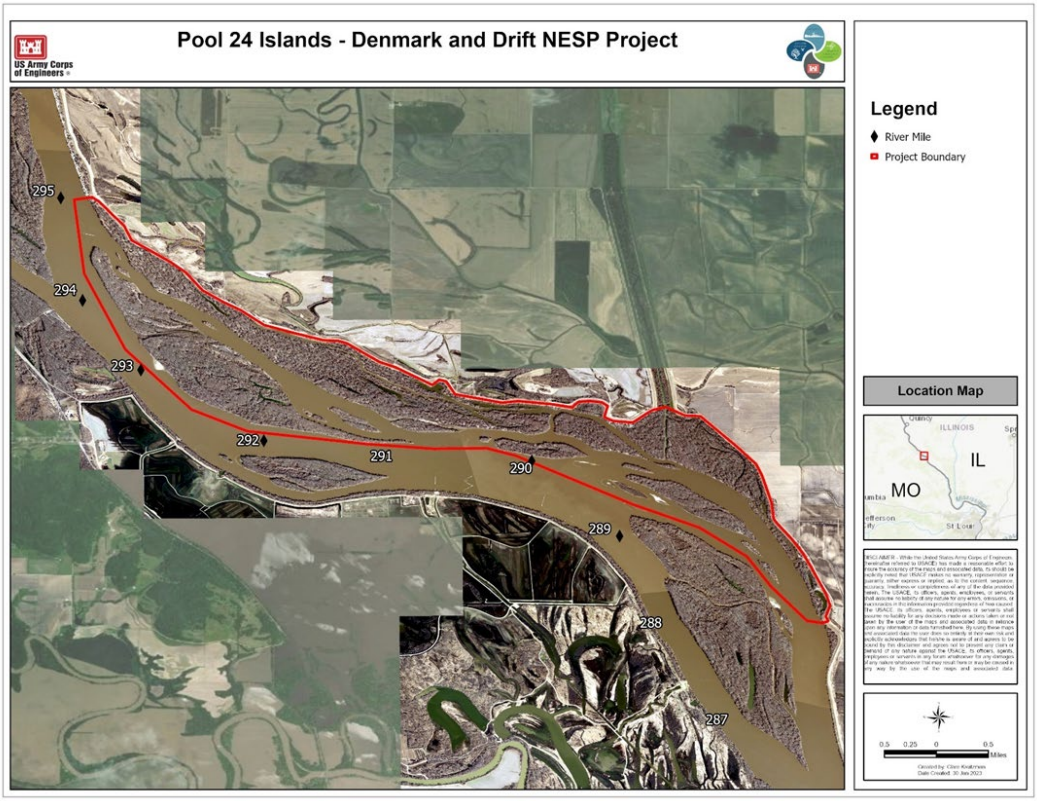
NAVIGATION AND ECOSYSTEM SUSTAINABILITY PROGRAM
DRAFT PROJECT IMPLEMENTATION REPORT
WITH INTEGRATED ENVIRONMENTAL ASSESSMENT

POOL 24 ISLANDS - DENMARK AND DRIFT ISLANDS

POOL 24, Mississippi River, Miles 295 – 288
Pike County, Illinois



US Army Corps of Engineers ®
St. Louis District

Navigation Ecosystem Sustainability Program
US Army Corps of Engineers - St. Louis District
March 29, 2024

ACKNOWLEDGEMENTS

Pool 24 Islands NESP-ECO Project USACE Project Delivery Team (PDT) Members, with roles and experience, are listed below.

Name	Role	Education	Years of Experience
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Asher Leff, P.E.	Civil Engineer	BS Civil Engineering BS Architectural Engineering MS Civil Engineering	10
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Meredith Trautt	Cultural Resources & Tribal Liaison	BA Anthropology MS Historical Archaeology	17

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NAVIGATION ECOSYSTEM SUSTAINABILITY PROGRAM

PROJECT IMPLEMENTATION REPORT

WITH INTEGRATED ENVIRONMENTAL ASSESSMENT

POOL 24 – DENMARK AND DRIFT ISLANDS

UPPER MISSISSIPPI RIVER MILES 295 THROUGH 288

PIKE COUNTY, ILLINOIS

EXECUTIVE SUMMARY

Purpose of the Report: The purpose of this project implementation report (PIR) with environmental assessment (EA) (report), including the anticipated Finding of No Significant Impact (FONSI), is to document the decision-making process for the proposed U.S. Army Corps of Engineers (USACE), NESP Pool 24 Islands – Denmark and Drift ecosystem restoration project. The proposed project focuses on an approximate 3,320-acre island/side channel complex in the Upper Mississippi River in the upper portion of Pool 24.

This report was developed by the USACE serving as the lead federal agency and the U.S. Fish and Wildlife Service (USFWS) serving as a federal coordinating agency. This report provides planning (including National Environmental Policy Act compliance), engineering, and sufficient construction details for the Tentatively Selected Plan (TSP) to help inform the final recommendation.

Project Area Description: The project is located on the left descending bank of the Mississippi River, approximately nine miles west of the town of Atlas, in Pike County, Illinois. The proposed project lies in the upper portion of Pool 24 between Upper Mississippi River Miles (RM) 295 and 288. The approximate 3,320-acre area is primarily described as floodplain forest, but also includes wet meadow, sandbar habitat, shallow marsh, side-channel, and open backwaters. The area is currently owned and managed by the USACE Rivers Project Office and is not included in the General Plan (GP) lands agreement. Management of the area has largely been passive over the last 75 years; however, a detailed Forest Management Plan was developed over the past five years identifying forest management objectives and prescriptions at the stand level.

Problem Identification:

- Backwater sedimentation causes poor water quality, shallow depths, and loss of connectivity with subsequent decreases in habitat function and availability for aquatic and riverine species.
- Loss of topographic and hydrologic diversity reduces vegetative community diversity and wildlife resources (e.g., forage, invertebrate production, nesting habitat, and resting sites).

- Sediment deposition impacts natural hydrologic processes and their influence on terrestrial areas, resulting in increased flood durations and decreased forest health and diversity.

Project Objectives:

- Restore flow diversity, connectivity, and substrate diversity throughout project area (side channel, main channel, off channel, backwaters, etc.) during the 50-year period of analysis.
- Restore native aquatic and terrestrial vegetation diversity throughout project area during the 50-year period of analysis.
- Restore topographic and bathymetric diversity and structural complexity throughout the project area during the 50-year period of analysis.
- Reduce inundation hydroperiod on impacted forest stands during the 50-year period of analysis.

Plan Formulation, Evaluation, and Comparison: The project delivery team (PDT), which includes biologists, foresters, engineers, and planners from the USACE, developed a series of measures for consideration. Measures were then assessed for ability to address project problems, goals, and objectives. The final list of measures included:

- Floodplain forest restoration
- High priority - floodplain forest restoration
- Mussel riffles - large stone spread out
- Mussel riffles - on new and existing dikes
- Backwater dredge of sediment (Drift Island)
- Mechanical excavation of sediment in backwaters (Denmark Island)
- Notching existing dikes
- Rootless dikes
- Sediment plug removal
- Terrestrial elevation raise
- Scour structures

Plan Selection: The TSP for the Pool 24 Islands – Denmark and Drift NESP Project (Maximum Mussel and Forest Management Alternative) is shown in Executive Summary ES-Figure 1. It consists of multiple measures to restore and improve the island complex ecosystem structure and function by implementation of the following:

- Floodplain Forest Restoration
- Sediment Plug Removal
- Mussel Riffles

The TSP was identified as the National Ecosystem Restoration (NER) Plan. For ecosystem restoration projects, the plan that maximizes ecosystem benefits compared to costs is selected as the NER Plan. The TSP is a best buy alternative that yields 355 net average annual habitat units (AAHUs) at an average cost of $2,104 per AAHU (FY2024 price level; FY2024 federal discount rate of 2.75%). It best meets the identified objectives and has support from consulting agencies. Implementation of the TSP would

increase the quality and quantity of ecosystem resources and meet the needs for a large variety of native aquatic and terrestrial species. Restoring backwater connectivity and side channel depth diversity would improve aquatic habitat for migratory wildlife within the Mississippi River flyway. Improved mussel habitat and floodplain forest habitat restoration would provide for and enhance vital habitat for fish and wildlife for the proposed project area and the upper Mississippi River. The project outputs are also consistent with the goals and objectives of the NESP.

All proposed project measures would be located within federally-owned lands and waters of the United States managed by the USACE staff from the St. Louis District - Rivers Project Office. As such, project first cost funding for restoration measures would be 100 percent federal; and responsibility for the operation, maintenance, rehabilitation, replacement, and repair (OMRR&R) of the project would also be the responsibility of the USACE.

The St. Louis District Engineer has reviewed the proposed project outputs, a gain of 355 net AAHUs, and determined that the implementation of the TSP is in the Federal interest. Therefore, the District Engineer recommends construction approval for the Pool 24 Islands – Denmark and Drift NESP project. The current estimated project first cost (FY2024 price level) of the project (including contingencies) is estimated at $18,256,000 which includes monitoring ($952,000) and adaptive management ($1,548,000). The average annual cost based on the project first cost is $747,000. The fully funded project cost estimate is $18,776,000. The USACE would be responsible for project OMRR&R at an estimated average annual cost of $74,000 (including contingencies).

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POOL 24 ISLANDS – DENMARK AND DRIFT

***Denotes National Environmental Policy Act required sections**

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1.0 STUDY PURPOSE

The U.S. Army Corps of Engineers (USACE), St. Louis District (District), has prepared this project implementation report (PIR) with an integrated environmental assessment (EA) to present a detailed account of the planning, engineering, construction considerations, and environmental considerations that resulted in the Tentatively Selected Plan (TSP) for the Pool 24 Islands- Denmark and Drift project (project). This ecosystem study is an interim response to restoring the Upper Mississippi and Illinois Waterways as outlined in the Navigation and Ecosystem Sustainability Program. The PIR/EA also meets applicable USACE guidance and documents and evaluates environmental effects of the recommended plan and alternatives in compliance with the National Environmental Policy Act (NEPA).

1.1 PROJECT PURPOSE & SCOPE OF INVESTIGATION

The scope of this project focuses on evaluating proposed management measures that would restore structure, function, and processes of the backwaters, side-channels, islands, sandbars, and floodplain wetlands and forests within the Pool 24 Islands – Denmark and Drift NESP project area (Figure 1). This project follows the U.S. Army Corps of Engineers' (USACE's) six-step planning process as specified in Engineer Regulation (ER) 1105-2-103, Policy for Conducting Civil Works Planning Studies, as well as the Planning Guidance Notebook, ER 1105-2-100, and is consistent with agency goals. The process identifies and responds to problems and opportunities; provides a flexible and rational framework to make decisions; and allows the interested public and decision makers to be fully aware of the basic assumptions employed, data analyzed, risks and uncertainties identified, and significant implications of each alternative plan, including the No Action alternative.

A single alternative plan has been selected for recommendation from among all those that have been considered. The four accounts identified by the 1983 U.S. Water Resources Council's Economic and Environmental Principles and Guidelines for Water and Related Land Resources Implementation Studies (P&G) include (for ecosystem restoration studies) National Ecosystem Restoration (NER), Environmental Quality (EQ), Regional Economic Development (RED), and Other Social Effects (OSE), and are used to facilitate the evaluation and display of effects of alternatives plans. As outlined by the Assistant Secretary of the Army (Civil Works) in the 2021 policy directive Comprehensive Documentation of Benefits in Decision Documents, the PDT considered the contribution of the Project objectives to all four accounts, including benefits to national and regional economic development, environmental quality, and other social effects for the local and visiting populations. The development and comparison of alternatives allows for the ultimate identification of the National Ecosystem Restoration (NER) Plan. The NER plan reasonably maximizes ecosystem restoration benefits compared to costs. The NER also considers information that cannot be quantified, such as environmental significance, scarcity, socioeconomic impacts, and historic properties.

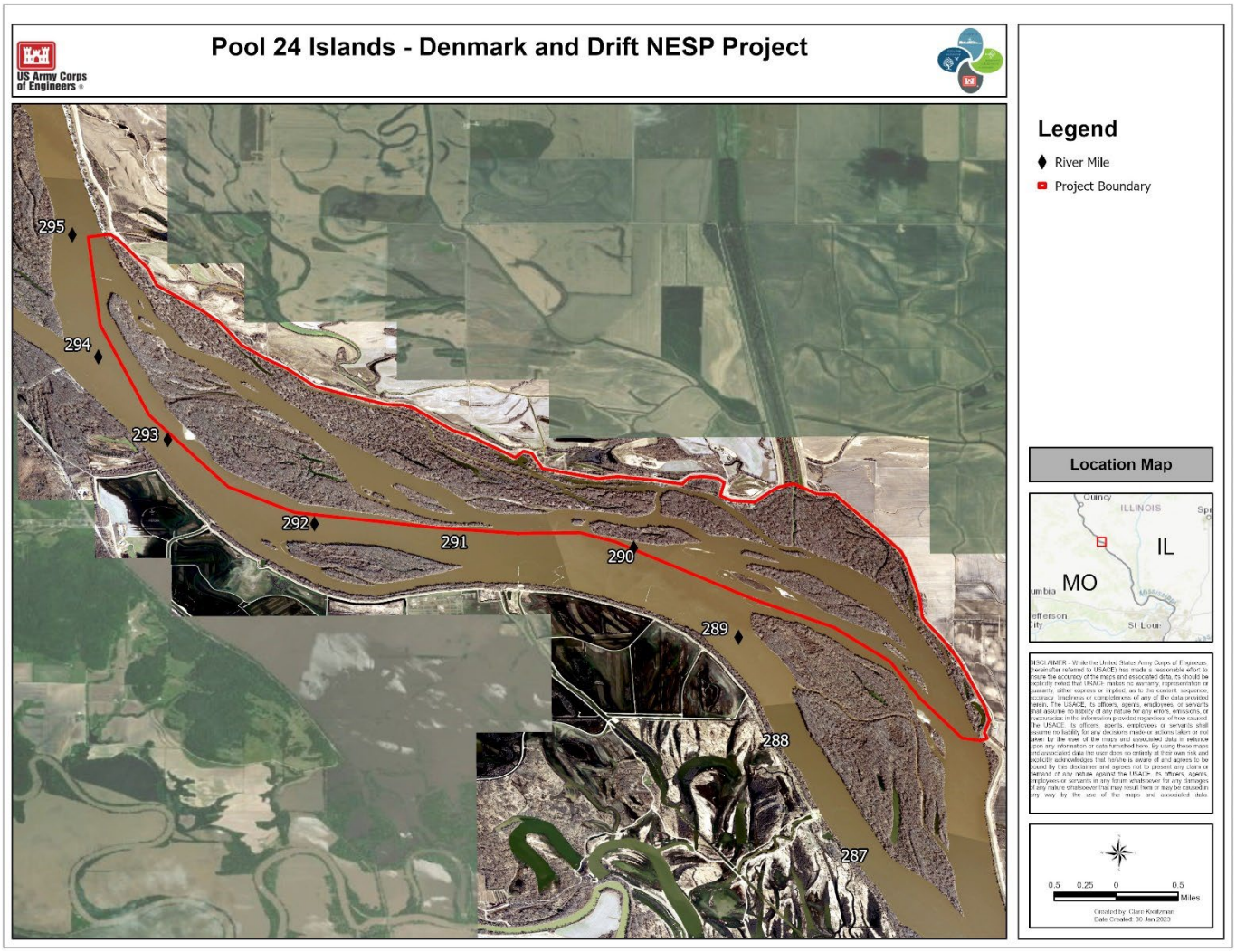


Figure 1: Pool 24 Islands- Denmark and Drift NESP Project Area

1.2 AUTHORITY

NESP is a dual-purpose navigation and ecosystem restoration program for the Upper Mississippi River and Illinois Waterway System authorized by Title VIII (Sections 8001-8005) of the Water Resources Development Act (WRDA) of 2007 (Public Law (PL) 110-114, 33 USC 652 statutory note), substantially in accordance with the Report of the Chief of Engineers dated 15 December 2004 (Chief's Report). NESP is a regional program that includes geographic areas within the boundaries of the USACE St. Paul, Rock Island, and St. Louis Districts. The navigation portion of the NESP includes both small- and large-scale navigation improvements and mitigation. The ecosystem restoration portion of the NESP includes large projects at specific locations and a

programmatic authorization for projects with a total single project cost not to exceed $25 million. Under the ecosystem restoration portion of NESP, a project will be implemented at 100 percent Federal expense if it (i) is located below the ordinary high water mark (OHWM) or in a connected backwater; (ii) modifies the operation of structures for navigation; or (iii) is located on federally owned land. All other ecosystem restoration projects under the NESP are implemented with cost sharing of 65 percent Federal, 35 percent non-federal. (PL 110-114, Section 8004(b)(3)).

In accordance with Section 8004(b)(2)(a-h) of WRDA 2007, the USACE and interagency partners identified potential ecosystem restoration projects based on their ability to address system restoration needs, represent a range of habitats, provide restoration actions throughout various parts of the system, and contribute to system learning (i.e. refine understanding of the most cost-effective restoration methods and best techniques to restore natural river processes).

Upon receiving additional funding in FY21 to continue Preconstruction Engineering Design (PED) activities, the upper three districts coordinated with UMRBA, USFWS, and the state natural resource agencies to develop a strategy on future project identification and prioritization, while also identifying the most immediate ecosystem restoration needs and readily available opportunities for starting new feasibility studies. St. Louis District personnel met with representatives from the River Resources Action Team (RRAT) over the course of 2021, evaluating draft fact sheets from earlier NESP planning efforts (circa 2010) and cross-referencing them with more recent ecosystem restoration activities implemented in the region, as well as more recent scientific literature and research, e.g., the Habitat Needs Assessment (De Jager, et al.). Through this process, a new set of fact sheets was developed and endorsed by the RRAT on July 30, 2021. The fact sheets were approved by MVD on February 2, 2022.

Project eligibility was judged based on whether the restoration efforts addressed the ecosystem restoration goals, which include:

- Manage for a more natural hydrologic regime
- Manage for processes that shape a physically diverse and dynamic river-floodplain system
- Manage for processes that input, transport, assimilate, and output material within the UMR basin river-floodplains: e.g., water quality, sediments, and nutrients
- Manage for a diverse and dynamic pattern of habitats to support native biota
- Manage for viable populations of native species within diverse plant and animal communities

The Denmark Drift project would be implemented under the NESP’s programmatic authorization for ecosystem restoration.

1.3 NEPA Tiering

The Chief's Report, supported by the Integrated Feasibility Report and Programmatic Environmental Impact Statement for the Upper Mississippi River and Illinois Waterway System Navigation Feasibility Study (USACE, 2004) (2004 IFR/EIS), describes the framework for the ecosystem restoration component of NESP, including establishing the Federal interest, establishing the justified scope of the plan, and identifying preliminary locations of projects. The remaining requirement for implementation on a project-specific basis is detailed formulation and description of recommended project plans. Pursuant to implementation guidance for the NESP issued by the Assistant Secretary of the Army (Civil Works) dated 2 July 2008, the site-specific assessments are accomplished by preparation of PIRs. The 2008 implementation guidance identifies the specific items to be included in each PIR. This PIR/EA is intended to fulfill those requirements.

The 2004 IFR/EIS includes the purpose, need, plan formulation, benefits, and effects of the NESP in compliance with NEPA. For the ecosystem restoration program, the 2004 IFR/EIS provided analyses at a program level. The conditions and environmental effects described in the 2004 IFR/EIS are still valid to support the ecosystem restoration project evaluated in this PIR/EA. This PIR/EA provides project-specific analysis of the proposed project and alternatives as a tiered NEPA document consistent with 40 CFR 1501.11 and 1508.1(ff). When the analysis presented in the 2004 IFR/EIS is adequate, no additional analysis is provided and instead the 2004 IFR is incorporated by reference.

1.4 PROJECT SPONSORS

The proposed project is located on USACE fee title federal lands; therefore, the construction of this project would be 100% federal and does not require a cost-share sponsor.

1.5 PROJECT AREA DESCRIPTION

The Denmark and Drift Islands proposed project area is approximately 3,320 acres of island, side channel, backwater, and floodplain forest habitats on the left descending bank of the Mississippi River in Pike County, Illinois, between river miles (RM) 295 and 288 (Figures 1 and 2). The area lies within Navigation Pool 24 of the UMR between Lock & Dam (LD) 22, just downstream of Saverton, MO (RM 301.2) and LD 24 in Clarksville, MO (RM 273.4) (Figure 3). There is no LD 23. The project area encompasses Denmark Island, Upper Drift Island and side channel, Drift Chute, Cottonwood Island, Bay Island, Murphy Bay, Willow Island, and Lower Drift Island. Figure 2 and Figure 3 provide vicinity maps and a Pool 24 location map for the project area.

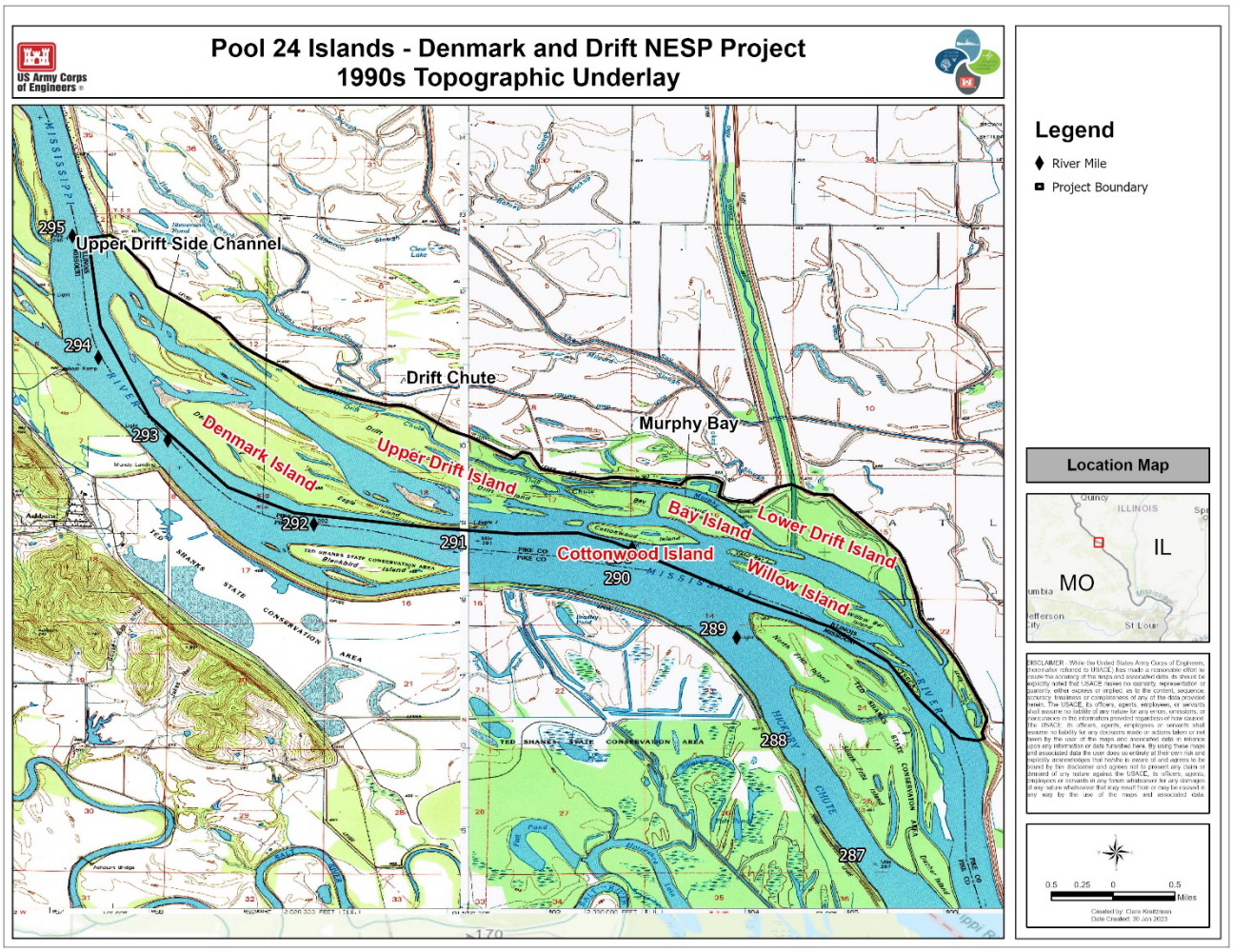


Figure 2: Historical topographic map of Pool 24 Islands- Denmark and Drift NESP project area

