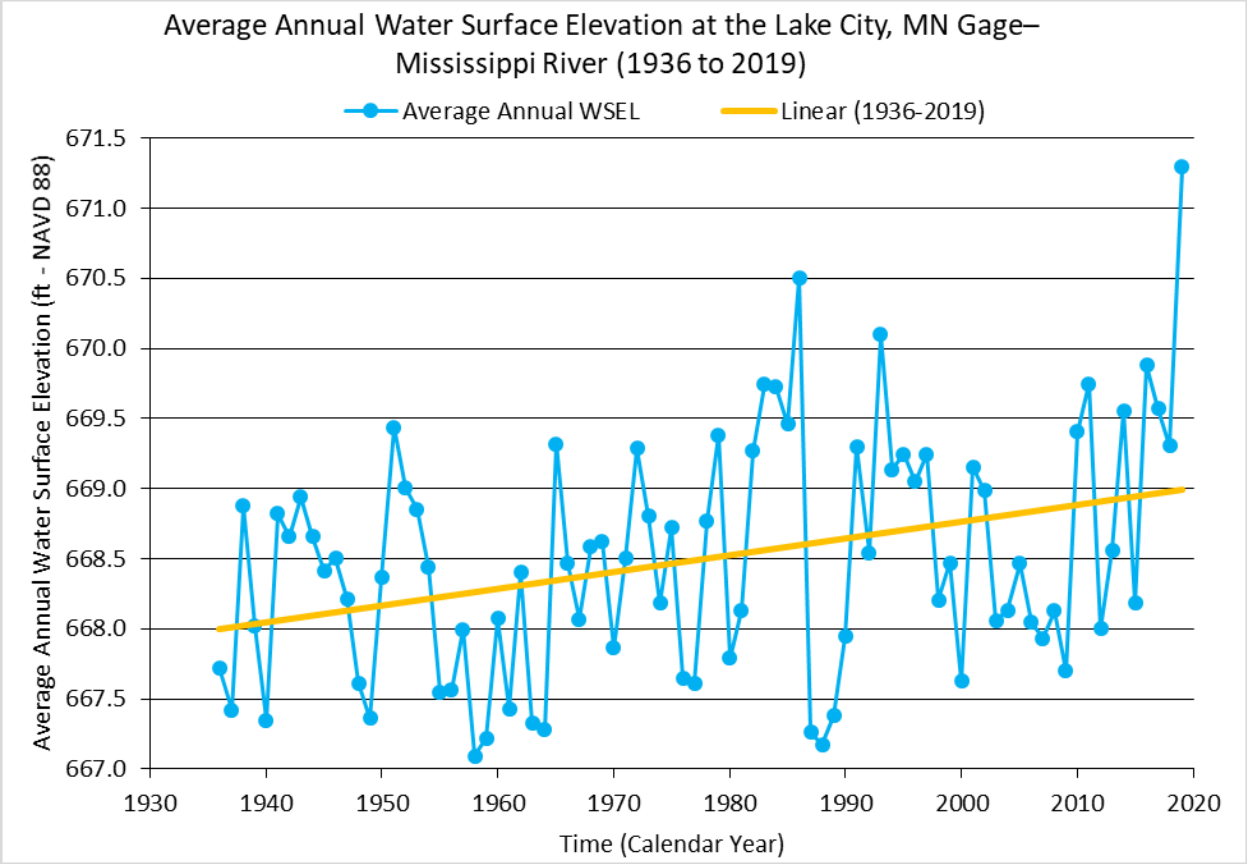


Figure 5: Average Annual Water Surface Elevation (1936-2019)

Other results from the climate change assessment include variable such as water temperatures, precipitation and air temperatures. Some of these findings are summarized below.

- Winters are shorter – since the 1840's, the average duration of ice cover on Lake Pepin has decreased by 17 days.
- Water temperatures are warmer – water temperatures have increase 3.7°F
- Precipitation has increased – the amount of water entering Lake Pepin has doubled since the 1960's.

The number of high flow days has also increased and the number of low flow days has decreased. The variability associated with average annual flows and the number of high and low flows also appears to have increased. Collectively, this changing flow regime indicates that any proposed project features must be designed for a wider flow regime and to operate at higher discharges and fewer days of low flow. Using average conditions for the entire period of record may leave the proposed project vulnerable to changes in hydroclimatic variables.

Studies on the Minnesota River Basin, as well as analyses on this study area support the U.S. Global Research program's findings of wetter and warmer climate in the future.

2.2 Estimated Future Without-Project Conditions

The Future Without Project (FWOP) condition is the forecasted condition of the project area for the next 50 years assuming that no significant action is taken to address the resource problems identified.

Based on the climate change analysis, the study area is expected to get warmer and wetter in the future. In general, average annual discharge has increased and is expected to continue increasing in the project area. The increase of average annual discharge would lead to increased erosion of the natural levees protecting Catherine Pass. Eroding natural levees means that flow is entering Catherine Pass at smaller flow events than previously, which compromises overwintering habitat and allows for increased sediment deposition in the area.

Based on a combination of climate and hydrologic modeling and analysis, water quality of the project area is expected to decrease in the future as the result of increased loading of total suspended sediment, total phosphorus, and total nitrogen. Decreases in water quality in the Minnesota River watershed will likely decrease water quality in the downstream Pool 4 project area.

Sediment-laden flows into the future are expected to continue to reduce water depth in Lake Pepin. In the absence of a project, wind and wave action are expected to persist maintaining turbid water and low quality habitat for aquatic vegetation. Furthermore, the long duration of high flow and flood events limit the ability of the system to have naturally occurring low-level conditions.

Water depths in the study area are expected to continue to become shallower as sediment continues to deposit in the area. The lack of overwintering areas for backwater fish (areas greater than 6-8 feet deep) will continue to result in poor habitat for fish. Winter fish kills, as observed near Bay City, may become more frequent.

3 PLAN FORMULATION

Plan formulation for Upper Pool 4 Head of Lake Pepin study 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* (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 project area; 2) Inventory and forecast existing conditions; 3) Formulate alternative plans; 4) Evaluate alternative plans; 5) Compare alternative plans; and 6) Select the recommended plan.

The basis for selection of the Tentatively Selected Plan is fully documented below, including the logic used in the plan formulation and selection process.

3.1 Problems and Opportunities

The Corps planning process starts with identifying problems and associated opportunities within the geographic scope of the project area. Problem statements are concise characterizations of the broad issue that will be addressed with the project. Opportunities are often ancillary to the identified problems. From the list of problems and opportunities, problems are the primary drivers of the objectives that are drafted by the team. From the list of problems and opportunities, and in collaboration with agency partners, the Corps drafts specific objectives for the project. The Corps determines the success of the project planning by the fulfillment of the objectives through identified measures.

Problem Statements

- Sedimentation and sediment re-suspension of fine materials
- Elevated nitrogen and phosphorus concentrations
- Lack of emergent and submerged aquatic vegetation
- Limited light penetration and water transparency
- Lack of protected wetlands and aquatic areas

- Limited habitat for migrating waterfowl and other species
- Limited aquatic plant coverage and bathymetric diversity for fisheries habitat
- Limited habitat for floodplain forest and associated species
- Lack of off-channel water depth

Opportunities

- Available dredged material put to beneficial use for habitat improvements
- Leveraging non-federal partnerships
- Provide increased recreational opportunities in the project area, including hunting, fishing, trapping, wildlife observation, wildlife photography, interpretation, and environmental education opportunities
- Improve small boat navigation where compatible with overall habitat objectives

3.2 Objectives and Constraints

Based on the Project's problems and opportunities, the planning team established specific objectives (Table 2). The Corps planning guidance ER 1105-2-100 provides guidance for developing objectives and specifies that objectives must be clearly defined and provide the effect desired, the subject of the objective, the location where the effect will occur and the timing and duration of the effect. For the purpose of this report, the timing or duration of the objectives is assumed to be the 50 year period of analysis. Project objectives should be specific, measurable, attainable, risk informed, and timely (SMART). The performance targets to measure the success of each objective are discussed in Appendix J – Monitoring and Adaptive Management.

In general, when determining the target objectives for a project and within specific locations for that project, the most efficiently-obtained desired habitat types are targeted. That is, the "best use" of an area is envisioned and features are designed to attain that use in a cost-efficient manner. The objectives in Table 2 were chosen based on this concept through meetings and discussions to address problems in the study area. Through these discussions it was determined that objectives to address water clarity, depths and vegetation growth are important and attainable in this area. The locations targeted, especially within the Catherine Pass area, are positioned within the floodplain such that the construction of typical project features would be expected to effect a beneficial change in conditions. This expectation is primarily related to the fact that the targeted areas are already somewhat protected from sediment-laden flows and the effects of wind and wave action. Therefore, further protection from these factors would lead to improvements in vegetation and, therefore, habitat for fish and wildlife.

Improving backwater fish habitat in the study area is important because much of the habitat structure is already in place to support this fish community. While Lake Pepin does provide a large expanse of lentic backwater-like habitat that is also being used by backwater fish species, the most productive use of the project area is also as backwater fish habitat. The project area would have a valuable mix of shallow vegetated and deeper areas that would meet all the needs of backwater fish species both during the summer and winter seasons. For these reasons, investing in backwater fish habitat in the project area has been determined to be worthwhile by the project team and state natural resource agencies. Areas targeted for wetland or waterfowl habitat would similarly be more beneficial than current conditions. As an example, the shallow vegetated northwest area of Catherine Pass would be most suitable to improve as wetland and waterfowl habitat, and would require less investment than fish habitat.

In developing these objectives for the project area, consideration was also given to sedimentation and suspended sediment concerns in Lake Pepin. The Minnesota Pollution Control Agency is undertaking a Total Maximum Daily Load (TMDL) study for Lake Pepin to address nutrients, and another TMDL has been completed for the Mississippi River upstream of Lake Pepin addressing total suspended sediment. Sediment inflow to Lake Pepin is a well-known problem and is related to nutrient loading being addressed by the TMDL study. At first, it may seem counterintuitive to construct features in the project area, because doing so requires the placement of more sediment in an area where sedimentation is a problem. Furthermore, meeting project objectives can lead to features that reduce future sedimentation here, but can increase sedimentation in other areas. However, the project area has great potential for improved habitat, which the study team and natural resource agencies believe outweighs any tradeoffs related to constructing features or minor increased downstream sedimentation. The sedimentation problem occurring in Lake Pepin is of a magnitude much greater than any potential minor effects of this project. As discussed in more detail in Section 3.6.4 and Appendix H, the potential increase in sedimentation in Pepin as a result of this project over the project life is a very small fraction of the overall sedimentation in the lake. This fraction is small enough that the adverse impacts to the lake relative to what is already occurring are nearly indistinguishable. However, real improvements can be measured and obtained for the project area.

Table 2: Project Objectives

HABITAT AREA	OBJECTIVES
Aquatic Vegetation	1. Increase the health, diversity, and acreage of emergent and floating leafed aquatic vegetation 2. Increase the health, diversity, and acreage of submerged aquatic vegetation
Wetland	3. Improve and increase the quantity and quality of wetland habitat for backwater waterfowl species
Shoreline	4. Protect existing shoreline habitat and increase the linear feet of sheltered bank and associated littoral habitat for use by marsh and water birds, shorebirds, aquatic mammals, amphibians, and reptiles
Floodplain Forest	5. Improve and increase the overall health and quantity of floodplain forest
Fish	6. Improve or maintain the quantity and quality of habitat for riverine aquatic species 7. Increase the quantity and quality of backwater fish habitat

Planning constraints are temporary or permanent limits imposed on the scope of the planning process and the choice of solutions. These limits can be related to the ecological, economic, engineering, legal, and administrative aspects of a project. Some constraints are states of nature, whereas others are based on the design of built structures and other engineering considerations. Legislation and decision makers can impose other constraints and such human-imposed constraints are possible to change. The Corps established the following planning constraints to guide and set boundaries on the formulation and evaluation of alternatives.

- 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.

- Environmental constraints: Construct measures consistent with federal, state, and local laws. Compliance and coordination under NEPA emphasizes 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
    - Minimize adverse waterbird and migratory bird impacts
    - Avoid adverse impacts to cultural resources

3.3 Management Measures and Screening

A management measure is a feature (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 project area problems, meet project objectives, and to capitalize upon project 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).

Screening of measures is a process whereby various criteria are evaluated to better characterize a specific measure and the likelihood that it can achieve project objectives and cost effective restoration. The evaluation criteria identified in the P&G were used to identify the alternative management measures retained for further consideration. The purpose of this preliminary screening is to narrow down the number of alternatives to be subjected to detailed further analysis; however, it will not preclude resurrecting a measure at a future date if it becomes apparent that a measure was screened out based on incomplete data or an invalid assumption. The measures that are retained for further consideration must derive from the planning objectives for the project, must be feasible within the project constraints, and must be considered to best meet the screening criteria within the range of alternatives considered.

Alternative plans are developed from the measures carried forward; if a measure is not justified and not carried forward, the measure would not be further developed into an alternative plan. Alternative plans are different combinations of various sizes and scales of measures that would contribute to attaining the planning objectives. A measure may stand alone as an alternative plan that can be implemented independently of other measures, resulting in some achievement of the planning objectives. Measures are screened against selected criteria in the first iteration of the planning process and alternative plans are developed and screened against the same criteria in a later iteration of the planning process. Review of the four formulation criteria suggested by the P&G (completeness, effectiveness, efficiency, and acceptability, defined below) and resource significance (institutional, public, and technical, described in the previous section) were used to aide in the selection of the Tentatively Selected Plan.

- **Completeness -** Completeness is the extent to which the alternative plans provide and account for all necessary investments or other actions to ensure the realization of the planned effects.
- **Effectiveness -** Effectiveness is the extent to which an alternative plan alleviates the specified problems and achieves the specified objectives.
- **Efficiency -** Efficiency refers to cost-effectiveness and the most efficient allocation of other resources. Efficiency is the extent to which an alternative plan is the most cost-effective means of alleviating the specified problems and achieving the specified objectives.

- **Acceptability -** Acceptability refers to the workability and viability of the alternative plan with respect to acceptance by state and local entities and the public and compatibility with existing laws, regulations, and public policies.

An array of general measures was developed that would address the problems identified in Section 2 (turbid inflows, wind fetch, and shallow depth) and meet study objectives:

- No Action - The no action measure is defined as no implementation of a project to modify habitat conditions in the project area. The No Action Alternative is required under NEPA for comparison of proposed actions to a baseline condition.

- 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 protects existing aquatic vegetation and improves conditions for the growth of aquatic vegetation in other shallow areas. Islands provide floodplain habitat, and their creation increases habitat diversity and provides habitat niches that have been lost in Upper Pool 4. This measure was carried forward for further consideration in alternative plans.

- Shoreline Protection – Shoreline or bank protection/stabilization could be accomplished by several types of features: Placement of coarse sand material on top of existing shoreline areas; Riprap; constructing groins, vanes, or berms; Bio-stabilization measures; or combinations of these features. This measure was carried forward for further consideration in alternative plans.

- Floodplain Forest – Floodplain forest enhancement could be accomplished by several types of features including timber stand improvement, planting new forested areas on newly constructed islands, and elevating areas to create more forest area. Terrestrial habitat in the study area is relatively flat and typically is only one to two feet above the low control pool elevation (666 ft.). Raising areas for floodplain forest could reduce the annual duration of inundation for the raised areas, and allow additional plant species to grow in the area. This measure was carried forward for further consideration in alternative plans.

- Habitat Dredging - The lack of depth diversity and aquatic structure in the Upper Pool 4 backwater limits the value of the area for some types of fish. Dredging deep water areas (greater than 6 feet in depth) could be implemented at critical locations for restored and expanded depth diversity, aquatic structure, deepwater habitat and improved water quality. This measure was carried forward for further consideration in alternative plans.

- Mudflats/Emergent Wetlands – Mudflats/Emergent wetlands could be established by creating areas protected from wind, stabilizing substrate, and planting wetland vegetation. Mudflats could be constructed to an elevation near low control pool elevation. This measure was carried forward for further consideration in alternative plan development.

- Closure Structures - Closures (or partial closures) are structural measures designed to control or reduce flow in existing secondary channels. 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. A closure structure was identified as a measure for consideration at Catherine Cut.

- Mussel Habitat - This feature could include riprap or cobble placement in areas identified as priority locations for mussel habitat. Some areas of quality habitat for mussels already exist in the channel in the study area and increased mussel habitat was not identified as a specific objective for this project. This measure was screened from further consideration.

- Channel Creation/Flowing Channels - Restoring or protecting flowing channels is important to riverine aquatic species. Islands can be positioned to maintain and/or encourage flowing channels. Project objectives in this area are aimed at protecting shorelines to reduce connectivity into backwaters, therefore this measure was screened from further consideration.

- Moist Soil Areas - The measure would consist of developing and managing seasonal wetlands in the study area. This type of feature would mimic the seasonal wet and dry cycles of natural wetlands and encourage the growth of native and desirable seed producing wetland plants and waterfowl habitat. Moist soil areas could be combined with water level management dikes. This measure was retained for further consideration in alternative plan development.

- Water Level Management – Water level management (WLM) of the water elevation within the study area could enhance aquatic habitat. This feature is dependent upon having a water source for waterfowl habitat management. Common designs for WLM include stoplog structures, dikes, pump stations, gated structures, rock-lined overflows, and plugging existing undesirable outlets (USACE 2012b). WLM in the form of earthen dikes would require clearing and grubbing trees and shrubs in the selected area, construction of a new water level management dike or reconstruction of an existing dike, and construction of a water level control structure. Management of the water elevation would be targeted to the northwest area of Catherine Pass and could enhance aquatic habitat. A disadvantage of this measure can be annual O&M, as WLM structures can require manual adjustment and monitoring, culverts can clog with debris or by beaver activity, and the size and complexity of some designs can be costly. However, given the numerous advantages of this measure, the planning team retained it for further evaluation. This measure was carried forward for further consideration in alternative plan development.

Table 3: Screening of Measures (Shaded Measures Were Screened From Further Analysis)

Measure	Complete	Effective	Efficient	Acceptable	Justification for Elimination from Further Consideration
No Action					No action will be carried forward. All alternative plans must be compared against the No Action alternative.
Island Creation	Yes	Yes	Yes	Yes	Islands would improve habitat quality, benefit aquatic vegetation, provide floodplain habitat, and reduce wind/wave impacts. This measure could be more cost effective based on island design and island size.
Bank Protection	No	Yes	Yes	Yes	This measure is retained.
Floodplain Forest	Yes	Yes	Yes	Yes	This measure is retained.
Habitat Dredging	No	Yes	Yes	Yes	Habitat dredging would be effective in meeting some project objectives. Combined with islands and the impacts on wind fetch and wave action, deeper water areas would contribute to improved water clarity and water quality. Habitat dredging would provide improved overwinter conditions for some fish.
Wetland Creation	Yes	Yes	Yes	Yes	Wetland creation and/or enhancement may be complete and effective. Emergent wetlands could be created in combination with islands, or peninsula designs, and could be scaled to be cost effective.
Closure Structures	No	Yes	Yes	?	This measure is retained for consideration at Catherine Cut.
Mussel Habitat	No	No	No	Yes	This measure does not meet project objectives and is not an efficient use of project resources.
Channel creation	No	No	Yes	No	This measure is not an efficient use of project resources and is not effective at meeting all project objectives.
Moist soil areas	No	Yes	Yes	Yes	This measure is retained.
WLM - dikes	No	Yes	Yes	Yes	This measure is retained.

The measures retained for further consideration (no action, island creation, bank protection, floodplain forest, habitat dredging, wetland creation, closure structure, moist soil areas, and water level management dikes) were derived from the planning objectives for the project, and are considered to be the most complete, effective, efficient, and acceptable within the range of measures considered. Increments and scales of the retained measures were developed and combinations of the different scales and increments of the measures were be used to formulate alternative plans.

3.4 Formulation of Alternative Plans

Alternatives are combinations of measures that would contribute to attaining the planning objectives. A measure may stand alone as an alternative plan that can be implemented independently of other measures, resulting in some achievement of the planning objectives. Measures that were deemed feasible were carried forward for consideration in the development of alternatives.

Three primary plan formulation strategies, described below, were used to narrow down the universe of possible solutions into a concise group of alternatives.

Alternative development is a complex, iterative process with many inputs, and the hydrologic analysis of the study area was the most influential in the development of alternatives leading up to the Tentatively Selected Plan.

Planning Strategy #1: First Iteration

The first iteration encompassed the entire the Pierce County Islands Head of Pepin Backwater Complex (Figure 6). This plan covered a large area, included extensive dredging, many large islands, and widespread shoreline & floodplain forest habitat. This plan was only developed to a conceptual level of detail and did not examine the balance between dredged quantities and quantities needed for the construction of the islands. This large concept would be costly and would have easily exceeded the CAP 204 funding limit ($10M federal). In addition, this concept exceeded the study scope, with an extent beyond the priority areas of the non-Federal sponsor. Lastly, using professional judgment from a hydraulic engineering perspective, the volume of granular fill needed to cover this vast extent would have very likely exceeded FEMA flood stage limits in Wisconsin.

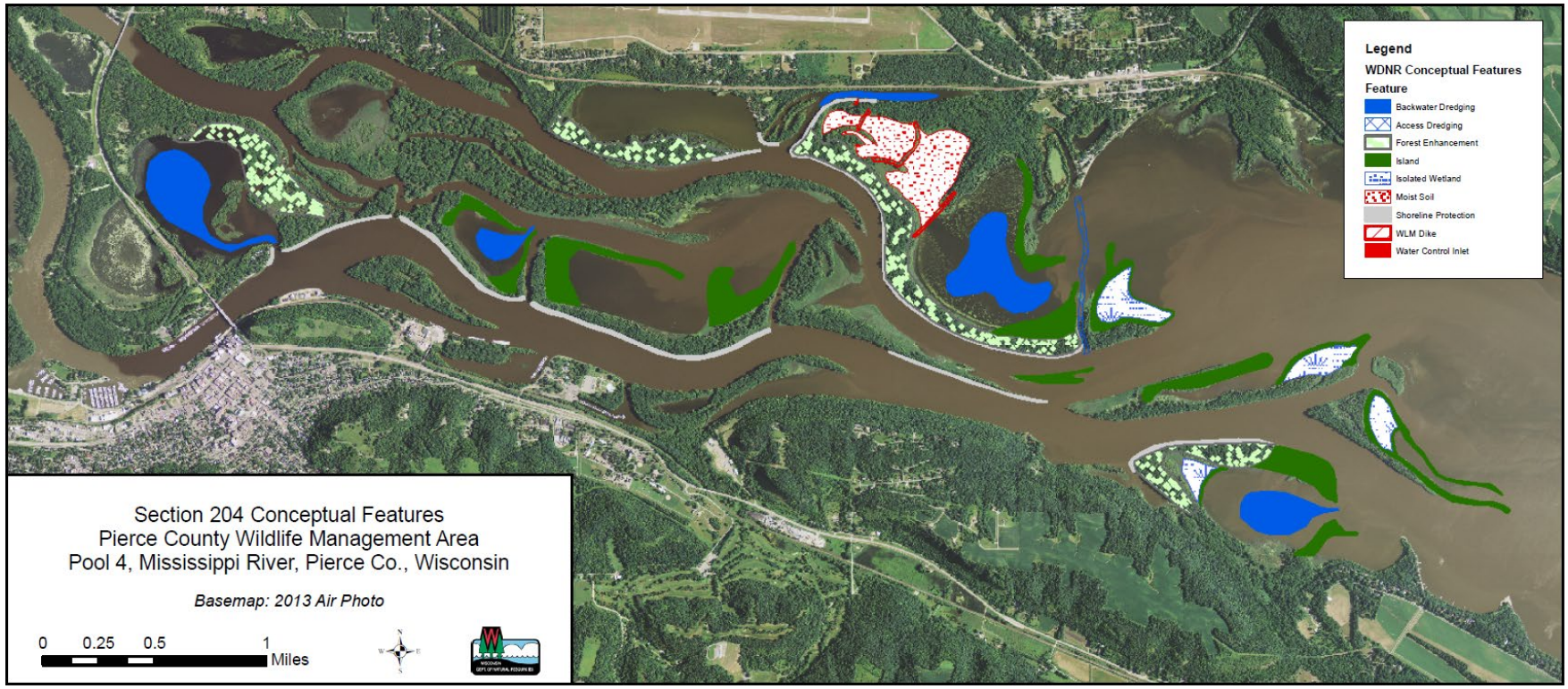


Figure 6: First Iteration of Planning – A Conceptual Layout of Features

Planning Strategy #2: Priority Areas

The next iteration consisted of sub-dividing the larger area and prioritizing sub-areas, largely based on feedback from the WDNR. The sub-areas in and around Catherine Pass were identified as Priority Area #1. The Catherine Pass area was deemed to have the most opportunity to "move the needle" in improving habitat conditions. The Catherine Pass area is already somewhat protected from wind fetch and river flows; therefore, fewer improvements would be needed to effect a change in water quality and plant response relative to other areas.

The areas in and around Wacouta Bay were identified as Priority Area #2. Habitat measures in Wacouta Bay would have benefits, however this area was not the top priority for this study. This area could be further evaluated in a future study.

Planning Strategy #3: Inclusion/Exclusion of Specific Measures

During the third iteration, the PDT focused on including or excluding various measures. A proposed closure structure at the southern end of Catherine Cut was considered and eventually screened out. Beneficial reasons for closure included reducing connectivity to the main channel, reducing turbid inflows, improving water clarity, improving growth of aquatic vegetation, and improving overall habitat quality in the backwater area. On the other hand, reasons for leaving the cut open included public input opposing closing recreational access through the cut to Bay City. In addition, a complete closure would result in a loss of existing flowing channel habitat. This area is considered valuable habitat for spawning walleye.

Including or excluding different access dredging routes was also considered in this phase of planning. The team considered accessing the study area from Lake Pepin, instead of through Catherine Cut. Access through Lake Pepin was screened out due to the high cost of access dredging a much longer route, compared to access through Catherine Cut. Material dredged from Catherine Cut could be placed in the adjacent mudflat. Access through Lake Pepin would also be challenging from a construction perspective. Without an adjacent disposal area, options are limited and not environmentally acceptable (e.g., sidecasting or thalweg disposal). Access routes and constructability concerns also impacted feasibility of off-shore islands within Lake Pepin; such islands would be difficult to construct, and would have minimal habitat benefits in that location and were not incorporated into final alternatives.

Several different locations were also considered for water level management. The team screened out two of the three water level management dikes in the upstream area of Catherine Pass. It was determined that only one of the proposed water level management dikes had a reliable water source and would be effective. The team also screened out the two open water islands on the downstream side of the area.

3.4.1 Final Array of Alternatives

After the third iteration of screening, the proposed project features still resulted in flood stage impacts. In order to eliminate flood stage impacts, the team worked to revise existing features. In order to successfully avoid stage impacts, the final array of alternatives were revised as follows:

- Peninsula elevations were all reduced from 673 feet to 671 feet.
- Peninsula widths and extents were reduced.
- Backwater overwintering dredge cuts were resized and reconfigured to maximize conveyance.

The remaining measures were formulated into standalone alternatives by building the smallest increment first (Alternative A), and incrementally adding in subsequent features. The final array consistent of six different alternatives ranging from A to F (Figure 9).

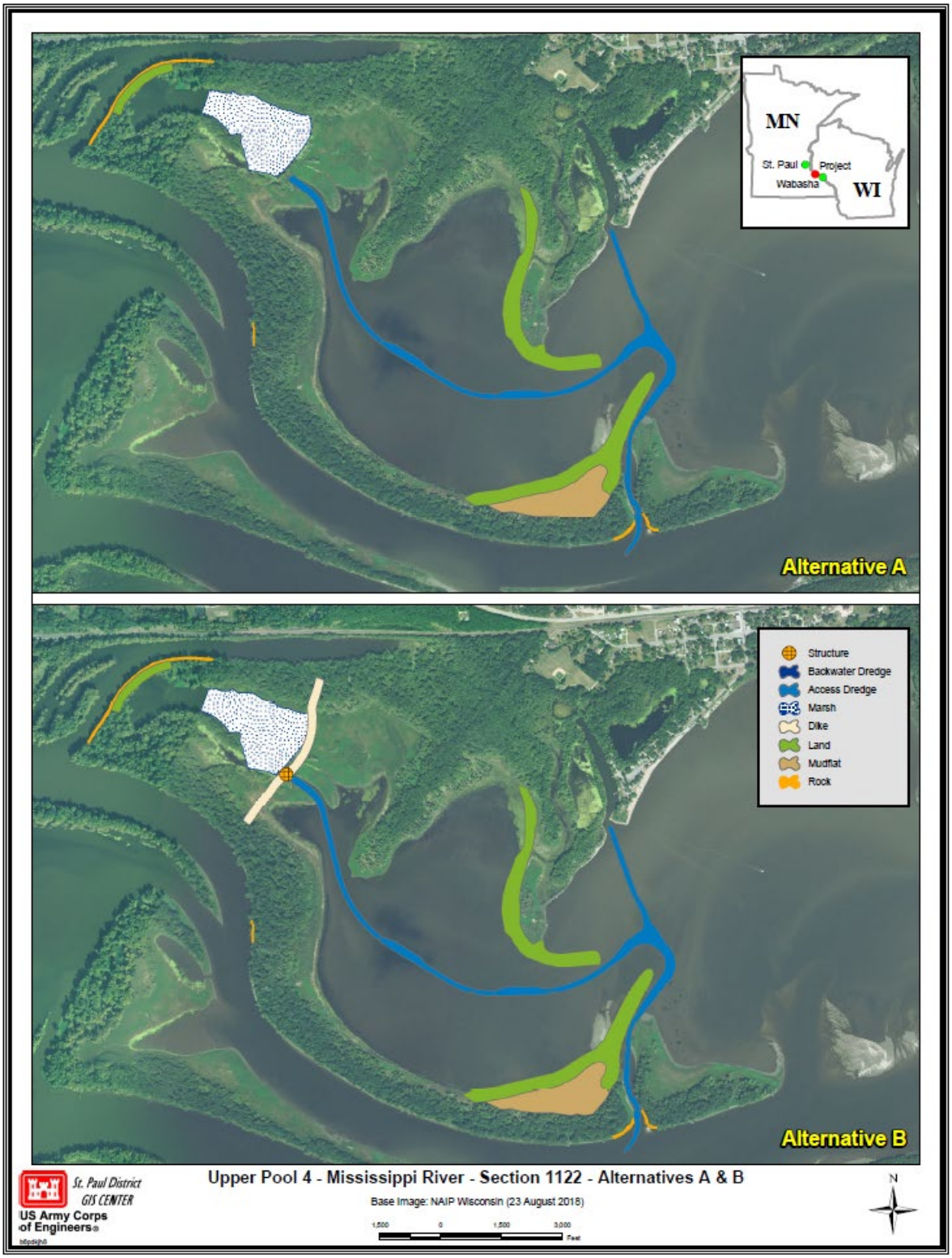


Figure 7: Alternatives A and B.

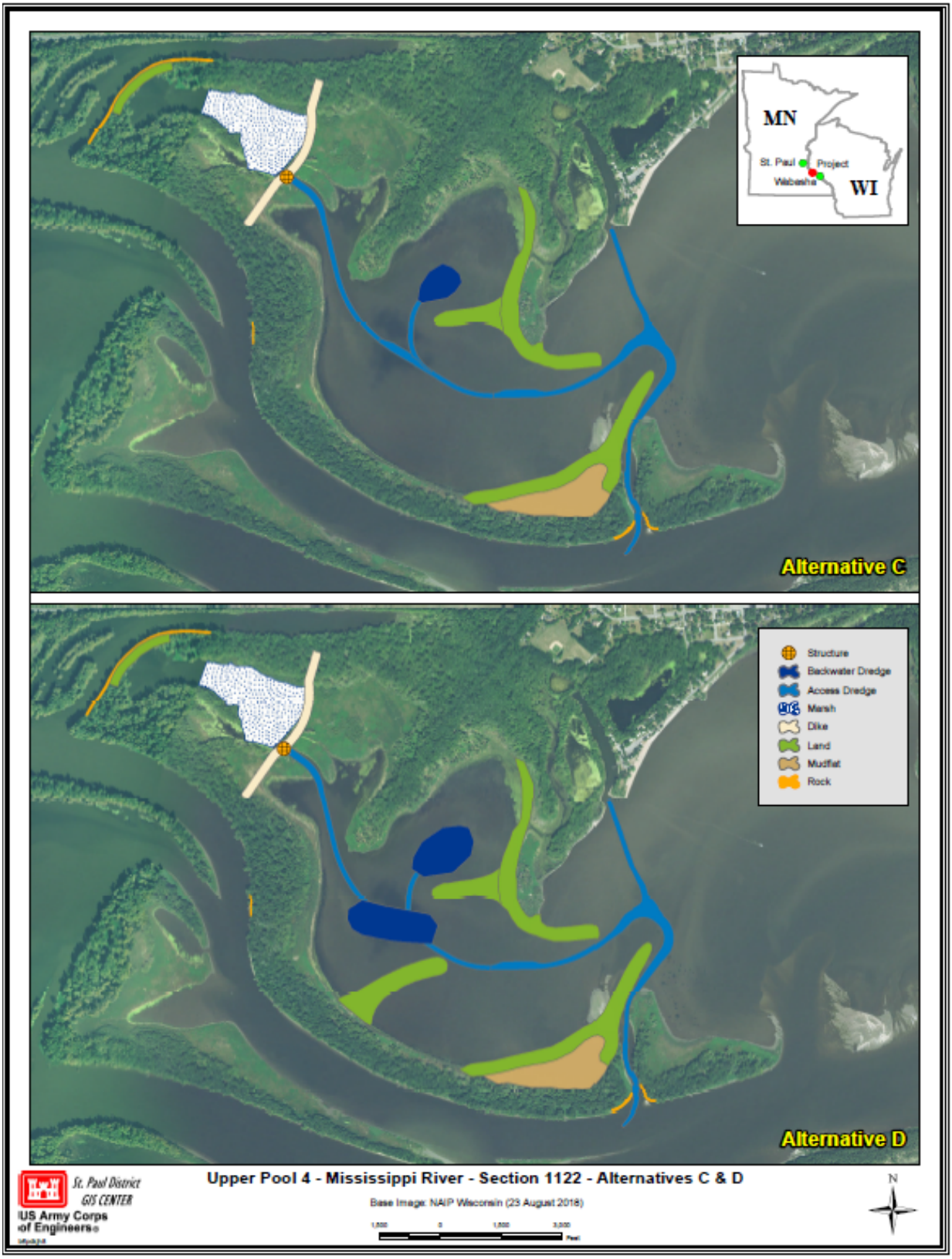


Figure 8: Alternatives C and D.

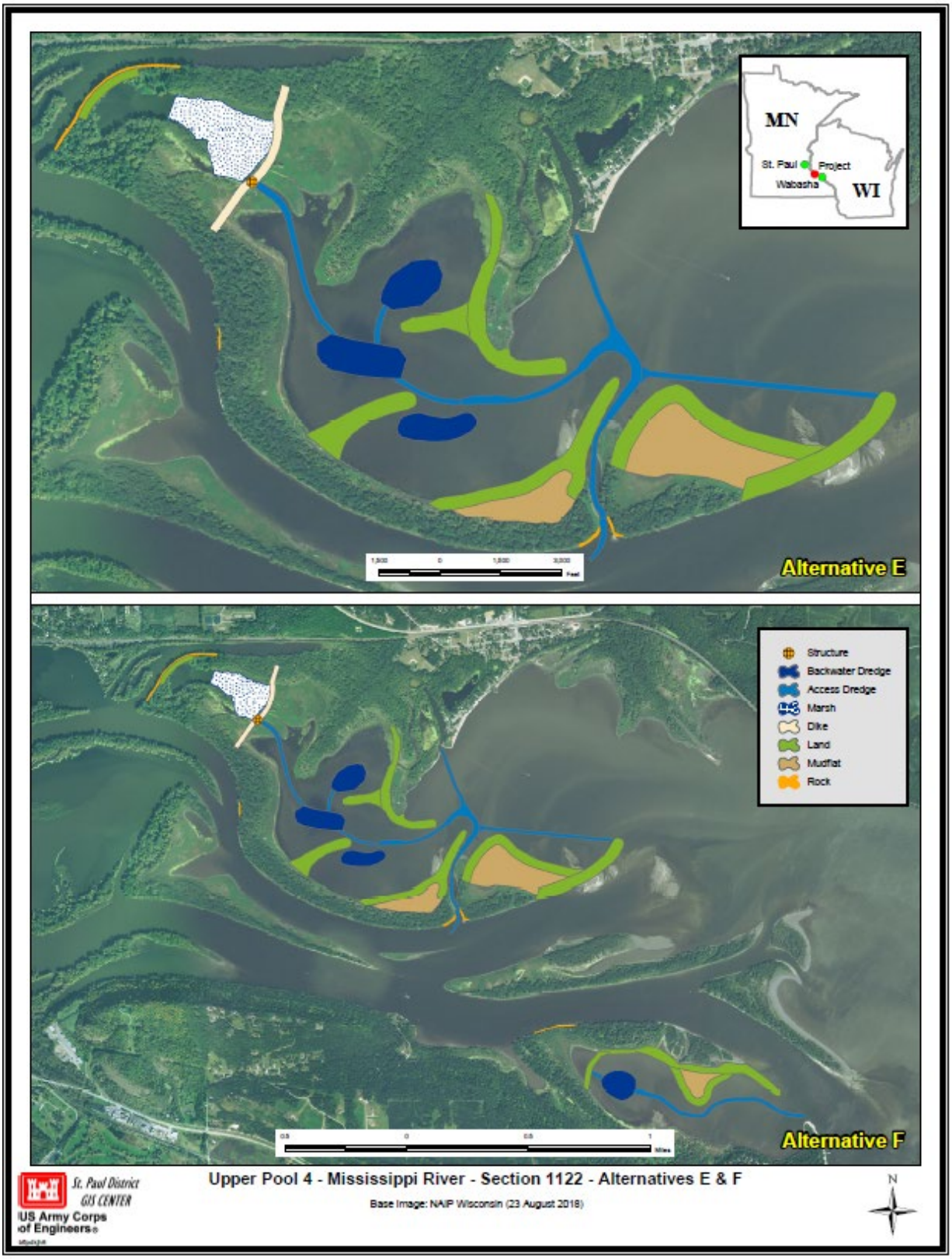


Figure 9: Alternatives E and F.

3.5 Evaluation and Comparison of Alternatives

This section describes the final array of alternatives that were evaluated. It also documents the process used to determine the potential costs and habitat benefits of each alternative.

3.5.1 Environmental Benefit Analysis

The USFWS Habitat Evaluation Procedure (HEP) was used to evaluate the potential benefits of alternative habitat improvement features (peninsula construction, dredging, wetland creation, etc.) for the Project (USFWS 1980). The HEP methodology utilizes Habitat Suitability Index (HSI) models to rate quality of habitat on a scale of 0 to 1 (1 being optimal). The HSI value is multiplied by the number of acres of available habitat to obtain Habitat Units (HUs); the HSIs and acreages are then projected into the future. One HU is equivalent to 1 acre of optimum habitat. HUs are then averaged annually across the project's 50-year period of analysis, referred to as Average Annualized Habitat Units (AAHUs). By comparing the AAHUs of the No-Action Alternative to each of the action alternatives, the benefits can be quantified (net gain in AAHUs).

The proposed features and alternatives were designed to benefit a wide range of native fish and wildlife species. Five habitat suitability index (HSI) models were selected to represent various species groups and were used to quantify the benefits of the study area; they included:

- Habitat Suitability Index Models: Black-Capped Chickadee (Schroeder, 1983)
- Habitat Suitability Index Models: Veery (Sousa, 1982)
- Modification of the Habitat Suitability Index Model for the Bluegill (*Lepomis macrochirus*) for Winter Conditions for Upper Mississippi River Backwater Habitats (Palesh & Anderson, 1990)
- Habitat Suitability Index Models: Marsh Wren (Gutzwiller and Anderson, 1987)
- Migratory Habitat Model for Dabbling Ducks (Devendorf, 2001)

The chickadee and veery models were used to assess floodplain forest habitat, the bluegill model was used to assess backwater aquatic habitat, the marsh wren was used to assess emergent wetland habitat, and the dabbling duck model was used to assess shallow marsh habitat. All models and spreadsheets used to assess benefits for the Project have been certified or approved for use through the Corps – Environmental Planning Center of Expertise (ECO-PCX).

Each of the alternatives evaluated would generally provide a mix of similar types of benefits, but at increasing levels with the addition of more features. The features in the north-western Catherine Pass area, include the refuge dredging, dike, and water control structure, are all designed to provide improved depths and control of water levels. This would improve vegetation and foraging conditions for waterfowl. The construction of peninsulas would directly benefit floodplain forest species through the establishment of forest in new areas. Similarly, the construction of a mudflat, which would vegetate as emergent marsh, would benefit marsh species such as the wren. Finally, the construction of the peninsulas and dredging for increased depths would benefit backwater fish species such as bluegill. These benefits would come from improved water clarity and vegetation growth, and also from increased depths for overwintering refuge habitat.

For a detailed discussion of the HEP conducted for this study, including the model spreadsheets, see Appendix D – Habitat Evaluation and Quantification. The habitat units that would be realized from each alternative are also listed in Table 4 below.

Table 4: Average Annual Habitat Units (AAHU) calculated per habitat type for Catherine Pass (CP) and Wacouta Bay (WB).

Alternative	Forest	Marsh	Bluegill	Duck	Total	**AAHU Gain Over Existing**
CP No Action	0.0	0.0	161.3	84.9	246.1	-
CP Alt A	17.0	8.1	354.7	94.2	474.0	228
CP Alt B	17.0	8.1	354.7	105.2	485.0	239
CP Alt C	20.3	8.1	372.3	105.2	505.9	260
CP Alt D	25.5	8.1	393.4	105.2	532.3	286
CP Alt E	43.8	26.7	371.7	105.2	547.3	301
CP Alt F	43.8	26.7	371.7	105.2	547.3	301
WB No Action	0.0	0.0	73.6	0.0	73.6	-
WB Alt F	14.4	8.9	107.7	0.0	130.9	57

3.5.2 Federal Standard Cost

The Federal Standard for the disposal of dredged material associated with construction or maintenance dredging of navigation projects is the least costly, environmentally acceptable plan. The Federal Standard costs for this project assume normal excavation and transportation costs based on the current practices in Pool 4. The Federal Standard costs were estimated based on dredge cuts (Trenton and Cannon) and excavation of dredged material from the nearest temporary placement sites (Reads Landing in Lower Pool 4), transportation to the nearest prospective permanent placement site, and the cost to acquire real estate for permanent placement. Real estate costs were estimated based on obtaining a one-time dredged material placement easement at the closest identified potential placement location. The total Federal Standard costs associated with the amount of dredged material needed for each alternative is presented in Table 5.

If a beneficial use is selected for a project and the costs exceed those of the Federal Standard, the costs borne by a Section 1122 project are those incremental costs above the Federal Standard and include transporting the material the additional distance up river to Upper Pool 4, unloading and placement of the dredged material, stabilizing with rock, capping the islands with fines, and seeding. The incremental portion are the costs that are used to compare the alternatives in the Cost Effectiveness and Incremental Cost Analyses.

Table 5: Federal Standard Costs for Each Alternative

Alternative	Total Granular (cy)	Federal Standard
No Action	-	-
A	218,000	$ 2,758,000
B	248,000	$ 3,104,000
C	300,000	$ 3,704,000
D	391,000	$ 4,771,000
E	684,000	$ 8,184,000
F	974,000	$ 11,560,000

3.5.3 Cost Effectiveness & Incremental Cost Analysis

Corps guidance requires a cost effectiveness analysis and incremental cost analysis (CE/ICA) for determining what project features and design alternatives should be built based on a comparison of quantified habitat benefits (outputs) and estimated costs of alternative designs. This process identifies which alternatives or combinations of features fully or partially meet the objectives of the project and are the most cost effective. A cost effective analysis is conducted to ensure that the least cost alternatives have been identified. Subsequent incremental cost analysis is conducted to evaluate changes in cost for increasing levels of environmental output.

CE/ICA is a three-step process: (1) calculate the environmental outputs for each alternative; (2) determine a cost estimate for each alternative; (3) compare and evaluate the alternatives based on habitat benefits and costs.

The incremental costs above the Federal Standard were annualized (AACost) over a 50-year period of analysis at an interest rate of 2.750 percent for Fiscal Year 2020. These costs included initial construction with mobilization and demobilization, contingency, planning, engineering, and design, and construction management, above the actual estimated cost for construction, adaptive management (3%), and interest during construction (2-8 years of construction were assumed for alternatives). The annual operation and maintenance (ranging from approximately $1,000 to almost $3,500 per year for 50 years) was added to generate the annualized incremental cost (above the Federal Standard) for each alternative.

Then, the environmental outputs (AAHU gains) from Table 4 were compared to the annualized costs, and the results are shown in Table 6.

Table 6: Total Project First Cost and Annualized Incremental Costs

Alt	Granular (cy)	Total Project First Costs	Federal Standard	Incremental Cost above the Federal Standard	Annualized Incremental Cost	AAHU Gain Over Existing
NA	-	-	-	-	-	-
A	218,000	$ 11,055,000	$ 2,758,000	$ 8,297,000	$ 317,000	228
B	248,000	$ 13,035,000	$ 3,104,000	$ 9,931,000	$ 386,000	239
C	300,000	$ 14,833,000	$ 3,704,000	$ 11,129,000	$ 439,000	260
D	391,000	$ 18,506,000	$ 4,771,000	$ 13,735,000	$ 548,000	286
E	684,000	$ 35,795,000	$ 8,184,000	$ 27,611,000	$ 1,114,000	301
F	974,000	$ 48,268,000	$ 11,560,000	$ 36,708,000	$ 1,522,000	358

*The annualized cost was determined using the FY20 discount rate of 2.750 percent

The CE/ICA analysis for each alternative was accomplished using the Corps Institute for Water Resources Planning Suite II. The results of the CE/ICA analysis is displayed in Figure 10. The incremental cost per unit of output for Best Buy plans are displayed in Figure 11.