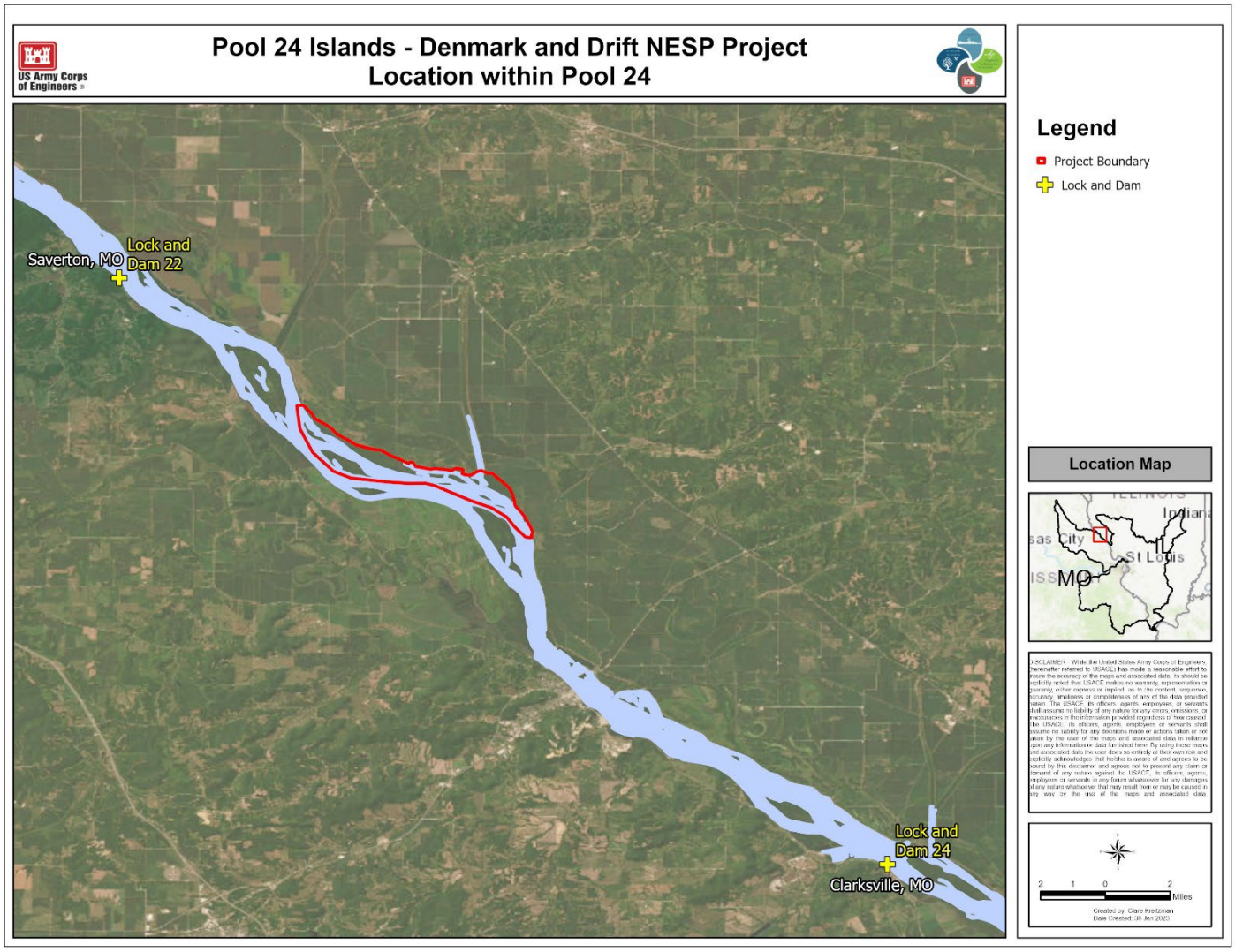


Figure 3: Vicinity Map of Pool 24 Islands- Denmark and Drift NESP project area

1.6 PURPOSE & NEED*

The goal of the NESP is to ensure an efficient and environmentally sustainable navigation system on the UMR-IWW system. The 2004 IFR/EIS (Chapter 1) established the purpose and need for the ecosystem restoration plan, which remain valid. Section 8004(b)(1) of WRDA 2007 directs the Secretary to "carry out, consistent with requirements to avoid adverse effects on navigation, ecosystem restoration projects to attain and maintain the sustainability of the ecosystem of the Upper Mississippi River and Illinois River in accordance with the general framework" outlined in the Chief's Report. Each PIR identifies a project-specific purpose and need, consistent with the 2004 IFR/EIS and WRDA 2007.

The purpose of this PIR with Integrated Environmental Assessment (EA), including the Finding of No Significant Impact (FONSI), is to conduct detailed formulation with project

specifics to help support the restoration of the aquatic and floodplain habitat on the UMR-IWW, and to evaluate a range of alternatives or actions and their environmental effects and identify the plan that reasonably maximizes ecosystem restoration benefits compared to costs. Developed alternatives, including the no action plan, comply with current applicable laws, regulations, and policies. The District proposes to restore the functionality of the project area through construction of measures that would support quality habitat for desirable native plant and animal species and emulate more natural river processes, structures, and functions for a resilient and sustainable ecosystem. The site-specific need for rehabilitation of backwaters, side channels, emergent wetlands, floodplain forest, sandbars, and island habitat in the study area is based on the following factors:

- The *Upper Mississippi Conservation Area Ten-Year Management Plan FY 2016-2025* identifies a need to protect forest, wetland, and aquatic habitats in the project area. The management plan identifies the need to address water level management issues, sedimentation, and tree recruitment/regeneration issues in the project area.
- The Upper Mississippi River System Habitat Needs Assessment II (McCain, Schmuecker, & De Jager, 2018). The HNA II summarized the desired future conditions in relation to high importance indicators for the Lower Impounded Mississippi River as: 1) Improve open water connectivity conditions, including island restoration; 2) Restore function and diversity of aquatic habitat types by improving quality, depth and distribution of lotic and lentic habitats and 3) Restore, maintain and enhance floodplain vegetation diversity, including hard-mast (nut- producing) trees.
- The *Rivers Project Office - Draft Forest Management Plan for Drift and Denmark Islands* (USACE, 2022) established the need for forest habitat restoration as it categorized forest health composition, with 66.1% of all trees across all plots surveyed as being Stressed (39.8%), Under Significant Decline (7.9%), or Dead (18.4%).
- The *Upper Mississippi River Systemic Forest Stewardship Plan* (Guyon, Deutsch, Lundh, & Urich, 2012) established goal and objectives including: 1) A functional, sustainable floodplain ecosystem that includes a mosaic of native vegetation communities sufficient to support important wildlife habitat; 2) Restore and maintain forest diversity, health, and sustainability on Federal lands; 3) Provide support for the restoration and maintenance of forest diversity, health and sustainability on non-Federal lands; and 4) Adaptive management.

1.7 RESOURCE SIGNIFICANCE

Resource significance of the UMR is fully described in the Chief's Report and 2004 IFR/EIS, (Chapter 1). Site-specific resource significance, where relevant, is described below.

The Mississippi River is the largest riverine ecosystem in North America and third largest in the world. The UMR floodplain ecosystem supports more than 300 species of birds, 57 species of mammals, 45 species of amphibians and reptiles, 150 species of

fish, and nearly 50 species of mussels. It is the backbone of the Mississippi Flyway, which is used by more than 40 percent of North America's migratory waterfowl. The UMR also has a record of human history spanning over 12,000 years and is increasingly being documented as one of the most archeologically and historically significant regions in the country.

The river has played a significant role in the development of the modern Midwestern economy and culture, and it continues to provide many benefits to the States and local communities along the river corridor (Guyon, Deutsch, Lundh, & Urich, 2012). For years, the UMR states (Illinois, Iowa, Minnesota, Missouri, and Wisconsin), non-governmental organizations, and other agencies have been engaged in activities that clearly demonstrate the institutional, public, and technical recognition of the resources of the UMR Basin.

1.7.1 Institutional Recognition

Institutional recognition means the importance of an environmental resource is acknowledged in the laws, adopted plans, and other policy statements of public agencies, tribes, or private groups. Sources of institutional recognition include public laws, executive orders, rules and regulations, treaties, and other policy statements of the federal government; plans, laws, resolutions, and other policy statements of states with jurisdiction in the planning area; laws, plans, codes, ordinances, and other policy statements of regional and local public entities with jurisdiction in the planning area; and charters, bylaws, and other policy statements of private groups.

The formal recognition of the UMR Basin in laws, adopted plans, and other policy statements of public agencies and private groups illustrates the significance of the basin. The U.S. Congress recognized the UMR as a unique, "…nationally significant ecosystem and a nationally significant commercial navigation system…" in Section 1103 of the WRDA of 1986.

1.7.2 Public Recognition

Public recognition means that some segment of the general public recognizes the importance of an environmental resource, as evidenced by people engaged in activities that reflect an interest or concern for that resource. Such activities may involve membership in an organization, financial contributions to resource-related efforts, and providing volunteer labor and correspondence regarding the importance of the resource.

In 2008, the National Audubon Society designated the Ted Shanks Alluvial Complex, an area comprised of over 15,000 acres of bottomland forest, wetland, and forested river island habitat as an Important Bird Area (IBA) (Jensen & Forbes, 2006). The IBA classification designates a location identified for its importance to particular bird species or groups of bird species. The area provides abundant migratory stopover and breeding habitat for water and forest birds. Breeding Pied-billed Grebes (*Podilymbus podiceps*), King Rails (*Rallus elegans*), Bald Eagles (*Haliaeetus leucocephalus*), Least Bittern (*Ixobrychus exilis*), and Common Moorhen (*Gallinula chloropus*) have been observed during their breeding seasons. There is also evidence of nesting for American Bittern

(*Botaurus lentiginosus*) and Bobolinks (*Dolichonyx oryzivorus*) on Ted Shanks Conservation Area (Palmer & Palmer, 2001). This identified IBA is located immediately adjacent to the Denmark and Drift Island proposed project area, and although Audubon Society's IBA classification follows strict state boundaries, it is noteworthy to mention that these very similar habitats exist within the project area, and are managed in the same fashion, albeit across the state line. Additionally, the Illinois Department of Natural Resources (IDNR) operates a waterfowl blind program within the Drift Island side channel that attracts numerous waterfowl hunters to this area every fall.

1.7.3 Technical Recognition

Technical recognition means that the resource qualifies as significant based on its "technical merits", which are based on scientific knowledge or judgment of critical resource characteristics. Whether a resource is determined to be significant may vary based on differences across geographical areas and spatial scale. While the technical significance of a resource may depend on whether a local, regional, or national perspective is taken, typically a watershed or larger context should be considered. Technical significance should be described in terms of one or more of the following criteria: scarcity, representativeness, status and trends, connectivity, limiting habitat, and biodiversity.

Numerous scientific analyses and long-term evaluations of the Upper Mississippi River System (UMRS) have documented its significant ecological resources. Since the early 20th century, researchers, government agencies, and private groups have studied the larger river floodplain system and proposed ecosystem restoration in the UMRS. Numerous scientific analyses and long-term studies through the USACE's Upper Mississippi River Restoration (UMRR) Long Term Resource Monitoring (LTRM) program have documented the significance of the resources in the UMR basin.

In a 1995 report, the U.S. Department of Interior (DOI) listed large streams and rivers as endangered ecosystems in the United States. The DOI documented an 85 to 98 percent decline in this ecosystem type since European settlement. Large floodplain-river ecosystems have become increasingly rare worldwide. Two large floodplain-river ecosystems lay within the UMRS, namely the Upper Mississippi and Illinois Rivers. These two ecosystems still retain some seasonal flood pulses, and half of their original floodplains remains un-leveed and open to the rivers (Sparks, J.C., & Yin, 1998). The UMRS is one of the few areas in the developed world where ecosystem restoration can be implemented on large floodplain-river ecosystems (Sparks R. , 1995)

In addition, technical resource agencies (federal, state, and non-profit) view the resources in the UMR as significant, as reflected in the ongoing habitat restoration efforts in the region including the completed Habitat Rehabilitation and Enhancement Project (HREP) project located at Ted Shanks Conservation Area which lies directly across the river from Denmark and Drift Islands. The UMRS Habitat Needs Assessment II (McCain, Schmuecker, & De Jager, 2018) has also technically recognized the need to restore floodplain habitat and connectivity to the main river channel, restore islands, restore diversity of aquatic habitat types (deep lentic backwaters and shallow lotic

channel areas), restore aquatic vegetation in backwaters, restore floodplain forest diversity, restore floodplain vegetation diversity, enhance topographic diversity, restore water level fluctuation to mimic pre-dam conditions, and improve water clarity. These are all relevant to the proposed project area.

1.8 PROPOSED FEDERAL ACTION*

The proposed project focuses on restoration measures that would improve ecosystem resources (wetlands, floodplain forests, backwaters, side channels, and islands) within the UMR.

The federal action of selecting one of the alternatives for potential implementation would be determined by the USACE- St. Louis District Engineer. The District Engineer would also determine, based on the facts and recommendations contained herein, whether this EA is adequate to support a FONSI or whether an Environmental Impact Statement (EIS) would need to be prepared.

1.9 SCOPING & COORDINATION

Scoping is an early and open process for determining the span of issues to be addressed and for identifying the significant issues related to a proposed action. Scoping was conducted at the onset of the planning process using a variety of communication methods with the affected public, agencies, and organizations.

Scoping and coordination have been conducted with the following State and Federal agencies, and other interested parties:

- Missouri Department of Conservation
- U.S. Fish and Wildlife Service
- Missouri State Historic Preservation Office
- U.S. Environmental Protection Agency
- Illinois Natural History Survey
- Illinois Department of Natural Resources

The input received during scoping was incorporated in the process of making decisions for the project. Appendix A – *Coordination* documents those coordination efforts.

1.9.1 Coordination Meetings

Numerous coordination and stakeholder meetings were held with the project cooperators to discuss problems, opportunities, goals and objectives, potential restoration measures, and expected outcomes with and without a project.

The project delivery team (PDT) developed an initial summary of the problems, opportunities, objectives, and constraints. Additionally, the PDT developed potential project measures and alternatives, existing conditions and future conditions of the site without a project. Subsequently, the PDT met with stakeholders for additional input and concurrence on the proposed lists.

A stakeholder information meeting was held October 26th, 2022, at the National Great Rivers Museum in Alton, IL to inform the local stakeholders of the potential project and gather input about their ideas, concerns, and considerations. The 17 attendees included members or representatives from Illinois Department of Natural Resources (IDNR), Missouri Department of Conservation (MDC), and the US Fish and Wildlife Service (USFWS).

Refer to Appendix A – *Coordination* for more information about project stakeholder meetings and coordination.

1.10 PRIOR STUDIES & REPORTS

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

U.S. Army Corps of Engineers, Final Integrated Feasibility Report and Programmatic Environmental Impact Statement for the UMR-IWW System Navigation Feasibility Study (Rock Island District, St. Louis District, St. Paul District, 2004). Available at: *https://www.mvr.usace.army.mil/Portals/48/docs/Nav/NESP/Main_Report_Final.pdf?ver=2017-06-20-173431-180*

U.S. Army Corps of Engineers, 15 December 2004. Upper Mississippi River – Illinois Waterway System Chief's Report. Available at: *https://www.mvr.usace.army.mil/Portals/48/docs/Nav/NESP/CHIEFS%20REPORT%20FINAL%20(15%20Dec%2004).pdf*

NESP Design Pamphlets. 2023. Set of project measure design examples developed specifically for habitat restoration projects under the NESP program.

Upper Mississippi and Illinois River Floodplain Forests: Desired Future and Recommended Actions. 2002. Upper Mississippi River Conservation Committee (Urich, Swenson, & Neslon, 2002). This report highlights the ecological importance of floodplain forests in the Upper Mississippi (from the head of navigation at Minneapolis, MN to the confluence with the Ohio River at Cairo, Illinois) and Illinois Rivers (entire Illinois River) and provides management recommendations to achieve desired future conditions for those forests.

Johnson, B.L., and K.H. Hagerty, editors. (2008). Status and Trends of Selected Resources of the Upper Mississippi River System. U.S. Geological Survey, Upper Midwest Environmental Sciences Center, La Crosse, WI. Technical Report LTRMP 2008-T002. (Johnson & Hagerty, 2008). This report describes the UMRS and includes discussions on the historic and existing conditions, river monitoring and management, and ecosystem goals and indicators. It also discusses the status and trends of biological, physical, and chemical indicators of system health developed through UMRR-LTRM.

Upper Mississippi River Restoration Environmental Design Handbook. 2012. USACE, Rock Island District, Rock Island, Illinois (USACE, 2012). The design handbook of the UMRR evaluates project measures and incorporates lessons learned throughout the lifetime of the program.

McCain, K., Schmuecker, S., and De Jager, N. 2018. Habitat Needs Assessment-II: Linking Science to Management Perspectives (McCain, Schmuecker, & De Jager, 2018). This report summarizes the second Habitat Needs Assessment of the UMRS and is intended to help inform the UMRR Program in selecting, designing, and evaluating future restoration projects to achieve the UMRR Program's vision. It describes and compares historical, existing, forecasted, and desired future conditions to identify habitat needs within the UMRS.

Guyon, L., Deutsch, C., Lundh, J., & Urich, R. (2012). Upper Mississippi River Systemic Forest Stewardship Plan. U.S. Army Corps of Engineers. (Guyon, Deutsch, Lundh, & Urich, 2012). This report was developed to provide a guide for the sustainable management of UMRS forests, including opportunities for their restoration, and to ensure that the UMRS maintains its recognition as a nationally treasured ecological resource. The report accomplishes this by describing the current understanding of the state of the resource and its ecological stressors; providing guidance for forest restoration activities; establishing goals and objectives; identifying opportunities and data needs; establishing a monitoring strategy through an adaptive management framework; and developing additional recommendations that would ensure the long-term sustainability of this key component of the UMRS ecosystem.

2.0 ASSESSMENT OF EXISTING CONDITIONS*

At a broad scale, the existing and future without project conditions of the UMRS are accurately described within the 2004 IFR/EIS, Chapter 4. Information and conditions specifically relevant to the study area are described below.

2.1 RESOURCE HISTORY OF THE PROJECT AREA

The project area consists of two primary islands (Denmark and Drift Islands), associated smaller islands, side channels, and backwaters. The area is bounded to the north by the Sny Levee and the main channel of the Mississippi River to the south.

The earliest information found on the land cover of the project area is from the Government Land Office (GLO) surveys that took place in 1843. Surveyors identified the area as being mostly timber composed of Maple, Ash, Elm, Locust, Red Bud, Hackberry, Pecan, and Oaks with undergrowth of Oak, Locust, Red Bud, Hackberry, Mulberry, grape vines, and green briars. Some wet meadow areas were noted as well. Surveyors noted a number of sloughs that ran through this area that were not able to be crossed on foot, that the land was slightly rolling, and parts were fit for cultivation. GLO surveyors recorded species for the project area that are similar to what Nelson et al. (1998) described for islands in Pools 25 and 26. Approximately 46% of the land cover of Pools 25 and 26 was prairie, 35% forested, and the rest open water and swamp or

marsh. Most of the prairie occurred on the mainland and the islands were mostly forested. Even though the project area is in Pool 24, historical data from nearby Pools 25 and 26 would have been similar to the forest composition of Pool 24 (USACE, 2022).

Most of the floodplain forests in this region had timber cut during the mid-1800s to support the early steamboat industry. While there is no direct evidence to support this happening on the project area, the area's close proximity to the main channel likely did not preclude it from this activity (USACE, 2022).

In the late 1880s and early 1900s, the Mississippi River Commission (MRC) conducted an extensive high-resolution survey of the Mississippi River from Cairo, IL to Minneapolis, MN. Island accretion and erosion were the most significant events occurring at the time of this survey. Evaluation of the GLO maps and notes indicates that the current backwater and side channel system present today were not present in the 1890s. Instead, it was classified as sand/mud and was likely only inundated during events of high water. The only tree species listed in the survey map was Maple. There were noticeable ridges and swales in the survey. Higher ridges had an elevation approximately 5-10 feet above the low swales. There are some areas that have since been eroded on the river side of Upper Drift Island. There are also areas that have since accreted on the downstream end of Upper Drift Island near Cottonwood Island. The island now known as Bay Island was connected to Upper Drift Island in the past. Agriculture was also present in several locations on the downstream end of Upper Drift Island during that time (USACE, 2022).

1939 aerial photography shows accretion still occurring on the upper and the lower end of the Upper Drift Island. Bay Island had become separated from Upper Drift Island by this time. The side channel between Upper Drift Island and Denmark Island contained many sand bars. Many areas were being actively farmed at this time. The backwaters and side channels were starting to become more permanent and in the same locations as present time (USACE, 2022). Side channels are naturally transitory features in un-engineered systems. This system has been highly engineered over the last 80+ years, through damming, river training, and bank armoring, leading to the relative stability of the features now; attribution to individual constructed features is not possible. The side channel flow reduction from river training and stability of the islands has resulted in sediment deposition being one of the dominant geomorphic processes in these side channels and backwaters.

The agriculture on Upper Drift Island stopped around the time of USACE acquisition in the mid-1940s. By 1975, some areas that were previously farmed transitioned to shallow perennial marsh (Figure 4). Other areas of previous agricultural operations transitioned into young Cottonwood or Willow forest, young lowland hardwood forest (mostly Maple/Ash/Elm community), and some grassland/forb habitat (USACE, 2022).

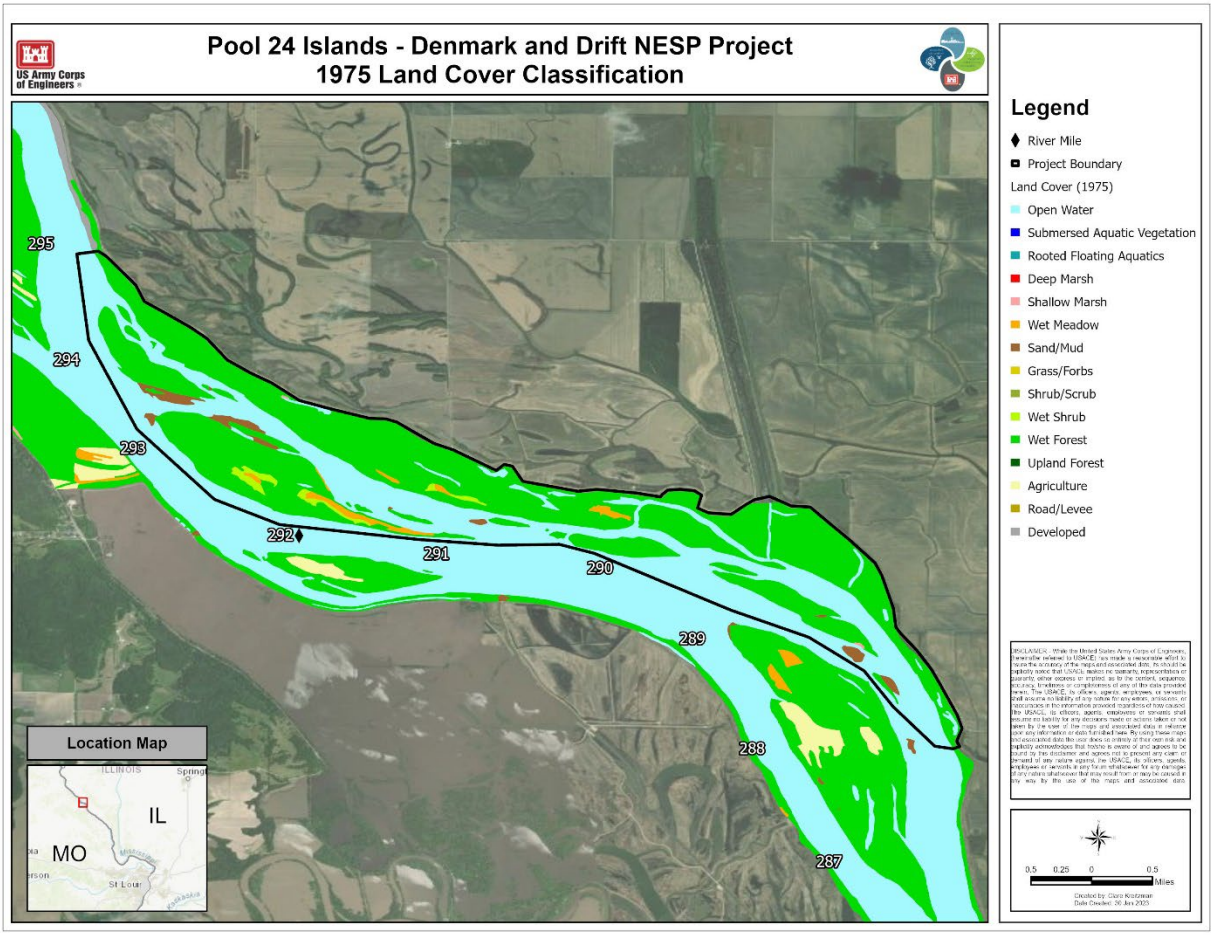


Figure 4: 1975 Denmark and Drift Land Cover Classification

By 2011, Upper Drift Island had stopped accreting. Upper Drift Island was classified as 638.6 acres of floodplain forest, 74 acres of open backwater, 14.3 acres of sandbar habitat, 11.5 acres of wet meadow, and 1.6 acres of shallow marsh in the land cover classification conducted by LTRM in 2011 (USACE, 2022).