Of the 7 alternatives, the two plans were considered Cost Effective and five were considered Best Buys, including the No-Action Alternative. “Cost Effective” means that for a given level of non-monetary output, no other plan costs less, and no other plan yields more output for less money. From the set of Cost Effective plans, “Best Buy” plans are the most efficient and give the greatest increases in output for the least increase in cost. Given that Alternatives B and E were not best buys, and did not address project objectives as fully as other alternatives, they were eliminated from further consideration.

Figure 10. CE/ICA Analysis of all Alternatives

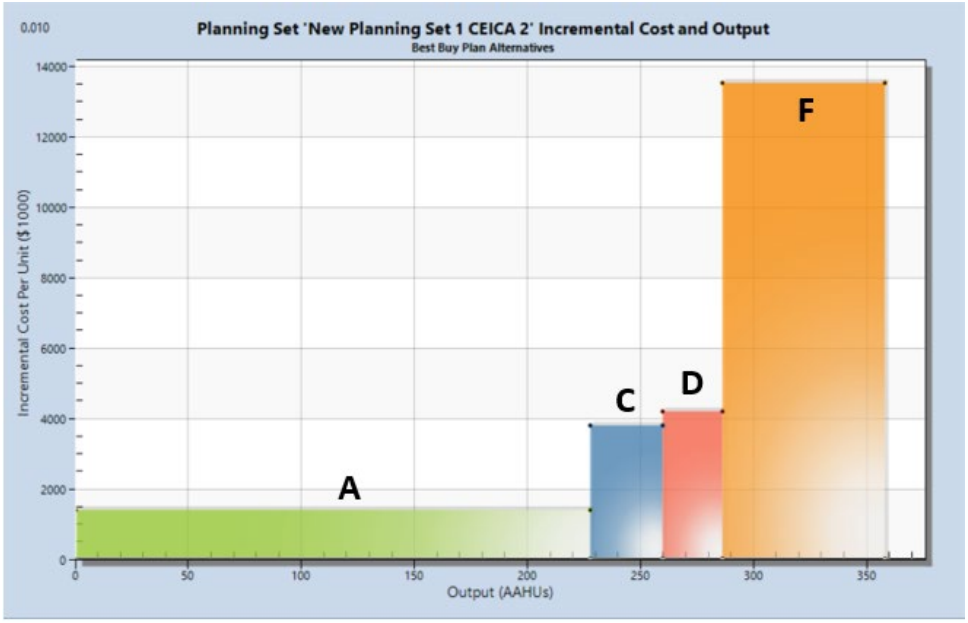


Figure 11. Incremental Cost and Output Results of Best Buy Plans

The Best Buy plans presented provide the information necessary to make well-informed decisions regarding desired project scale and features. Progressing through the increasing levels of output for the alternatives helps determine whether the increase in output is worth the 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”, and the final decision regarding desired project scale and features for environmental restoration will be reached.

Typically in the evaluation of Best Buy plans, “break points” are identified in either the second-to-last column in

Table 7, or in the stair-step progression from left to right in Figure 11. Break points are defined as significant increases or jumps in incremental cost per output, such that subsequent levels of output may not be considered “worth it”. Identification of such break points can be subjective. For this study, break points were identified between each of the five Best Buy plans (No Action, Alternative A, C, D, and F).

Table 7. CE/ICA Report - Incremental Cost of Best Buy Plans.

Alt	Output (AAHUs)	Cost ($1,000)	Average Cost ($1,000/AAHUs)	Incremental Cost ($1,000)	Inc. Output (AAHUs)	Inc. Cost Per Output
NA	0	$0	$0	$0	0	$0
A	228	$317,000	$1,400	$317,000	228	$1,400
C	260	$439,000	$1,700	$122,000	32	$3,800
D	286	$548,000	$2,000	$109,000	26	$4,200
F	358	$1,523,000	$4,300	$974,000	72	$13,500

3.5.4 Comparison of Best Buy Alternatives

No-Action Alternative – This alternative was not chosen because it does not improve or maintain the ecosystem resources within the study area. This alternative would cost $0. The continued high flow events would continue to supply suspended sediments to Catherine Pass and reduce the habitat value in the study area. The existing study area provides 159 HUs, and is assumed to remain at this level over the next 50 years. This alternative does not meet any of the project objectives.

Alternative A – This alternative includes two peninsulas and improves waterfowl habitat in Catherine Pass. While this alternative has a low cost per AAHU of $1,400, it failed to address study objectives to improve fish habitat and manage water levels for migratory birds. Without any backwater habitat dredging for overwintering fish, this area will remain shallow. Additionally, without a dike, water levels will be too shallow during some parts of the year for migratory birds. For these reasons, Alternative A was deemed as not effective by the Corps and the WDNR, and this alternative was eliminated.

Alternative C – This alternative includes the features described in Alternative A, as well as a dike with a stoplog structure, and 1 additional peninsula. This alternative would cost approximately $15 million to construct and would result in a net gain of 260 AAHUs, at an average annual cost per average annual habitat unit of $1,700. The incremental output is 32 habitat units and the incremental average annual cost per average annual habitat unit is $3,800. However, this alternative had minimal backwater overwintering habitat for fish. Alternative C was not considered worth the investment as it did not fully meet project objectives.

Alternative D – Similar to Alternative C with the addition of a fourth peninsula and two much larger backwater dredged areas. The almost doubling of backwater habitat, creation of more floodplain forest (on the peninsulas), and reduction in wind fetch was significant compared to the previous alternatives. This alternative meets 6 out of 7 project objectives and provides a net gain of 286 (26 AAHU above Alternative C). Objective 6 (enhancing habitat for riverine species)

was the only objective not met and no alternatives in the final array were able to address this objective. The cost per average annual habitat unit is $1,900, which is below average for most recent HREP studies. Alternative D was considered well-worth the investment as it meets the majority of project objectives and maximizes habitat benefits at a reasonable cost.

Alternative F – In addition to all the features included in Alternative D, this largest plan adds features in Wacouta Bay. The additional features included a peninsula, mudflat, and backwater dredging. This alternative meets most of the project objectives and provides 72 additional AAHU above Alternative D, however the incremental cost was almost $1M, as the incremental cost per average annual habitat unit is $13,500. The increase in habitat units, at a much larger cost, was deemed not worth it, and this alternative was eliminated. Although features in the Wacouta Bay increment were not pursued in this study, this area could be examined in a future study separately.

3.6 Plan Selection

3.6.1 National Ecosystem Restoration Plan

Selecting the National Ecosystem Restoration (NER) plan requires careful consideration of the plan that meets planning objectives and constraints and reasonably maximizes environmental benefits while passing tests of cost effectiveness and incremental cost analyses, significance of outputs, completeness, effectiveness, efficiency, and acceptability.

The alternative plan that reasonably maximizes the benefits in relation to cost and meets the overall planning objectives is Alternative D, tentatively selected as the National Ecosystem Restoration Plan (NER Plan). The $1,900 per AAHU created by Alternative D is efficient in achieving the ecosystem restoration objectives and has been considered reasonable. For reference, the Districts' Upper Mississippi River Restoration (UMRR) Habitat Restoration and Enhancement Projects (HREP) yielding an average annual cost per AAHU of $2,000-3,000 have generally been accepted as justified, with over $5,000 per AAHU accepted in some circumstances. These numbers have not been adjusted for inflation since they were developed in the early 1990s. These criteria have been used to justify construction of over $59 million in habitat projects within the St. Paul District since the UMRR program began. The Tentatively Selected Plan – Alternative D is consistent with regional and State planning for the area.

The federal objective for water and related land resources planning is to contribute to national economic development consistent with protecting the Nation's environment, pursuant to national environmental statutes, applicable Executive Orders, and other federal planning requirements. Achievement of the federal objective is measured in terms of contribution to federal accounts intended to track the overall benefits of a given project.

3.6.2 Resource Agency Support

The WDNR supports Alternative D over the other Best Buy plans as it meets all the project objectives, and addresses the problems in the priority area of Catherine Pass.

3.6.3 Resource Significance

All of the Best Buy alternatives demonstrate institutional and public significance as they meet goals and objectives of the WDNR in maintaining a high quality ecosystem while avoiding adverse impacts.

Review of technical importance for the Best Buy alternatives considered to be worth the investment, supported the selection of Alternative D. Technical importance can best be

demonstrated using six criteria: scarcity, representativeness, status and trends, connectivity, limiting habitat, and biodiversity. In terms of status and trends, resource agencies have clearly documented an increase in flows in the Mississippi River, especially over the last two decades. Increased major flood events and duration of inundation have resulted in degradation of habitat for migratory waterbirds and waterfowl. Furthermore, in terms of limited habitat, increased flows have resulted in shoreline erosion and island loss. Alternative D would protect shoreline and create floodplain forest habitat.

3.6.4 Risk and Uncertainty

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

The team worked to manage risk in developing measures. The team used experience from past projects to identify potential risks and reduce uncertainty during plan formulation. This included developing measures by expanding on and referencing successful similar habitat restoration work on the Upper Mississippi River (especially Harpers Slough, IA and Capoli Slough, WI), referencing the *UMRR Environmental Design Handbook* (USACE, 2012), and using best professional judgment. The team also had several meetings to conduct an Abbreviated Risk Analysis during which project risks were factored into project costs. The primary risks identified for Upper Pool 4 included:

Constructability – Based on existing geotechnical information, the Upper Pool 4 area was known to consist of unconsolidated sediments which can result in significant settlement during island construction. Historic maps and existing data were evaluated in order to consider placing proposed features in locations where land had previously existed with the thought that these areas would experience less settlement. In addition, the cost estimate accounts for additional material to be placed for island construction. Roughly 2.5 feet of settlement was assumed during construction, and another 1 foot post-construction. The cost estimate also accounted for settlement within the construction costs.

An overtopping analysis was conducted that concluded that the proposed peninsulas in this area with a design elevation of 671 feet would have been overtopped 16% of the time in the years 1988-2019. The islands constructed as part of Harpers Slough and Capoli Slough HREPs would have been overtopped 6% of the time in same time period. There will be less time to construct the Upper Pool 4 peninsulas because of the higher overtopping percentage. The proposed five year construction contract should allow for sufficient opportunities to complete these features.

Flow Risks – An extensive H&H analysis was done to evaluate the extent and location that fill could be added to the floodplain without inducing flood stage impacts. An HEC-RAS steady state model was used to assess flood stage impacts. These results have been provided to the Wisconsin DNR, which is the regulatory agency. In addition to flood stage, the risk of future formation of channels was taken into consideration by providing rock protection at existing low spots in the natural levee to prevent these areas from eroding. If water were to get into newly enhanced overwintering habitat, it would degrade these areas by adding sediment and cold water.

Given that the Mississippi River is a dynamic system, post-construction monitoring and adaptive management would be used to address any unplanned outcomes of the Tentatively Selected

Plan. None of the project measures are believed to be burdened by significant risk or uncertainty regarding the eventual success of the proposed habitat.

Sediment Deposition Unknowns – In general, sediment transport and deposition is complex as it is influenced by a number of variables including upstream sediment loads, seasonal patterns of river discharge, wind-driven wave action, sediment mobilization, and local hydraulic conditions.

The project area can best be described hydraulically as a connected system with flow entering the project area through a small side channel called Catherine Cut. This cut has existed a long time, and is visible on maps as far back as the 1890s (Figure 2). Although sediment inflows can be clearly observed on aerial imagery passing through the cut and forming sand deltas (Figure 4), no data exists in the project area specifically. Many studies have been completed to estimate sediment loads and depositions rates at Lake Pepin. Additionally, a hydraulic analysis was completed to estimate the sediment through Catherine Cut. With the conclusion of these analyses, it was determined a partial closure would be beneficial to decrease the sediment load entering Catherine Cut and thus the project area. The structure would include a deflector to reduce the sand load into Catherine Cut. Reducing the amount of sediment entering Catherine Cut would help to stabilize the access cut post-construction.

There are slight changes that would occur to both fine sediment and course sediment (sand) deposition with the construction of a rock partial closure at Catherine Cut. The course sediment has historically deposited within Catherine Pass just downstream of the Catherine Cut outlet. The partial closure would deflect course sediment downstream of the structure. The course sediment that is deflected downstream by this structure will quickly deposit at the downstream end of the Wisconsin Channel as the flow spreads out in Lake Pepin. This is an area where course sediment is currently depositing, so course sediment load changes are not anticipated to affect the downstream communities such as Lake City. However, the partial closure structure would decrease the course sediment load through Catherine Cut, so more material than existing conditions will settle in this Wisconsin Channel location. Figure 12 illustrates the course sediment deposition changes due to the proposed partial closure. The Catherine Cut course sediment load was estimated earlier to be between 1,500–1,900 tons per year. In contrast, Lake Pepin course sediment load was estimated to be between 800,000–1.5 million tons per year (Blumentritt et al., 2013 and Groten et al., 2019, respectively).

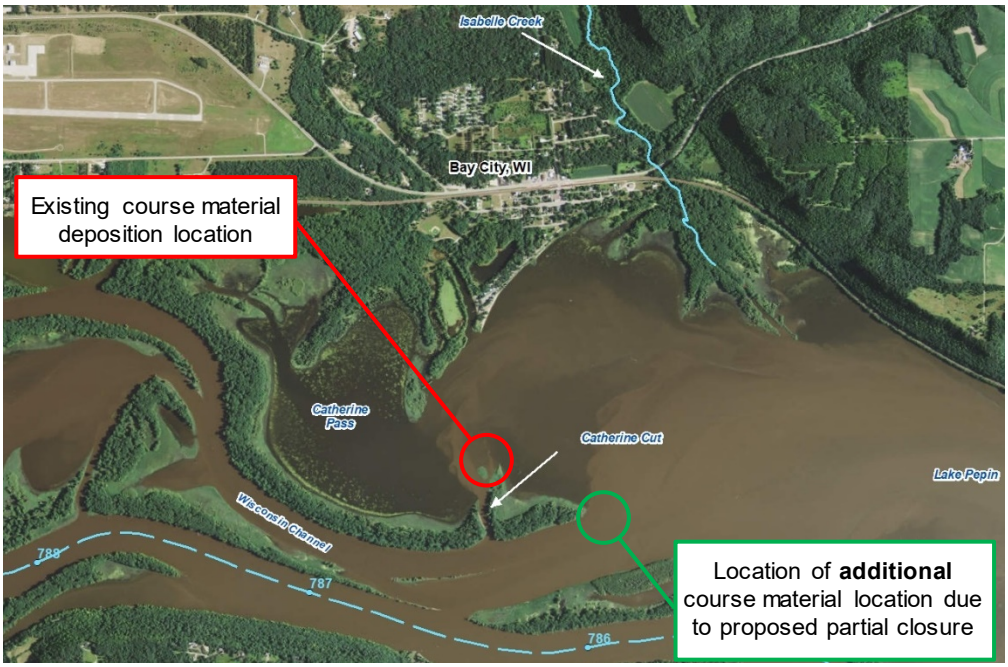


Figure 12: Estimated Course Material Deposition Existing vs. With-Project Condition

The effects of the partial closure structure on fine sediment deposition in Lake Pepin will be relatively small. For existing conditions the water that splits out through Catherine Cut flows past Bay City and rejoins the Wisconsin Channel in the vicinity of Isabelle Creek, just east of Bay City. Visually this can be seen in Figure 13 where the Catherine Cut sediment plume rejoins the larger plume from the Wisconsin Channel. Under the with-project condition, the same flow pattern would exist with the Catherine Cut and Wisconsin Channel flows coming together at approximately the same location near Isabelle Creek. Any changes in sediment deposition due to the partial closure should be limited to the Bay City and Head of Lake Pepin area because the sediment path through Catherine Cut and downstream of the Wisconsin Channel will be unchanged.

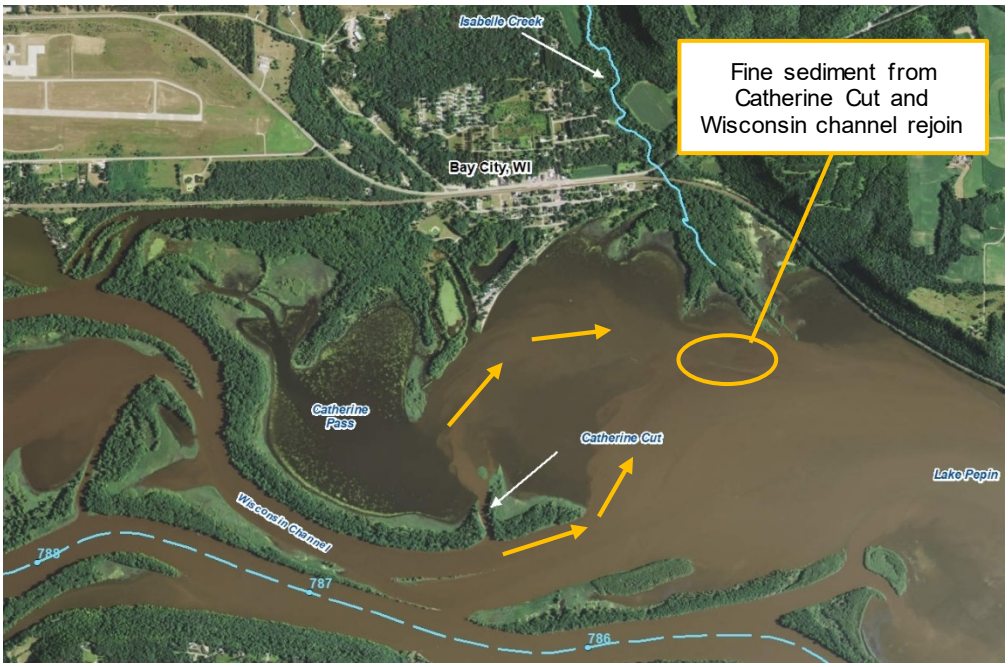


Figure 13: Fine Sediment Path

Another way to look at this is by comparing the change in deposition area with the project. It is well documented that Lake Pepin is a sediment sink, has a variable fine sediment deposition rate that decreases in the downstream direction (Engstrom et al., 2009 and McHenry, 1978), and is affected by wind-driven wave action that resuspends and redistributes sediments once it has settled in the shallow areas of the lake. Simulating these complex sediment transport processes has not been done and is beyond the scope of this project. However, if a simplified assumption was made that fine sediment deposition was completely eliminated in Catherine Pass with this project in place, the area of the lake where fine sediment could be deposited would be reduced by approximately only 1.2 percent. This further illustrates the minimal impacts the project will have on the fine sediment deposition and load for Lake Pepin.

3.6.5 Consistency with Corps Campaign Plan

The Corps has developed a Campaign Plan with a mission to "provide vital public engineering services in peace and war to strengthen our Nation's security, energize the economy, and reduce risk from disasters." This study is consistent with the Corps Campaign Plan by producing lasting benefits for the nation, by optimizing agency coordination, and by using innovative solutions in pursuit of a sustainable, environmentally beneficial, and cost-effective ecosystem restoration design.

3.6.6 Consistency with Corps Environmental Operating Principles

The Corps has reaffirmed its commitment to the environment by formalizing a set of Environmental Operating Principles (EOP) applicable to all of its decision-making and programs. The formulation of alternatives considered for implementation met all of the EOP principles.

The EOPs are: foster sustainability as a way of life throughout the organization; proactively consider environmental consequences of all Corps activities and act accordingly; create

mutually supporting economic and environmentally sustainable solutions; continue to meet our corporate responsibility and accountability under the law for activities undertaken by the Corps, which may impact human and natural environments; consider the environment in employing a risk management and systems approach throughout the life cycles of projects and programs; leverage scientific, economic and social knowledge to understand the environmental context and effects of Corps actions in a collaborative manner; and employ an open, transparent process that respects views of individuals and groups interested in Corps activities. The EOPs were considered during the plan formulation and the Tentatively Selected Plan is consistent with the EOPs. The Tentatively Selected Plan promotes sustainability and economically sound measures by incorporating the most natural and least cost methods for restoring habitat at the Head of Lake Pepin for aquatic plants, migratory waterfowl, fish, and other wildlife.

3.6.7 Refinement of the Tentatively Selected Plan

After the study team established the TSP as the conceptual plan, the plan was refined to include minor additions that would better address access and improve construction efficiencies, including:

- Incorporated an access road to the water level management dike to allow for both construction and long-term O&M.
- Adjusted the refuge dredge layout to reduce constructability concerns. The conceptual layout called for 18 acres of dredging 1 foot deep throughout, which would result in inefficiencies with double handling material. The team revised the dredging to be more constructible, by narrowing and deepening the refuge dredge cut. This change does not reduce the extent of the inundated area due to the proposed dike. The dike will hold back 2-4 feet of water in the refuge marsh in both dredging methods. By narrowing and deepening the dredging cut with the new method, the depths in that cut will be deeper for barge access, with a narrow strip on each side of the cut dredged to a 1 foot depth.
- Reduced the dredge depths of the access cuts and overwintering dredged areas by 0.5 feet. This decision was informed by hydraulic analysis that the project rarely experiences low control pool due to the long distance upstream of the Wabasha control point. This change reduces overall dredge quantities and costs while maintaining project objectives.

These refinements to TSP had some potential to change the habitat units quantified for the project and were evaluated in Appendix D - Habitat Evaluation and Quantification. After a review, the reduction in refuge dredging, however, was the only modification likely to change the benefits analysis. When the duck model was repeated for the changed conditions, the impact to the outputs was insignificant. In general, it was determined that reducing this dredging acreage would only reduce the habitat units by 1.5. This small reduction is due in part to the limited sensitivity the model has for such changes, and also due to the benefit that is gained by the dike and control structure.

4 TENTATIVELY SELECTED PLAN

The results of the NEPA analysis, incremental cost analysis, P&G criteria evaluation, and habitat evaluation were all considered in the decision-making process along with other factors including physical features on the site, management objectives, critical needs of the region, and ecosystem needs. The Upper Pool 4 PDT concluded that the alternative plan that best meets the objectives is Alternative D. This alternative is cost-effective and justified as a “Best Buy” plan.

Alternative D was identified by the PDT as the NER Plan and is the Tentatively Selected Plan, and is supported by the non-Federal sponsor, WDNR (Appendix A – Correspondence & Coordination). The plan would enhance the Catherine Pass, Bay City area through the construction four peninsulas, refuge dredging, a water level management dike with a water control structure, an access road, two backwater dredged areas, three areas of shoreline protection, a mudflat, access dredging, and a partial closure. (Figure 13).

Construction, operation, maintenance, repairs, rehabilitation, and replacement considerations are discussed in this section. The project schedule and initial cost estimates are provided. The project has been developed to a detailed feasibility level of design. Further details will continue to be refined in the Plans & Specifications (P&S) Stage.

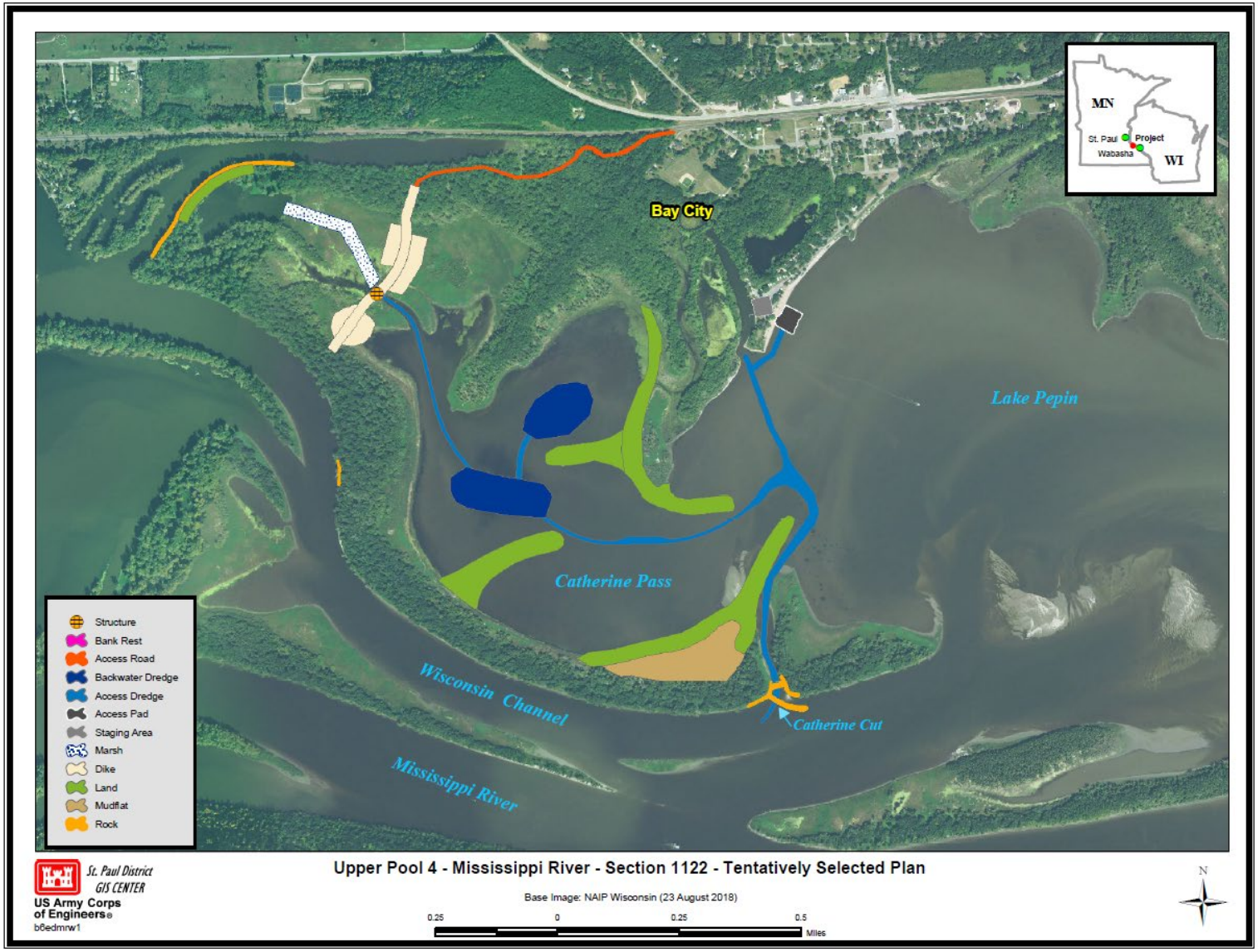


Figure 14: Upper Pool 4 Tentatively Selected Plan

4.1 Plan Features

Each of the proposed project features are related to creating and enhancing habitat in Catherine Pass and contribute to meeting all the study objectives. The primary features are described in Table 8 below.

The Project has been developed to a feasibility level of design. Details are included in Appendix C – Civil Drawings and Appendix I – Structural Engineering. Design quantities are based on topographical and bathymetry surveys performed by the Corps in June 2018. Vertical Datum for the surveys is NAVD 88 and Horizontal Datum is NAD 83-MN SPCS-South Zone, U.S. Survey Feet). As with all feasibility level studies, these details will be refined in the Plans and Specifications (P&S) Stage.

The Corps has constructed many islands to improve habitat in the Upper Mississippi over the past three decades. Many of the features and recommendations have been denoted in the *Upper Mississippi River Restoration Program - Environmental Design Handbook, December 2012*. This document was used to ensure structure dimensions and design criteria were in general agreement with currently accepted design characteristics.

Table 8: Description of Project Features

Feature	Description
Peninsulas	Four peninsulas would be constructed to improve habitat conditions by reducing wind, waves, and redirecting sediment inflows. The peninsulas would range from 150-200 feet wide and include rock protection (rock tips and groins). Peninsulas would be capped with 24 inches of fines, and plantings will include a mix of turf, willows, and trees.
Refuge Dredging	Dredging in the marsh area would provide a protected area for shallow aquatic vegetation and waterfowl habitat. The dredge cut would be approximately 40 feet wide, and approximately 6 feet deep (667 feet elevation) from the 50% AEP event water surface elevation to allow sufficient barge draft during a high water event. The cut would also include approximately 50 feet on either side of the cut to be dredged 1-2 feet from the existing ground.
Water Level Management Dike	The dike and associated water control structure would allow enhanced management of wetland resources for waterbirds and waterfowl. The dike would have a top width of 100 feet and would be approximately 2,000 feet long.
Water Control Structure	The control structure would allow the ability to manipulate water levels to promote moist soil plant growth. The stoplog structure would consist of a single 36 inch corrugated metal pipe with aluminum stoplogs. The structure in the dike would allow the marsh to hold up to 4 foot depths, and fully drawdown the marsh in less than 2 days.
Access Road	The access road to the dike would provide construction access and long-term O&M for the dike and water control structure. The road would be approximately 3,600 feet in length and 12 feet wide.
Backwater Dredged Areas	Two backwater habitat areas would be dredged to a depth of 7.5 feet.
Shoreline Protection	Shoreline protection would reduce inflows and erosion during high flow events and prevent breaches in narrow areas. This feature would be constructed along the north shoreline, west along the Wisconsin channel, and within Catherine Cut.
Mudflat	The mudflat would be created using fill dredged from the backwater areas. After establishment, the mudflat would provide emergent wetland habitat.
Access Dredging	Access dredge cuts would have a width of 40 feet and would provide both access to construct features in the study area as well as improve hydraulic conveyance

	and backwater areas. Dredged fines would be placed in adjacent mudflats and used as peninsula topsoil.
Partial Closure	The partial closure at Catherine Cut would be constructed to reduce the sediment load entering the project area which will help to stabilize the access dredge cut post-construction. The partial closure would be constructed out of R140 rock and contains three basic features: • Deflector: Constructed at a top elevation of 673 feet which is approximately the 50% AEP (2 year) event. It was analyzed that in the years 1981-2019 this structure would have been overtopped 7% of the time. This feature will deflect sediment downstream of Catherine Cut. • Shoreline stabilization: Located on the opposite bank of the deflector to protect existing shoreline/bank. • Rock liner: Constructed at an invert elevation consistent with the cut's access dredging (661.1 feet). This means that during low control pool conditions there is 5.5 feet of water depth over this structure. The rock liner which ties into the deflector and shoreline stabilization creates a hardened cross section that should minimize future channel scour. This design referenced the Long Lake HREP in Pool 7. Photos of the Long Lake HREP partial closure and the Upper Pool 4 partial closure design concept can be observed in Figure 15 below.

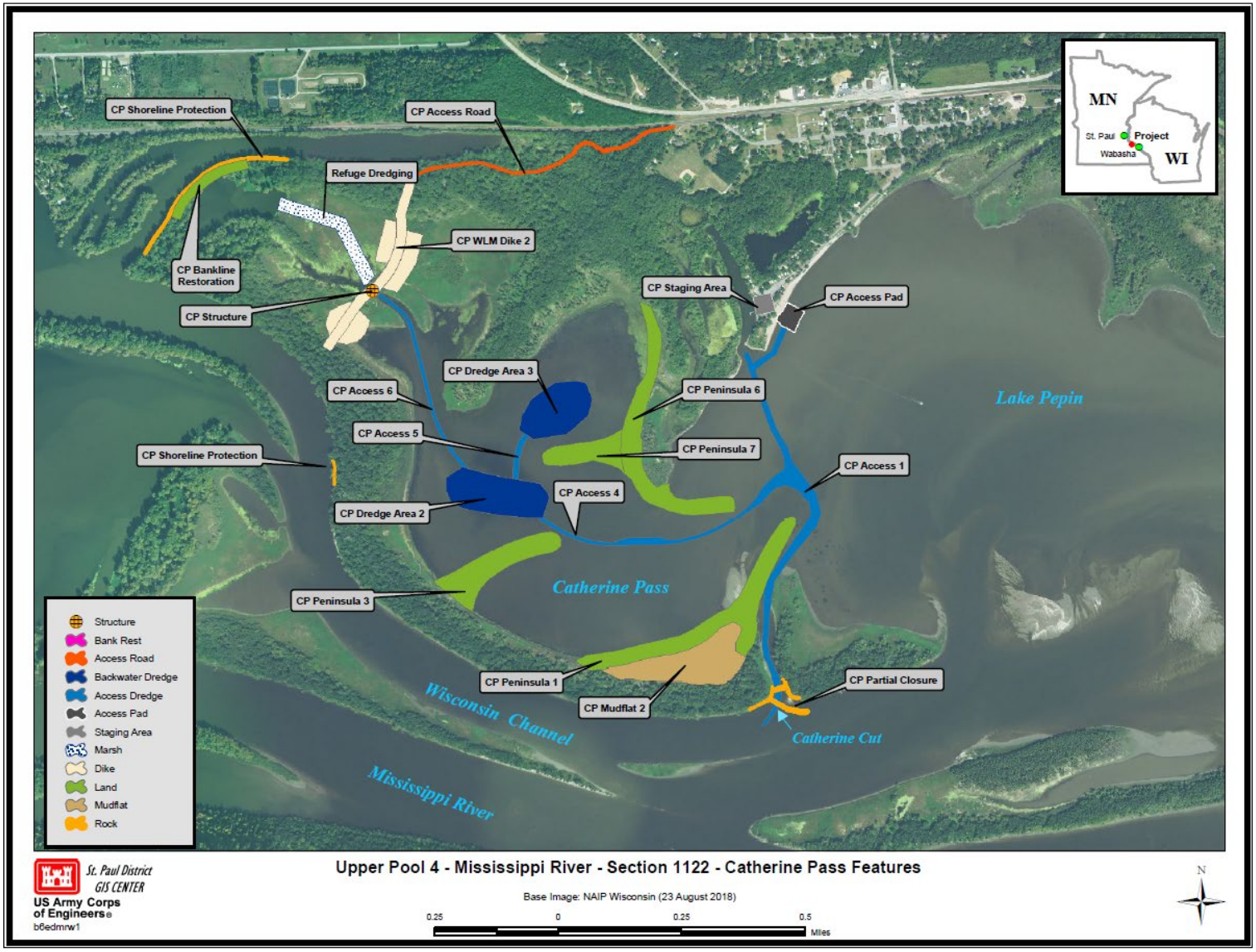


Figure 15: Tentatively Selected Plan Feature Labels

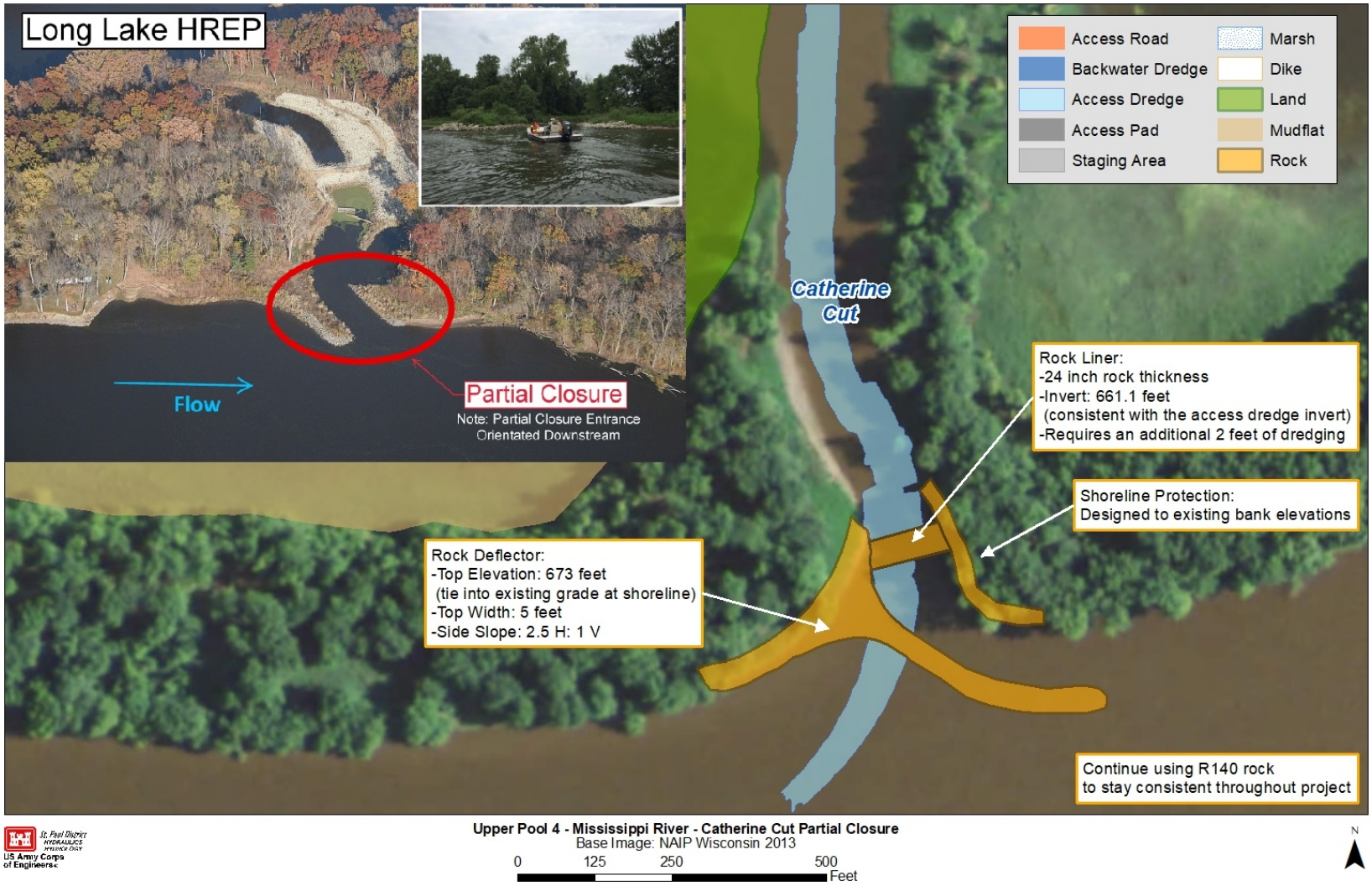


Figure 16: Upper Pool 4 Partial Closure Design Concept

4.2 Plan Quantities

The quantities associated with individual project features are listed in Table 9. Additional details on quantities can be found in Appendix C – Civil – Drawings.

Key assumptions in the development of quantities were:

- Settlement: 3.5 feet (2.5 feet initial displacement and 1 foot long-term settlement)
- Topsoil thickness: 24 inches
- CP Depths: 7.5 feet (Dredge Areas); 5.5 feet (Access Dredging); 6 feet (Refuge Dredge during 2 year event, 50% AEP)
- Shrinkage value: 0.5
- Peninsula side slops: 1V:3H
- Staging – Access Pad: 675.0 ft; not a permanent feature, the 4,000 cy granular and 1,300 cy riprap for this feature will be reused.

Table 9: Quantities Associated with Project Features

Feature Name	Total Wet Borrow Cut (cy)	Placed Dry Topsoil (Fines) (cy)	Sand Fill (Granular) (cy)	Rock (Riprap) (tons)	Invert/Top Elevations (ft-NAVD88)	Surface Area (acres)
CP Access Dredging (A22, A32, A3, A4, A5, A6, A_PAD)	124,000				661.10	22
CP Dredge Area 3	76,000				659.10	8.0
CP Dredge Area 2	72,000				659.10	7.0
CP Peninsula 1		37,400	114,800	3,400	671.00	13.4
CP Peninsula 3		19,200	84,200	-	671.00	7.6
CP Peninsula 6+7		44,500	143,500	4,200	671.00	15.8
CP Refuge Dredge	13,000				667.00	4.5
CP Shoreline Protection (north)				4,500	Existing	0.6
CP Shoreline Protection (west)				700	Existing	0.2
CP Partial Closure				5,950	Varies	0.9
CP Dike (100 ft wide, 1:3 side slopes)		38,000	30,500		672.00	12.5
CP Access Road (for long-term O&M)				(3,600 LF)		1.0
CP Bankline Protection/Restoration (north)		3,000	16,000		674.00	2.7
CP Mudflat 2		1,200			666.60	2.6
CP Dike 2 Structure (36" diameter)				100	668.00	
Total	**285,000**	**143,300**	**389,000**	**15,900**		**98.3**

4.3 Construction Implementation

The sand and topsoil needed to construct the islands would be sourced from material dredged for maintenance of the 9 foot navigation channel project on the Upper Mississippi River. Most likely, sand would be obtained by mechanically offloading Reads Landing in Lower Pool 4 and/or from the navigation channel (Trenton or Cannon River cuts, located between river miles 792 and 794). Preliminary analysis has indicated that Catherine Pass could be accessed by floating plant through Catherine Cut if access dredging is done.

How structures 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 any necessary State permits and/or water quality certifications.

Rock and fill material utilized for the rock-lined overflows can be trucked to the sites, likely through Bay City's Campground.

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.

4.3.1 Construction Restrictions

Construction restrictions could be applied for any number of reasons. Restrictions are generally applied in the construction of habitat projects to minimize the adverse effects of construction and to protect valuable habitats. The following are the basic construction restrictions that would likely be applied in the construction of the project features, shown on Figure 16.

Higgins Eye Mussels – An existing Higgins Eye mussel bed south of Catherine Cut should be avoided during construction access.

Bald Eagles – Bald Eagle nests are federally protected by the Bald and Golden Eagle Protection Act and guidelines would be provided to avoid impacting nesting eagles. There are 10-15 potential eagle nests in the study area (Figure 16).

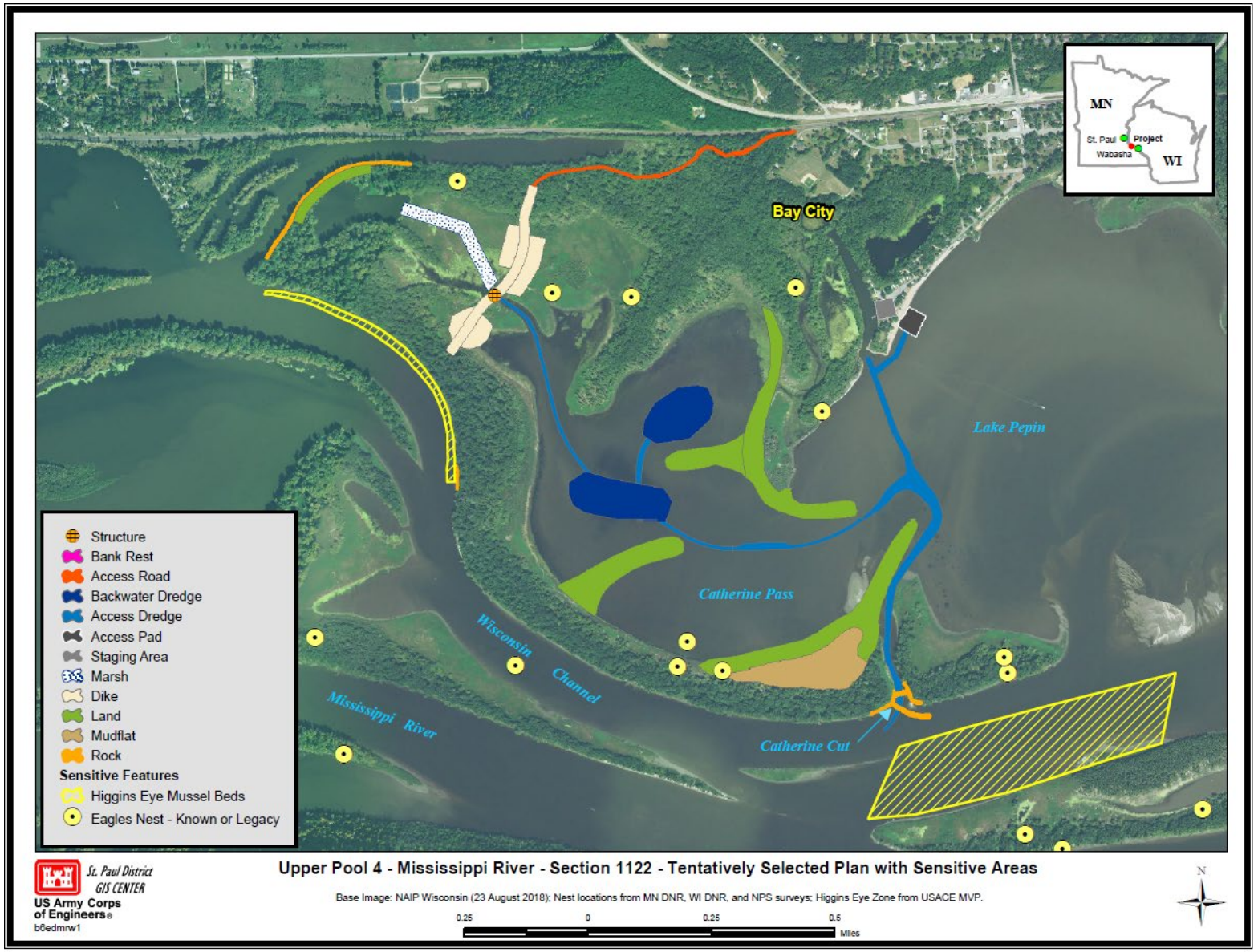


Figure 17: Eagle Nests and Higgins Eye Mussel Beds in the Study Area

4.3.2 Construction Schedule

The length of the schedule was determined to allow the contractor to commence construction in 2021. The project duration is assumed to be five years to complete construction.

4.3.3 Permits

The St. Paul District will ensure that the proposed activity is in compliance with all environmental laws and regulations, including the Endangered Species Act, Clean Water Act, NEPA, and Bald and Golden Eagle Protection Act. A Chapter 30 permit and 401 water quality certification would be obtained from the WDNR prior to project construction.

4.4 Operation, Maintenance, Repair, Rehabilitation, and Replacement

The purpose of assigning Operations, Maintenance, Repair, Rehabilitation, and Replacement (OMRR&R) costs is to ensure commitment and accountability by the non-Federal sponsor. The majority of project features are dynamic and intended to emulate natural backwater processes, therefore, operation and maintenance will be minimal. Dynamic features are those where river and lake forces will be allowed to shape the measures with no future maintenance anticipated. The water control structure within the dike, may require regular attention in order to manage water levels, as such the present value and estimated average annual OMRR&R costs for the WDNR are estimated to be $3,500 annually. The WDNR, if a Project Partnership Agreement is executed, would be responsible for 100 percent of the operation and maintenance of the project features.