Table 1: Land Cover Classification 1890 - 2011

Land Cover Classification	1890	1975	2011
Agriculture	15	0	0
Floodplain Forest	1147	1288	1482
Swamp/Shrub Marsh	20	31	13
Grassland/Wet Prairie	74	36	32
Mud/Sand flat	471	48	31
Open Water	1594	1918	1757
Developed	0	0	6

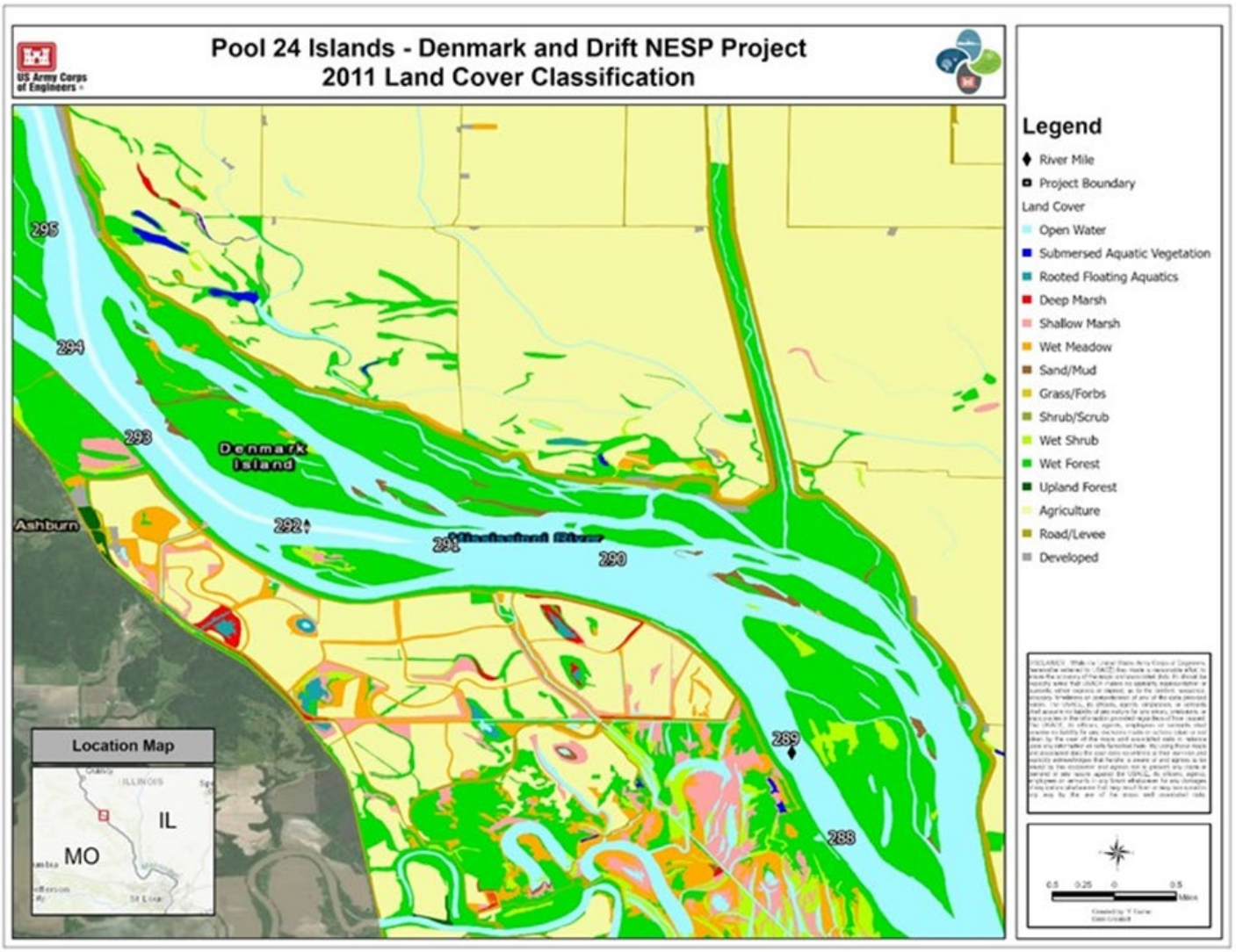


Figure 5: 2011 Denmark and Drift Land Cover Classification

Hydrology has also changed significantly over the past 150 years. The Lock and Dam 24 at Clarksville, MO is approximately 16 river miles downstream of the project area. It began operating in March of 1940. Due to the USACE-mandated 9-Foot Navigation Channel, the river levels are more than 7 feet higher on average since the lock and dam system was implemented and there is less fluctuation in annual water levels. Prior to the lock and dam system, floodplain forests were historically drier overall and dried out faster as water receded after high water events (USACE, 2022).

2.2 DESCRIPTION OF CURRENT MANAGEMENT

The project area (Figure 5) includes 3,320 acres of backwater, side channel, island, and floodplain forest habitat. Drift and Denmark Islands are primarily forested islands within the project area.

The terrestrial habitats in the area are owned and managed by the USACE for migratory and resident wildlife and recreation. This area is a popular recreation destination for waterfowl hunters, as well as other forms of ecotourism such as fishing, kayaking, and wildlife viewing.

2.3 HYDROLOGY & HYDRAULICS

Dams, when they are exerting control, set the water surface elevation by restricting the flow of water through the dam until a target water surface elevation is reached. The water surface elevation of Pool 24 is primarily controlled by LD22 upstream and LD24 downstream, with tributary flows entering the pool from the Salt River at RM 284.1. The gages in the pool are the LD22 tailwater gage, the “hinge point” gage at Louisiana, MO (one of two points of water surface elevation restriction), and the LD24 pool gage; the lowest gage on the Salt River is the Ashburn gage.

The series of lock and dams on the UMRS are not for flood risk reduction by way of water storage. Instead, the river still experiences flood pulses during the spring, but the historic summer extreme low-flow conditions have been eliminated (Wlosinski & Hill, 1995). Consequently, water surface elevations within the UMRS, including the project area within Pool 24, are higher than they were historically, especially at low discharges. This change can be seen on a hydrograph of the stage from the Louisiana gage (located at RM 282.9) (Figure 6).

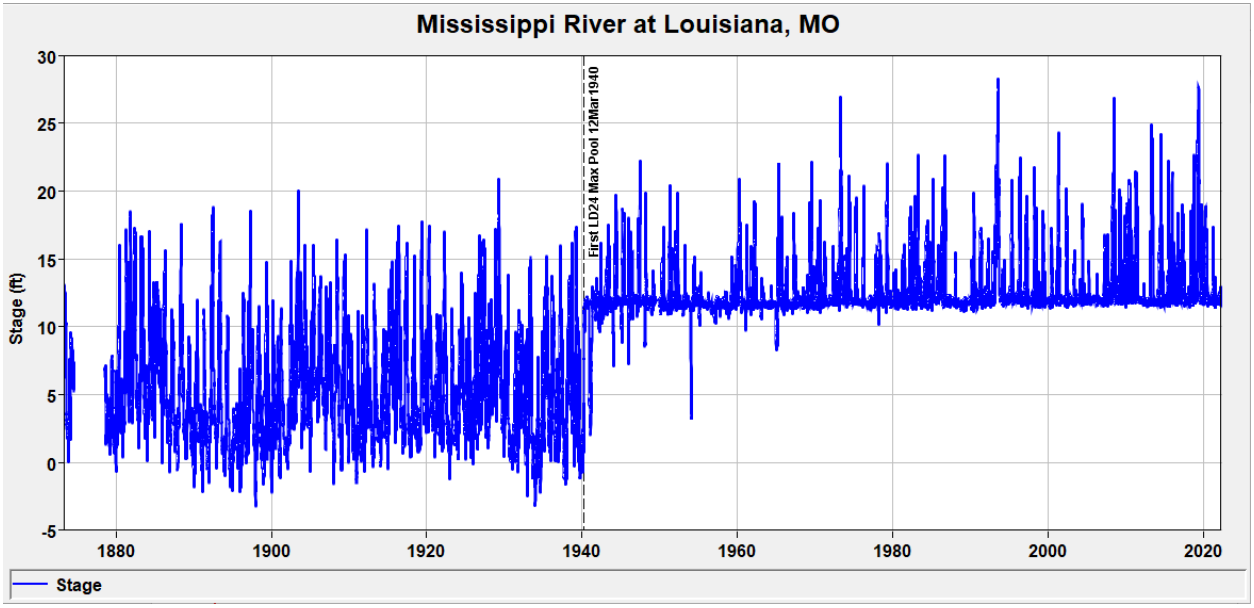


Figure 6: Stage Hydrograph for the Mississippi River at Louisiana, MO (RM 282.9)

There are different ways to operate dams to achieve a desired water surface. LD24 is operated using a technique called “hinge-point control”. This means that there are defined operational stage ranges for the gages both at the dam itself (the LD24 pool gage) and at a “hinge” (the Louisiana gage) approximately halfway upstream into the

pool resulting from the dam. At low flows, water is released through the dam to maintain the maximum pool elevation at the dam. As flows begin to increase, additional gates are opened at the dam to draw down the water surface at the dam, leading to a slope in the pool's water surface and keeping the water stage within the mandated limits at the hinge. This drawdown continues until reaching the minimum stage allowed at the dam under the operations plan, a point called maximum drawdown. As flows continue to increase, the stage would eventually exceed the upper operation range at the hinge. Eventually, flows increase to a point that the water surface between the pool and the tailwater of the dam equilibrate, at which point the gates of the dam are out of the water and exerting no control. The flows at this point and above are known as an "open river" condition. Being above the hinge point, the project area has an increased water surface condition during drawdown as compared to what is experienced during a flat pool condition.

Environmental Pool Management (EPM) has been implemented since 1994 in an attempt to create thousands of acres of wetland vegetation in the navigation pools, while still maintaining a safe and dependable navigation channel. During early implementation of EPM, the navigation pool water level was held approximately one foot lower than maximum pool for a period of 30-45 days typically between May and July. In more recent implementation, EPM has been targeting a 90+ day drawdown starting with a drawdown in March before centrarchid spawn. The "drawdown" is then followed by a slow rise back to "full pool" in late August or early September. What usually results is an expanse of wetland vegetation, that when flooded, provides habitat for both fish and wildlife. The navigation pools are held either near the top of the operating range to improve fish spawning, held low to allow for maximum vegetation growth or somewhere in between depending on the determined needs and attainable river levels for that year. For Pool 24, the operating pool limits range in elevation from 445.28 feet to 448.78 feet NAVD88. Even with EPM, the annual hydrograph for Pool 24 does show a spring rise followed by relatively stable water elevations the rest of the year. By drawing down the pool for EPM, a slight slope is introduced in the pool, resulting in slightly higher water surface elevations in the project area than those that would be experienced at flat pool (< 1 ft).

Since the 1870s, the USACE has used revetment to control the planform geometry of the navigation channel of the Mississippi River by armoring the banks against the erosive flows that would lead to channel migration (Robinson & Ethridge, 1984). The level of revetment in a reach provides an indicator of how much planform geometry evolution is possible and where it is still possible. The main channel side of Denmark Island has been partially armored (revetted) with riprap; the main channel side of Cottonwood Island has been completely revetted. Across the river, the Missouri bank is revetted opposite Denmark Island and the main channel side of Blackbird Island. The Missouri bank is not revetted opposite Cottonwood Island, but there have been multiple river training structures constructed along the bank in that area that have led to deposition amongst the structures. The end result of the revetment and structure usage is that the planform of the main channel is functionally locked into place, with side

channel, islands and off-channel banklines remaining as the main locations for potential geometry change.

An analysis was performed on the 2007, 2011, 2015, 2019, and 2020 hydrographic surveys of the main channel adjacent to the project reach to investigate variability of the main channel over time. For this analysis, raster surfaces were created for these surveys, and cells common to the individual rasters of each survey were compared. For the majority of common cells, the standard deviation of elevation was found to be less than two and half feet, suggesting that there was little change in elevation for most of the main channel.

River training structures take advantage of the river's hydraulics to promote the evolution of the river towards desired outcomes (e.g., additional depth of navigation, flow concentration in the main channel, less erosion in bends, etc.). The number of river training structures in a reach can be used to understand how much and where the reach has been manipulated from natural conditions, with a higher structure count indicating more manipulation. Approximately 20 river training structures have been partially or completely constructed within the project limits. This includes a combination of longitudinal dikes in the main channel, closure structures in side channels, and chevrons. Helicopter imagery of the locations of the closure structures was examined; water surface disturbances and the roots of some of the structures could be observed (294.6L, 294.2L, 291.7L, 289.3L).

The District does not frequently dredge in the main channel adjacent to the project reach. The District last dredged in this reach near Cottonwood Island in 2021; before that, the District dredged once in 2016 in close to the same area, and twice in 2010 (once near Mundy's Landing at RM 294.2 and once near Cottonwood Island).

Sediment is generally stated to get trapped in pools and build up in backwater areas. The rate of this sediment deposition provides a measure of how long the side channels and backwaters in the pool would exist for water storage, flow connectivity, and aquatic habitat versus becoming landmass. The team was unable to identify any true measurements of deposition rate within the side channels of the project area. As a surrogate measure, the District performed an analysis comparing 2006 to 2018 hydrographic survey data collected in the side channels from between Drift and Denmark Islands and between Cottonwood Island and Drift Island. This survey comparison provided a change in elevation between the two surveys; combining the elevation change with the difference in time between the collection of the two surveys allows for the estimation of a deposition rate. To do this, the survey data were converted to Triangulated Irregular Network (.TIN) surfaces for data editing and then rasters for comparison. The mean deposition rate for this area was determined to be approximately 0.8 inches/year. However, this deposition rate is highly sensitive to comparison extents, as expanding the extents of the comparison of the two surveys to the project area yields a mean deposition rate of approximately 3.8 inches/year, driven largely by deposition adjacent to and downstream of Willow Island. However, a rate of 3.8 inches/year would have led to far more planform change than identified by aerial photos, and thus, the 0.8

inches/year of deposition calculated is taken as the best available measure. It is worth noting, among other considerations, that 1) hydrographic surveys are merely snapshots in time; 2) converting survey data points to surfaces has multiple ways to introduce error; 3) hydrographic surveys collected in side channels usually have limited coverage; and 4) data was limited to comparison between only two surveys. Pool 24 has been noted as having experienced general aggradation between 1940 and the mid-1980s (Chen & Simons, 1986) due to its tendency to trap sediments from LD22 and the Salt River.

2.4 AQUATIC RESOURCES

There are over 300 species of freshwater mussels in North America, all considered to be important for an assortment of reasons; however, they have experienced severe decline over the last few decades and are likely the most endangered group of animals globally (Geist, 2010). In 2021, the USFWS proposed 23 species be removed from the endangered species due to extinction; eight of those 23 were freshwater mussels. This diverse group of species can be found in nearly every type of waterbody (streams, rivers, lakes) in North America (Strayer, 2008). Mussel decline causes great concern, because mussels, which are filter feeders, provide a litany of ecosystem goods and services (Vaughn, 2018), such as nutrient cycling and storage, structural habitat, food web regulation, removal of harmful bacteria and metals, and cultural and recreational resources (Vaughn, 2018; Wang, et al., 2021; Puri, Juan, Catarina, Leandro, & Rubal, 2021). Mussel beds of sufficient size can filter millions of gallons of water a day (Smith, Shaffer, Koupal, & Hoback, 2012). Water quality can subsequently impact mussels through pollution, such as contaminants contained in run-off from agriculture (e.g., pesticides, sediments), industry (e.g., chemicals), and developed areas (e.g., road salt) (Naimo, 1995). In addition to the natural service of increasing water quality, mussels provide a source of protein and material (buttons & pearls) for human consumption. However, decades of overharvesting of mussel beds, habitat degradation and hydraulic alteration (e.g., navigation and dam projects) have severely limited their numbers in North America’s water bodies.

Mussel reproduction and life histories are complex, involving distinct fish species that act as carriers of mussel larvae, or glochidia. Fish hosts are parasitized by glochidia by coming into close proximity or making contact with reproductively active adult mussels (see Appendix D, Table D-1 for a cross reference of known Pool 24 mussel species and their associated fish hosts). Glochidia develop on the gills of their host fish until mature enough to drop off fish host and start new mussel beds. Compounding pollution and overharvesting, many populations have become disconnected from their host fish through the installation of dams and water diversion structures (Watters 1996, Vaughn and Taylor 1999).

The availability of mussel bed habitat, i.e., adequate depth, flow, and substrate components are just as imperative as side channel connectivity for host fish mobility to the overall health, diversity, and abundance of native mussels (Osterling, Lope-Lima, & Foufe, 2020). Another obstacle is the level of specificity in mussel to host fish relationships. Some of the more imperiled mussel species sometimes rely on only one

or two specific fish species as glochidia hosts, and if the aquatic habitat is not adequate to support both the fish and mussels, or at least allow for fish host mobility to and from appropriate habitat, successful recruitment of new mussels is diminished.

Although many challenges face mussel species, their importance as providers of ecosystem goods and services and their contribution to overall aquatic diversity place them on a national scale of environmental concern. To address the threats and decline in mussel populations, it is important to prioritize the ecological requirements of freshwater mussel species in aquatic ecosystem restoration plans and actions.

The District maintains a navigation channel on the lower 80 miles of the Illinois River, 300 miles of the Mississippi River from Saverton, Missouri to Cairo, Illinois, and the lower 36 miles of the Kaskaskia River. Additionally, the USACE constructs smaller projects in and around waterways for flood management and environmental restoration. These projects involve dredging and placement of dredged material, as well as the placement of rock structures; activities that have the potential to either negatively or positively impact freshwater unionid mussel species (unionids). To better understand the unionid mussel habitat requirements within its waterways and to ascertain whether habitat can be enhanced or created during its undertakings, the USACE contracted Ecological Specialists, Inc. (ESI) to compile a list of published literature on mussel habitat, with emphasis on the Upper Mississippi River Basin (UMRB), and then summarize that compilation (ESI, 2014). The following information has been extracted from that summary report as it pertains to this effort‘s project specific location.

Pool 24 is perhaps the most studied pool with respect to mussels within the St. Louis District reach of the UMRB. Much of the thalweg and channel borders were loose sand, which is unsuitable for unionids. However, 13 mussel beds are known to occur in the pool. In general, unionids were limited to small pockets (< 500 meters long) within secondary or tertiary channels or in thin strips (< 100 meters wide) along the channel borders in silt/sand/clay substrate, although a few larger mussel beds occur in the upper portions of the pool with cobble, gravel, and sand substrate. Beds contained a low density (≤ 5/meter^2) of unionids and were dominated by either Washboard (*Megalonaias nervosa*) or Threeridge (*Amblema plicata*). The few larger beds in this pool have cobble, gravel, and sand substrate, resulting in higher species richness and density than the smaller beds with silt/sand/clay substrate. One federally endangered species Spectaclecase (*Cumberlandia monodonta*), one Missouri endangered species Ebonyshell (*Fusconaia ebena*), and two Illinois threatened species Butterfly (*Ellipsaria lineolata* and Black Sandshell (*Ligumia recta*) appear to be extant in Pool 24.

Upstream of the project area, a small bed was found along the left descending bank, just upstream of the Hadley-McCraney canal (RM 296.9-297.3). Substrate in this bed consisted of large cobble and sand, and 15 species were found in 2008 (Corgiat & Moore, 2008). Part of this area was sampled by ESI in 2002. Substrate was cobble, gravel, sand, and bedrock within 50 meters of the bank where unionids were found (ESI, 2002) and (ESI, 2014).

On the Missouri side of the channel, adjacent to the project area, Blackbird Island Bed (RM 291.8-292.4; (Corgiat, D.A., 2008) is also one of the best beds in the St. Louis District reach of the UMRB. This bed was quantitatively sampled in 1989 (14.8/meter²) and in 2003 (3.9/meter²). Construction of an “L” dike upstream of the side channel in 1987 and/or a bullnose dike at the head of the island in 1996 may have caused the significant decline in density. These structures altered local hydraulic conditions, which resulted in changes in substrate characteristics, which could have affected mussel distribution and abundance. In 1989, gravel and sand substrate and unionid mussels extended across the side channel. In 2003, substrate in most of the side channel was loose sand. Gravel substrate and mussels were limited to the area along the right descending bank. However, sampling further downstream in 2003 resulted in 16 species. In 2008, the identified substrate was clay/silt with pockets of sand along the island edge and sand/gravel along the right descending bank. *Obliquaria reflexa*, *Obovaria olivaria*, *Amblema plicata*, and *Quadrula pustulosa* dominated this community in 2008, but the Missouri endangered *Fusconaia ebena* was also collected (Corgiat, D.A., 2008). A few unionids were also found in the silt/clay substrate near the right descending bank between RM 290 and 291 downstream of Blackbird Island, but the majority of the sampled area was unstable sand (ESI, 2009) and (ESI, 2014).

Within the project area, three chevron Dikes were constructed between RM 290 and 289 on the left descending bank in 1993 (ESI, 2012). Most of the area on the exterior of the dikes was loose sand in 1994 (ESI, 1994) and 2012, but the sand between dikes had started to form a crust and stabilize in 2012 (ESI, 2012). No live unionids were found in the area surrounding the dikes in either 1994 or 2012, but one weathered dead shell of *Cumberlandia monodonta* was recovered in 2012. The face of the dikes was investigated, but no live or additional shells of this species were found. A weathered *Potamilus capax* shell was also recovered, but no evidence of live individuals was found. The area directly within the structures was deep silt and a few thin-shelled unionids were found in 2012. One strip of unionids was found in silt, sand, clay substrate near the island upstream of the upstream most dike. Most of the unionids were *Amblema plicata*. It is not known whether this strip of unionids was present in 1994 or whether the chevron dikes created this habitat (ESI, 2014).

Unionids have also been found in the Fritz Island complex side channels. A bed occurred in the southern end between RM 287-287.5, and in a tertiary channel within the project area (Murphy Bed, 289.6; (Corgiat, D.A., 2008)) and (ESI, 2014).

Within the project boundary, there are more records of older samplings that returned mussels and beds (Figure 7).

The project area was surveyed again in 2023 with a contracted mussel survey. Quantitative and qualitative sampling methods were used to characterize the mussel community. Quantitative sampling provided data to determine mussel density estimates and distribution, and qualitative sampling provided information on mussel species composition within the approximately 1,100-acre Denmark and Drift Islands project area

(Figure 8). The sampling design targeted as much aquatic area as possible to facilitate mapping of the existing mussel resources within the project area.

The survey showed that the project area supports a low-density mussel community dominated by a few common Mississippi River species. The survey yielded only 112 live mussels of 16 species, and no state or federal T&E species were observed. Density and catch per unit effort (CPUE) were low, nearly 80% of the mussels collected in quantitative samples were young individuals with ≤5 external annuli, and most individuals were of tribe Lampsilini, which are generally regarded to be more tolerant of disturbed or unstable habitat. Mussels were scattered throughout the survey area, but no distinct mussel concentrations or areas of high density were observed. Mussels appeared to be associated with small patches of more stable habitat near island banks or structures (wing dams, closing structures). The contractor concluded that if feasible, future project or restoration designs that enhance or stabilize substrate, by introducing coarser substrate materials and/or by reducing sand movement and accumulation, could increase the quantity and quality of mussel habitat in the project area (EnviroScience, Inc., 2023) see Appendix L – *Baseline Mussel Survey* for more details.

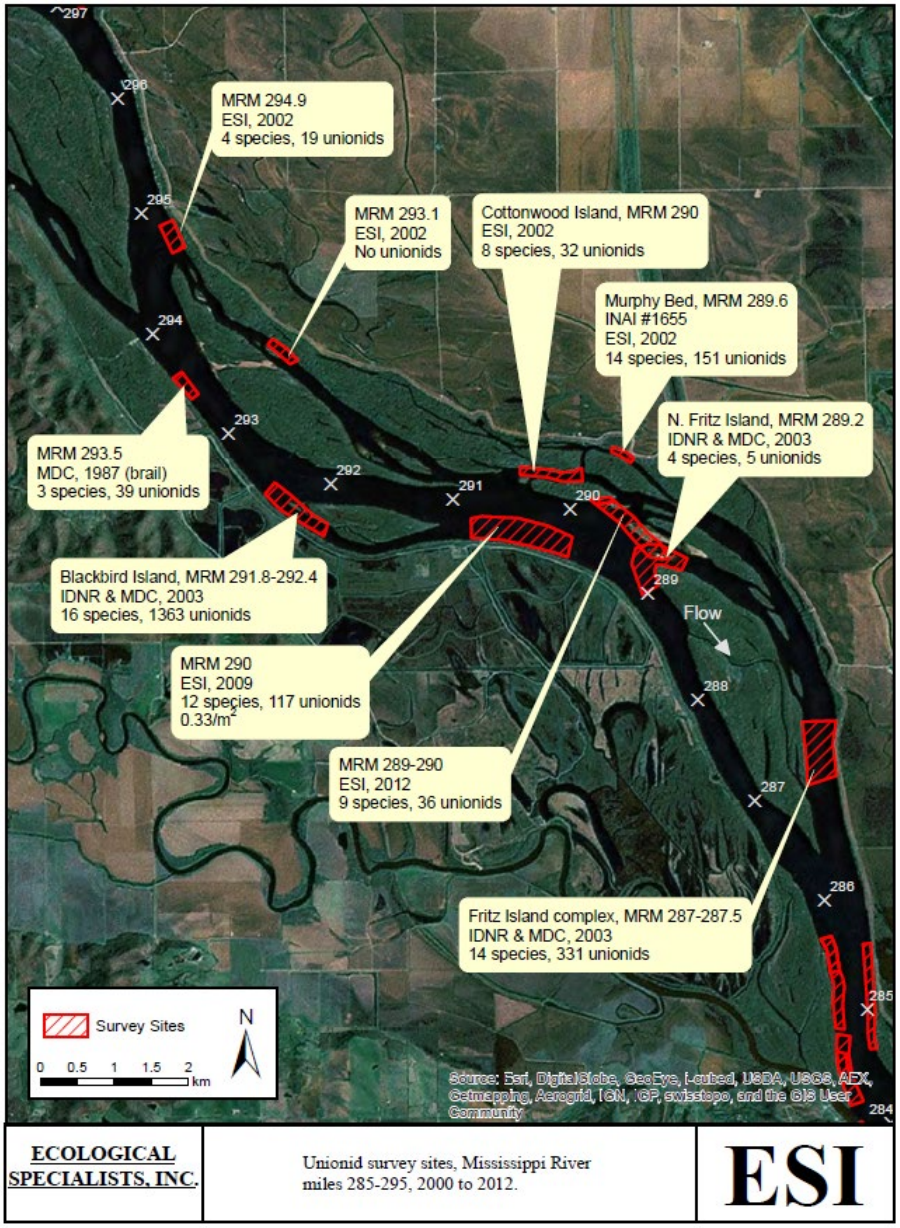


Figure 7: Historical records of known mussel resources (ESI, 2014)

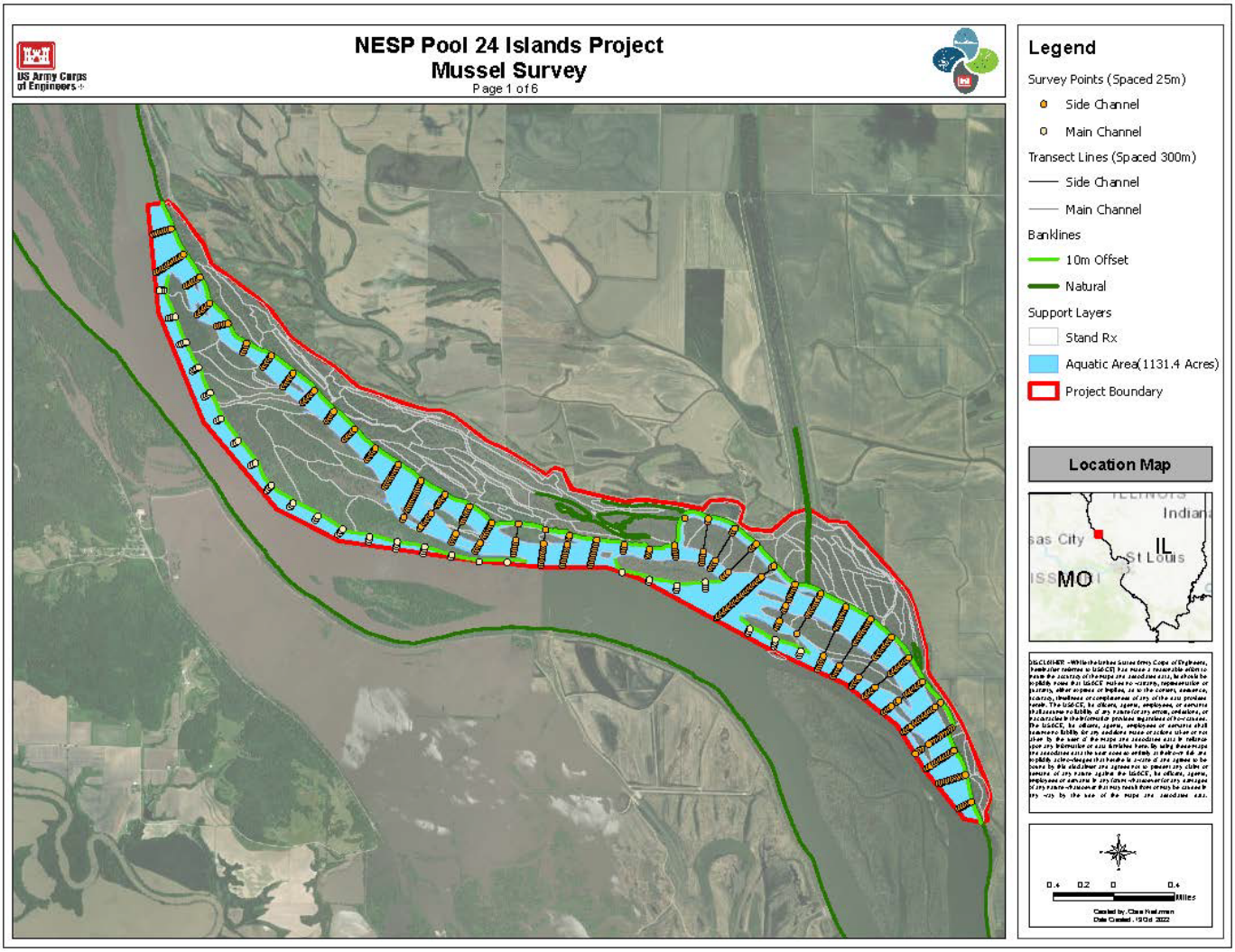


Figure 8: Mussel survey sampling effort to be completed in FY 2023

2.5 FLOODPLAIN HABITAT

2.5.1 Bottomland Forest

Bottomland forest communities provide many ecological functions and services ranging from local ecosystem benefits to promoting ecosystem health of the UMRS as a whole. Ecosystem benefits of bottomland forests include improved water quality, fish and wildlife habitat, erosion protection, carbon sequestration, consumptive and non-consumptive use, and aesthetic value. These forests are generally two- or three-layered with woody species dominating the canopy, mid-story, and understory layers. However, herbaceous vegetation may dominate the understory seasonally and in canopy gaps or less densely canopied areas of floodplain forests. The bottomland forest ecosystem is a hot spot of biodiversity and exhibits a high rate of biological productivity in marked contrast to the larger landscape.

Modern UMRS forests represent only a small portion of pre-European settlement floodplain forests in some reaches. The amount of bottomland forest within the UMR floodplain has been significantly reduced from historic levels by clearing of land for agriculture and development, primarily on the lower impounded (RM 203-522.5), unimpounded (RM 0-203), and Illinois River reaches. Forests covered 56 percent of the landscape at the confluence of the Illinois and Mississippi Rivers in 1817. By 1975, these forests were reduced to 35 percent of the landscape (Figure 4).

Current management of the 3,320-acre project area falls under the USACE Rivers Project Office and is guided by broad habitat goals and objectives outlined in the Upper Mississippi River Systemic Forest Stewardship Plan (Guyon, Deutsch, Lundh, & Urich, 2012). Site specific goals and objectives were developed by Rivers Project foresters and biologists in 2020.

2.5.1.1. Upper Drift Island

Upper Drift Island is mostly classified as floodplain forest (638 acres) but also includes 11.5 acres of wet meadow, 14.3 acres of sandbar, 1.6 acres of shallow marsh, and 74 acres of open backwater. Upper Drift Island supports a large expanse of contiguous forest with highly variable ridge and swale topography. The variation in topography and hydrology supports a highly diverse group of forest communities including Maple/Ash/Elm, Cottonwood/Maple, Cottonwood, Oak/Hickory, Mixed, Willow, and Swamp Shrubland. This sub-unit is accessible by river and partially accessible by land.

Forest inventory data were collected on this site in 2009 and then again in 2017 (Table 2). This data shows a slight increase in basal area over that time and no change in the average trees per acre. However, all the larger size class of trees have decreased in abundance over that time and the amount of snag trees per acre has more than doubled.

When comparing the most recent data to the desired stand conditions outlined in the UMR Systemic Forest Stewardship Plan (Table 3), most metrics fall within the lower end of acceptable range. However, tree stocking is lower than desired conditions. As of 2017, stocking density for Upper Drift Island is 45% and desired minimum stocking density is 50%. This data was collected prior to the 2019 flood, which resulted in higher-than-normal flood mortality, due to an extended period of tree root inundation. It can be expected that forest metrics collected after the 2019 flood would be below the desired conditions and would require active management to restore these sites.

Table 2: USACE High Intensity Phase II Forest Inventory Data

SITE	Year	Average Basal Area (feet2/Acre)	Average Trees/ Acre	Pole (5”-12”) Trees/ Acre	Saw (12”-18”) Trees/ Acre	Mature (18”-24”) Trees/ Acre	Overmature (>24”) Trees/ Acre	Snag Trees/ Acre	Hard Mast Trees/ Acre	Soft Mast Trees/ Acre	Trees Sampled	Plots Sampled	Species Richness
Upper Drift Island	2009	104.5	47.3	15.1	12.8	8.8	10.5	4.2	0.4	1.8	3033	290	17

Upper Drift Island	2017	104.7	47.3	20.6	10.1	7.3	9.3	9.1	0.5	3.6	3067	293	17
Lower Drift Island	2009	112.5	64.9	20.7	18.7	10.9	10.1	4.5	3	1.9	1744	155	16
Lower Drift Island	2017	118.7	60.5	16.7	12.2	10.4	10.7	10.5	2.4	0.1	1851	156	17
Denmark Island	2009	105.7	81.8	34.3	19.8	10.4	7.6	9.7	0.3	5.1	2389	226	11
Denmark Island	2017	124.6	89.4	37.8	18.9	11.7	10.2	10.8	0	9.8	2977	239	12

2.5.1.2. Lower Drift Island

Lower Drift Island is mostly classified as floodplain forest (301 acres) but also includes 29 acres of open water, 6 acres of developed land/recreational cabins, and 2 acres of mud flat. Lower Drift Island supports a large expanse of contiguous forest with highly variable ridge and swale topography. The variation in topography and hydrology supports a highly diverse group of forest communities. This sub-unit is accessible by river and partially accessible by land.

Forest inventory data was collected on this site in 2009 and 2017 (Table 2) and shows an increase in basal area over that time, but a decrease in trees per acre occurring in the pole, saw, and mature size classes. Snag trees have also more than doubled over that time.

When comparing the most recent data to the desired stand conditions outlined in the UMR Systemic Forest Stewardship Plan (Table 3), most metrics fall within the lower end of acceptable range. However, tree stocking is lower than desired conditions. As of 2017, stocking density for Lower Drift Island is 48% and desired minimum stocking density is 50%. This data was collected prior to the 2019 flood, which resulted in higher than normal flood mortality.

2.5.1.3. Denmark Island

Denmark Island is mostly classified as floodplain forest (543 acres) but also includes 20 acres of wet meadow, 15 acres of sand bar habitat, and 6 acres of open water. Denmark Island supports a large expanse of contiguous forest with highly variable ridge and swale topography. The variation in topography and hydrology has potential to support a highly diverse group of forest communities. This sub-unit is only accessible by river. Forest inventory was collected on this site in 2009 and in 2017 (Table 2) and shows an increase in basal area and trees per acre over that time. Most data collected during the two sampling iterations are comparable, showing a stable forest system. There are a few areas of Denmark Island, however, that have decreased in health and composition in recent years.

When comparing the most recent data to the desired stand conditions outlined in the UMR Systemic Forest Stewardship Plan (Guyon L. D., 2012) (Table 3), most metrics fall within the acceptable range. The majority of the forest resources on Denmark Island are not currently imperiled and would continue to progress through natural forest succession. The areas that are impacted by water retention issues would continue to degrade without forest management and elevation modification. Invasive species would become more prevalent and widespread as forest health declines over time. While there is not a large amount of Japanese Hops (*Humulus japonicus*) on this site currently, it is able to establish quickly under suitable conditions. Aquatic areas would continue to experience increased siltation and provide minimal fish and mussel habitat.

Table 3: Desired Stand Conditions for Bottomland Forests within UMRS (Guyon, Deutsch, Lundh, & Urich, 2012)

Forest Variables [1]	Desired UMRS Stand Structure	Conditions that may warrant active management
Overstory Canopy Cover	70-80%	>80%
Overstory Species	2 species or more	Large blocks of single species
Basal area	90-140 feet^2 / acre with ≥25% in older age classes [2]	>200 feet^2 / acre
Tree Stocking	NA	<50% or >90%
Emergent Trees [3]	>2 / acre	<1 / acre
Understory Cover	>10%	<10%
Coarse woody debris	- - -	- - -
Small cavities (>10 inch diameter)	≥1 visible hole / 10 acres mature timber	< 1 visible holes / 10 acres
Den trees / large cavities (>10 inch diameter)	≥1 visible hole / 10 acres mature timber	< 1 visible hole / 10 acres
Standing dead and / or stressed trees	≥2 large trees / acre	<2 large trees / acre
Invasive herbaceous	<10%	>10% of herbaceous layer
Invasive woody	<10%	>10% of any canopy layer

2.6 GEOLOGY & SOILS

The soils in the project area primarily consist of silty clay loams, silt loams, and clay loams (NRCS, 2023). The soil type found most abundantly within the project area is characterized by the Natural Resource Conservation Service as Titus silty clay loam. The geomorphic position is described as floodplains, typically found on zero to two percent slopes and frequently flooded under long duration. It is described as a vertic endoaquoll, found in ponded floodplain marshes, poorly drained and hydric.

The second most common soil type found in the project area is characterized as Wakeland silt loam. The geomorphic position is also described as floodplains, typically found on zero to two percent slopes and frequently flooded under long duration. It is

made up of four components: Wakeland, an aeric fluvaquent, found in loamy floodplain forests, classified as somewhat poorly drained and hydric. Sawmill, a cumulic endoquoll found in wet floodplain sedge meadows, classified as poorly drained and hydric. Birds, a typic fluvaquent found in ponded floodplain marshes, classified as poorly drained and hydric. And Beaucoup, a fluvaquentic endoquoll found in ponded floodplain marshes, also classified as poorly drained and hydric.

The third most common soil type found within the project area is characterized as Ambraw clay loam. The geomorphic position is described as floodplains, typically found on zero to two percent slopes and frequently flooded under long duration. It is described as a fluvaquentic endoquoll, found in ponded floodplain marshes, poorly drained and hydric.

2.7 WILDLIFE

2.7.1. Birds

Large river floodplains, such as the UMRS, provide a mosaic of forest, grassland, islands, backwaters, side channels, and wetlands (Guyon, Deutsch, Lundh, & Urich, 2012). There are over 300 species of bird that migrate along the Mississippi Flyway. The project area is located on the mainstem of the UMR and is an important link along this migratory corridor. Recreational hunting opportunities are provided in portions of the project area for waterfowl, whitetail deer, and furbearing animals.

Neotropical migrants are bird species that breed in North America but migrate to wintering grounds in Mexico, Central and South America, and the Caribbean Islands. Floodplain complexes and the habitats provided are highly important to migratory bird species such as neotropical migrants. The diverse array of floodplain habitat types within the project area and in close proximity tend to support a high abundance of species and individuals.

Please see section 1.6.2 about public recognition for additional information related to birds.

USFWS Information for Planning and Consultation (IPaC) website provided a species list for migratory birds of concern that may be affected by project measures implemented in the project area (Table 4). (IPAC Report dated 04 January 2023; Appendix A, *Coordination*).

Table 4: List of Migratory Birds from USFWS IPaC System

Common Name	**Scientific Name**	**Breeding Season**
Chimney Swift	*Chaetura pelagica*	Mar 15-Aug 25
Eastern Whip-poor-will	*Antrostomus vociferus*	May 1-Aug 20
Golden Eagle	*Aquila chrysaetos*	Breeds elsewhere
Henslow's Sparrow	*Ammodramus henslowii*	May 1-Aug 31
Hudsonian Godwit	*Limosa haemastica*	Breeds elsewhere
Kentucky Warbler	*Oporornis formosus*	Apr 20-Aug 20

Lesser Yellowlegs	*Tringa flavipes*	Breeds elsewhere
Prothonotary Warbler	*Protonotaria citrea*	Apr 1-Jul 31
Red-headed Woodpecker	*Melanerpes erthrocephalus*	May 10-Sep 10
Rusty Blackbird	*Euphagus carolinus*	Breeds elsewhere
Wood Thrush	*Hylocichla mustelina*	May 10-Aug 31

2.7.2. Bald Eagle

Although the Bald Eagle (*Haliaeetus leucocephalus*) was removed from the federal list of threatened and endangered species in 2007, it continues to be protected under the Migratory Bird Treaty Act and the Bald and Golden Eagle Protection Act (BGEPA). The BGEPA prohibits unregulated take of Bald Eagles, including disturbance. The USFWS developed the National Bald Eagle Management Guidelines (USFWS, 2007) to provide land managers, landowners, and others with information and recommendations regarding how to minimize potential project impacts to Bald Eagles, particularly where such impacts may constitute disturbance.

Bald eagles generally nest near coastlines, rivers, large lakes or streams that support an adequate food supply. They often nest in mature or old-growth trees, snags (dead trees), cliffs, and rock promontories. They rarely nest on the ground, and nest with increasing frequency on anthropogenic structures such as power poles and communication towers. In forested areas, bald eagles often select the tallest trees with limbs strong enough to support a nest that can weigh more than 1,000 pounds (USFWS, 2007). There are known bald eagle nests within the general vicinity of the project area, and mature trees fitting this description also occur in numerous locations across the project area.

2.8 ILLINOIS STATE SPECIES OF CONSERVATION CONCERN

The state of Illinois has their state threatened and endangered listed by county. Table 5 was derived from the Pike County, IL list.

Table 5: IL State Species of Concern for Pike County (LE- listed as endangered, LT- listed as threatened)

Common Name	**Scientific Name**	**Classification**
Lake Sturgeon	*Acipenser fulvescens*	LE
Pale False Foxglove	*Agalinis skinneriana*	LT
Western Sand Darter	*Ammocrypta clara*	LE
Smooth Softshell	*Apalone mutica*	LT
Narrow-leaved Green Milkweed	*Asclepias stenophylla*	LE
Decurrent False Aster	*Boltonia decurrens*	LT
Blue Hearts	*Buchnera americana*	LT
Gray/Timber Wolf	*Canis lupus*	LE

Northern Harrier	*Circus hudsonius*	LE
Leatherflower	*Clematis viorna*	LE
Spotted Coral-root Orchid	*Corallorhiza maculata*	LE
Timber Rattlesnake	*Crotalus horridus*	LT
Hill Prairie Larkspur	*Delphinium carolinianum*	LE
Butterfly	*Ellipsaria lineolata*	LT
Elephant-ear	*Elliptio crassidens*	LE
Starhead Topminnow	*Fundulus dispar*	LT
Cobweb Skipper	*Hesperia metea*	LE
Loggerhead Shrike	*Lanius ludovicianus*	LE
Spectaclecase	*Margaritifera monodonta*	LE
Stickleaf	*Mentzelia oligosperma*	LE
River Redhorse	*Moxostoma carinatum*	LT
Gray Bat	*Myotis grisescens*	LE
Northern Long-eared Myotis	*Myotis septentrionalis*	LT
Indiana Bat	*Myotis sodalis*	LE
Bigeye Shiner	*Notropis boops*	LE
Heart-leaved Plantain	*Plantago cordata*	LE
Wolf's Bluegrass	*Poa wolfii*	LE
Fat Pocketbook	*Potamilus capax*	LE
Monkeyface	*Quadrula metanevra*	LT
Ebonyshell	*Reginaia ebenus*	LE
Regal Fritillary	*Speyeria idalia*	LT
Ornate Box Turtle	*Terrapene ornata*	LT
Prairie Spiderwort	*Tradescantia bracteata*	LE
Buffalo Clover	*Trifolium reflexum*	LT
Arrowwood	*Viburnum molle*	LT

2.9 FEDERALLY THREATENED & ENDANGERED SPECIES

In compliance with Section 7(c) of the Endangered Species Act of 1973, as amended, the USFWS provided a list of eight federally threatened, endangered, or candidate species that could potentially be found in the area (Pike County, IL) via a letter dated 04 January 2023 (IPAC report), updated 21 March 2024; see *Appendix C, Biological Assessment,* for more details. The listed species, federal protection status, and habitat descriptions can be found below in Table 6. No critical habitats are located in the project area. USFWS Ecological Services Office provided a Draft Fish and Wildlife Coordination

Act Report (FWCAR) for the project that was reviewed and concurred by IDNR and USFWS (Appendix A, *Coordination*).

Table 6: List of Federally Threatened and Endangered Species that may occur within the project area.

Species	Status	Habitat
Gray Bat (*Myotis grisescens*)	Endangered	Roost in caves or mines year-round. Use water features and forested riparian corridors for travel and foraging.
Indiana Bat (*Myotis sodalis*)	Endangered	Hibernates in caves and mines. Maternity & foraging habitat includes small stream corridors with well-developed riparian woods, upland & bottomland forests.
Northern Long-Eared Bat *(Myotis septentrionalis*)	Endangered	Hibernates in caves and mines. Swarming in surrounding wooded areas occurs in autumn. Roosts and forages in understory of a wide range of forested habitats during spring and summer.
Tricolored Bat (*Perimyotis subflavus*)	Proposed Endangered	Roosts among live and dead leaf clusters of live or recently dead deciduous hardwood trees in summer and fall. Hibernates in caves and mines in winter.
Spectaclecase (mussel) (*Cumberlandia monodonta*)	Endangered	Found in large rivers where they live in areas sheltered from the main force of the river current. Often clusters in firm mud and in sheltered areas, like beneath rock slabs, between boulders and even under tree roots.
Monarch (*Danaus plexippus)*	Candidate	Grassland and other herbaceous dominated habitats with Milkweed resources during the breeding life stage and similar habitats with abundant nectar resources during breeding and migration life stages. Overwintering occurs outside our region and must provide specific roosting microclimate conditions.
Decurrent False Aster (*Boltonia decurrens*)	Threatened	Disturbed alluvial soils. Moist, sandy floodplains and prairie wetlands along the Illinois River and a small portion of the Mississippi River primarily above the Missouri-Mississippi River confluence.
Eastern Prairie Fringed Orchid (*Platanthera leucophaea*)	Threatened	Occurs in a wide variety of habitats, from wet to mesic prairie, to wetland communities, including sedge meadow, fen, marsh, and marsh edge. Can occupy a very wide moisture gradient of prairie and wetland vegetation. In general, the habitat is moist or moderately moist.

2.10 INVASIVE SPECIES (EXECUTIVE ORDER 13112)

Invasive Species Executive Order 13112 aims “to prevent the introduction of invasive species and provide for their control and to minimize the economic, ecological, and human health impacts that invasive species cause”. To abide by this Executive Order, construction best management practices (BMP), such as cleaning equipment, would be in place and enforced to prevent the introduction of additional species to and transfer from the project.

Invasive Carp, including Bighead Carp (*Hypophthalmichthys nobilis*), Silver Carp (*Hypophthalmichthys molitrix*), Common Carp (*Cyprinus carpio*) and Grass Carp (*Ctenopharyngodon idella*), are found throughout the region and utilize habitats with low water velocity such as those found in the backwaters and side channels. Bighead and Silver Carp, species of particular management concern, were first documented in the UMRS in 1982 (Koel, Irons, & Ratcliff, 2000). Since then, populations have increased dramatically in the Upper Mississippi River (Koel, Irons, & Ratcliff, 2000) and Illinois River reaches (Irons, Sass, McClelland, & O'Hara, 2011).