Operation and maintenance would be similar to that undertaken by the WDNR for day-to-day management of wildlife areas and other public use areas. The maintenance actions anticipated would be wildlife management activities such as inspections, monitoring water levels, cleaning structures, maintaining riprap, and management of stoplogs.

4.5 Real Estate Considerations

The land surrounding Catherine Pass is owned by the State of Wisconsin and managed by the WDNR, the non-federal sponsor for this project. As of the date of this report, the Bay City's campground, which includes land-based staging and an in-water access pad, appear to be the project's most likely staging and access point from the water and if utilized, would be provided at no cost. However, the exact staging area and access point for construction will be determined during the development of plans and specifications. Coordination with the city is currently underway.

A temporary road easement, estimated to be ~.23 acres, will be necessary from Bay City for the reach of roadway from their property line near Saratoga Street, then Southwest bound, to the adjoining WDNR lands. The real estate costs for the easement are estimated at $7,500.

No additional real estate or relocations are anticipated and/or deemed necessary.

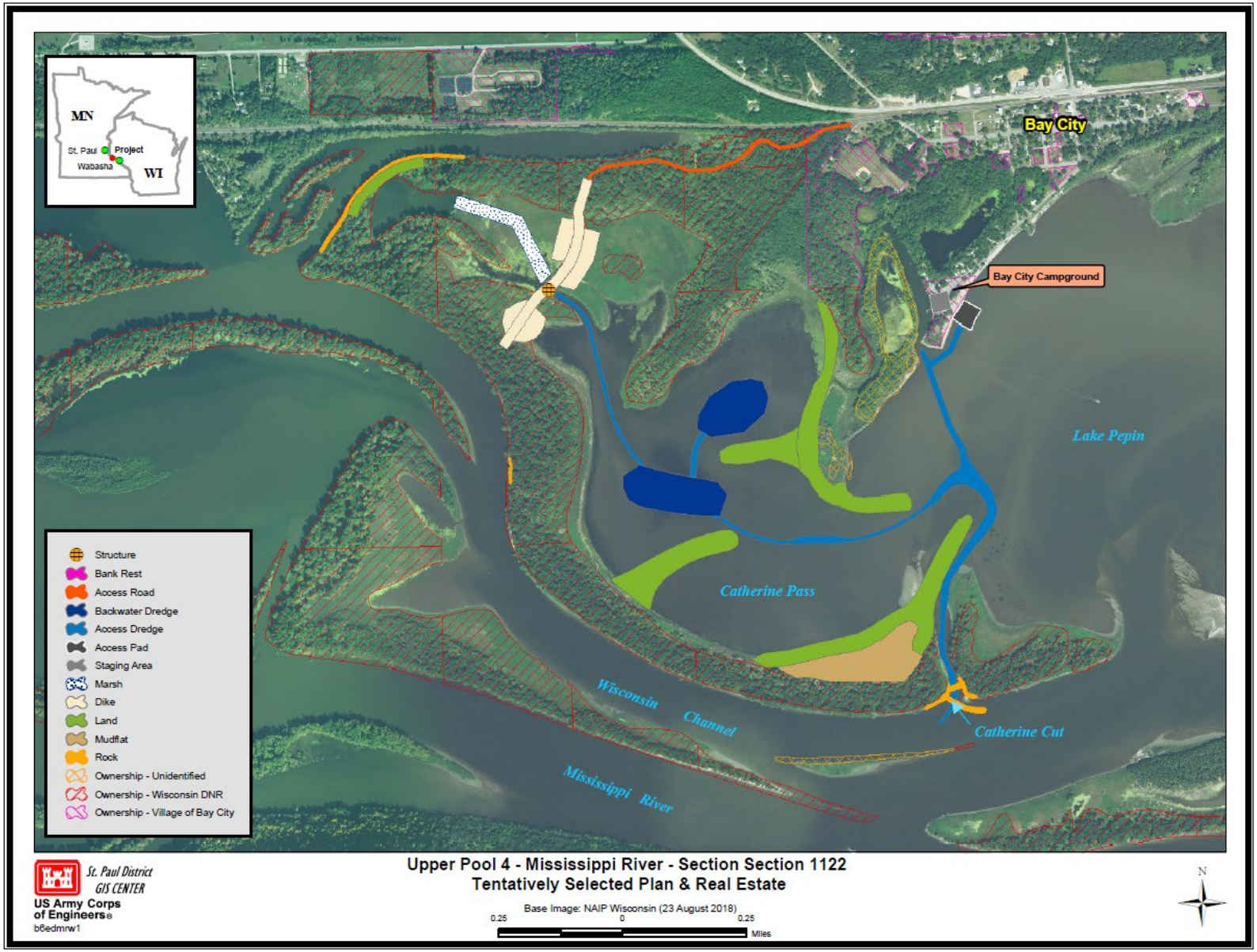


Figure 18. Real Estate around the Tentatively Selected Plan Features

4.6 Project Cost Summary

After a Tentatively Selected Plan was identified using preliminary costs, a more detailed cost estimate was completed for the plan. The detailed estimate of the project design and construction costs is provided in Appendix F – Cost Engineering; however due to the sensitivity of providing this detailed cost information which could bias construction contract bidding, this material will be omitted in the public document. Quantities and costs may vary during final design.

Table 10 shows the estimated cost by account. The costs are expressed as Project First Costs and include construction, contingencies, engineering, planning, design, and construction management. The Project First Costs are the project costs at the effective price level of October 2019.

Table 10. Project First Cost (in thousands of dollars)

Account	Item	Cost ($1,000)	Contingency (%)	Contingency ($1,000)	Project First Cost ($1,000)
1	Real Estate Acquisition	$7.5	25%	$2	$9
6	Construction	$16,336	28%	$4,579	$20,915
30	Planning, Engineering, and Design (PED)	$1,144	14%	$160	$1,304
30	Adaptive Management & Monitoring (3%)	$490	14%	$69	$559
31	Construction Management	$1,307	24%	$314	$1,621
	Total	**$19,284**		**$5,123**	**$24,407**

A cost summary is included in Table 11. Annual O&M costs for the water level management structures include monitoring water levels, cleaning structures, maintaining riprap, and management of stoplogs, and are estimated at $3,500 per year.

A more refined cost estimate will be done on the final Recommended Plan using the Micro-Computer Aided Cost Estimating System (MCACES), and Total Project Cost System (TPCS) to determine Present Value costs.

Table 11: Cost Summary Table

Item	Cost
Total Project First Cost	$24,407,000
Annual O&M	$3,500
Total Average Annual Cost	$795,000
AAHU Gain	278
Total AA Cost / AAHU	$2,780

The project cost-share was determined following discussions with the Section 1122 Program Managers (see Table 12). The cost-share would be split across three funding sources: O&M ($4.7M), Section 1122 ($14.4M), and the Sponsor ($5.2M).

Table 12: Project Cost-Share

Total Project First Cost	O&M Contribution (Federal Standard)	Incremental Cost above the Federal Standard	Sec 1122 Program			
			Granular Transport Cost & Placement (100% Fed)	Fed Contribution (65%)	Sponsor Contribution (35%)	Total 1122 Cost (Transport + Federal Contribution)
$24,407,000	$4,745,000	$19,662,000	$4,683,000	$9,736,000	$5,243,000	$14,419,000

Because the Section 1122 Pilot Study funding offsets the significant transportation and placement costs ($4.68M) related to the distant location of granular source material (NEP23 miles) it allows the Sponsor contribution to be dedicated to building habitat restoration features. As a result, this is a win-win-win project for the Corps; partners including the WDNR and the Lake Pepin Legacy Alliance; and the environment.

4.7 Project Performance (Monitoring and Adaptive Management)

The project performance assessment will 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 allows for the modification of drawdowns regimes, vegetation management features and/or documentation of the lessons learned when the functionality of the project is determined insufficient. 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.

The Corps is responsible for determining ecological success for the ecosystem restoration projects it constructs. Monitoring and adaptive management may extend for up to ten years following project completion and would be cost-shared 65% federal, 35% non-federal. The WDNR will be responsible for providing the waterbird and vegetation monitoring as described in Appendix J, as well as periodic visual inspections of project features. A project evaluation report will be the Corps' responsibility. Findings of the inspections are to be documented and shared with the partner agencies.

5 ASSESSMENT OF EXISTING RESOURCES AND ENVIRONMENTAL CONSEQUENCES OF THE TSP

This chapter identifies the existing conditions of the resources for the Upper Pool 4 study area and describes the environmental consequences of the alternatives considered compared to the no-action FWOP condition. The depth of analysis of the alternatives corresponds to the scope and magnitude of the potential environmental impact. This chapter provides the scientific and analytic basis for the comparison of alternatives and describes the probable consequences ("impacts" or "effects") of each alternative on the selected environmental resources. The

purpose of characterizing the environmental consequences is to determine whether the resources, ecosystems, and human communities of concern are approaching conditions where additional stresses will have an important direct, indirect, or cumulative effect.

The TSP (Alternative D) and No-Action Alternative are the primary actions evaluated and discussed in this section. The full array of Best Buy alternatives presented in Section 3.5.4 (No-Action Alternative and Alternatives A, C, D, and F) were also considered for environmental consequences. However, these action alternatives involve many of the same restoration measures, and the type and degree of the impacts, if any, to the human environment and would not be appreciably different from those associated with the TSP. Environmental consequences of the proposed action are discussed below and summarized in Table 17.

5.1 Physical Setting

5.1.1 Geology and Soil Substrate

The most significant geologic event explaining the nature of the Mississippi River within Pool 4 occurred as the Pleistocene glaciation, approximately 10,000 years ago, came to a conclusion. During this time, tremendous volumes of glacial meltwater, primary from the Red River Valley's glacial Lake Agassiz, eroded the pre-glacial Minnesota and Mississippi River valleys. Glacial Lake Duluth also provided a significant amount of meltwater, carving out the St. Croix River that joins the Mississippi River upstream of the project area. As meltwaters diminished, the deeply eroded river valleys aggraded substantially to about the present levels. Prior to construction of the Lock and Dams and impoundment, the broad flood plain of the river contained depressions, sloughs, natural levees, islands, and shallow lakes.

The bluffs of the Upper Mississippi valley along Pool 3 and Upper Pool 4 consist of exposed Lower Paleozoic sedimentary rocks, dominantly carbonates (limestone and dolomite) and sandstones, overlain by unconsolidated materials of Quaternary (Upper Cenozoic) age loess of the earlier glacial advances. Pool 3 and Upper Pool 4 are at the northwest boundary of the Driftless Area that was not covered by the Wisconsin age advances of ice sheet. Prairie Island on the Minnesota bank is a fluvial terrace that has been cut from the valley wall by the Vermillion River to form an island.

In the reach from Red Wing, MN south to Alma, WI, the rock formations exposed in the bluffs are the Upper Cambrian sandstones from Jordan (Upper Cambrian). Overlying the Jordan Sandstone, with an unconformable contact, is the Lower Ordovician Prairie due Chien Formation.

The principal parent materials of soils in the Pool 3 and Upper Pool 4 drainage basin are loess, and alluvium glacial drift. The loess lay either over bedrock or over clay loam till which is the major historic parent material of Pool 3 and Upper Pool 4 and associated uplands. The slopes associated with these soil types make them very susceptible to erosion in upland areas, where cover of plants is sparse or where inadequate soil conservation practices are used. The sediment load carried into Pool 3 and Upper Pool 4 by the Mississippi River accumulates in backwater areas and in the navigation channel. This project area is part of the prograding delta that continues to form at the head of Lake Pepin.

Lake Pepin has many characteristics of an inland lake, including a fairly regular shoreline with few backwater bays and shoreline substrates comprised of sand, gravel, and rock. Much of the rock substrate is artificial bank protection where the railroad tracks border the lake. Deeper portions of the lake have predominantly silt substrates. Sedimentation has covered the pre-

settlement lake bed in Lake Pepin except in the lower most area that retains significant areas of gravel substrates. Wind driven wave action in the lake maintains a beach zone of cobbled sized rock and coarse sand. Much of the beach zone is covered with shells of zebra mussels. (Environmental Pool Plans Mississippi River Pools 1-10, 2004).

Impacts of the No-Action Alternative – No changes to soils would be expected.

Impacts of the Tentatively Selected Plan – Construction of the TSP would result in some minor displacement of sediment and soils due to settlement where features are being constructed. A "mud wave" may form adjacent to the base of the peninsulas. These mudwaves would likely be reshaped through wave action and also result in increased diversity in bottom composition. Eventually, they would likely become vegetated with aquatic or wetland vegetation types.

5.1.2 Substrate and Contaminants

Sediment quality is generally good in 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, silt, and clay sediments are found within defined sloughs, while finer silt and clay materials are found in boat harbors and marshy backwater areas.

To ascertain the extent of sediment contamination in Pool 4, Corps staff collected surficial sediment samples from all of the main channel dredge cuts between 2013 and 2019 and collected borehole samples from Catherine Pass in 2017 and 2019. All samples were analyzed for PCBs, PAHs, pesticides and heavy metals and compared to Wisconsin Department of Natural Resource's Consensus Based Sediment Quality Guidelines (CBSQGs) and the Minnesota Pollution Control Agency's (MPCA) Soil Reference Values (SRVs) and Sediment Quality Targets (SQTs).

Results of the 2013-2019 main channel surveys (Appendix G) shows that the material in Pool 4 which will be used for constructing the TSP is fairly clean sand. The only main-channel sample that was a concern was collected at Trenton (river mile 794) in 2013. However, this location has not been dredged since 1975 and would not contribute any material for this project.

Results of the 2017 and 2019 Catherine Pass boreholes (Appendix G) showed that the sediments within the footprint of the TSP are mostly silt and clay with some exceedances of SQTs and CBSQGs.

Impacts of the No-Action Alternative – No major changes to sediment quality would be expected.

Impacts of the Tentatively Selected Plan – For placement of Pool 4 navigational channel dredged material within the flood plain, such as fill for the proposed land creation in Catherine Pass, the dredged sand does not pose a likely concern for benthic invertebrates and is therefore deemed to be clean fill for the needs of this project.

However, unlike the navigational channel sand, the existing material in Catherine Pass is finer grained and does have some SQT and CBSQG exceedances that may affect benthic invertebrates if the material is disturbed during project construction, or left exposed to the water column post–project. But since the exceedances of SQTs and CBSQGs in question are only minimally exceeded or from locations that will not be left exposed or disturbed, and because no new contaminated sediments are being brought into the project area, the TSP would likely have no measurable effects on contaminants there in the long term.

5.1.3 Hydrologic and Hydraulic Conditions

Lock and Dam 4 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 in an effort 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 for the existing operating plan are 666.09 (NAVD 88) at the lock, and 666.59 (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. The water surface elevation 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.

Inflows of sediment and nutrients to Lake Pepin depend on hydrologic conditions at Lock and Dam (LD) 3. Early summer (June) discharges at LD 3, approximately 10 miles upstream of Upper Lake Pepin, generally range from 10,000 to 35,000 cubic feet per second (cfs). By late summer, discharges usually decrease to 5,000 to 20,000 cfs. Winter low flows are generally in the range of 5,000 to 15,000 cfs.

Table 13 and Table 14 contains water surface elevation versus discharge information for 50% to 0.2% Annual Exceedance Probability (AEP) events at the primary control point (Wabasha, MN) and the nearest gage to the project (Lake City, MN).

Table 13: Annual Exceedance Probability Water Surface Elevations at Wabasha, MN according to the Upper Mississippi River System Flow Frequency Study (USACE, 2004) versus Discharge Data

Annual Exceedance Probability	Discharge at Wabasha, MN (cubic feet per second)	WSEL at Wabasha, MN (NGVD 29)	WSEL at Wabasha, MN (NAVD 88)
50.00%	78,000	670.3	670.42
20.00%	123,171	672.5	672.62
10.00%	155,814	673.9	674.02
4.00%	192,889	675.5	675.62
2.00%	217,333	676.6	676.72
1.00%	243,714	677.7	677.82
0.50%	NA	678.8	678.92
0.20%	NA	680.2	680.32

Table 14: Annual Exceedance Probability Water Surface Elevations at Lake City, MN according to the Upper Mississippi River System Flow Frequency Study (USACE, 2004) versus Discharge Data

Annual Exceedance Probability	Discharge at Lake City, MN (cubic feet per second)	WSEL at Lake City, MN (NGVD 29)	WSEL at Lake City, MN (NAVD 88)
50.0%	80,375	672.8	672.9
20.0%	142,600	676.5	676.6
10.0%	168,600	677.8	677.9
4.0%	198,444	679.1	679.2
2.0%	222,286	680.2	680.3
1.0%	259,916	681.3	681.4
0.5%	NA	682.5	682.6
0.2%	NA	684.2	684.3

Impacts of the No-Action Alternative – The no-action alternative would have no effect on hydraulic or hydrologic conditions, include flood stage levels, in the project area.

Impacts of the Tentatively Selected Plan – A one-dimensional hydraulic model was modified to analyze flood stage impacts of proposed project features (see Appendix H). The modeling software used was Hydrologic Engineering Centers River Analysis System (HEC-RAS). The analysis required the reduction in peninsula heights and extents/sizes, and adjustments to the dredge depths of the access cuts and overwintering dredged areas. The results of the flood stage impacts analysis show that the features of the TSP meet the Federal Emergency Management Agency's (FEMA) no-rise constraint as defined by the Wisconsin DNR. These results have been provided to the Wisconsin DNR, which is the regulatory agency.

5.1.4 Water Quality

The location of Lake Pepin divides the rest of the pool into Upper Pool 4 and Lower Pool 4. The smaller backwaters of Upper Pool 4 have been degraded by sedimentation and high turbidity, resulting in limited aquatic vegetation. In contrast, the backwaters of Lower Pool 4 have less turbidity and better conditions for supporting aquatic vegetation, which is often abundant. Transparencies in the main channel above Lake Pepin during summer average 19 inches, while below Lake Pepin transparency averages 38 inches (LTRMP, Pool 4 Water Quality - Transparencies, 2014).

The high sediment and nutrient loads from the Minnesota River greatly influence light penetration, primary production, and the growth of aquatic vegetation in Upper Pool 4. The general water chemistry of Upper Pool 4 is considered adequate to maintain most aquatic life. 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 dissolved oxygen, particularly in isolated sloughs and backwater lakes. Otherwise, the dissolved oxygen content of the water remains high year round and above levels required to sustain a quality fishery. Because it is well mixed and has a large flow, the river is well aerated and it can assimilate a considerable biochemical oxygen demand (BOD) loading.

The WDNR includes Lake Pepin as a 303(d)-listed impaired water for total phosphorus. As of 2019 for the 2020 listing cycle, total phosphorus sample data clearly exceeded 2020 WisCALM listing thresholds for Recreation use and Aquatic Life use (WDNR, 2019).

The Minnesota Pollution Control Agency has included the Mississippi River in the project reach on the draft 2020 303(d) list of impaired waters for total suspended solids (TSS), mercury and PCBs in fish tissue, mercury in the water column, and aluminum (MPCA, 2020).

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 addressing mercury, nutrients and TSS, no major changes to water quality are expected under the no-action alternative.

Impacts of the Tentatively Selected Plan – The Tentatively Selected Plan would have temporary, short-term adverse impacts to water quality by increasing turbidity in Catherine Pass where construction and excavation occur. There could also be the potential for oil spills from construction equipment; however, Best Management Practices (BMPs) would be used to minimize impacts to water quality during construction. Overall, the TSP would have a long-term, substantial beneficial effect on water quality by increasing the overall percent coverage of aquatic vegetation. Aquatic vegetation can slow the velocity of flood waters entering the project area, allowing suspended materials to settle to the sediment surface. Excess nutrient or toxic chemicals entering the system, can be taken up by aquatic vegetation, trapped with settled soil particles or converted to less harmful chemical forms by biological processes.

5.1.5 Air Quality and Greenhouse Gases

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.” Pierce 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 2018). This designation means that the project area has relatively few air pollution sources of concern.

Carbon dioxide (CO2) is the primary greenhouse gas emitted from human activities, chiefly through combustion of fossil fuels. Greenhouse gases absorb reflected energy from the sun and warm Earth’s atmosphere. Increases in greenhouse gases have resulted in measurable warming of the Earth’s surfaces and ultimately changes to some ecosystems. Wetlands are able to reduce the amount of CO2 in the atmosphere by sequestering the gas during photosynthesis and returning oxygen to the atmosphere as a byproduct.

Impacts of the No-Action Alternative – The No-Action Alternative would have no impacts to air quality or greenhouse gasses.

Impacts of the Tentatively Selected Plan – Minor, temporary increases in airborne particulates are anticipated as a result of mobilization and use of construction equipment. Frequent inspections of construction equipment will be made during construction to ensure they are properly functioning and do not release unnecessary amounts of emissions.

Construction of the TSP would result in a temporary minor release in CO2 as a result of operating construction equipment. However, the improvement of vegetation growth in the

project area could have a minor beneficial effect to greenhouse gasses by sequestering carbon in plant tissue.

5.2 Natural Resources

5.2.1 Aquatic Habitat

According to Dan Dieterman, Fisheries Biologist, Minnesota Department of Natural Resources, "aquatic habitat conditions in Upper Pool 4 can be generally characterized as somewhat impaired. Relatively high suspended solids concentrations, originating mainly from fine sediment inputs via the Minnesota River, Cannon and Vermillion Rivers and re-suspension of those sediments by wave action from wind, large recreational boat wakes and fish activity, continue to limit light penetration and rooting capability of submersed vegetation. These conditions have had the greatest influence on aquatic habitat in the upper portion of Lake Pepin, Wacouta Bay, and the Bay City Flats. Contiguous backwater lakes and sloughs located between Red Wing and the head of Lake Pepin also exhibit conditions impaired by fine sediment deposition and re-suspension, although not quite to the extent as areas subjected to large waves from boat wakes and wind. Consequently, these areas have a better emergent vegetation component and greater diversity and frequency of occurrence of submersed vegetation.

Sediment deposition and deltaic activity throughout Upper Lake Pepin are rapidly converting shallow windswept aquatic habitat to sandbars and mudflats. These terrestrial habitats exhibit rapid vegetation development transitioning from colonizing species of annual moist soil species to perennial forbs and grasses to willows, cottonwoods and silver maples. The shallow (<3 feet) water, and changed substrate composition in these deltas has resulted in much improved distribution, density, and diversity of submersed aquatic vegetation in recent years compared to what existed during the past 30-40 years. Emergent vegetation loss appears to have diminished as newly formed islands also serve as a physical barrier to wind and wave action, adding some protection to existing and newly formed beds of submersed vegetation." (Dieterman, 2014)

Impacts of the No-Action Alternative – Aquatic habitat is expected to continue to decline under the no-action alternative. Further sedimentation would result in the general loss of depth and conversion to terrestrial habitat throughout the project area, but especially in deltaic areas such as the one at the end of Catherine Cut. Continued wind and wave action would maintain high sediment resuspension rates and turbidity, preventing aquatic plant growth, and suppressing the quality of the aquatic habitat that remains.

Impacts of the Tentatively Selected Plan – During construction of the TSP 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 50 acres of peninsulas and mudflat. As discussed in Section 3.6.4, there would be a negligible impact to aquatic habitat in Lake Pepin as a result of redirecting sediment loading from some of the project area downstream to Lake Pepin.