Zebra Mussels (*Dreissena polymorpha*) have been identified in much of the UMRS. The Zebra Mussel is a small shellfish native to eastern Europe and Western Russia, named for the striped pattern of its shell. In their introduced range they are known to clog irrigation intakes, attach in clusters to various types of watercraft reducing performance and efficiency, attach to submerged rocks, ladders, and swim rafts causing a cut hazard to swimmers, attach to and smother native mussels, while competing for the same food resources as those native bivalves. According to the USGS Nonindigenous Aquatic Species (NAS) database, Zebra Mussels have been collected in clusters of 2 to 5 specimens just upstream of the project area near the left descending bank at RM 295.2, and adjacent to the project area near the right descending bank at RM 291.6. Individual specimen collections are also mapped along the right descending bank near RM 290, 292.5, and 293.

Common invasive plant species likely to be present within the project area include Reed Canary Grass (*Phalaris arundinacea*), Japanese Hops (*Humulus japonicus*), Wintercreeper (*Eunonymus fortunei*), and Purple Loosestrife (*Lythrum salicaria*).

Reed Canary Grass is a variable species with circumpolar distribution (Yatskievych, 1999). The Eurasian ecotype, originally planted for forage and erosion control, has spread throughout much of the United States and invades wetland communities and wet prairies (MDC, 2010). This cool-season grass forms dense clumps once established, and spreads aggressively through creeping rhizomes and an abundance of seed. Stems lodge by mid to late summer to form a dense mat that prevents other species from establishing. Seeds are dispersed within and between sites by waterways, animals, and on machinery primarily.

Japanese Hops is an herbaceous annual vine native to East Asia. The species is well adapted to disturbed, open floodplain habitats (MDC, 2012). The seed is dispersed primarily by water, wind, and machinery. Seed germinates in early spring but can also

occur later in the season when suitable moisture and light are available. Frequent floods in floodplain habitats create ideal conditions for the spread and establishment of this species. Once established, this twining vine can quickly overtop, blanket, and outcompete surrounding herbaceous vegetation, woody shrubs, and trees up to about ten feet in height.

Additional species have increased in the project area over the past decade at some locations. Wintercreeper (*Euonymus fortunei*) is a perennial, evergreen vine that is well adapted to light and soil conditions (MDC, 2011). In the floodplain, it is occasionally found along islands' edges and in canopy gaps but could increase in extent rapidly through vegetative spread or by bird-dispersed seed.

Purple Loosestrife (*Lythrum salicaria*) is a perennial wetland plant native to Europe and Asia (Munger, 2002). The species occupies a range of wetland habitats, including marshes, wet prairies, moist fields and pastures, and along river and stream banks. The plant spreads rapidly due its high seed production rate (e.g., up to 300,000 seeds per plant) and ability to spread vegetatively through rapidly growing rhizomes, cuttings, and offshoots (MDC, 2009). In addition, seed viability of up to twenty years results in a prolonged risk of establishment in natural communities. Increasingly, established patches of Purple Loosestrife have been identified in Pool 24, as well as Pools 25 and 26.

2.11 WATER QUALITY

Section 303(d) of the Clean Water Act requires that each state identify waters not meeting water quality standards related to beneficial uses of water including whole body contact (e.g., swimming), support aquatic life, and provide drinking water for people, livestock, and wildlife. The Mississippi River within the vicinity of the project area (Assessment ID #: IL_K-21, an 89-mile reach) is listed in the Illinois 2020 and 2022 303(d) list for impairment for aldrin, dieldrin, endrin, heptachlor, mercury, toxaphene, and polychlorinated biphenyls (PCBs) (based on fish consumption). This reach was listed in the 2018 and 2016 assessments for mercury and PCBs. Fecal coliforms were also listed for this reach (for primary contact) in the 2022, 2020, 2018, and 2016 assessments (based on primary contact recreation) (USEPA, 2023a).

2.12 AIR QUALITY

The Clean Air Act of 1963 requires the U.S. Environmental Protection Agency (USEPA) to designate National Ambient Air Quality Standards (NAAQS). The USEPA has identified standards for six pollutants: lead, sulfur dioxide, carbon monoxide, nitrogen dioxide, ozone, and particulate matter (at less than 10 microns and at less than 2.5 microns in diameter), along with some heavy metals, nitrates, sulfates, volatile organic and toxic compounds. The USEPA regulates these pollutants by developing human health-based or environmentally-based permissible pollutant concentrations. The USEPA then publishes the results of air quality monitoring, designating areas as meeting (attainment) or not meeting (nonattainment) the standards or as being maintenance areas. Maintenance areas are those areas that have been re-designated as in attainment from a previous nonattainment status. A maintenance plan establishes

measures to control emissions to ensure the air quality standard is maintained in these areas.

The Pike County, IL area currently meets all USEPA air quality standards and is not a designated maintenance area (USEPA, 2023a).

2.13 GREENHOUSE GAS EMISSIONS & CLIMATE CHANGE

Climate change is a fundamental environmental issue and is a particularly complex challenge given its global nature and inherent interrelationships among its sources, causation, mechanisms of action, and impacts. Analyzing a proposed management measure's greenhouse gas emissions (GHG) and how climate change may change a management measure's environmental effects can provide useful information to decision makers and the public. Climate change science is evolving and is only briefly summarized here. In 1970 the Council of Environmental Quality estimated the level of atmospheric carbon dioxide to be 325 parts per million (ppm). Since 1970, the concentration of atmospheric carbon dioxide has increased at a rate of about 1.67 ppm per year (1970-2019) to approximately 407 ppm as of September 2019 (current globally averaged value). Based on the United States Global Change Research Program as well as other scientific records, it is now well-established that rising global atmospheric greenhouse gas emission concentrations are significantly affecting the Earth's climate (IPCC, 2020). A large body of scientific evidence indicates that increases in GHG in the Earth's atmosphere are contributing to changes in national and global climatic conditions (Melillo, Richmond, & Yohe, 2014). These changes include such things as average temperature, changes in precipitation patterns, and increases in the frequency and intensity of severe weather events. These changes have the potential to impact a wide sector of the human environment including water resources, agriculture, transportation, human health, energy, and aquatic and terrestrial ecosystems. Therefore, it is important to understand the potential impacts of federal actions on GHG emissions and climate change as well as the potential changes that may occur to the human environment that could affect the assumptions made with respect to determining the impacts and efficacy of the federal action in question. The climate analysis specific to this project is contained in *Appendix H – Climate Analysis*.

The climate analysis appendix concluded that floodplain forest would be inundated more frequently with the expected increases in mean streamflow, and that projected rising temperatures might negatively affect water quality and aquatic habitat. It was found to be unlikely that climate change-induced increases in flow would undermine project features, although the use of the UMRR Design Handbook (USACE 2012) in the more detailed design, with an adaptive management plan, would serve to promote the resilience of ecosystem restoration features of the TSP.

2.13.1 Upper Mississippi River Region Climate Trends

The USACE is undertaking climate change preparedness and resilience planning and implementation in consultation with internal and external experts using the best available climate science and climate change information. The USACE has prepared concise and broadly accessible summary reports of the current climate change science

with specific attention to the USACE missions and operations for the continental United States, Alaska, Hawaii, and Puerto Rico. Each regional report summarizes observed and projected climate and hydrological patterns cited in reputable peer-reviewed literature and authoritative national and regional reports. The following information on climate trends and future climate projections comes from the climate change and hydrology literature synthesis report for the UMR region (USACE, 2015).

Summary of Observed Climate Findings:
"The general consensus in the recent literature points toward moderate increases in temperature and precipitation, and streamflow in the Upper Mississippi Region over the past century. In some studies, and some locations, statistically significant trends have been quantified. In other studies and locales within the Upper Mississippi Region, apparent trends are merely observed graphically but not statistically quantified. There has also been some evidence presented of increased frequency in the occurrence of extreme storm events (Villarini, Smith, & Vecchi, 2013)*. Lastly, a transition point in climate data trends, where rates of increase changed significantly, at approximately 1970 was identified by multiple authors."* - (USACE, 2015)*.*

Summary of Future Climate Projection Findings:
"There is strong consensus in the literature that air temperatures will increase in the study region, and throughout the country, over the next century. The studies reviewed here generally agree on an increase in mean annual air temperature of approximately 2 to 6 ºC (3.6 to 10.8 ºF) by the latter half of the 21st century in the Upper Mississippi Region. Reasonable consensus is also seen in the literature with respect to projected increases in extreme temperature events, including more frequent, longer, and more intense summer heat waves in the long-term future compared to the recent past. Projections of precipitation found in a majority of the studies forecast an increase in annual precipitation and in the frequency of large storm events. However, there is some evidence presented that the northern portion of the Upper Mississippi Region will experience a slight decrease in annual precipitation. Additionally, seasonal deviations from the general projection pattern have been presented, with some studies indicating a potential for drier summers. Lastly, despite projected precipitation increases, droughts are also projected to increase in the basin as a result of increased temperature and [evapotranspiration] *rates.*

A clear consensus is lacking in the hydrologic projection literature. Projections generated by coupling [Global Climate Models] *with macro scale hydrologic models in some cases indicate a reduction in future streamflow but in other cases indicate a potential increase in streamflow. Of the limited number of studies reviewed here, more results point toward the latter than the former, particularly during the critical summer months."* - (USACE, 2015)

Given the high degree of variability and uncertainty of weather patterns in general and in predictions of future weather patterns, quantifying future climate impacts in the project area is inexact. As summarized above, there is no consensus with respect to forecasts for future streamflow in the basin.

2.13.2 Project Area Climate Trends & Greenhouse Gas Emissions

In terms of climate change, changes in the annual and long-term hydrologic cycles of the Mississippi River influence the project area. The two primary factors influencing hydrology in the vicinity of the project area include: 1) snowmelt and precipitation events throughout the Upper Midwest, which includes the portions of the Mississippi River upstream of St. Louis, Missouri; and 2) local and regional precipitation. In general, there is a seasonal pattern to the river's hydrology with peak flows typically occurring in the spring and early summer associated with rain and snowmelt followed by declining flows from early summer through early fall. In addition to the annual seasonal pattern of the river's hydrology, historical data shows an 11-to-15-year cycle of increasing discharge and flooding followed by declining flows and drought (Knox, 1984); (Franklin, Wasklewicz, Grubaugh, & Greulich, 2003). Changes in hydrology (e.g., wet vs. dry periods) ultimately influence which floodplain habitats are established and able to persist.

2.14 HAZARDOUS, TOXIC, & RADIOACTIVE WASTE (HTRW)

The USACE regulations (ER-1165-2-132, ER 200-2-3) and Division policy require procedures be established to facilitate early identification and appropriate consideration of potential Hazardous Toxic Radioactive Waste (HTRW) in reconnaissance, feasibility, preconstruction engineering and design, land acquisition, construction, operations and maintenance, repairs, replacement, and rehabilitation phases of water resources studies or projects by conducting a Phase I ESA. The USACE specifies that these assessments follow the process/standard practices for conducting Phase I ESAs published by the American Society for Testing and Materials (ASTM) E2247-16.

A Phase I ESA following ASTM E2247-16 was performed for the project located in Pike County, IL. Based on the information available for this assessment, it was concluded that the project contains no RECs that would have a major impact to the project's cost and/or schedule. The environmental impact for the migration of off-site hazardous material onto the project area is negligible. A Phase II ESA is not recommended at this time.

2.15 HISTORICAL & CULTURAL RESOURCES

Historic maps from 1872 to 1942 were investigated and no buildings were identified within the project area. A review of Illinois State Historic Preservation Office files revealed that two cultural resource surveys have been conducted within the project area, but no historic properties have been identified. Survey 1090 was conducted in 1978 by Foundation for Illinois Archaeology (FIA). FIA surveyed 52 tracts along the Mississippi River shoreline; 35 on islands, 9 on the Missouri shore, and 8 on the Illinois shore. A total of 45.8 acres were surveyed for this project. No cultural resources were identified by this survey (Udesen, 1978). Survey 12823 was conducted by Center for American Archeology (CAA) in 2002 for the construction of berms on the landward side of the levee. CAA surveyed 8.35 acres. No cultural resources were identified by the survey and project clearance was recommended (Anderson, 2002).

Additional cultural resource surveys will be conducted following the implementation of the NESP/UMRR Programmatic Agreement.

2.16 SOCIOECONOMIC RESOURCES

Economic Base: According to the American Community Survey (2022) dataset (U.S. Census Bureau, 2023) for Pike County, Illinois, the median household income was $51,529 from 2017-2021 (in 2021 dollars). Approximately 13.7% of the population in Pike County, Illinois is below the poverty line.

Education: Based on the American Community Survey (2022) dataset (U.S. Census Bureau, 2023) for Pike County, Illinois, an estimated 91.1% of the population is a high school graduate or higher, and 17.6% hold a bachelor's degree or higher.

Population Demographics: According to the 2020 Census (U.S. Census Bureau, 2023), Pike County, Illinois, has a total population of 14,739, which is in decline from the 2010 census of 16,430. Median age in the 2020 census was 42.2 years, with 6.2% of the population under 5 years old, and 21.5% of the population over the age of 65. The population within the county is approximately 96.7% white, 1.7% black, 1.6% Hispanic or Latino, 0.3% American Indian and Alaska Native, and 0.3% Asian.

Recreational Resources: The Mississippi River is among some of the most productive fishing and duck hunting areas in the country. Currently, the project area is used for limited commercial and recreational fishing. Commercial fishermen typically target Common Carp, Bigmouth and Smallmouth Buffalo, Channel and Flathead Catfish, and Freshwater Drum. Recreational fishermen typically target catfish. Additionally, IDNR operates a waterfowl blind program within the Drift Island side channel that attracts numerous waterfowl hunters to the project location every fall.

2.17 AESTHETIC RESOURCES

Aesthetic resources of the project area consist primarily of natural habitats. These include riverine, wetland, wet meadow, and floodplain forest habitats that serve as scenery for visitors.

2.18 NOISE LEVELS

Inadequately controlled noise presents a risk for adverse impact to humans. Noise can also impact wildlife in the vicinity. Sounds at or below 70 dBA are usually considered safe, even if they last a long time. Noises are more likely to damage your hearing if they are: 85 dBA and last a few hours; 100 dBA and last at least 14 minutes; or 110 dBA and last at least 2 minutes (U.S. Department of Health and Human Services). Noise levels surrounding the project area are varied depending on the time of day and season. The current human activities causing elevated noise levels in the vicinity of the project area includes recreational boat traffic and commercial navigation. A pleasure boat or barge traffic noise can typically range between 65-115 decibels (dB) (USEPA, 1974). Infrequent horn blasts may be in excess of 120 dB at one foot. Noise during the hunting season may occur with typical 12 gauge shot gun at 130 dB. All of these may contribute

to noise levels within the project area. There are no noise sensitive areas in the project vicinity.

2.19 ENVIRONMENTAL JUSTICE

Under this Executive Order (EO 12898), a Federal agency "shall make achieving environmental justice part of its mission by identifying and addressing, as appropriate, disproportionately high and adverse human health or environmental effects of its programs, policies, and activities on minority populations and low-income populations in the United States." An Environmental Justice (EJ) analysis focuses on the potential for disproportionately high and adverse impacts to minority and low-income populations during the construction and normal operation of the federal action. Additionally, if the impact is appreciably more severe or greater in magnitude on minority or low-income populations than the adverse effect suffered by the non-minority or non-low-income populations after taking offsetting benefits into account, then there may be a disproportionate finding. Avoidance and mitigation are then required.

The EJ assessment was performed on the project boundary, with an additional 5 mile buffer around the project area for Pike County, Illinois (total approximate area included was 154.95 square miles). For this assessment, the EJSCREEN tool was used (USEPA, 2023b). EJScreen is an environmental justice mapping and screening tool that combines up-to-date economic statistics, U.S. Census Bureau decennial data (2020), and the 2017-2021 American Community Survey (ACS) estimates for a given area. The project area is rural in nature, consisting primarily of riverine and island habitat, with much of the surrounding area in agricultural production. The ACS population estimate (2017-2021) was 1,520 with 15 percent of the residents identified as being a minority. Forty percent of the population was identified as low-income, which is higher than the state average of 33 percent. For more details, please refer to the EJScreen report included in Appendix A – *Coordination.*

3.0 FUTURE WITHOUT PROJECT CONDITIONS, NO ACTION ALTERNATIVE

Forecasting the future is an essential part of the USACE planning process with the most important recurring forecasts being the future without project (FWOP) and future with project (FWP) conditions. The FWOP is the basis from which alternative plans are formulated and impacts are assessed and can be defined as "the most likely condition to exist in the future in the absence of a proposed water resources project" (ER 1105-2-100 p. 2-8). The FWOP, considered the No Action Alternative, would not include any of the USACE project measures, and no additional costs to the USACE would be generated.

A 50-year period of analysis was used to forecast the FWOP conditions. The period of analysis was limited to 50 years in accordance with USACE regulations (ER 1105-2-100), even though project measures are anticipated to continue having beneficial effects beyond 50 years. The base year (the year when a proposed project is expected to be operational or, in this case, when construction is complete and benefits begin accruing) considered for this project is 2027, and period of analysis is 2027-2077.

Assumptions are one of the most common ways to address uncertainty in a planning study. Several assumptions have been made in forecasting the FWOP scenario, which is further detailed below in Section 6:

1) The operations plans for LD 22 and LD 24 will not appreciably change.
2) Water levels in Pool 24 would continue to be managed for Environmental Pool Management as they are now.
3) The navigation channel would be maintained in its current location.
4) Sediment delivery from outside the project area would result in continued deposition in the Drift/Denmark Island side channel complex.
5) Forestry management would continue based on the Forest Management Plans developed for the project area by the USACE - Rivers Project Office.

3.1 HYDROLOGY AND HYDRAULICS

Assuming a deposition rate of approximately 0.8 inch/year continuing in the backwaters into the future, approximately 3.4 feet of deposition would be anticipated over a 50-year span. This rate of deposition would cause the sedimentation/siltation of the side channels surrounding Drift Island and Denmark Island and they would become part of the bankline. If a 0.8 inch/year deposition rate is too high (which is very possible given the limited data), it would be anticipated that the habitat in both side channels would have degraded due to deposition within 50 years.

Since side channel habitat improvement has been an identified habitat need for Pool 24, losing the side channels at Denmark Island and Drift Island and degrading the remaining side channel habitat in the project area would be detrimental to the overall goal of restoring and enhancing side channel habitat to promote a healthy and resilient aquatic ecosystem.

3.2 HISTORICAL & CULTURAL RESOURCES

No impacts to cultural or historic resources are anticipated in the FWOP condition. No known historic properties exist within the project area. If unknown historic properties are within the project area, the continuous sedimentation caused by the frequent flooding would bury them deeper and thus preserve the property.

3.3 FLOODPLAIN HABITAT

Without intervention in the form of forest management and elevation manipulation, the forest resources of the project area would continue to degrade. The water retention issue would continue to put undue stress on terrestrial areas and convert floodplain forest to swamp shrubland. Invasive species would continue to increase and outcompete native vegetation. Japanese Hops readily occupy newly created canopy gaps and would prevent the establishment of new forest. Aquatic areas would continue to experience increased siltation and provide minimal fish and mussel habitat. Lack of adequate depth and flow would continue to be a problem.

4.0 PROBLEMS & OPPORTUNITIES

The problems and opportunities for the NESP are described in the 2004 IFR/EIS, Chapters 1. Purpose and Need for Action and 4. Inventory and Forecast Resource Conditions. Site-specific problems and opportunities, consistent with the 2004 IFR/EIS, are described below.

4.1 PROBLEM IDENTIFICATION AND OPPORTUNITIES

Human-induced physical modifications over the past two centuries within the UMRS floodplain have altered hydrology, topography, and biotic communities historically present within the project area. These alterations have degraded aquatic resources (i.e. side channel, fisheries, and wetland habitat), reduced forest community diversity (i.e. age, structure, and species composition), impaired ecosystem functions, and threatened the future sustainability of the river-floodplain ecosystem.

4.1.1 PROBLEMS

The following site-specific problems have been identified:

- Backwater sedimentation causes poor water quality, shallow depths, and loss of connectivity with subsequent decreases in habitat function and availability for aquatic and riverine species.
- Loss of topographic and hydrologic diversity reduces vegetative community diversity and wildlife resources (e.g., forage, invertebrate production, nesting habitat, and resting sites).
- Sediment deposition impacts natural hydrologic processes and their influence on terrestrial areas, resulting in increased flood durations and decreased forest health and diversity.

4.2 OPPORTUNITIES

Opportunities exist to restore wetland and floodplain forest habitat, function, and process. Within the project area, there are opportunities for additional beneficial outcomes beyond solving the stated problems related to wetland and floodplain forest habitats.

- Design with resiliency
- Design with minimal Operation, Maintenance, Repair, Replacement & Rehabilitation (OMRR&R)
- Establishing other natural habitat types (i.e. wetlands) which may be more resilient to frequent flooding
- Developing suitable habitat types for mussels to thrive
- Evaluate global climate change opportunities (i.e. habitat types, resiliency)
- Collaborate with Sny Levee and Drainage District
- Develop habitat types for species of interest (i.e.. mussels, bats, migratory species)
- Beneficial use of excavated material

4.3 GOALS & OBJECTIVES

4.3.1 Overarching NESP Program Goal and Objectives

The primary goal of the NESP, as an integrated dual-purpose plan, is to ensure the economic and environmental sustainability of the UMR-IWW Navigation System.

To fully address this goal, the following three planning objectives were established (2004 IFR/EIS, Chapter 1.3):

OBJECTIVE 1. Recommend measures to provide for a safe, reliable, efficient, and sustainable UMR-IWW Navigation System over the planning horizon.

OBJECTIVE 2. Recommend measures to address the cumulative impacts including ongoing effects of the operation and maintenance of the UMR-IWW Navigation System.

OBJECTIVE 3. Assure that any recommended measures are consistent with protecting the Nation's environment and avoiding, minimizing, or mitigating significant environmental, cultural, or social impacts.

The goal and vision statement imply conserving the UMRS's remaining structure and function while restoring the degraded components to realize a sustainable UMRS. Five system-wide objectives have been identified (Galat, et al., 2007):

- Manage for a more natural hydrologic regime;
- Manage for processes that shape a physically diverse and dynamic river-floodplain system;
- Manage for processes that input, transport, assimilate, and output material within the UMR basin river-floodplains;
- Manage for a diverse and dynamic pattern of habitats to support native biota; and
- Manage for viable populations of native species within diverse plant and animal communities.

4.4 PROJECT GOALS AND OBJECTIVES

The goal of any potential project would be to restore and improve the quality and diversity of wetland, aquatic, and floodplain forest ecosystems within the project area.

4.4.1 Project Goals and Objectives

Specific project objectives were established and are listed below. These objectives are interrelated and together will assist in meeting the overall project goal. The guidance for developing project objectives is provided in USACE planning guidance ER 1105-2-100 and specifies that objectives must be clearly defined, must provide information on the effect desired, and must include the subject of the objective, the location where the effect would occur and the timing and duration of the effect. For the purpose of the Project Implementation Report (PIR), the location for all objectives is generally defined as the project area. The timing and duration of the objectives is assumed to be the 50-year period of analysis starting in 2027. The objectives for the NESP Pool 24 Island project are as follows.

a. Restore flow diversity, connectivity, and substrate diversity throughout project area for the benefit of terrestrial and aquatic species and habitat (side channel, main channel, off channel, backwaters, etc.).
b. Restore native aquatic and terrestrial vegetation diversity throughout the project area.
c. Restore topographic and bathymetric diversity and structural complexity throughout the project area.
d. Reduce inundation hydroperiod on impacted forest stands.

The relationship between objectives and the criteria to determine achievement of those objectives is summarized in Appendix E - *Monitoring and Adaptive Management Plan*, and Table 7 below summarizes objectives, performance criteria, and rationale for each. It should be noted that not all criteria must be met in order to achieve the objective; the criteria are indicators of ideal conditions.

Table 7: Summary of Objectives, Performance Criteria, and Rationale of the Proposed Project.

Objective	Performance Criteria	Rationale
Restore flow diversity, connectivity, and substrate diversity of aquatic areas throughout project area for the benefit of terrestrial and aquatic species and habitat (side channel, main channel, off channel, backwaters, etc).	An increase in flow diversity in the side channel as measured by flow profiles across side channel habitat. An increase in bathymetric diversity in aquatic habitats. Create, maintain or improve mussel habitat.	The performance criteria described is meant to restore bathymetric and flow diversity within side channels and backwaters at Denmark Island, Drift Island, Cottonwood Island, Bay Island, and Willow Island area. Mussels are a major concern and often viewed as an indicator of river health. An increase in backwater connectivity would improve aquatic habitat and facilitate terrestrial drainage and improve forest and wetland health and diversity. Backwater connectivity would allow aquatic habitat to fluctuate in a relatively natural state with river elevation changes, facilitating use of the backwaters by aquatic species and migratory waterfowl and shorebirds.
Restore native aquatic and terrestrial vegetation diversity throughout the project area.	An increase in wetland (aquatic) and wet prairie diversity measured by acres of native perennial vegetation. An increase in oak-hickory forests communities measured by acres. An increase in early successional forest communities measured by acres.	The performance criteria described is meant to capture success at reducing competitive stress on native stands of vegetation within the project area. Oak-hickory forest restoration is a goal outlined in the UMRS Systemic Forest Stewardship Plan Cottonwood/sycamore forest restoration is a goal outlined in the UMRS Systemic Forest Stewardship Plan
Restore topographic and bathymetric diversity and structural complexity throughout the project area.	Maintain and/or improve aquatic habitat in terms of structural complexity throughout the project area. Improve elevation diversity within strategic areas throughout the project. An increase in bathymetric diversity throughout backwater areas as measured in acres.	The performance criteria described is meant to restore vegetative structural diversity and aquatic structural diversity that historically occurred within the study area. The performance criteria described is meant to create conditions that support vegetative diversity that historically occurred within the study area. The performance criteria described is meant to restore bathymetric and flow diversity within backwater areas.
Reduce inundation hydroperiod on impacted forest stands.	A decrease in inundation hydroperiods by way of improved drainage measures throughout the island complex. An increase in the amount of suitable elevation for native oak and hickory trees to survive during a fluctuating hydroperiod. An increase in the amount of suitable elevation for establishment of early successional cottonwood and sycamore trees.	The performance criteria described is meant to capture success at reducing inundation stress on vulnerable forest stands in the project area. Oak-hickory forest restoration is a goal outlined in the UMRS Systemic Forest Stewardship Plan Cottonwood/sycamore forest restoration is a goal outlined in the UMRS Systemic Forest Stewardship Plan

4.5 PLANNING CONSTRAINTS & CONSIDERATIONS

The following constraints and concerns were considered in plan formulation:

- Constraints:
  - Work within the Pool 24 operations limits
  - Work within approved areas as determined by Real Estate

- Considerations:
  - Consider if existing habitat is desirable once surveys are complete (if desired species are thriving)
  - IDNR waterfowl blind locations exist within the project area and could be impacted by measure placement
  - Accessibility for OMRR&R
  - Outgrant to Sny Levee and Drainage District for access to maintain canal should be considered to ensure continued access
  - Work within approved areas as determined by Real Estate
  - Avoid and minimize impacts to Threatened & Endangered species
  - Avoid and minimize impacts to Cultural/Historic properties
  - Avoid and minimize impacts to Navigation
  - Avoid and minimize impacts to Waters of the United States (WOTUS)
  - Work within the existing project schedule

5.0 PLAN FORMULATION AND EVALUATION

Plan formulation is the process of building different plans that meet the study objectives and avoid planning constraints. The process helps decision-makers identify water resources problems, conceive solutions to them, and compare the importance of the inevitable conflicting values inherent in any solution.

The USACE planning process consists of six steps including: problem identification and opportunities, study objectives and constraints, data collection and analysis, formulation of alternative plans, and then the evaluation and comparison of those alternatives to make a recommendation on plan selection. The USACE planning process, as well as NEPA, requires USACE to evaluate a range of reasonable alternatives.

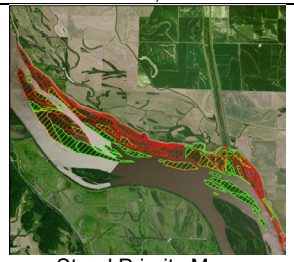
5.1 MANAGMENT MEASURES

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 used alone or combined with other management measures to form alternative plans. Management measures were selected to address study area problems and to capitalize upon study area opportunities. The management measures discussed below (Table 8) were identified from similar projects, subject matter experts, and meetings with state and federal resources agencies.

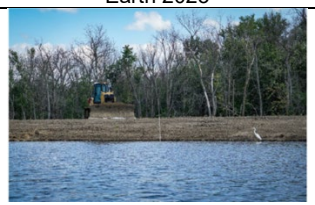
It should be noted that the Floodplain Forest Restoration (FFR) is an existing plan with

numerous measures included within it. The areas within the plan are also prioritized by level of need. For ease of discussion, the FFR is referred to as a single measure as it is recommended that the entire plan be implemented and therefore is not broken out by specific measure.

Table 8: Management Measures

Aquatic & Terrestrial Measures						
Type of Measure	Representative Photograph	Description	Obj. 1 Restore flow diversity, connectivity, and substrate diversity	Obj. 2 Restore native aquatic and terrestrial vegetation diversity	Obj. 3 Restore topographic and bathymetric diversity and structural complexity	Obj. 4 Reduce inundation hydroperiod on impacted forest stands
Floodplain Forest Restoration (FFR)	 Beaver Island HREP. Source: USACE, 2021	Timber Stand Improvement, Tree Planting, Implement Wet Prairie, Improve Oak Hickory Stands, Improve Early Successional Forest Stands, Modify Management Practices, Enhance Emergent Vegetation		X		
High Priority Prescription Areas (FFR)	 Stand Priority Map. Source: USACE	Implementation of the Forest Management Plan in the High Priority areas only.		X		
Mussel Riffles	 Photo: Roger Tabor / USFWS	This will be broken into two measures. Fields of sporadically spaced large stone/cobble in the side channel and 12” lift of 2-4” rounded river stone placed in footprint of new and existing rock structures to create flow, substrate and bathymetric heterogeneity & diversity.	X		X	

Type of Measure	Representative Photograph	Description	Obj. 1 Restore flow diversity, connectivity, and substrate diversity	Obj. 2 Restore native aquatic and terrestrial vegetation diversity	Obj. 3 Restore topographic and bathymetric diversity and structural complexity	Obj. 4 Reduce inundation hydroperiod on impacted forest stands
Woody Bundles	 USACE- UMRR Environmental Design Handbook, 2012	Creates flow diversity, shade and refugia for aquatic species	X		X	
Deep Water Pockets for overwinter fish habitat	 Harlow Island HREP. USACE, 2023	Creates bathymetric diversity and overwintering habitat for aquatic species.	X		X	
Removal of woody debris	 Woody Debris at Gilead Slough USACE 2023	Removal of woody material that creates blockages reducing the flow and connectivity of backwaters. It can have positive benefit in the right location. Removal is not applicable in this project area. Screened for Effectiveness.				
Submerged aquatic vegetation	 USACE- NESP Engineering	Plantings of native submerged aquatic vegetation.		X		

	Pamphlet, 2023					
Type of Measure	Representative Photograph	Description	Obj. 1 Restore flow diversity, connectivity, and substrate diversity	Obj. 2 Restore native aquatic and terrestrial vegetation diversity	Obj. 3 Restore topographic and bathymetric diversity and structural complexity	Obj. 4 Reduce inundation hydroperiod on impacted forest stands
Scour structures	 Bolters Island Source: Google Earth 2023	Promotes scour to remove sediment deposition in the backwater areas.	X			
Terrestrial elevation diversity	 USACE- NESP Engineering Pamphlet, 2023	Creates elevations sufficient to encourage the successful establishment of hard mast trees and reduce periods of inundation.		X	X	X
Rootless Dikes	 Source: Google Earth 2023	Encourages sufficient velocity to move sediment downstream to reduce the amount of deposition at the mouth of the backwater areas. Additional benefit potential by incorporating mussel habitat along the base.	X			
Notching existing dikes		Promotes flow diversity within the side channel. Additional benefit potential by incorporating mussel habitat along the base.	X			

	USACE- NESP Engineering Pamphlet, 2023					
Type of Measure	Representative Photograph	Description	Obj. 1 Restore flow diversity, connectivity, and substrate diversity	Obj. 2 Restore native aquatic and terrestrial vegetation diversity	Obj. 3 Restore topographic and bathymetric diversity and structural complexity	Obj. 4 Reduce inundation hydroperiod on impacted forest stands
Excavation of sediment in backwaters	 Beaver Island HREP. Source: USACE, 2021	Mechanical or Hydraulic Dredge – removal of sediment to allow for positive drainage of water from backwater areas. Material excavated could be used for beneficial purposes such as terrestrial elevation	X			X
Sediment Plug Removal	 USACE- NESP Engineering Pamphlet, 2023	Removal of sediment from the connection of the backwater to the river channel or side channel to facilitate drainage from the terrestrial area.				X
Water Level Management	 USACE- Mel Price L&D	Manipulation of Pool 24 water levels to increase depth of the side channel and backwater	X	X		

5.1.1 Evaluation and Screening of Measures

Screening is the ongoing process of eliminating, based on planning criteria, measures that will no longer be considered. Criteria are derived from the specific planning study, based on the planning objectives, constraints, and the opportunities and problems of the study area. Management measures were screened by the team (Table 9) and key technical partners throughout the formulation process utilizing the following four criteria described in the Principles and Guidelines (P&G):

• **Completeness**: extent to which the measures or alternatives provide and account for all necessary investments or other actions to ensure the realization of the planning objectives, including actions by other federal and non-federal entities. Completeness must consider the sustainability and long-term aspects of the plans and whether all resource requirements are included.

• **Effectiveness**: extent to which the measures or alternative plans contribute to achieving the planning objectives. Benefit metrics reflect the effectiveness of each alternative. Effectiveness does not mean that all planning objectives need to be addressed or fully realized. The degree of effectiveness will be used to illustrate the trade-offs between plans when compared.

• **Efficiency:** the extent to which a measures or alternative plan is a cost-effective means of solving the problem and achieving the objectives. Efficiency is determined through a comparison of the costs and benefits of each alternative.

• **Acceptability**: the workability and viability of the measure or alternative plan with respect to acceptance by state and local entities and the public and compatibility with existing laws, regulations, and public policies. Acceptability has two dimensions – implementability and satisfaction. Implementability means the extent to which the alternative is feasible from a technical, financial, and legal perspective. Satisfaction is the extent to which the plan is welcome from a political or preferential perspective.

Table 9: Measure Screening

Measure	Meets Objective	Retained (Y/N)	Rationale
Floodplain Forest Restoration: Timber Stand Improvement, Tree Planting, Implement Wet Prairie, Improve Oak Hickory, Improve Early Successional Forest, Emergent Wetland Plantings, Modify Management Practices	2	Y	Promotes native terrestrial vegetation and improves forest health
High Priority - Floodplain Forest Restoration	2	Y	Subset of the FFR. Just the highest priority areas.
Mussel Riffles- on new and existing dikes	1, 3	Y	More cost-effective approach to creating mussel habitat utilizing existing or new structures and just adding to it. Limited footprint however which is smaller than stone fields.
Mussel Riffles- Large stone spread out, improving mussel habitat	1, 3	Y	Promotes flow and bathymetric diversity and creates conditions favorable mussel habitat
Backwater dredge of sediment (Drift Island)	1,4	Y	Provides flow necessary to fish/life cycle of mussels.
Mechanical excavation of sediment in backwaters (Denmark Is)	1,4	Y	Improves backwater habitat for aquatic species and promotes drainage of water from area- reducing inundation periods which are distressing forest stand health
Notching existing dikes in side channel (dike alterations)	1, 2	Y	Promotes flow diversity
Rootless dikes at backwater opening	1, 3	Y	Encourages sediment to continue to move downstream - extending the life of the backwater opening
Sediment plug removal	1, 4	Y	Promotes drainage from terrestrial areas - reducing inundation periods which are distressing forest stand health
Terrestrial elevation diversity	2, 3, 4	Y	Areas will have reduced inundation periods and promote hard mast forest development
Scour structures	1, 3	Y	Encourage scouring during high water flow conditions to lengthen the lifespan of the backwater habitat areas
Submergent aquatic plants	2	N	Screened due to effectiveness - unable to be sustained in this area due to turbidity and herbivory
Removal of woody debris		N	Screened due to effectiveness - Not an appropriate measure for this type of area. Woody debris can also be good habitat for wildlife. Preferred retain woody structure.
Deep water pockets	1,3	N	Screened due to effectiveness- Sufficient deep water habitat for overwintering currently exists. Not a limiting part of the environment. High Cost and High O&M.
Woody bundles	1, 3	N	Screened due to effectiveness - Plenty of natural woody debris habitat.
Water level management	1,3	N	Pool 24 is under Environmental Pool Management and is expected to be into the future

The following measures were considered but were not selected for alternative formulation because they were found to be incomplete, ineffective, or not within the scope of the project. Six measures were initially identified but not retained for further consideration:

- Woody Bundles – measure was screened due to effectiveness at meeting study objectives. Not a limiting factor in the environment.
- Deep Water Pockets – measure was screened due to effectiveness at meeting study objectives. Not a limiting factor in the environment.
- Woody Debris Removal – measure was screened due to effectiveness at meeting study objectives. Woody debris is not considered a management issue.
- Submergent Aquatic Plants – measure was screeded due to efficiency at meeting study objectives. Not able to be sustained in this area due to hydrologic conditions and herbivory.
- Water Level Management- measure screened due to effectiveness at meeting study objectives. Pool 24 is under environmental pool management and is expected to be into the future. The pooled area is already capitalizing on environmental benefits through water level management.

The measures carried forward for alternative formulation included:

- Floodplain Forest Restoration Activities
- High Priority Prescription Areas- Floodplain Forest Restoration Activities
- Mussel Riffles (fields of spread rock and dike footprints)
- Modify Management Practices
- Scour Structures
- Terrestrial Elevation Diversity
- Rootless Dikes
- Notch Existing Dikes
- Excavation of sediment (mechanical and dredge)
- Sediment Plug Removal

It should be noted that the excavated material from the backwater areas would be used beneficially to create the terrestrial elevation areas.

Table 10 shows how the measures align with the problems, opportunities and objectives identified in section 4.

Table 10: Alignment of Final Array of Measures with Problems, Opportunities, Objectives and Measures

PROBLEMS	OPPORTUNITIES	OBJECTIVES	MEASURES
Backwater sedimentation causes poor water quality, shallow depths, and loss of connectivity with subsequent decreases in habitat function and availability for aquatic and riverine species.	• Design with resiliency • Design with minimal OMRR&R • Establish other natural habitat types (i.e. wetlands) which may be more resilient to frequent flooding • Develop suitable habitat types for mussels to thrive • Evaluate global climate change opportunities (i.e. habitat types, resiliency) • Collaborate with Sny Levee and Drainage District • Develop habitat types for species of interest (i.e.. mussels, bats, migratory species) • Beneficial use of excavated material	#1 Restore flow diversity, connectivity, and substrate diversity throughout project area for the benefit of terrestrial and aquatic species and habitat (side channel, main channel, off channel, backwaters, etc.)	• Mussel Riffles • Excavation of Sediment • Notch existing dikes • Rootless dikes • Sediment plug removal • Scour Structures • Mussel Riffles
Loss of topographic and hydrologic diversity reduces vegetative community diversity and wildlife resources (e.g., forage, invertebrate production, nesting habitat, and resting sites).		#2 Restore native aquatic and terrestrial vegetation diversity throughout project area.	• Floodplain Forest Restoration • Terrestrial Elevation Diversity • High Priority Prescription Area (FFR) • Emergent Aquatic Planting • Modify Management Practices
		#3 Restore topographic and bathymetric diversity and structural complexity throughout the project area.	• Mussel Riffles • Terrestrial Elevation Diversity • Scour Structures • Rootless Dikes
Sediment deposition impacts natural hydrologic processes and their influence on terrestrial areas, resulting in increased flood durations and decreased forest health and diversity.		#4 Reduce inundation hydroperiod on impacted forest stands.	• Sediment plug removal • Terrestrial Elevation Diversity • Excavation of sediment

5.2 INITIAL ARRAY OF ALTERNATIVES

Measures deemed feasible were carried forward for consideration in the development of alternatives. Alternatives are combinations of measures that will contribute to attaining the planning objectives. This section describes considerations that led to the development of an initial array of alternatives for this project and the evaluation of alternative plans ability to meet project objectives.

Formulation strategies, defined by Planning Manual Part II: Risk -Informed Planning 2017, are a set of conditional decisions that shape and guide the development of alternatives.

The initial array of alternatives were defined by combining the remaining management measures to narrow down the universe of possible solutions to a concise group of initial alternatives that links them to the study goal, objectives, planning criteria, and opportunities while avoiding constraints.

- **Alternative 1 - No Action plan:** The National Environmental Policy Act (NEPA) requires Federal agencies to consider the option of no action as one of the alternatives. The No Action plan assumes no action is taken by the USACE to achieve the planning objectives and is synonymous with the FWOP condition. The No Action Plan forms the basis against which all other alternative plans are measured.

- **Alternative 2 - Maximum Habitat Benefit:** Alternative that gets the habitat closest to historical conditions as possible or has optimal functionality in both aquatic and terrestrial areas.

- **Alternative 3 – Maximum Terrestrial:** Alternative that gets the habitat closest to historical conditions as possible or has optimal functionality in terrestrial areas only.

- **Alternative 4 – Maximum Mussel and Forest Management:** Alternative that gets the maximum mussel and forest benefits with minimal excavation.

- **Alternative 5 – Minimum Habitat Benefit:** Alternative is the minimum that can be done for project success.

- **Alternative 6 – Mussel and High Priority Forest:** Alternative of measures that prioritize maximizing benefits with minimal cost and focus on the highest priority areas.

- **Alternative 7 – Topographic Site Diversity:** Alternative strategy that promotes interior drainage and creates areas of varying elevation on the islands.

Table 11 shows the initial array of measures and the alternatives formulated.

Table 11: Initial Array of Alternatives

	RETAINED ALTERNATIVES						SCREENED ALTERNATIVE
Retained Measures	**No Action**	**Maximum Habitat Benefit**	**Maximum Terrestrial**	**Maximum Mussel & Forest Management**	**Minimum Habitat Benefit**	**Mussels & High Priority Forest**	**Topographic Site Diversity**
Floodplain Forest Restoration: Timber Stand Improvement, Tree Planting, Implement Wet Prairie, Improve Oak Hickory, Improve Early Successional Forest		X	X	X			
High Priority - Floodplain Forest Restoration					X	X	
Mussel Riffles- Large stone spread out, improving mussel habitat		X		X			
Mussel Riffles- on new and existing dikes		X				X	
Backwater dredge of sediment (Drift Island)		X	X				X
Mechanical excavation of sediment in backwaters (Denmark Is)		X	X				X
Notching existing dikes		X					
Rootless dikes		X				X	
Sediment plug removal				X	X	X	
Terrestrial elevation raise		X	X				X
Scour structures		X	X				

Upon review, the PDT screened one alternative. The Topographic Site Diversity Alternative was screened due to lack of effectiveness. This alternative does not adequately meet overall project needs as it does not include any measures to address the declining forests and aquatic needs in the area.

The focused array of alternatives include:

- No Action
- Maximum Habitat Benefits
- Maximum Terrestrial
- Maximum Mussel and Forest Management
- Minimum Habitat Benefit
- Mussel and High Priority Forest

Figures 9 - 15 show the proposed arrangement of the measures within the study areas for each alternative. The first two maps are of individual measures. The first is the Floodplain Forest Restoration measure. The second is the Forest Prescription Areas. Since both of these measures cover nearly the entire project area, it becomes very difficult to see the other measures presented on the maps. Therefore, these measures are represented by themselves in the maps for visual representation; however, they are noted on each alternative map where these measures are included.