One area currently providing quality aquatic habitat is the Catherine Cut. That side channel contains large woody debris, water depths, and flows that provide habitat for riverine fish species. Under the TSP, an access channel would be dredged through the cut to allow efficient barge access for construction equipment and materials to the project area. This dredging and disturbance would change the habitat conditions in the cut. When the project is complete though, the flows through the cut should approximate the existing conditions, and deeper areas may still provide quality habitat for riverine species. Large woody debris would also likely

continue to be trapped in the deeper areas to provide similar habitat to what is there now. So while project construction would have adverse effect on this side channel in the short-term, the long term effects are unknown and may or may not be adverse.

In total and in the long term, the project features are designed to benefit aquatic habitat; therefore, there would be substantial long-term beneficial effects to the remaining 595 acres of aquatic habitat evaluated (see Appendix D – Habitat Evaluation and Quantification).

5.2.2 Terrestrial Habitat

Terrestrial habitats within the floodplain of Pool 4 include areas of forest, brush and shrub areas, wet and upland meadows, and areas disturbed by commercial or residential development and agricultural land. The floodplain around Pool 4 is low and seasonally flooded. The dominant trees are mature native trees, including silver maple (Acer saccharinum), green ash (Fraxinum pennsylvanica), black willow (Salix niger), and box elder (Acer negundo), with some mature cottonwood (Populus deltoides) along the riverbanks. Some hardwood trees including red oak, black walnut, and American elm also occur within the floodplain.

Terrestrial habitat in the study area is relatively flat and typically has only one to two feet of relief above the low control pool elevation (666.6 feet). These areas are flooded frequently and support low diversity floodplain forests with flood tolerant species.

Ground cover over much of the area is mostly reed canary grass (*Phalaris arundinacea*) jewelweed (*Impatiens capensis*), wood nettle (*Laportea Canadensis*), poison ivy (*Rhus radicans*) and wild grape (*Vitis* sp.). Areas with open tree canopy have dense stands of reed canary grass. The floodplain forest is low to tall broadleaf deciduous forest, open to dense, with woody vines often present.

Impacts of the No-Action Alternative – Under the no-action alternative, it is expected that there would be some minor increase in terrestrial habitat as a result of continued sedimentation. This could be considered a minor beneficial effect, but the quality of this new terrestrial habitat is uncertain and it is possible that new terrestrial areas could become vegetated with reed canary grass. In total, it is assumed this effect is neither positive nor negative.

Impacts of the Tentatively Selected Plan – Overall, the TSP would have substantial beneficial effects on terrestrial habitat, with the construction and establishment of about 40 acres of floodplain forest. However, there would be some adverse impacts to this habitat type as a result of constructing the project. The dike access road would be about 3,600 feet long, and 12 feet wide, and constructed over an existing unimproved logging road. It is anticipated that minimal or no grading would be required, with a gravel base for a driving surface. Some tree removal is expected to be required, possibly as much as a half-acre of trees. Also the construction of the dike would result in some adverse effects to terrestrial habitat, with the removal of about 2.5 acres of trees. These adverse effects would be minimal relative to the overwhelming beneficial effects.

5.2.3 Wetlands

The Corps' definition of wetlands are, "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 does not support aquatic vegetation. Wetland vegetation is present on and around the edge of existing islands and is most abundant in the northwest section of the Catherine Pass area. Submersed, rooted-floating, emergent wet meadow and floodplain forest plant communities are all present.

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 may result in the expansion of wetlands in some areas as they become shallow enough to support vegetation, but a loss in wetlands as areas become more terrestrial and drier could also occur, likely offsetting any gains.

Impacts of the Tentatively Selected Plan – Under the TSP, an estimated 24.4 acres of wetlands would be filled or excavated. Table 16 listed estimated impacts to wetlands per feature. These estimates were based on a reviewed of land cover types and aerial photography and are conservative in that the actual acreage affected would likely be less than shown. Of the 24.4 acres filled or excavated, 13.3 acres would be permanently lost. The remaining acreage would be converted from wetter types, to floodplain forest. As a result of constructing new floodplain forest and mudflat/emergent marsh wetland types, there would be gain of 30.7 acres of new wetland in the project area. This is a net gain of 17.4 acres of wetland as a direct result of project construction.

In addition to the direct gain in wetland habitat, the project features are designed to improve aquatic and emergent vegetation in the project area. This effect is expected to be more substantial than the direct gain of 17.4 acres estimated above, but quantifying the total acreage affected is more difficult to do. The most marked change in vegetation quantity and quality, other than the mudflat, is expected in the protected areas associated with the peninsulas. The reduced inflow of turbid water, reduced wave action and reduced sediment resuspension are expected to result in aquatic vegetation growth, which would increase wetland acreage. It is estimated that as much as about 40 acres would see an improvement in aquatic vegetation.

During construction there would be minor adverse effects to wetlands due to the excavation and fill activities quantified above. There may also be some temporary adverse effects related to general sediment resuspension and settlement from general construction activities. However, the project would have substantial beneficial effects to wetlands through wetland creation and vegetation improvement resulting from the project.

Table 15: Estimated acres of wetland impacts per feature of the TSP.

Feature	Total Feature Surface Area	Estimated Surface Area of Wetland Fill*	Estimated Surface Area of Wetland Excavation	Total Wetland Area Lost	Wetland Acres gained
CP Access Dredging	22	0	1.4	1.4	0
CP Dredge Area 3	8	0	0	0	0
CP Dredge Area 2	7	0	0	0	0
CP Peninsula 1	13.4	3*	0	0	10.4
CP Peninsula 3	7.6	0.7*	0	0	6.9
CP Peninsula 6+7	15.8	5*	0	0	10.8
CP Refuge Dredging	4.4	0	4.4	2**	0
CP Shoreline Protection (north)	0.6	0.6	0	0.6	0
CP Shoreline Protection (west)	0.1	0.1	0	0.1	0
CP Shoreline Protection (CP cut)	0.02	0.02	0	.02	0
CP Access Road	1.0	1.0	0	1.0	0
CP Bankline Restoration	2.7	2.7	0	2.7	0
CP Mudflat 2	2.6	0	0	0	2.6
CP Dike 2 Structure	5.5	5.5	0	5.5	0
Staging Pad	0.6	0	0	0	0
Total	**91.3**	**18.6**	**5.8**	**13.3**	**30.7**

*Not all wetland fill is wetland loss. Fill for peninsulas will become floodplain forest wetland, and fill for mudflats will become emergent wetland.

**About 2 acres of the refuge dredging will be too deep to support aquatic plants and, therefore, will not be wetland.

5.2.4 Biological Productivity and Habitat Diversity

Impacts of the No-Action Alternative – Measurable changes to biological productivity or habitat diversity are not expected under the no-action alternative. The effects of sedimentation and erosion are expected to slowly change habitat types over time, but the diversity of types and productivity of those habitats would not likely change markedly.

Impacts of the Tentatively Selected Plan – Under the TSP, during construction there may a minor suppression in biological productively due to disturbance in the project area. In the long-term there would be substantial beneficial effects to both biological productivity and habitat diversity. Habitat diversity would increase through peninsula construction, dredging, and the

expected vegetation response. This improvement in habitat would result in an increase in biological productivity.

5.2.5 Fish

The fishery of Pool 4 is considered quite productive. Game fish found in the pools include northern pike, walleye, sauger, yellow perch, white bass and a variety of centrarchids. Species including carp, buffalo, catfish, and drum dominate the commercial catch. Pool 4, especially Lake Pepin, is one of the most productive pools in terms of pound of fish caught commercially. Pool 4 supports a very productive and highly-utilized walleye sport fishery.

Lake Pepin is annually sampled by the Minnesota DNR as part of the DNR's Large Lake Program. The Large Lake Monitoring Program was initiated in 1983 to provide long-term monitoring information of fish populations in Minnesota's nine largest lakes and Minnesota's portion of Lake Superior. Lake Pepin was added to the monitoring program in 1986. Sampling includes shoreline seining, bottom trawling, gill netting, and electrofishing. Since 1991, 89 species have been identified by the Lake City Long Term Resources Monitoring Element in Lake Pepin. (LTRM, Large Lake Monitoring Program: Lake Pepin, 2014)

The following is a summary of the LTRM's fish collection efforts conducted by the Lake City Field Station for Pool 4 of the Upper Mississippi River in 2013:

- 246 fish collections were conducted using six gear types.
- Side channel borders, backwaters, and main channel borders received the most sampling effort.
- 20,377 fish representing 62 species and 2 hybrids were collected. Historical fish distribution for the Upper Mississippi River (Pitlo, Vooren, & Rasmussen, 1995) documents 99 fish species from Pool 4. To date the Lake City Field Station has collected a total of 88 species and 5 hybrids.
- The three fish species with the highest total catch were 5,152 emerald shiners, 3,386 bluegill, and 3,841 mimic shiners.
- Twenty-nine shovelnose sturgeons, four lake sturgeon, six black buffalo, and one blue sucker, all Minnesota species of special concern, were collected.

The fish community is monitored on Pool 4 through indices such as relative abundance and species richness, along with the size structure of all species, during three time periods in summer and fall at stratified random sites (LTRMP, Long Term Resource Monitoring Element: Aquatic Vegetation Yearly Summary, 2014). The Pool 4 fish community as a whole is comprised of species not sensitive to silt (80% not particularly sensitive to silt – LTRMP Fish Life History Database (in review) – 67% intermediate, 12% tolerant and 21% intolerant) (Weiss, 2014). Invasive Species found in Lake Pepin include bighead carp (one found in 2003 – 23 pounds near southern end of the lake) and grass carp (one found in 2007 – 39.4 inches, 28.7 pounds upstream of Wells Creek) (Weiss, 2014).

Direct effects of turbidity and sedimentation on fishes include: loss of benthic interstitial spaces for incubation, decreased water clarity for visual feeding species, habitat homogenization, physiological damage (e.g. gills, energy conversion, and stress), increased mortality, and altered distribution. Indirect effects include: reduced recruitment rates, loss of structure (e.g. aquatic macrophytes), altered predator/prey ratios, reduced diversity, and skewed community structure – toward tolerant species (Ickles, 2003).

Centrarchid overwintering habitat for backwater fish (bluegill, largemouth bass, crappie, etc.) has declined in Upper Pool 4 due to sedimentation and island dissection. Historically, centrarchid overwintering habitat was present in numerous locations including Dead Slough Lake, Mud Lake, Goose Lake, Wacouta Bay, and Bay City Area. Presently, Goose Lake provides the most consistent overwintering habitat with some overwintering habitat located near the Bay City boat harbor. A fish kill was reported in late winter 2019 in the upper end of the Bay City boat harbor. Bluegills were the primary species affected.

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 centrarchids, mostly as a result of continued sedimentation and loss of depth. This loss of habitat is quantified in the HEP analysis found in Appendix D – Habitat Evaluation and Quantification.

Impacts of the Tentatively Selected 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 physiological impacts and reduce feeding efficiency. Fish would likely move away from areas of the most disturbance, and then return when construction is complete.

One area currently providing quality fish habitat is the Catherine Cut. That side channel contains large woody debris, water depths, and flows that provide habitat for riverine fish species. Under the TSP, an access channel would be dredged through the cut to allow efficient barge access for construction equipment and materials to the project area. This dredging and disturbance would change the habitat conditions in the cut. The disturbance from barge traffic would be a temporary adverse effect, but the dredging would result in long-term changes that may have lasting adverse effects to the habitat there. When the project is complete though, the flows through the cut should approximate the existing conditions, and deeper areas may still provide quality habitat for riverine species. Large woody debris would also likely continue to be trapped in the deeper areas to provide similar habitat to what is there now. So while project construction would have adverse effect on this side channel in the short-term, the long term effects are unknown and may or may not be adverse.

In total, and in the long term, the TSP would have substantial beneficial effects to fish in the project area. Backwater fishes, such as centrarchids, would benefit the most through habitat improvements as discussed throughout this report and quantified in Appendix D – Habitat Evaluation and Quantification.

5.2.6 Wildlife

A variety of mammals inhabit the floodplain forests and wetlands that remain adjacent to Pool 4. These wooded and wetland areas support species including: rodents such as muskrat, beaver, mice, and common rats; moles and shrews, rabbits, red fox, skunks, and raccoons.

The floodplain forest and shallow aquatic areas in the project area provide critical 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 central Canada to the region surrounding the Gulf of Mexico. 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.

The northwest portion of the Catherine Pass area is especially suited as waterfowl habitat, and project features in the TSP have been designed to improve it.

Impacts of the No-Action Alternative – Under the no-action alternative, it is expected that conditions for wildlife would not change appreciably. While it is expected that there would be some minor increase in terrestrial habitat as a result of continued sedimentation, the quality of this new habitat is uncertain and it is possible that new terrestrial areas could become vegetated with reed canary grass.

Impacts of the Tentatively Selected Plan – The floodplain forest construction, wetland creation, and vegetation 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. Construction activities may lead to short-term direct and indirect adverse effects to wildlife. Wildlife would most likely avoid or be displaced from the areas under 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 resources. Benefits to waterfowl were also quantified in the HEP analysis found in Appendix D – Habitat Evaluation and Quantification.

5.2.7 Aquatic Invertebrates

Conditions for invertebrate fauna generally improve as one goes downstream from the urban, metropolitan areas of the river. The diverse invertebrate assemblage within Pool 4 can be attributed to a wide variety of habitats available. Lake forms of invertebrates find suitable habitat in the lentic portions of the pool, especially Lake Pepin. Organisms that require running water find a wide range of water velocities in the tailwater, main channel, along the wing dams, and in side channels. The rocks associated with wing dams and shoreline protection, as well as woody debris accumulated in backwater areas, provide a suitable habitat for many taxa. Other aquatic invertebrates can be found attached to emergent and submerged aquatic vegetation in backwater areas.

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. In upper Pool 4 and near the project location there also exists a diverse mussel assemblage with as many as 25 live species reported from long term monitoring of two mussel beds, Goose Lake and 4th Cut, within the Wisconsin Channel adjacent to the project site (see Table 16 and Figure 18). Included in the assemblages is the federally-listed endangered Higgins eye (*Lampsilis higginsii*) and several additional species listed for protection in either Minnesota or Wisconsin (see Table 17). Higgins eye were extirpated from the pool in the last century but given the recent resurgence in native mussel natural re-colonization in the past few decades in the upper pools of the UMR and within the Wisconsin Channel in particular, the species was artificially propagated and reintroduced into the Goose Lake and 4th Cut mussel beds beginning in 2003 (Cyphers, 2018). The individuals have survived and there is recent evidence of reproduction and recruitment of new individuals of the species into the pool and adjacent pools.

Zebra mussels (*Dreissena polymorpha*) are present within upper Pool 4 but numbers have steadily remained low as is the case in other UMR pools above Lake Pepin. The species first appeared in the UMR in 1991 and Lake Pepin appears to contain the main upstream source population in the UMR which continually supplies lower pools with its free floating larval form. UMR pools upstream of Lake Pepin including upper Pool 4 contain sparse occurrences of adult zebra mussels given the only mode of distribution is by barge and recreational boat traffic and limited downstream dispersal of larval zebra mussels from Lake St. Croix into the UMR. This

coupled with regular annual late summer die-offs results in overall low numbers of zebra mussels.

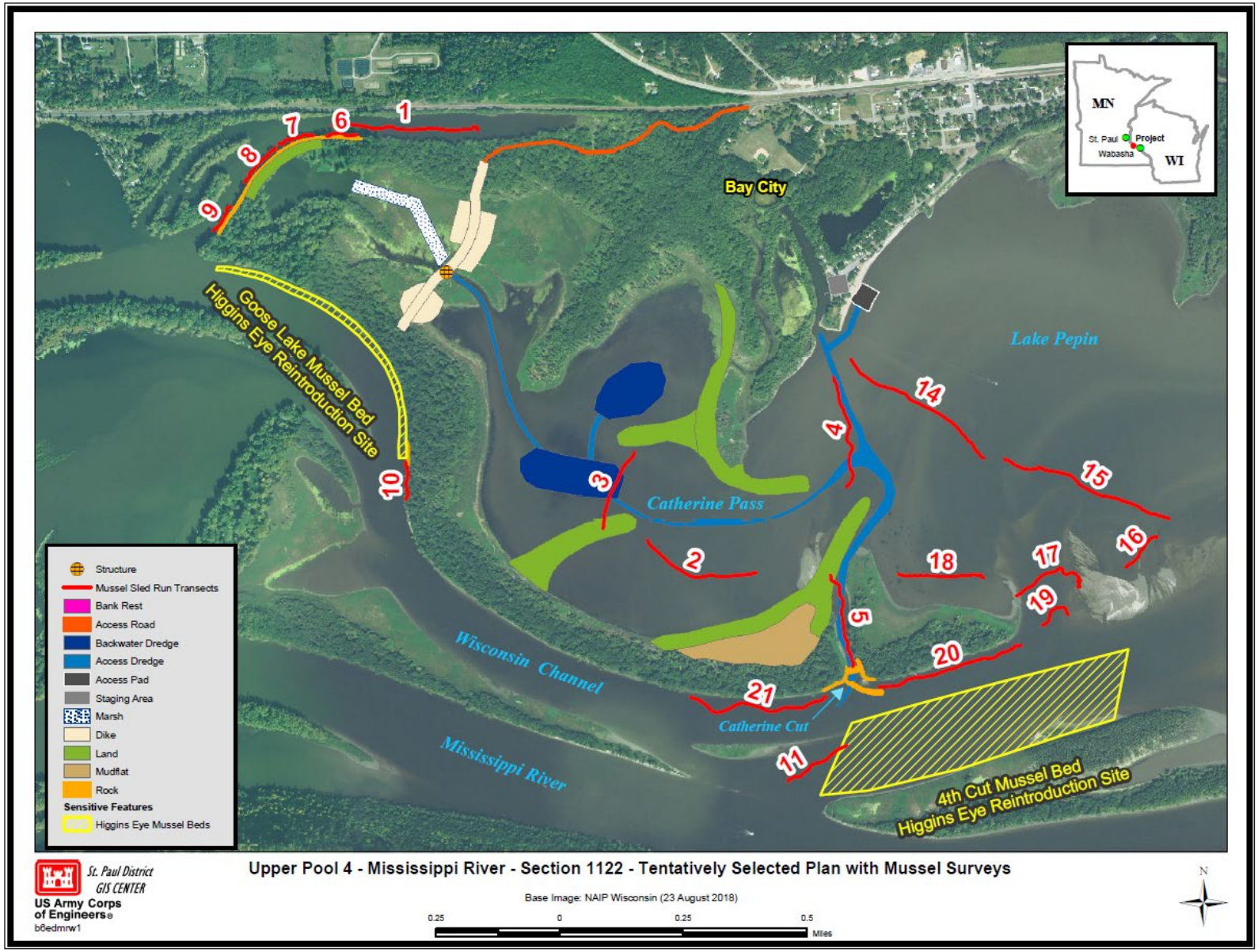


Figure 19. Mussel survey transects in the project area.

Table 16: Native mussel species within UMR Pool 4 and Wisconsin Channel (Goose Lake and 4th Cut) mussel beds.

Scientific name	Common name	Status*	UMR Pool 4** Live/Historic	Goose Lake*** 2010, 2011, 2014, 2017	4th Cut*** 2011, 2014, 2017
Subfamily Cumberlandinae					
Cumberlandia monodonta	spectaclecase	FE/ME/WE	H		
Subfamily Ambleminae					
Amblema plicata	threeridge		L	L	L
Cyclonaias tuberculata	purple wartyback	ME/WE	L	D	
Elliptio crassidens	elephant ear	ME/WE	H		
Elliptio dilatata	spike	MT	L	D	
Fusconaia ebena	ebonyshell	ME/WE	H		
Fusconaia flava	Wabash pigtoe		L	L	L
Megalonaias nervosa	washboard		L	L	L
Plethobasus cyphyus	sheepnose	FE/ME/WE	L		
Pleurobema sintoxia	round pigtoe		L	L	L
Quadrula fragosa	winged mapleleaf	FE/ME/WE	H		
Quadrula metanevra	monkeyface	MT/WT	L	L	L
Quadrula nodulata	wartyback	ME/WT	L		L
Quadrula pustulosa	pimpleback		L	L	L
Quadrula quadrula	mapleleaf		L	L	L
Tritogonia verrucosa	pistolgrip	ME/WT	L	D	
Subfamily Anodontinae					
Alasmidonta marginata	elktoe	MT	L		
Anodonta suborbiculata	flat floater		L		
Anodontoides ferussacianus	cylindrical papershell		H		
Arcidens confragosus	rock pocketbook	ME/WT	L	L	L
Lasmigona complanata	white heelsplitter		L	L	L
Lasmigona costata	fluted shell	MT	H		
Pyganodon grandis	giant floater		L	L	L
Strophitus undulatus	strange floater		L	D	L
Utterbackia imbecillis	paper pondshell		L	L	L
Subfamily Lampsilinae					
Actinonaias ligamentina	mucket	MT	L	D	
Ellipsaria lineolata	butterfly	ME/WT	L		L
Epioblasma triquetra	snuffbox	FE/ME/WE	H		
Lampsilis cardium	plain pocketbook		L	L	L
Lampsilis higginsii	**Higgins eye**	**FE/ME/WE**	**L**	**L**	**L**
Lampsilis siliquoidea	fatmucket		L	L	L
Lampsilis teres	yellow sandshell	ME/WE	L		D
Leptodea fragilis	fragile papershell		L	L	L
Ligumia recta	black sandshell		L	L	D
Obliquaria reflexa	threehorn wartyback		L	L	L
Obovaria olivaria	hickorynut		L	D	L
Potamilus alatus	pink heelsplitter		L	D	L
Potamilus capax	fat pocketbook	FE	H		
Potamilus ohiensis	pink papershell		L		L
Toxolasma parvus	lilliput		L	D	D
Truncilla donaciformis	fawnsfoot	MT/WT	L	L	L
Truncilla truncata	deertoe		L	L	L
Venustaconcha ellipsiformis	ellipse	MT/WT	H		
Live species			34	19	24
Historic/Dead			9	8	3
Total species			43	27	27

*FE = federally endangered; ME = Minnesota endangered; MT = Minnesota threatened; WE = Wisconsin endangered; WT = Wisconsin threatened

L = live; H = historic, D=dead (empty shell)

**Kelner, D. (2018). Upper Mississippi River mussel species list. U.S. Army Corps of Engineers, St. Paul District.

***Cyphers, T. (2018). Long Term Monitoring, UMR Pool 4, Wisconsin Channel 4th Cut and Goose Lake Higgins eye Reintroduction Sites, Minnesota and Wisconsin.

Table 20: Mussel Skimmer Dredge Transect Survey Results.