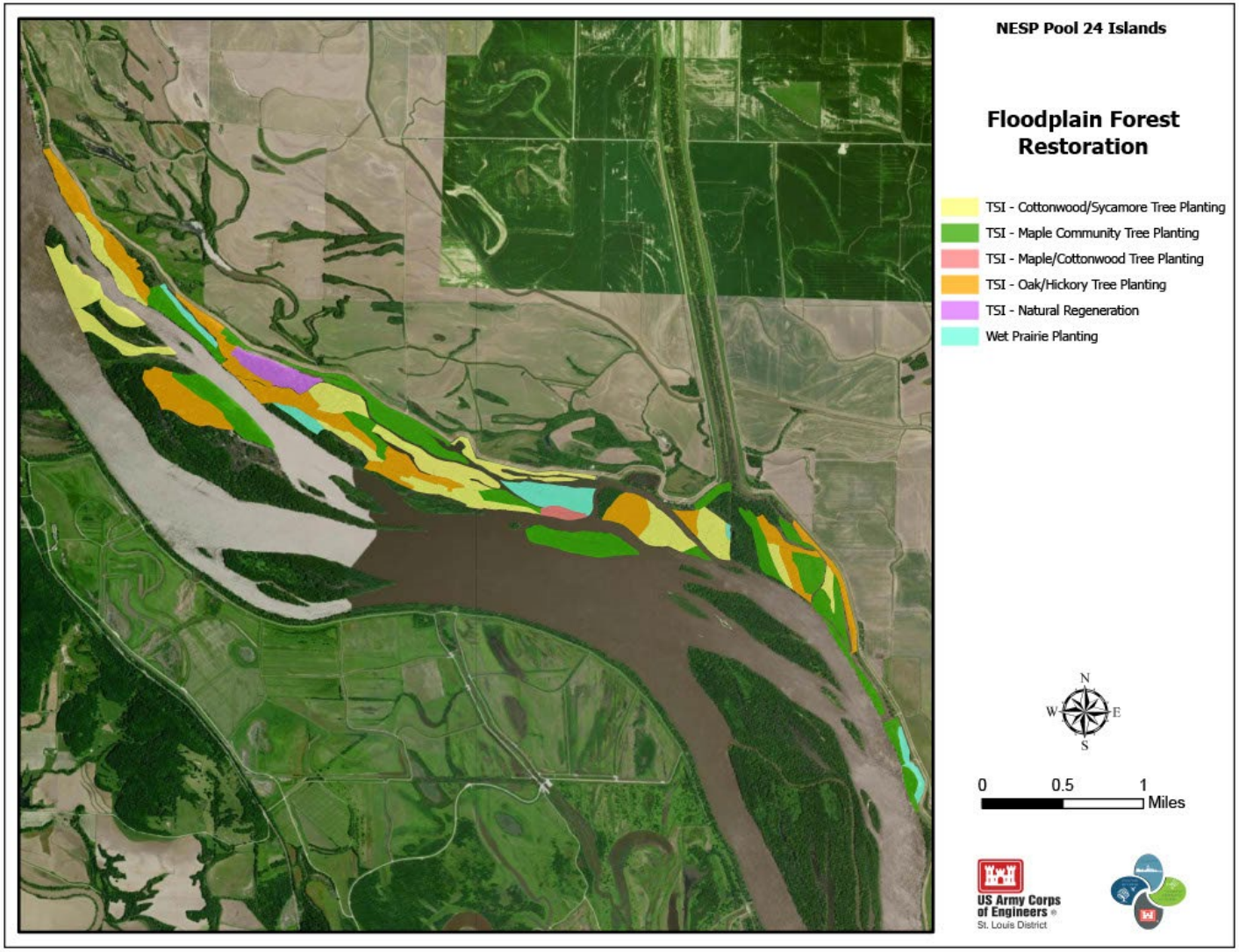


Figure 9: Denmark and Drift Is. - Floodplain Forest Restoration

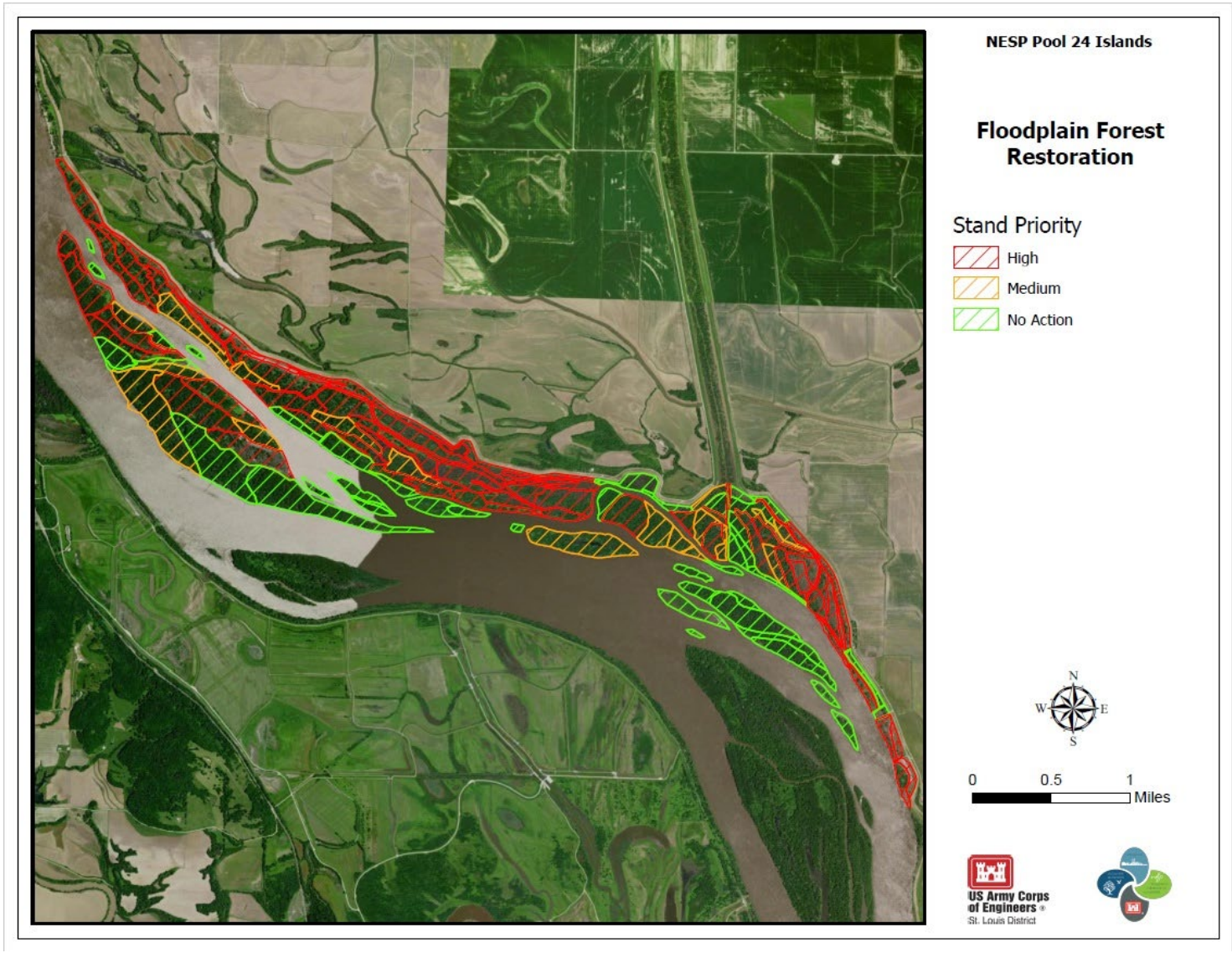


Figure 10: Denmark and Drift Is- Floodplain Forest Restoration- Stand Priority

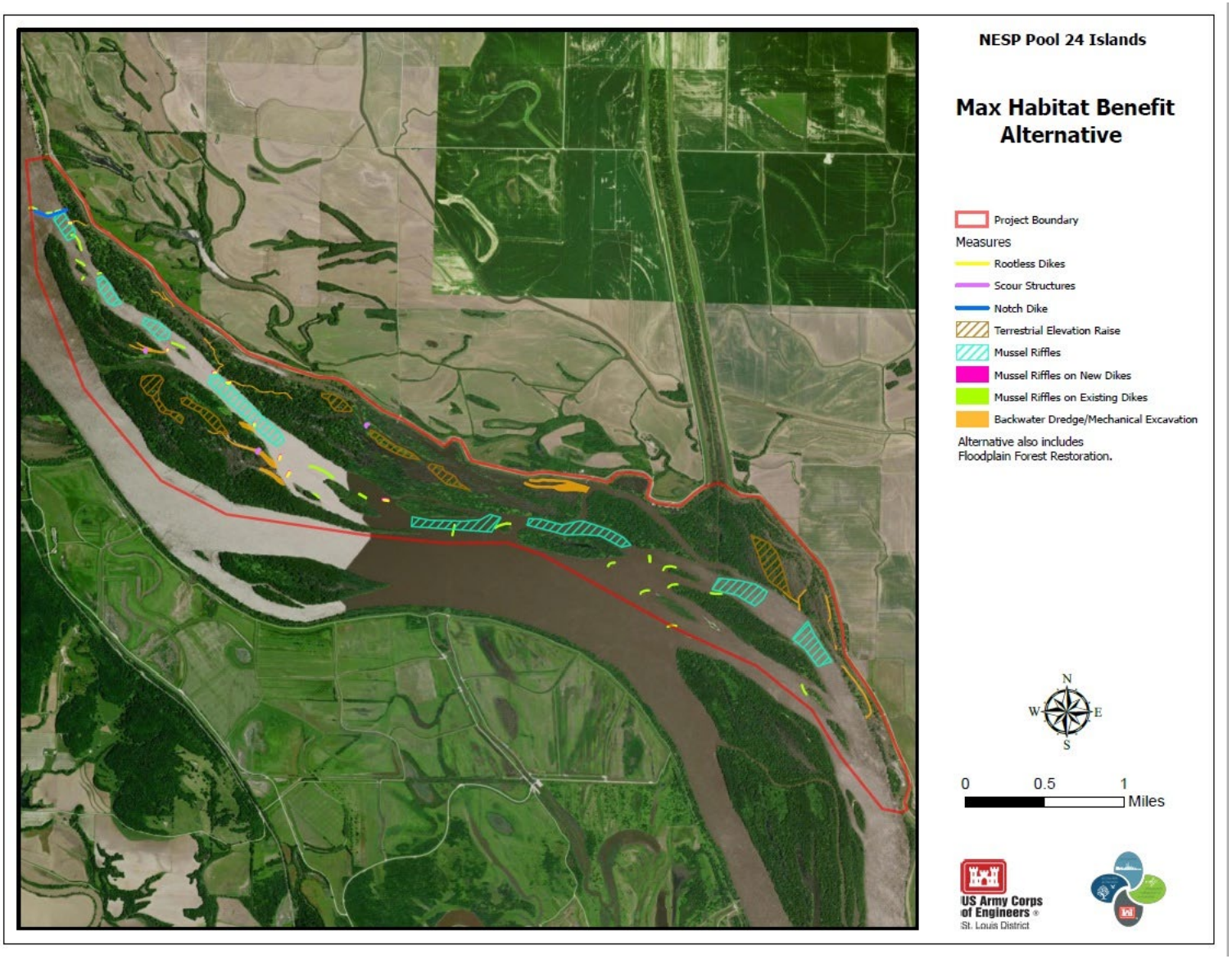


Figure 11: Maximum Habitat Benefit Alternative

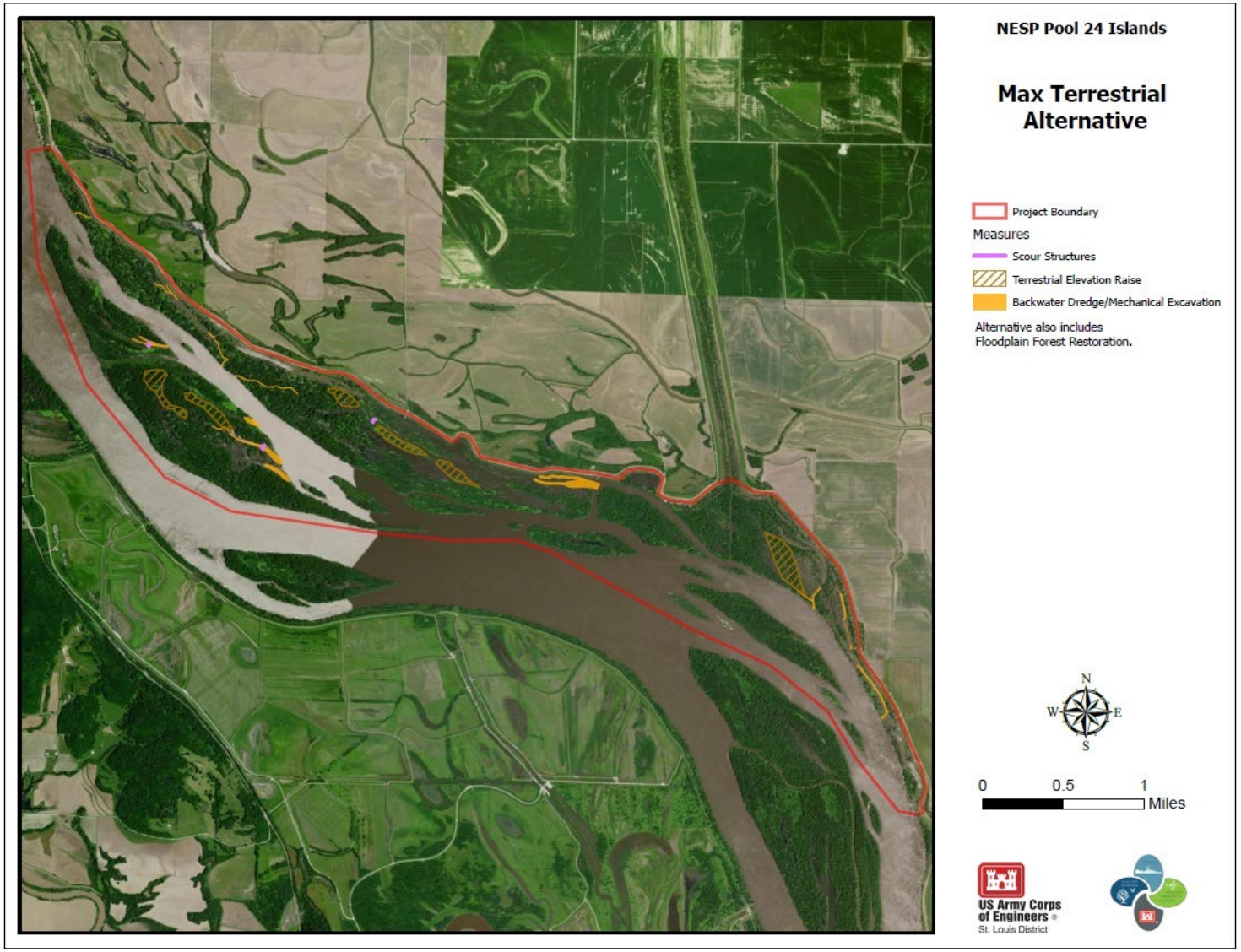


Figure 12: Maximum Terrestrial Alternative

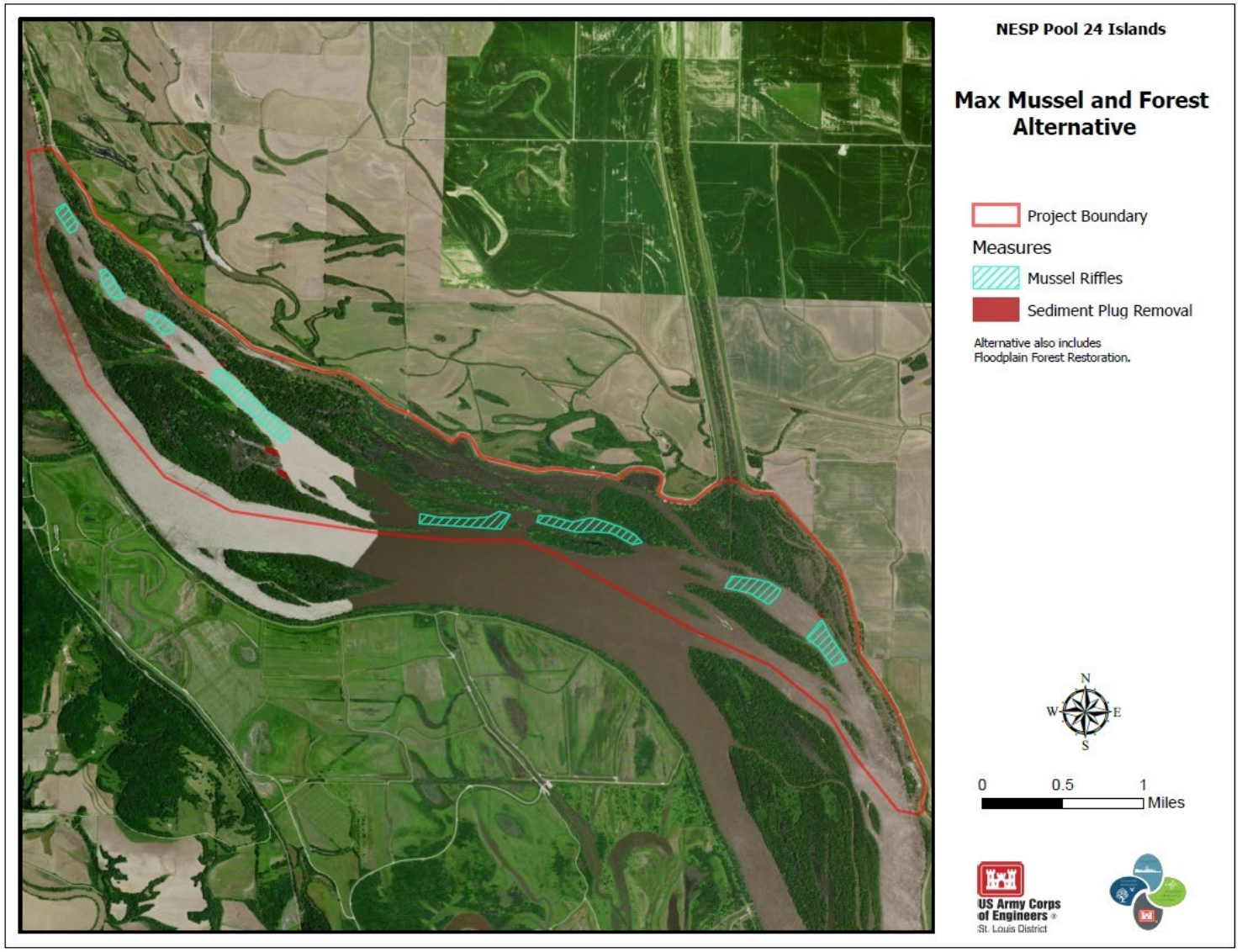


Figure 13: Maximum Mussel and Forest Alternative

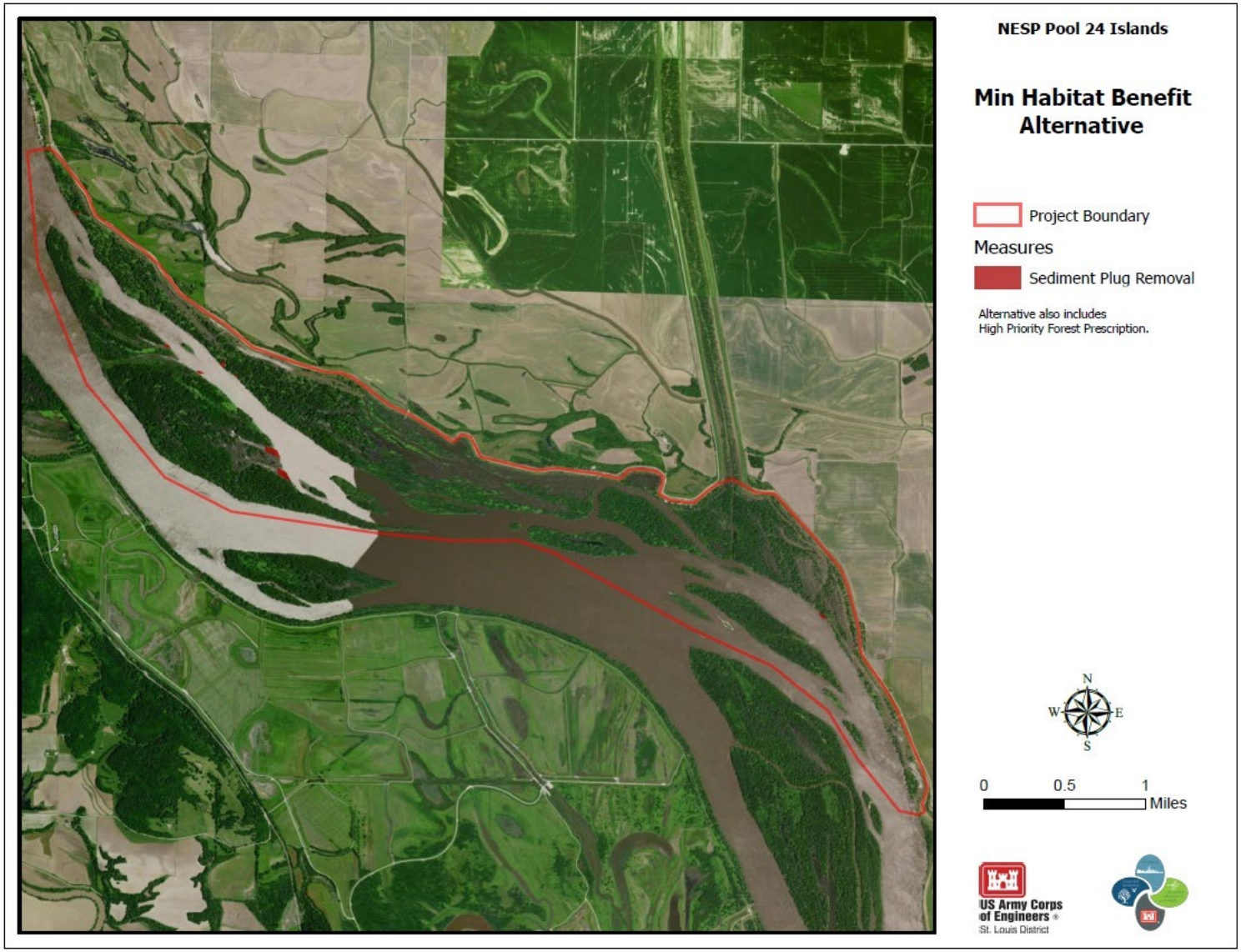


Figure 14: Minimum Habitat Benefit Alternative

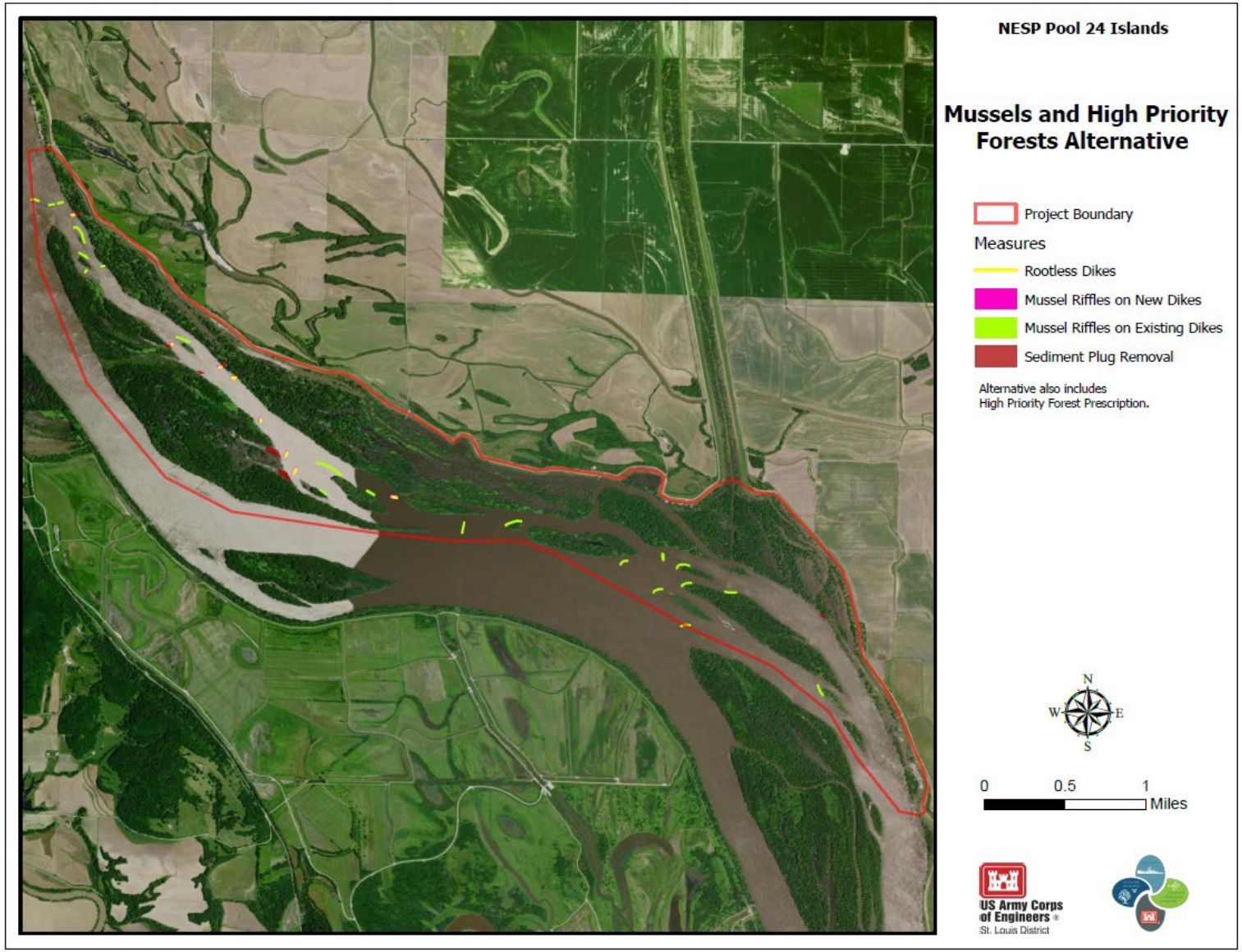


Figure 15: Mussels and High Priority Forest Alternative

Further screening of the remaining focused array of alternatives was based on Economic and Environmental Principles and Guidelines for Water and Related Land Resources Implementation Studies (1983, referred to as P&G for the remainder of this report).

The PDT gave each alternative a qualitative metric (high/moderate/low) and a quantitative score for tallying. A qualitative score of "high" signifies the metric was met considerably, a score of "moderate" denotes the metric was met moderately, and a score of "low" indicates the metric was minimally met, if at all. The metrics are described below. Table 12 provides the evaluation for each alternative.

Acceptability: In order to measure the acceptability of each alternative, the study team created the metrics described below. All the alternatives in the final array are in accordance with federal law and policy so all alternatives scored high.

> USACE Policy Compliant – This metric evaluated the magnitude of potential policy concerns for each alternative.
>
> Complements the larger federal, state and local objectives – This metric provided how well each alternative complemented other USFWS and MDC management objectives in and adjacent to the study area, showing the alternatives' viability for acceptance by non-federal entities and the public.

Completeness: The study team evaluated future potential investments, state investments, non-governmental investments, and land use changes to determine if these activities were necessary to or would prohibit achievement of this study's planning objectives. The study team determined that at this stage of the planning process, no additional investments were needed to obtain benefits so all alternatives are considered "complete".

Efficiency: The efficiency metric used to compare the initial array included whether Construction, and OMRR&R costs are anticipated to be high in comparison to the predicted benefits.

Effectiveness: In order to measure the effectiveness of each alternative, the study team created metrics for the project objectives and opportunities:

> Restore flow diversity, connectivity, and substrate diversity – This metric documents how well each alternative improves flow, connectivity and increasing substrate diversity within the project area.
>
> Restore native aquatic and terrestrial vegetation diversity – This metric documents how well each alternative improves vegetative diversity throughout

the area.

Restore topographic and bathymetric diversity and structural complexity – This metric documents how well each alternative restores topographic and bathymetric diversity and the structural complexity of the project area.

Reduce inundation hydroperiod on impacted forest stands – This metric documents how well each alternative improves interior drainage on the islands, reducing inundation on forest stands.

Considered additional opportunity metrics – low OMRR&R, habitat for species of interest, beneficial use of excavated material, and resiliency.