	2017					2018						2019								Total	
Transect	1	2	3	4	5	6	7	8	9	10	11	14	15	16	17	18	19	20	21	No	%
Species																					
Ambleminae																					
Amblema plicata				1							2		3	9	2	3	1	2	D	23	30.3
Fusconaia flava											6						1	1		8	10.5
Quadrula pustulosa											5			1	1					7	9.2
Quadrula quadrula																		1		1	1.3
Anodontinae																					
Pyganodon grandis		1						1			D	1								3	3.9
Utterbackia imbecillis		1																		1	1.3
Lampsilinae																					
Lampsilis cardium											D				D		D			D	
Leptodea fragilis				2							1									3	3.9
Obliquaria reflexa		1		2							6	2	2	4	1			10		28	36.8
Potamilus ohiensis																		1	D	1	1.3
Potamilus alatus													1							1	1.3
Total Live	0	3	0	5	0	0	0	1	0	0	20	3	6	14	4	3	2	15	0	76	
Live species	0	3	0	3	0	0	0	1	0	0	5	2	3	3	3	1	2	4	0	10	
Total species	0	3	0	3	0	0	0	1	0	0	7	2	3	3	4	1	3	4	2	11	
Transect length (m)	500	404	279	390	328	107	130	163	101	133	235	558	593	155	311	285	134	494	482		
Density (no./m^2)*	0	0.02	0	0.04	0	0	0	0.02	0	0	0.27	0.02	0.03	0.29	0.04	0.03	0.05	0.1	0		

*Skimmer dredge efficiency is 62%, corrected by multiplying actual density by 1.61

Impacts of the No-Action Alternative – Conditions under the no-action alternative would not result in marked changes to aquatic invertebrates in the future.

Impacts of the Tentatively Selected Plan – Generally, aquatic invertebrates are expected to be adversely affected during project construction, but the habitat improvements would benefit them in the long term due to increase vegetation.

Mussel surveys were conducted during 2017, 2018, and 2019 to assess impacts of project feature construction on mussels (Figure 16 and Table 18). Skimmer dredge transect surveys were collected in project footprint areas including access dredging areas and adjacent to features to determine presence of mussels. Overall, 19 transects were conducted with 76 live mussels collected representing 10 species. Mussel species richness and density were very low among all transects and no live federal- or state-listed species were collected. Average density along transects ranged from 0.00/m2 to 0.27/m2. The most common species overall were threehorn wartyback (36.8%) (*Obliquaria reflexa*), threeridge (30.3%) (*Amblema plicata*), Wabash pigtoe (10.5%) (*Fusconaia flava*), and pimpleback (9.2%) (*Quadrula pustulosa*), species all common in the UMR.

Complete coverage of project footprint impacts in the project area was not achieved in part given the shallow water and abundant submerged vegetation conditions preventing effective sampling. But mussels were nearly absent from transects collected within the backwater and it is unlikely mussels occur throughout given similarly poor mussel habitat conditions consisting of

lentic shallow water with submerged vegetation and flocculent substrate. Access dredging from Bay City, WI through Catherine Cut to the Wisconsin Channel should have minimal impacts on mussels as no mussels were collected along Transect 5 within Catherine Cut and only five live mussels of three common species were collected along Transect 4 resulting in an average density of 0.04/m2. Mussels were also nearly absent along transects 1, 6, 7, 8, and 9 at proposed bank rock protection feature in the inlet within only one live mussel collected among the transects.

An area of more concern for mussel impacts are within the Wisconsin Channel where there is adequate flow and a more consolidated sand substrate; habitat conditions more conducive to mussels. The two mussel beds within the Wisconsin Channel supporting diverse mussel assemblages including Higgins eye would be avoided during construction. They would be designated "exclusion zones" and barge traffic would not be allowed to travel over the beds. The stream bank rock protection feature in the Wisconsin Channel near the downstream extent of the Goose Lake mussel bed that Transect 10 assessed should not adversely impact mussels given no mussels were found along the transect and the structure would be placed in shallow water within the inlet away from the mussel bed.

Overall, project impacts on mussels are expected to be adverse but minor.

5.2.8 Federally-Listed Threatened and Endangered Species

The USFWS' Information for Planning and Conservation (IPaC) website was consulted on December 31, 2019 to determine if any proposed, candidate, threatened, or endangered species may occur within the project area. The results indicated that two federally-listed endangered species and three federally-listed threatened species may occur within the project area. The species listed as endangered are freshwater mussels: the Higgins eye (*Lampsilis higginsii*), and sheepnose (*Plethobasus cyphus*). The species listed as threatened include: one mammal, the northern long-eared bat (*Myotis septentrionalis*); one reptile (a rattlesnake), the eastern massasauga (*Sistrurus catenatus*), and one flowering plant, the prairie bush-clover (*Lespedeza leptostachya*). No critical habitat for any of these species exists in or near the project area.

Regarding the two federally-listed freshwater mussel species, naturally-occurring individuals of Higgins eye and sheepnose were presumed extirpated from upper Pool 4. However, 5,777 artificially-propagated Higgins eye were placed in the Wisconsin Channel within the Goose Lake and 4th Cut Mussel Beds (Figure 16) beginning in 2003 and in four additional years (2004, 05, 08, 10) since then. Recent surveys in Pool 4 have recovered non-introduced live Higgins eye, which most likely indicates that propagated individuals have successfully reproduced and recruited new individuals into the area. It is not yet clear how widespread recruitment is, but Higgins eye are still very rare in Pool 4 outside of the mussel beds where reintroduced. While relic shells of sheepnose are occasionally found in upper Pool 4, this species has likely been extirpated from the UMR upstream of Lake Pepin for over a century. Single live individuals have been collected in Lower Pool 4 and in Pool 7 within the past 20 years, and the species may be effectively extirpated from the upper pools of the UMR. Additionally, relic shells of four other federally listed species have been collected in Pool 4, spectaclecase (*Cumberlandia monodonta*), winged mapleleaf, (*Quadrula fragosa*), snuffbox (*Epioblasma triquetra*), and fat pocketbook (*Potamilus capax*) but all are likely extirpated from Pool 4 for many decades.

Suitable habitat for the northern long-eared bat (NLEB) is variable depending on the season and the life stage of the individual. In the summer, these bats often roost under the 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 a threatened species because a fungal pathogen causing white-nose syndrome is sharply reducing populations.

The prairie bush clover only occurs within high-quality, dry to mesic, native tallgrass prairie habitats. The proposed project does not include any of these habitat types, and there are no known occurrences of the prairie bush clover within the proposed project area.

The eastern massasauga uses a variety of wetland habitats, including wet meadows, marshes, and floodplain forests. There are no records of the species within the project area, and the likelihood of encountering a massasauga very low.

Impacts of the No-Action Alternative – No impacts to federally-listed threatened and endangered species would be expected.

Impacts of the Tentatively Selected Plan – The Corps has initially determined that the proposed project may affect NLEB. Trees will need to be removed to allow construction equipment access to the project features. The Corps will implement the USFWS 4(d) Rule streamline consultation process. If USFWS does not respond within the 30 days, no further consultation is required, thus supporting the Corps determination.

Given that mussels were absent or at very low density with no federal- or state-listed species were collected at or near project features, and given that the mussel beds will be avoided during construction there should be no adverse impacts to federally-listed mussel species from the construction of the proposed project.

Because of the lack of suitable habitat for the prairie bush-clover, the project would have no effect on this species. Similarly, due to the lack of evidence for the occurrence of the massasauga in the project area, it has been determined that the project would have no effect on this species.

5.2.9 Wisconsin State-Listed Species

The WDNR Natural Heritage Information System Rare Features Database (NHIS) identified 29 species in townships T24N R18W and R17W of the project area. An additional five species were identified at the county level (Pierce County). Of the 34 species identified, 13 are mussels and have not been collected in the project area as described above. Nine are fish species, and it is expected that if any do occur in the project area, they would only be temporarily displaced during construction. Six are plant species that generally occur in more upland habitats and are not known to occur in the project area. The remaining species are either mobile and/or highly unlikely to be found in the project area. No impact to Wisconsin state-listed species would be expected for the no-action alternative or the TSP.

5.3 Cultural Resources

The upper Pool 4 locality contains numerous cultural resources indicating continual human occupation over approximately the last 13,000 years. Cultural resources include precontact village sites, cemeteries, petroforms and other archaeological sites, historic shipwrecks, river training features and standing structures. Several cultural resource sites within this locality have been listed on the National Register of Historic Places (NRHP) or are eligible to be listed on the Register. One precontact site, 47PI5, is located within the project area at the Bay City Campground.

While most of the cultural resources research in the area have focused on precontact village and burial sites located on glacial terraces in and around Red Wing, Minnesota, numerous precontact cultural resources sites are situated in the upper pool. Most of the identified precontact sites are located on glacial terraces while some are situated on tributary delta fans and beach cusps near the head of the river lake. The floodplain landforms between Red Wing and the head of Lake Pepin are relatively recent, forming after approximately 1,000 years ago as the Mississippi River delta progrades into the lake. Historic cultural resources include a variety of standing structures located on the tributary fan of Catherine Pass and Isabelle Creek at Bay City.

Previous cultural resources investigations examined areas proximal to and within portions of the project area in 1979-1980, 1988-1989 and 1993. The first survey was completed along portions of the Great River Road/State Road 35 (Penman 1980). The 1988-1989 survey occurred during and after a drought that included surface surveys and subsurface testing at the head of Catherine Pass, at the debouchure of the pass with Lake Pepin, and at the Village of Bay City's campground (Dobbs and Mooers 1991). The 1993 investigation included portions of the access road and the campground during a survey for the village's wastewater treatment plant (Salkin 1994).

Impacts of the No-Action Alternative – No impact to cultural resources would be expected.

Impacts of the Tentatively Selected Plan – Construction of mud flats, peninsulas, and the dike and water control structure would occur within historically marsh or current open water locations or on sediments formed since the end of the Nineteenth Century (cf. 1890 MRC charts and 1974 USGS topographic map). As such, these features have no potential to effect historic properties.

Rip-rap would be placed at several locations on the natural levee along the left descending bank of the Wisconsin Channel, the crevasse near Lily Pond, and the area around the head of Catherine Pass. Shoreline surveys were completed from the head of Catherine Pass along the left descending bank of the Wisconsin Channel to its mouth at the head of the lake. The survey, occurring in August 2017, consisted of pedestrian reconnaissance along the shoreline with surface visibility typically ranging from approximately 25-100 percent. No cultural resources were identified. Placing rock along the shoreline with no subsurface alterations would have no impacts to cultural resources.

Rip-rap is also to be placed at the head of Catherine Pass and for a stretch along the right descending bank of the slough. A shoreline survey for this portion of the project occurred in November 2019. Surface visibility typically ranged from approximately 25 to 75 percent. The survey also included the access trail. The placement of rock on the surface of the shoreline would not affect cultural resources.

The Bay City Campground is identified as a staging area for the project. The developed campground includes paved parking areas, camp pads with underground utilities, a comfort station and a picnic shelter. The Wisconsin state codification file places the Spingle site (47Pl5) as residing within the campground. The Sprigle site is described as a thin artifact scatter with an Oneota component (ca. 1000-1650 CE). First recorded in 1925, the site was identified as residing "… on the shore of Lake Pepin, west of Isabelle Creek…" in Bay City (Brown 1925:94). Penman indicates that he relocated the site "… on the west bank of Isabelle Creek" (Penman 1980:36) during a survey that included "a two mile segment east of Bay City" (Ibid). While Penman's report does not include a map or other locational data for 47Pl5, Isabelle Creek is approximately 1,100 meters (3,609 feet) east/northeast of the campground. Importantly, a note in the codification file indicates that the site in the campground was destroyed by rip-rap activities in the 1960s (Salkin 1994). The report for the 1988-1989 survey of Pool 4 indicates that one subsurface auger test was completed in the vicinity of the campground, although there are no details on the findings (Dobbs and Moore 1994:50-51). The 1993 investigations included subsurface testing in portions of the campground for a water line. The soil profiles across the area consisted of one to two meters of fill over wetland soils. No cultural materials or other evidence for site 47Pl5 were recovered. Salkin concluded that the area is highly disturbed, probably as a result of rip-rap activities and the development of the campground (Salkin 1994). Based on the above, it appears that the mapped location 47Pl5 is in error. The site described by Brown and Penman may be either 47Pl84 (Mad Dog) or 47Pl378 (Hohmann), both on the west side of Isabelle Creek on the east end of Bay City and separated by the Great River Road/State Highway 35.

In addition to the 1993 investigations, the campground was subjected to surface surveys in 2017 and 2019. No archaeological phenomena were identified. The campground has been extensively developed with a variety of concrete block structures, utilities, picnic shelter, boat ramp, playground and extensive macadamized surfaces. In addition, the dominant trees (Quercus sp.) in the campground do not appear to be older than approximately 50 to 60 years, seemingly corresponding with a ca. 1960s modification of the area. In any event, use of the campground for staging would be restricted to the existing improved surfaces to avoid earth moving activities. A temporary boat/barge access pad along the beach would be placed on existing ground with no subsurface disturbance. Because the staging area would not entail subsurface disturbances, there would be no effect to cultural resources, if present.

Construction of a proposed access road from the village ball fields to the dike and water control structure may impact cultural resources. The route would follow an existing, unimproved, access trail. The eastern segment, near the ball fields, corresponds with an area examined in 1993 with negative results for cultural resources (Salkin 1994). The middle segment transects a portion of the Catherine Pass channel that has been filled. The western segment would pass over a natural levee along the right descending bank of Catherine Pass. While the shoreline in this area was surveyed in 2019 (no cultural resources identified), excavation for the road may impact deeply buried sites that may exist on the natural levee, a landform that has a high probability to contain cultural resources.

Additional archaeological investigations will be conducted prior to construction of the proposed access road to assess the depth of Post-Settlement-Alluvium (PSA) and detect deeply buried archaeological deposits. If significant archaeological phenomena are identified, steps will be taken to avoid, minimize, or mitigate adverse effects. For example, there would be no effect to historic properties provided that any subsurface preparation for the road would occur within PSA. Further, the effects of access road construction (i.e., depth of excavation, weight of construction equipment, specifications of base material, soil structure, etc.) on buried

surfaces/deeply buried archaeological sites will be reviewed using modified Boussinesq's Equation or other suitable models. Management plans would be developed in consultation with various partners, such as Native American groups, the Wisconsin DNR, and the Wisconsin Historic Preservation Officer (WISHPO).

Historic standing structures and other historic resources located within the Village of Bay City, but none of the permanent elements of the project would be visible from those structures. The design of the campground and its structures-cinder block restrooms, concession building, picnic shelter, playground, other edifies- do not appear to meet eligibility criteria for listing on the National Register of Historic Places. No direct or indirect effects to historic standing structures or other historic resources would occur from the project.

Preliminarily, the Corps has determined that the project will have no adverse effect to historic properties. Consultation with the Ho-Chunk Nation, the Prairie Island Mdewakanton Community, the Shakopee Mdewakanton Community, the Lower Sioux Community and the Upper Sioux Community as well as coordination with the WISHPO is underway.

5.4 Socioeconomic Setting

The Pool 4 region is mainly composed of rural small cities, towns, villages, and unincorporated areas, bounded by Lock and Dam 3 around Mississippi river mile 797 and Lock and Dam 4 near mile 753. Red Wing, Minnesota is the largest community along this stretch with a population of 16,444 and is located southeast of Lock and Dam 3 between river miles 792 and 789. Sprinkled along the River on the Wisconsin side are towns and villages with populations under 1,000, including Bay City, Maiden Rock, Stockholm, Pepin, and Nelson (Bureau, 2014).

The Burlington Northern Santa Fe Railroad closely follows all of Pool 4's shoreline on the Wisconsin side. The Canadian Pacific Railroad traces along most of Pool 4 on the Minnesota side, veering away from the river around river mile 763 in order to pass through Wabasha, Minnesota (USACE & USFWS, 2014)

The Mississippi River serves as a corridor for commercial navigation of barge traffic via the 9-foot navigation channel as authorized by Congress. Barge traffic transports a wide variety of essential goods on the UMRS; agricultural commodities, petroleum products, and coal are the leading cargoes, with farm products accounting for approximately half the total tonnage shipped.

Based on the American Community Survey (Bureau, 2014), demographic factors across counties bordering Pool 4 are quite similar. Goodhue County is 96.8% white and 2.9% Hispanic or Latino of any race, has an unemployment rate of 4.2% among the labor force, and has a median annual household income of $55,603 with 8.7% of the population below the poverty line. On the Wisconsin side, Pierce County is 97.8% white with 1.5% Hispanic or Latino of any race, has an unemployment rate of 4.0%, and has a median household income of $61,153 with 12.4% living below the poverty line.

The EPA's EJSCREEN tool was used to evaluate local socioeconomic conditions directly surrounding the project area (Figure 20). The area within a 2-mile buffer from the approximate center of the project area is sparsely populated and has a population of roughly 800 people, and includes the community of Bay City, WI. The evaluation area is shown in Figure 18. The area has a minority population of 5%, with a low-income population of 20%. The Bay City Campground has been identified as a staging area for use during project construction. The Bay City Campground provides paved parking areas, a boat launch, camping, a comfort station, and a picnic shelter

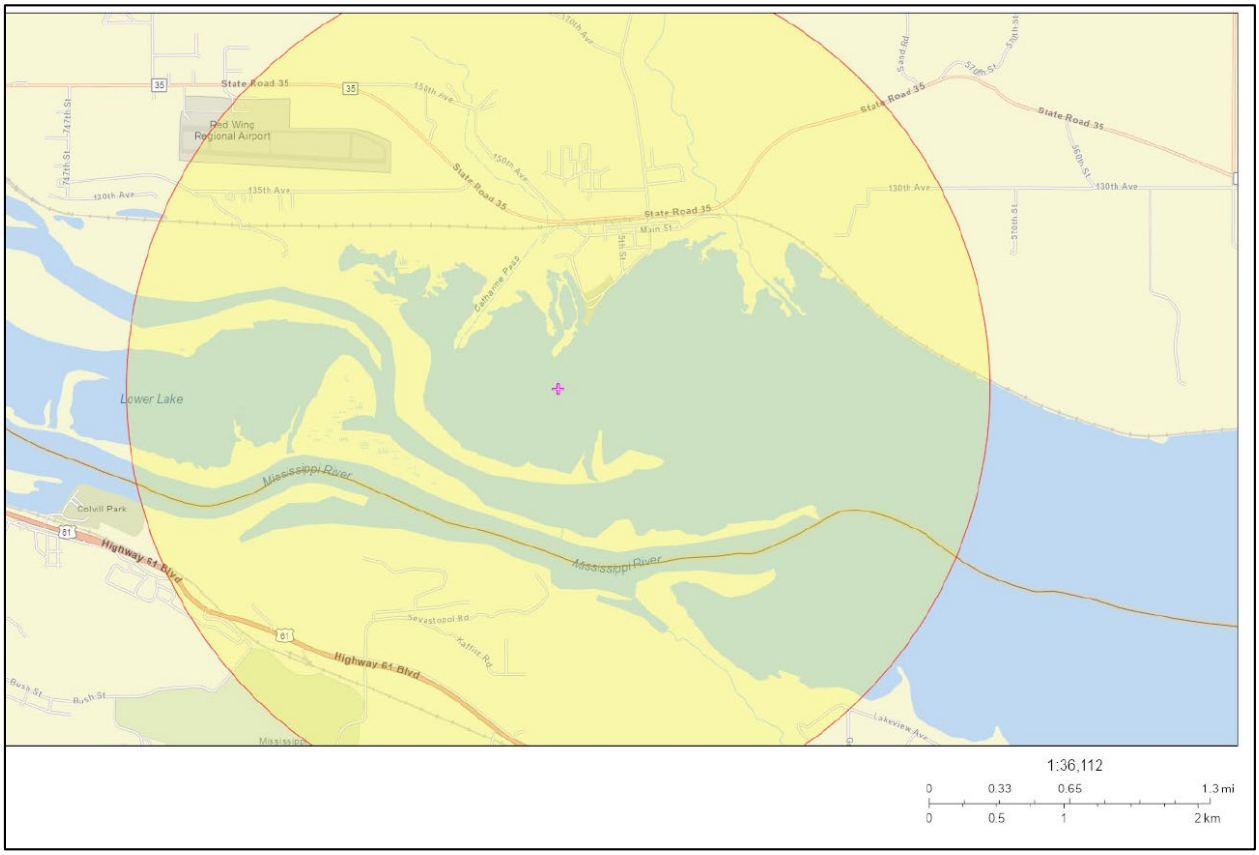


Figure 21: Area evaluated for Socioeconomic Indicators using EPA's EJSCREEN Tool

5.4.1 Noise

Impacts of the No-Action Alternative – No impacts or changes in noise would be expected.

Impacts of the Tentatively Selected Plan – The construction of the TSP would cause temporary, minor, adverse impacts on local noise levels during construction. Temporary increases in noise levels would be generated by heavy equipment used in the construction process. Increased noise to people would occur around the Bay City Campground, where construction equipment and material staging would occur. Other recreationists, tourists, or local residents of Bay City may also experience minor increases in noise during use of the project staging area. Noise would also be expected from truck traffic, likely through Bay City and the campground, while trucking rock for the project. It is expected that as many as 2,000 truckloads of rock would be needed for the project. This would equate to 30-40 loads per day for two or three months during the construction season. The majority of construction activity and noise generation would occur further away from permanent human use areas, in the backwater area of Catherine Pass. In this area, construction noise would likely cause temporary displacement of some wildlife species and decreased recreational use. Noise levels throughout the project area would return to the baseline condition after construction is complete.

5.4.2 Aesthetics

Impacts of the No-Action Alternative – No major changes to aesthetics would be expected.

Impacts of the Tentatively Selected Plan – The proposed project would cause temporary, minor, adverse impacts on aesthetics during construction. The aesthetic value of the project area would be reduced as a result of the activity and disturbance associated with construction and the presence of construction equipment.

The proposed project would also have long-term minor beneficial impacts. Impacted entities would primarily be recreational boaters who use the area. Construction of the TSP would change the views within Catherine Pass from the current open-water bay, to interspersed, vegetated land in the form of peninsulas. Aesthetic values are somewhat subjective, but the vegetated peninsulas would likely be considered aesthetically pleasing to most.

5.4.3 Recreation

The river supports valued recreational activities and aesthetic enjoyment, which has led to the development of numerous elements of recreational and aesthetic infrastructure around Pool 4. These elements are efficiently summarized by the 2011 Mississippi River Guide (MDNR, 2014) by the Minnesota Department of Natural Resources. Based on this guide, throughout the Pool 4 stretch there are 11 marinas, 3 docking facilities, 4 fishing piers, 11 parks, 2 resorts, 7 private campgrounds, 23 areas of public access to the river, a national wildlife refuge, and two other areas of interest.

Frontenac State Park in Minnesota is a large park and campground, covering river miles 784 to 776. It provides bird watching, public camping, 13 miles of hiking trails, picnicking, and panoramic overlooks.

Marinas surrounding Pool 4 within the project area include Red Wing Marina (Red Wing, Minnesota, river mile 791), Trenton Island Marina (Hager City, Wisconsin, river mile 791), and Bill's Bay Marina (Red Wing, Minnesota, river mile 789).

Other marinas within Pool 4 include: Hansen's Harbor & Trailer Court (Lake City, Minnesota, river mile 776), Lake City Marina (Lake City, Minnesota, river mile 773), Dan's Pepin Marina (Pepin, Wisconsin, river mile 767), Mississippi Parkside Marina (Wabasha, Minnesota, river mile 761), and Wabasha Marina & Boat Yard (Wabasha, Minnesota, river mile 759).

Impacts of the No-Action Alternative – Minor long-term adverse effects to recreational resources would be expected. Human use of the project area may decline due to further degradation of habitat quality and the continued effects of sedimentation, wind-generated waves, lack of habitat diversity, and lack of aquatic vegetation.

Impacts of the Tentatively Selected Plan – The construction of the TSP would result in a short-term minor adverse impact to recreation, and a long-term minor beneficial effect on recreation. In the short-term, construction activities would disturb recreational activities around the project area. Construction staging at the Bay City Campground would reduce camping and boating opportunities. Other camping and boating opportunities are present nearby. Recreational boaters that use Catherine Pass would be displaced, but would likely find similar backwater conditions in a number of areas nearby.

In the long-term, the TSP would result in habitat improvements that would enhance recreational opportunities. Project features would increase aquatic habitat quality for fish, waterfowl, and

plants. This would, in turn, increase outdoor recreational opportunities including bird watching, hunting, fishing, and paddling. Additionally, the access channel through Catherine Cut would be more suitable for recreational boat traffic than current conditions. This channel may fill in over time, though it is expected to remain passable for many years.

5.4.4 Transportation

Impacts of the No-Action Alternative – No major changes would be expected.

Impacts of the Tentatively Selected Plan – The TSP may result in a temporary minor adverse effect to local transportation, as a result of truck traffic from rock delivery the project site (see Noise 5.4.1).

5.4.5 Airport Wildlife Hazards

The Red Wing Regional Airport is a city-owned public use airport located in Pierce County, Wisconsin, three nautical miles northeast of the central business district of Red Wing, a city in Goodhue County, Minnesota. The airport first opened in 1928. The airport has two runways and services more than 14,000 takeoffs and landings annually, an average of 38 per day. Aircraft collisions with birds and other wildlife can pose a threat to aircraft safety.

The proposed project is being undertaken to restore lost value and function of an existing wildlife area. There would not be any changes in human management of the area, it would continue to be a part of the Pierce County Islands Wildlife Area.

The proposed project was coordinated with the Red Wing Regional Airport during the planning phase, and the draft report will be provided during public review.

Impacts of the No-Action Alternative – No major changes would be expected.

Impacts of the Tentatively Selected Plan – The TSP is being undertaken to restore lost value and function to a long-standing, previously existing wildlife area. No new wildlife attractants would be constructed, and therefore no substantial increases in wildlife hazards over those historically present in the area would be expected for the Red Wing Regional Airport.

5.4.6 Employment

Impacts of the No-Action Alternative – No major changes would be expected.

Impacts of the Tentatively Selected Plan – The TSP would result in a minor short term benefit to employment. Construction of the project would require a contract with a construction company.

5.4.7 Commercial Navigation

Impacts of the No-Action Alternative – No major changes would be expected.

Impacts of the Tentatively Selected Plan – The TSP would result in a minor short term benefit to commercial navigation. Much of the fill used to construct the project would be obtained as a result of maintenance activities (dredging) of the 9-foot navigation channel. Using this dredged

material for construction benefits navigation in that it provides a use for the material in a navigation pool where is has been difficult to obtain placement sites, which provides additional capacity for additional dredge material.

5.4.8 Environmental Justice

Executive Order 12898, Federal Actions to Address Environmental Justice in Minority Populations and Low Income Populations (1994), directs Federal agencies and state agencies receiving Federal funds to assess the effects of their actions on minority and/or low-income populations within their region of influence. The EPA has published *Guidance for Incorporating Environmental Justice Concerns in EPA's NEPA Compliance Analyses* (USEPA, 1998) which indicates that a minority population exists when either:

- The minority population of the affected area is greater than fifty percent of the affected area's general population.
- The minority population percentage of the affected area is meaningfully greater than the population percentage in the general population or other appropriate unit of geographic analysis.

Impacts of the No-Action Alternative – No impacts would be expected.

Impacts of the Tentatively Selected Plan – The TSP would not have disproportionate impacts to low-income or minority populations. The proportion of minority residents is only 5% in the project area. The proportion of minority or low income residents in the project area are below the statewide and regional levels.

Table 17: Environmental Assessment Matrix for Proposed Project

Alternative	No Action							Tentatively Selected Plan (Alt 11)						
	BENEFICIAL[a]				ADVERSE[b]			BENEFICIAL[a]				ADVERSE[b]		
PARAMETER	+++	++	+	0	-	--	---	+++	++	+	0	-	--	---
A.SOCIAL EFFECTS														
1. Noise Levels				X								ST		
2. Aesthetic Values				X						X		ST		
3. Recreational Opportunities					X					X		ST		
4. Transportation				X								ST		
5. Public Health and Safety				X							X			
6. Community Cohesion (Sense of Unity)				X							X			
7. Community Growth & 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						ST				
6. Business Activity				X							X			
7. Farmland/Food Supply				X							X			
8. Commercial Navigation				X						X				
9. Flooding Effects				X							X			
10. Energy Needs and Resources				X							X			
C. NATURAL RESOURCE EFFECTS														
1. Air Quality				X								ST		
2. Terrestrial Habitat				X					X			ST		
3. Wetlands				X					X			ST		
4. Aquatic Habitat					X				X			ST		
5. Habitat Diversity and Interspersion				X					X					
6. Biological Productivity				X					X			ST		
7. Surface Water Quality				X					X			ST		
8. Water Supply				X							X			
9. Groundwater				X							X			
10. Soils				X								ST		
11. Threatened or Endangered Species				X							X			
D. CULTURAL RESOURCE EFFECTS														
1. Historic Architectural Values				X							X			
2. Pre- & Historic Archeological Values				X							X			

[a] Beneficial: '+++' = significant; '++' = substantial; '+' = minor. [b] Adverse: '---'= significant; '--' = substantial; '-' = minor. '0' = No effect. X = Long-term effects; ST = Short-term effects, TBD = to be determined.

6 CUMULATIVE EFFECTS

6.1 Scope of Cumulative Effects Analysis

Cumulative effects are defined by the Council on Environmental Quality as, "[T]he impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (federal or non-federal) or person undertakes such actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time."

The time frame considered for the scoping of potential future cumulative impacts was bounded by the project life considered during other analyses, which was 50 years, which is the time frame used for project planning and analysis of the project benefits. Although this life-span is somewhat arbitrary, no reasonably foreseeable future actions were identified beyond this time scale.

The geographic scale analyzed for cumulative impacts was limited to potential actions that have or would have effects in the immediate and adjacent project area. However, this does not mean that only activities with footprints overlapping the proposed project were considered - this is because the proposed project is a part of a large river system, which necessitates considering if actions upstream or downstream could also impact this particular reach of the river.

6.2 Actions Identified within the Project Area

The following past, present, and reasonably foreseeable future actions were identified as having the potential to interact with or have impacts related to those of the proposed project.

6.2.1 Past Actions

6.2.1.1 Modifications to UMR for Navigation

The floodplain geomorphology, stream hydraulics, and water levels of the Upper Mississippi River have been modified by impoundment and other navigation features since the 1820s. The most relevant navigation improvement actions within the project impact area are likely the construction of hundreds of channel training structures placed between 1866 and 1907 as part of the 4-foot, 4.5-foot, and 6-foot navigation channel projects, and finally the implementation and maintenance of the 9-foot navigation channel with the construction of Lock and Dam Number 4 is 1935. The cumulative effect of these actions has played a large role in the development of the habitat that currently exists in the project area.

6.2.2 Concurrent and Ongoing Actions

6.2.2.1 Navigation on the UMR

The operation, maintenance, and navigation use of the main channel of the UMR at its current authorized level is expected to continue into the future.

6.2.2.2 Total Maximum Daily Load (TMDL) Impairment Listings

The Minnesota Pollution Control Agency has identified the Mississippi River from the St. Croix River to the Chippewa River to be impaired for aluminum, mercury in fish, PCBs in fish, mercury in water, and total suspended solids (TSS). TMDL plans have been approved for this reach for mercury in fish, mercury in water, and TSS. Lake Pepin has been identified as being impaired for excess nutrients, and a Draft Lake Pepin Watershed Phosphorus TMDL report was released

in July 2019. TMDL plans identify the maximum quantities of these pollutants that can be allowed to enter the water body without exceeding water quality standards. Construction of the TSP would have an effect on TSS and turbidity levels. Turbidity in this reach of the river began increasing in the early 1920s as the Twin Cities metropolitan area grew and agricultural use of the Minnesota River Basin increased. Sediment cores from Lake Pepin have shown that the sediment load to Lake Pepin doubled between the 1930s and the 1960s and has stabilized at that level, although the source of the sediment has shifted from farm fields to increased erosion of stream banks and bluffs.

6.2.2.3 Minnesota River Watershed Study

The Corps is currently working on an integrated watershed study of the Minnesota River, with the intent to produce a watershed management plan. The results of the study will enable examination of existing conditions, forecasting of future conditions, and simulation of alternatives to identify management actions that are ecologically sustainable, economically sound, and socially desirable.

6.2.2.4 Operation and Management of Pierce County Islands Wildlife Area

The proposed project would be constructed within the existing Pierce County Islands Wildlife Area, which is a property owned and managed for outdoor recreation and wildlife habitat by the Wisconsin DNR. New land constructed as part of the proposed project would likely be managed as a part of this property. A recent draft management plan update for this land proposes a 212-acre increase in the property acreage goal, partially due to this project.

6.2.3 Reasonably Foreseeable Actions

No reasonably foreseeable actions beyond those discussed as current and ongoing have been identified in the project area at this time.

6.3 Environmental Consequences of Cumulative Effects

The environmental consequences outlined below are organized by the resource categories discussed for the project in Chapter 5. For brevity, only those resources where cumulative effects are expected are discussed.

6.3.1 Terrestrial Habitat, Aquatic Habitat, and Habitat Diversity/Interspersion

The TSP would be expected to have a long-term, substantial beneficial impact on terrestrial habitat, aquatic habitat, and habitat diversity and interspersion. The proposed project was designed to protect and improve the existing resources. The modification of the river for navigation purposes and the development around Lake Pepin and upstream has undoubtedly had an impact on the terrestrial and aquatic habitat resources surrounding the project area. Many of these actions have contributed to the problems identified as a part of this project. Further expansion or development could have additional adverse impacts on the habitat quantity and quality present within Lake Pepin, and on the UMR as a whole.

6.3.2 Surface Water Quality

The TSP would be expected to have a substantial beneficial effect on surface water quality due to the reduction in suspended sediments. Several of the other ongoing efforts are attempting to address water quality issues in the watershed – the Lake Pepin TMDL and the Minnesota River Watershed Study. These actions, considered together, would be expected to further benefit water quality. Due to the massive scale of actions that may impact water quality, other unknown

factors such as the effects of climate change on future watershed hydrology or due to unknown developments throughout the watershed have potential to impact water quality in both positive and negative ways. Overall, the identified ongoing efforts would be expected to have a net positive effect on water quality.

6.3.3 Recreation

The TSP would be expected to have a minor beneficial effect on local recreation opportunities by improving habitat conditions for wildlife in the project area. The anticipated positive effects of the TMDLs and Minnesota River Watershed studies, and continued management of the Pierce County Islands Wildlife Area would all add to the recreational opportunities and value provided by the project area.

7 SUMMARY OF ENVIRONMENTAL COMPLIANCE AND PUBLIC INVOLVEMENT

The planning for the Upper Pool 4 study has been an interagency effort involving the St. Paul District, the WDNR, MDNR, and the Lake Pepin Legacy Alliance. Interagency meetings and site visits were held on a periodic basis throughout the study. In addition to the meetings, information and coordination took place on an as-needed basis to address specific problems, issues, and ideas.

The draft Feasibility Report and Environmental Assessment will be made available to federal, state, and local agencies; Native American groups; special interest groups; and interested citizens.

7.1 Environmental Laws and Regulations

This document is an integrated environmental assessment with a Clean Water Act Section 404(b)(1) Evaluation. See Appendix B, *Clean Water Act Compliance*, for additional information.

A summary of compliance with the major environmental laws and regulations follows and is summarized in Table 18.

The Corps will need to obtain a Chapter 30 permit and Clean Water Act section 401 water quality certification for construction activities from the WDNR. Discussions with the WDNR have not indicated any obstacles with the issuance of permits that would be critical for construction of the project at this time.

National Historic Preservation Act: Section 106 of the NHPA specifies that federal agencies shall take into account the effect of an undertaking on any property included in or determined eligible for the National Register of Historic Places. The Corps has preliminarily determined that the proposed project would have no effect on historic properties. Coordination of this determination is ongoing with Wisconsin State Historic Preservation Office. The Corps would receive concurrence on our determination prior to project construction.

Bald and Golden Eagle Protection Act: The Bald and Golden Eagle Protection Act prohibits anyone from taking, possessing, or transporting an eagle, or the parts, nests, or eggs of such birds without prior authorization. Disturbing an eagle to a degree that causes, or is likely to cause injury to an eagle, decrease productivity, or cause nest abandonment are considered forms of take. Activities that directly or indirectly lead to take are prohibited without a permit.

Numerous bald eagle nests have been documented in the study area (Figure 14). The USFWS recommends maintaining 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 timeframe (nesting typically occurs between February 1 – July 15) if practicable. Further coordination with the USFWS would be conducted in the design and construction phases, and an incidental eagle take permit may be requested if avoidance measures are not practicable.

Clean Water Act: 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.

Section 404 of the CWA regulates the discharge of dredged or fill material into waters of the United States and is administered by the Corps. A Section 404(b)(1) Evaluation has been prepared for the project and is available in Appendix B, *Clean Water Act Compliance*.

Section 401 water quality certification is required for actions that may result in a discharge of a pollutant into waters of the United States to ensure that the discharge complies with applicable water quality standards. A Section 401 water quality certification would be requested from the WDNR during the design phase and obtained prior to project construction.

Endangered Species Act: There are five federally-listed species that are believed or known to occur within the study area, (see Section 5.2.8). For all but the northern long-eared bat, it was determined that the project would have no effect on federally-listed threatened and endangered species. For the northern long-eared bat, it was preliminarily determined that the project may affect the species, but would not result in prohibited take. Prior to construction, the Section 4(d) Rule streamline consultation process for the bat will be followed to confirm this determination.

Fish and Wildlife Coordination Act: In compliance with the Fish and Wildlife Coordination Act, project plans have been coordinated with the USFWS, WDNR, and MNDNR (see Appendix A – Correspondence and Coordination).

National Environmental Policy Act (NEPA): This document has integrated the content required of a NEPA environmental compliance document. A range of alternatives have been presented and project 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 identified during the comment period, a FONSI will be signed by the St. Paul District Commander.

Table 18: Compliance With Applicable Environmental Regulations and Guidelines

Environmental Requirement	Compliance[1]
Federal Statutes	
Archaeological and Historic Preservation Act	Partial
Bald and Golden Eagle Protection Act of 1940, as amended	Partial
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	Partial
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	Partial

National Wildlife Refuge Administration Act of 1966	Full
Noise Pollution and Abatement Act of 1972	Full
Watershed Protection and Flood Prevention Act	N/A
Wild and Scenic Rivers Act of 1968, as amended	N/A
Farmland Protection Policy Act of 1981	N/A
Executive Orders, Memoranda	
Floodplain Management (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)	N/A
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.
b. Partial - Some requirements of the statute, E.O., or other policy and related regulations remain to be met for the current stage of planning.
c. Noncompliance (NC) - Violation of a requirement of the statute, E.O., or other policy and related regulations.
d. Not Applicable (N/A) - Statute, E.O., or other policy and related regulations not applicable for the current stage of planning.
[2] 401 water quality certification required.
[3] Full compliance to be achieved with the District Engineer's signing of the Finding of No Significant Impact.

7.2 Coordination, Public Views, and Comments

This section will be completed after the public review and comment period.

- The Corps held several public meetings for potentially interested stakeholders and agencies (Appendix A – Correspondence and Coordination).
- The WDNR, the non-Federal sponsor, supports the Tentatively Selected Plan.
- The Corps is working to release the draft feasibility report and integrated environmental assessment for the project for public review in March 2020.
- In-person public meetings will not be scheduled at this time, per the COVID-19 recommendations. The team is exploring virtual options to present the TSP and field questions from the public.

8 RECOMMENDATION

The Tentatively Selected Plan is Alternative D, which includes four peninsulas, refuge dredging, a water level management dike with a water control structure, an access road, two backwater dredged areas, three areas of shoreline protection, a mudflat, access dredging, and a partial closure.

The estimated cost of the project at current price levels is $24.4 million. Upon completion, the Wisconsin Department of Natural Resources would be responsible for Operation, Maintenance, Repair, Rehabilitation, and Replacement at an estimated average annual cost at current price levels of $3,500. The recommended plan also includes a monitoring program at an estimated total cost at current price levels of $559,000.

The expected outputs of the Tentatively Selected Plan include the enhancement of over 800 acres of backwater aquatic habitat, marsh, and floodplain forest. The Tentatively Selected Plan will contribute 286 average annual habitat units for fish and wildlife over the 50-year period of analysis to the National Environmental Quality Account at an average annual cost of $2,780 per average annual habitat unit.

I have weighed the benefits to be obtained from the Upper Pool 4 Project against the cost and have considered the alternatives, impacts, and scope of the proposed project. I recommend that the Upper Pool 4 project for the beneficial use of dredged material in Pool 4 of the Upper Mississippi River be approved for construction.

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

Karl D Jansen
Colonel, Corps of Engineers
District Commander

9 LITERATURE CITED

Blumentritt, D. J., Engstrom, D. R., & Balogh, S. J. 2013. A novel repeat-coring approach to reconstruct recent sediment, phosphorus, and mercury loading from the upper Mississippi River to Lake Pepin, USA. *Journal of Paleolimnology*, *50*(3), 293-304. https://doi.org/10.1007/s10933-013-9724-8

Devendorf, R.D. 2013. A Dabbling Duck Migration Model for the Upper Mississippi River. U.S. Army Corps of Engineers, St. Paul District.

Dobbs, Clark and Howard Mooers. 1991. *A Phase I Archaeological survey and Geomorphological Study of Lake Pepin and the Upper Reaches of Navigation Pool 4, Upper Mississippi River, Pierce and Pepin Counties, Wisconsin Goodhue and Wabasha Counties, Minnesota*. Institute for Minnesota Archaeology Reports of Investigations Number 44. Institute for Minnesota archaeology, Minneapolis.

Engstrom, Daniel & Almendinger, James & Wolin, Julie. 2009. Historical changes in sediment and phosphorus loading to the upper Mississippi River: Mass-balance reconstruction from the sediments of Lake Pepin. Journal of Paleolimnology. 41. 563-588. 10.1007/s10933-008-9292-5.

Groten, J.T., Ziegeweid, J.R., Lund, J.W., Ellison, C.A., Costa, S.B., Coenen, E.N., and Kessler, E.W. 2019. Using acoustic Doppler velocity meters to estimate suspended sediment along the lower Minnesota and Mississippi Rivers: U.S. Geological Survey Scientific Investigations Report 2018–5165, 30 p., https://doi.org/10.3133/sir20185165.

Gutzwiller, K.J., and S.H. Anderson. 1987. Habitat suitability index models: Marsh Wren. U.S. Fish Wildlife Service. Biol. Rep. 82(10.139). 13 pp.

Minnesota Pollution Control Agency. 2011. Revisiting the Minnesota River Assessment Project. An Evaluation of Fish and Invertebrate Community Progress. https://www.pca.state.mn.us/sites/default/files/lrwq-s-2sy11.pdf.

2017. Lower Minnesota River Watershed Monitoring and Assessment Report. https://www.pca.state.mn.us/sites/default/files/wq-ws3-07020012b.pdf.

Minnesota Pollution Control Agency. 2015. Sediment Reduction Strategy for the Minnesota River Basin and South Metro Mississippi River. Establishing a foundation for local watershed planning to reach sediment TMDL goals. https://www.pca.state.mn.us/sites/default/files/wq-iw4-02.pdf.

Moore, M., R. Burdis, S. Delain, E. Lund, C. Dawald. 2019. Long-term Ecological Trends on the Upper Mississippi River: Implications of Climate Change. River Resources Forum Presentation, 4, December 2019.

Palesh, G., and D. Anderson. 1990. Modification of the Habitat Suitability Index Model for the Bluegill (Lepomis macrochirus) for Winter Conditions for Upper Mississippi River Backwater Habitats. U.S. Army Corps of Engineers. St. Paul District. St. Paul, Minnesota.

Penman, John. 1980. *Archaeology of the Great River Road: Site survey in Buffalo, Pepin and Pierce Counties*. Wisconsin Department of Transportation, Archaeology Report 3. Wisconsin Department of Transportation, Madison.

Salkin, Phillip. 1994. An Archaeological Survey of Proposed Water Facilities for the Village of Bay City, Pierce County, Wisconsin. Archaeological Consulting and Services, Verona.

Schroeder, R.L. 1983. Habitat suitability index models: black-capped chickadee. U.S. Fish & Wildlife Service FWS/OBS-82/10.37. 12 PP.

Sousa, P. J. 1982. Habitat suitability index models: Veery. U.S. Dept. Int., U.S. Fish & Wildlife Service. FWS/OBS-82/10.22. 12 pp.

U.S. Army Corps of Engineers. 2000. Planning Guidance Notebook, ER1105-2-100.

2004. Long Meadow Lake Habitat Rehabilitation and Enhancement Project. Definite Project Report and Integrated Environmental Assessment (SP-26). https://www.mvr.usace.army.mil/Portals/48/docs/Environmental/EMP/HREP/MVP/LongMeadowLake/LongMeadowLakeappend.pdf

2012a. Rice Lake Habitat Rehabilitation and Enhancement Project, Project Evaluation Report. Environmental Management Program for the Upper Mississippi River System. https://www.mvr.usace.army.mil/Portals/48/docs/Environmental/EMP/HREP/MVP/RiceLakeMN/RiceLakeMN_PER_2012.pdf.

2012b. Upper Mississippi River Restoration Environmental Design Handbook. Chapter 5. Localized Water Level Management. Upper Mississippi River Restoration Environmental Management Program.

2018. U. S. Army Corps of Engineers. U.S. Army Corps of Engineers Climate Hydrology Assessment (ECB 2018-14). Climate Preparedness and Resilience Community of Practice. Washington, D.C, 2018.

U.S. Environmental Protection Agency. 2015. Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2013. U.S. Environmental Protection Agency, Office of Atmospheric Programs, Washington, DC.

2018. Minnesota Nonattainment/Maintenance Status of Each County by Year for All Criteria Pollutants. https://www3.epa.gov/airquality/greenbook/anayo_mn.html. Accessed U.S. Army Corps of Engineers. 1987. Corps of Engineers Wetland Delineation Manual. Technical Report Y-87-1, U.S. Army Engineer Waterways Experiment Station, Vicksburg, MS.

U.S. Fish and Wildlife Service. 1980. Habitat Evaluation Procedures. Ecological Services Manual 102. Division of Ecological Services, Washington DC. https://www.fws.gov/policy/ESMindex.html.

2018b. Townships Containing Documented Northern Long-eared Bat Maternity Roost Trees and/or Hibernacula in Minnesota. Updated 1 April 2018. Online at: http://files.dnr.state.mn.us/eco/ereview/minnesota_nleb_township_list_and_map.pdf (Accessed 17 September 2018).