Table 12: Evaluation of Focused Array of Alternatives

Alternative	Acceptable	Complete	Efficient	Effective				Maximize Opportunities			
High- Green Moderate – Yellow Low - Red				**Restore flow diversity, connectivity, and substrate diversity**	**Restore native aquatic and terrestrial vegetation diversity**	**Restore topographic and bathymetric diversity and structural complexity**	**Reduce inundation hydroperiod on impacted forest stands**	**Low OMRR&R**	**Habitat for species of interest**	**Beneficial use of excavated material**	**Resiliency**
No Action	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Minimum Habitat Benefit	LOW	LOW	LOW	LOW	MODERATE	LOW	LOW	HIGH	LOW	LOW	MODERATE
Mussel and High Priority Forest	HIGH	HIGH	HIGH	HIGH	HIGH	HIGH	MODERATE	MODERATE	HIGH	LOW	HIGH
Max Terrestrial	MODERATE	MODERATE	MODERATE	LOW	HIGH	HIGH	HIGH	MODERATE	MODERATE	HIGH	MODERATE
Max Mussel and Forest Management	HIGH	HIGH	HIGH	MODERATE	HIGH	MODERATE	HIGH	MODERATE	HIGH	LOW	HIGH
Max Habitat Benefit	HIGH	HIGH	HIGH	HIGH	HIGH	HIGH	HIGH	LOW	HIGH	HIGH	HIGH

5.3 FINAL ARRAY OF ALTERNATIVES*

The final array of alternatives include:

- No Action
- Maximum Habitat Benefit
- Maximum Terrestrial
- Maximum Mussel and Forest Management
- Minimum Habitat Benefit
- Mussel and High Priority Forest

The measures included in each Alternative are:

- **No Action Alternative**
- **Maximum Habitat Benefit Alternative:** Floodplain forest restoration, mussel riffles (both fields of stone in the side channel and on new and existing dikes), backwater dredge of sediment (Drift Island), excavation of sediment in backwaters (Denmark Island), notching existing dikes, rootless dikes, terrestrial elevation raise, and scour structures.
- **Maximum Terrestrial Alternative**: Floodplain forest restoration, backwater dredge of sediment (Drift Island), excavation of sediment in backwaters (Denmark Island), terrestrial elevation raise, and scour structures
- **Maximum Mussel and Forest Management Alternative**: Floodplain forest restoration, mussel rifles (fields of stone), and sediment plug removal
- **Minimum Habitat Benefit Alternative:** High priority- floodplain forest restoration, and sediment plug removal
- **Mussel and High Priority Forest Alternative**: High priority- floodplain forest restoration, mussel riffles on new and existing dikes, rootless dikes, and sediment plug removal

6.0 EVALUATION AND COMPARISON OF FINAL ARRAY OF ALTERNATIVES

The following sections describe the anticipated environmental effects (both adverse and beneficial) of the No Action Alternative and the Action Alternatives on the resources addressed in Section 3, *Future Without Project Conditions*. When the analysis presented in the 2004 IFR/EIS is sufficiently comprehensive or adequate, no additional analysis is provided in this Section.

6.1 HABITAT BENEFITS EVALUATION

A multi-agency team (IDNR, MDC, USFWS, and USACE) conducted the habitat benefit evaluation using the Habitat Evaluation Procedures (HEP; (USFWS, 1980)) to estimate environmental benefits of the considered alternatives, see Appendix B – *Habitat Evaluation* for more details.

6.1.1 HABITAT EVALUATION PROCEDURES

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

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

The PDT used three USACE certified or approved (per EC 1105-2-412) habitat evaluation methodologies in their analyses:

- Floodplain Forest Habitat Model
- General Freshwater Mussel Habitat Model
- Marsh Wren Habitat Suitability Index (HSI) Model

The Marsh Wren HSI model is a FWS approved blue book model, the Floodplain Forest Habitat Model has been certified for regional use in the Upper Mississippi River System until September 8, 2028, and the General Freshwater Mussel Habitat Model has been certified for national use until February 15, 2030, see Appendix B – *Habitat Evaluation* for more details.

6.1.2 AVERAGE ANNUAL NET BENEFITS

Table 13 lists the calculated net average annual habitat benefits by habitat type for the final array of alternatives.

Table 13: Net Average Annualized Habitat Units (AAHU).

Alternative	Aquatic Habitat Net AAHU	Forest Habitat Net AAHU	Wetland Habitat Net AAHU	Total Net AAHU
No Action	0	0	0	0
Minimum Habitat Benefit	0	134	67	201

Mussels & High Priority Forest	56	134	67	257
Maximum Terrestrial	0	230	70	300
Maximum Mussel and Forest Management	73	215	67	355
Maximum Habitat Benefit	129	230	70	429

6.2 Cost Estimates

Cost estimates for alternative comparison were prepared using 2023 price levels; annualized costs include construction costs, contingency costs, adaptive management costs and OMRR&R costs (see Appendix J- Cost and K- Economics for more information)Project measures are on federal lands; consequently, there are no lands and damages or relocation costs. Total project costs were annualized based on the Fiscal Year 2023 discount rate of 2.5% and a 50-year period of analysis. Interest During Construction (IDC) was calculated using end of year compounding based on a two year period of construction, using the Fiscal Year 2023 discount rate of 2.5%. Table 14 shows the estimated cost of project alternatives as of completion of the habitat analysis and for use in the comparison of alternatives, prior to selection, refinement, and developing a full cost estimate of the Tentatively Selected Plan (TSP).

Table 14: Summary of Alternatives Annual Average Costs and AAHUs

Name of Alternative	First Cost	Interest During Construction	Average Annual Construction	Average Annual OMRR&R	Average Annual Cost	AAHUs	Cost Effective
No Action	$ -	$ -	$ -	$ -	$ -	-	**Yes**
Min Habitat	$ 11,972,000	$ 300,235	$ 432,695	$ 64,715	$ 497,410	201	Yes
Mussel & High Priority Forest	$ 14,378,000	$ 360,573	$ 519,653	$ 72,879	$ 592,532	257	Yes
Max Terrestrial	$ 16,081,000	$ 403,281	$ 581,204	$ 81,990	$ 663,194	300	Yes
Max Mussel & Forest Mgmt.	$ 17,499,000	$ 438,842	$ 632,453	$ 72,424	$ 704,878	355	**Yes**
Max Habitat	$ 24,557,000	$ 615,843	$ 887,546	$ 91,920	$ 979,465	429	**Yes**

- These are Class 4 cost estimates. Figures are rounded to the nearest thousand. Red text indicates best buy Alternatives.

6.3 Comparison of Final Array of Alternatives

IWR Planning Suite II was used to complete a Cost Effective and Incremental Cost Analysis (CE/ICA) for the six alternatives (including the No Action Alternative), using the

AAHUs and annualized costs described in this section. The CE/ICA is used when project benefits are not measured in dollars and is used to ensure the least cost alternative is identified for each possible level of environmental output, and the maximum level of output is identified for any level of investment. Cost Effectiveness evaluation is used to identify the least costly solution to achieve a range of project benefits; the Incremental Cost Analysis identifies the subset of cost-effective plans that are superior financial investments, called “Best Buys,” through analysis of the preliminary incremental costs. Best Buys are the plans that are the most efficient at producing the output variable or provide the greatest increase in AAHUs for the least increase in preliminary cost. The first Best Buy is the most efficient plan, producing output at the lowest incremental cost per unit. If a higher level of output is desired than that provided by the first Best Buy, the second Best Buy is the most efficient plan for producing additional output, and so on.

The CE/ICA analysis evaluated six possible plan combinations. Figure 16 shows the resulting alternatives differentiated by cost effectiveness. From this list of six alternatives, all were cost effective; however, three were identified as Best Buy Plans.

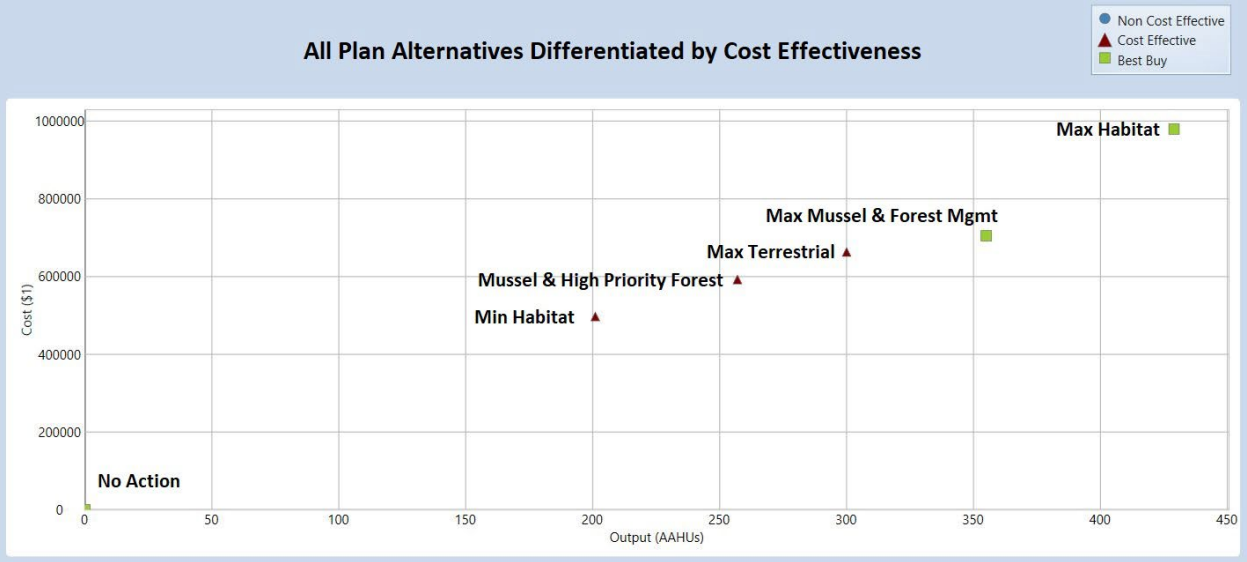


Figure 16: Cost Effectiveness Graph for Final Array of Alternatives

The three Best Buy alternatives (including No Action) were carried forward for further analysis; these were analyzed to determine which had the lowest incremental cost for each additional increment of output. Table 15 and Figure 17 present the alternatives’ incremental cost and benefit information.

The first Best Buy, the No Action Plan, is the lowest average annual cost but produces no benefit. The next Best Buy is the Maximum Mussel and Forest Management Alternative, which has an average annual cost of $1,986 per AAHU. The third Best Buy is Maximum Habitat Benefit Alternative, which has an average annual cost of $2,283 per AAHU.

The No Action Alternative does not include any measures or provide any additional AAHUs. The No Action Alternative would have no financial cost to the federal government but does not meet any of the project objectives. The study area would continue to degrade as discussed in section 3.0.

The Maximum Mussel and Forest Management Alternative would provide a net of 355 AAHU gain over the No Action alternative. This alternative would substantially meet the three objectives and has a low incremental cost of $1,986 per incremental output (AAHU). This alternative is expected to work with evolving changes in the terrestrial community including allowing specifically identified areas to transition to wetland communities and not raising elevations to artificially create desired hard mast habitats. The sediment plug removal will also provide a cost-effective way of promoting interior drainage on the islands therefore enhancing the terrestrial habitat. This alternative also creates large areas of diverse substrate habitat for aquatic species feeding, resting and reproducing. This alternative would contribute meaningfully to all of the objectives, is a Best Buy plan, and has a relatively low incremental cost, and would be worth the investment.

The Maximum Habitat Benefit Alternative would provide a net of 429 AAHUs over the No Action which is a gain of 74 AAHUs when compared to the Maximum Mussel and Forest Management Alternative. This alternative represents the maximum contribution towards meeting the objectives but there is a relatively high incremental cost to capturing the benefits above those in the Maximum Mussel and Forest Management Alternative.

The incremental cost to capture the 74 additional AAHUs for the Maximum Habitat Benefit Alternative is $3,711 per incremental unit. The maximum habitat benefit alternative comes with a lot of risk without much habitat benefit gain. The excavation measures are very costly without providing significant habitat gain and have a high associated risk of filling with sediment from additional flood events. The risk of the project exceeding the program financial cap is also high, with the total project cost nearing $25 million.

The study team felt that the large increase in federal costs and the minimal increase in habitat benefits, along with the high risks, were not worth the investment.

Table 15: Table of Incremental Cost and Output Results for Best Buy Plans

Name of Alternative	AAHUs	First Cost	Interest During Construction	Average Annual Cost	Average Annual Cost per AAHU	Additional Average Annual Cost	Additional Output (AAHUs)	Incremental Cost (per Incremental Output)
No Action	-	$ -	$ -	$ -	$ -	$ -	-	$ -
Max Mussel & Forest Mgmt.	355	$17,499,000	$ 438,842	$ 704,878	$ 1,986	$ 704,878	355	$ 1,986
Max Habitat	429	$24,557,000	$ 615,843	$ 979,465	$ 2,283	$ 274,587	74	$ 3,711

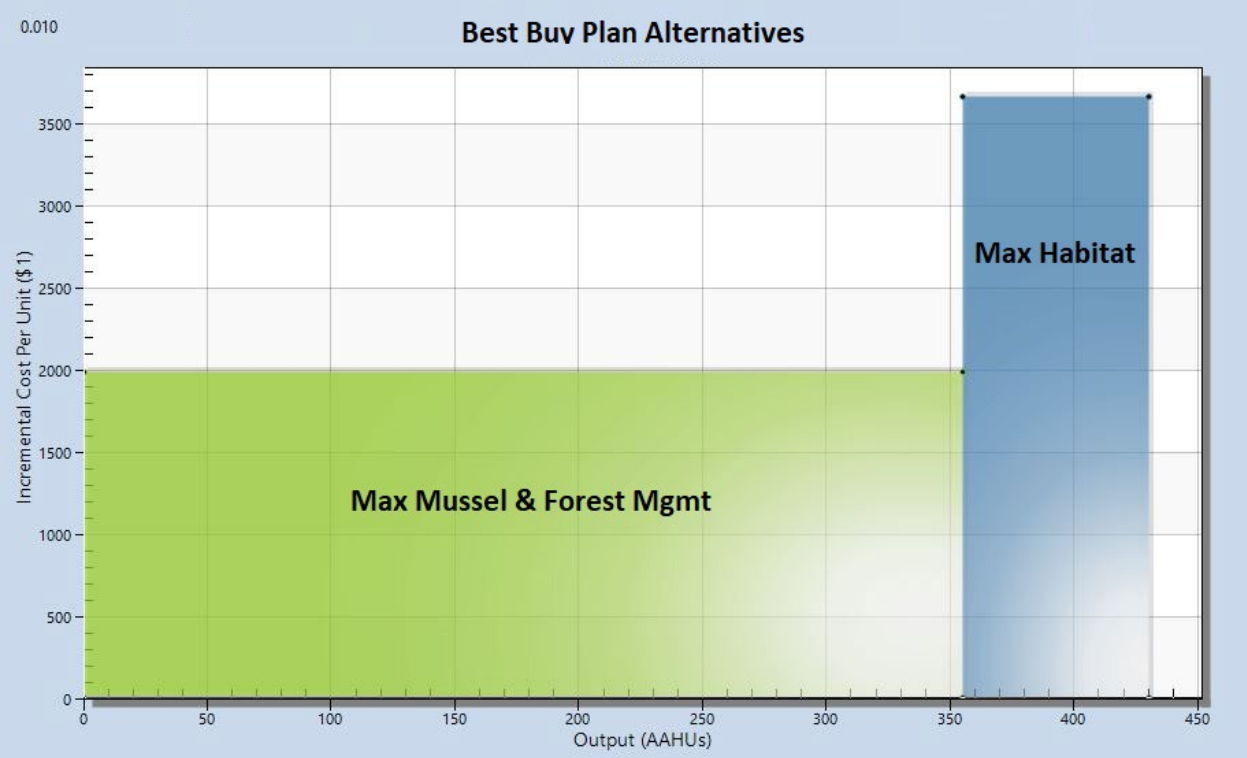


Figure 17: Graph of Incremental Cost and Output Results for Best Buy Plans

USACE is required to comprehensively evaluate and provide a complete accounting, consideration, and documentation of the total benefits of a full array of benefit categories: NER/NED, regional economic development, other social effects, and environmental quality (ASA(CW)Memorandum, SUBJECT: POLICY DIRECTIVE – Comprehensive Documentation of Benefits in Decision Document, January 5, 2021). Alternatives were assessed to determine if they have net benefits in total and type in each benefit category. Analysis was made using professional judgement with available data and analysis. The Maximum Habitat Benefit Alternative was identified as the plan that maximizes net total benefits across all benefit categories- and as such is the comprehensive benefit plan. Table 16 presents a summary of the comprehensive benefits evaluation across these four categories for each of the alternatives.

Table 16: Summary of Comprehensive Benefits

Alternative	P&G Accounts			
	NER (Presented as Acres per Habitat Type)	**RED** (Presented as local impact of the regional investment and jobs)	**EQ** (Presented as AAHUs)	**OSE**

No Action	-	-	-	-
Maximum Mussel and Forest Management	Terrestrial: 1096 ac Aquatic: 140 ac	$11.1 Million 135 Jobs	355	Increased recreational opportunities for fishing, boating, canoeing, and bird watching. Recreation benefits increase respective to habitat unit gain.
Maximum Habitat Benefit	Terrestrial: 1096 ac Aquatic: 237 ac	$15.6 Million 189 Jobs	429	

National Ecosystem Restoration (NER) Account

The USACE objective in ecosystem restoration is to contribute national ecosystem restoration (NER) via increases in the net quality and or quantity of desired ecosystem resources. The NER account benefit is displayed as the number of acres of impact by habitat type. The NER plan is the alternative plan that reasonably maximizes ecosystem restoration benefits compared to cost. Based on the cost benefit analysis described in Sec. 6.3, the PDT identified the Maximum Mussel and Forest Management Alternative as the NER Plan as it reasonably maximizes the average annual cost per habitat unit benefits over the 50-year period of analysis over the other Alternatives.

Regional Economic Development (RED) Account

The RED account is intended to illustrate the effects the alternatives will have on regional economic activity, specifically, regional income and employment. While a detailed regional economic development analysis was not performed for any of the alternatives, it is generally accepted that the ecosystem restoration projects that are part of the NESP will contribute RED benefits in small ways as each project is constructed. Over a longer term, ecosystem restoration projects contribute to RED benefits on a larger scale by creating added eco-tourism opportunities and increasing economic opportunities in local communities along the entire UMR system. Once completed, habitat projects create new or improved outdoor recreation opportunities, further stimulating local and regional expenditures.

The USACE regional economic model, RECONS (Regional ECONomic System), was run for all Best Buy action alternatives. This modeling tool automates calculations and generates estimates of jobs and other economic features such as income and sales associated with USACE's annual Civil Works program spending. The current first cost was used but without interest during Construction, Preconstruction Engineering and Design (PED), or Supervision & Administration (S&A) costs to approximate a more accurate representation of total regional investment. Total regional investment (Local Total Impact in (Table 17) is $11.1 million for the Maximum Mussel and Forest Management Alternative, and $15.6 million for the Maximum Habitat Benefit Alternative. Construction funds expended on various services and products are expected to generate additional economic activity featured in both output and jobs (Table 17). Both

action alternatives would positively impact the regional economy and increase respective to each alternative relative to the number and size of the measures implemented.

Table 17: Summary of Regional Economic Impact for Best Buy Alternatives

Maximum Mussel and Forest Management Alternative

Area	Local Capture	Output	Jobs*	Labor Income	Value Added
Local					
Direct Impact		$11,106,808	107.1	$6,321,962	$6,067,105
Secondary Impact		$4,579,580	27.5	$1,110,553	$2,312,426
Total Impact	$11,106,808	$15,686,388	134.6	$7,432,515	$8,379,532
State					
Direct Impact		$14,377,923	141.8	$10,940,170	$8,597,329
Secondary Impact		$17,744,555	88.6	$6,051,367	$10,506,967
Total Impact	$14,377,923	$32,122,478	230.4	$16,991,537	$19,104,295
US					
Direct Impact		$17,378,366	193.4	$14,001,306	$11,081,970
Secondary Impact		$35,805,673	164.5	$11,258,108	$19,432,214
Total Impact	$17,378,366	$53,184,039	358.0	$25,259,414	$30,514,184

.

Maximum Habitat Benefit Alternative

Area	Local Capture	Output	Jobs*	Labor Income	Value Added
Local					
Direct Impact		$15,586,598	150.3	$8,871,845	$8,514,195

Secondary Impact		$6,426,696	38.5	$1,558,481	$3,245,114
Total Impact	$15,586,598	$22,013,294	188.9	$10,430,326	$11,759,310
State					
Direct Impact		$20,177,076	199.0	$15,352,749	$12,064,952
Secondary Impact		$24,901,597	124.4	$8,492,109	$14,744,819
Total Impact	$20,177,076	$45,078,673	323.4	$23,844,858	$26,809,771
US					
Direct Impact		$24,387,710	271.4	$19,648,556	$15,551,743
Secondary Impact		$50,247,438	230.9	$15,798,923	$27,269,951
Total Impact	$24,387,710	$74,635,148	502.3	$35,447,478	$42,821,694

Environmental Quality (EQ) Account

The EQ account measures effects on ecological, cultural, and aesthetic resources. For ecosystem restoration projects such as this one, contributions to the EQ account are detailed both through NEPA compliance and through calculation of net ecosystem benefits. Here, NEPA compliance is achieved by integrating an EA into this feasibility report, with a qualitative summary of environmental effects detailed in section 7 of this report. A calculation of net ecosystem benefits was completed through the use of Habitat Evaluation Procedures, and the application of HSI models. The quantitative results of the evaluation are contained in *Appendix B – Habitat Evaluation* and *Quantification*. The credit for the EQ account is the quantified benefits resulting from the project (AAHUs). Intangible and or non-quantifiable environmental benefits associated with the alternatives are assumed to increase proportionally relative to the AAHU outputs associated with each alternative.

Other Social Effects (OSE) Account

The OSE account is intended to illustrate the effects the alternatives will have on lives of residents and the social fabric of communities in the study area. The OSE account assists in plan formulation and in choosing an alternative that maximizes social benefits. Ecosystem restoration projects such as this one typically have positive net effects on the OSE account. Quality of life variables such as health and safety, material well-being, and social connectedness are improved as a result of ecosystem restoration projects such as NESP. While the OSE benefits may be slight or difficult to measure for any individual NESP project, taken as a whole, it is anticipated the numerous completed restoration projects through the NESP program will greatly enhance social factors in the UMR system. All action alternatives considered would contribute positively and somewhat similarly to social benefits and, as such, OSE is not a useful metric for comparison of the final array of alternatives.

6.4 Selection of Tentatively Selected Plan

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

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

Review of the CE/ICA analysis, the four P&G criteria (completeness, effectiveness, efficiency, and acceptability), and the comprehensive benefits were used to aid the selection of the Tentatively Selected Plan (TSP).

The selected alternative would contribute to the attainment and maintenance of the stability of the UMR providing ecosystem benefits and restoration from floodplain restoration; backwater restoration; and side channel restoration. Through monitoring the success of the TSP measures including floodplain forest restoration, gravel placement in the side channel and sediment plug removal, it would support an adaptive management approach to UMR river restoration, ensuring that the larger NESP ecosystem restoration plan is implemented based on sound science and monitoring of the system response to modifications, and the design and performance evaluation of individual projects.

As a result of the discussions above and review of the evaluation criteria, the PDT recommends that the Maximum Mussel and Forest Management Alternative be the TSP. This alternative best meets the study goal and objectives, is cost effective and justified as a best buy alternative. The Maximum Mussel and Forest Management Alternative is the NER plan and yields an overall output of 355 net AAHUs.

Based on the comparisons and screening of alternatives as explained above, the Maximum Habitat Benefit Alternative, the Maximum Terrestrial Alternative, the Minimum Habitat Benefit Alternative, and the Mussel and High Priority Forest Alternative were deemed to no longer be reasonable alternatives for the project, and therefore were not carried forward for further environmental effects analyses under NEPA.

The preliminary estimated total first costs of the study were updated after the Maximum Mussel and Forest Management Alternative was identified as the TSP. This change would have been the same for all of the alternatives and would not have affected which alternative was selected. The Fiscal Year 2024 updated detailed project first cost of the Tentatively Selected Plan is $17,683,000 and is anticipated to yield 355 net AAHUs annually. Using the Fiscal Year 2024 federal discount rate of 2.75%, this results in an average annual cost of $2,104 per AAHU.

7.0 TENTATIVELY SELECTED PLAN*

The Tentatively Selected Plan (TSP) is consistent with the NESP ecosystem restoration program authorization in WRDA 2007 Section 8004 and would, in concert with other NESP ecosystem projects, ensure the environmental sustainability of the existing Upper Mississippi River and Illinois Waterway and address the cumulative environmental impacts of operation of the system and improve the ecological integrity of the Upper Mississippi River and Illinois River. The proposed project fits within the general framework of the larger Recommended Plan.

7.1 Description of Tentatively Selected Plan

The alternative plan that reasonably maximizes benefits in relation to cost and meets the overall planning objectives is the Maximum Mussel and Forest Management Alternative, which was selected as the NER Plan and approved by Mississippi Valley Division during the TSP milestone briefing held on September 8, 2023. When viewed relative to the preliminary costs of similar ecosystem restoration projects, the cost per AAHU of the Maximum Mussel and Forest Management Alternative is efficient in achieving the ecosystem restoration objectives. The TSP is consistent with regional plans for the area.

After the Maximum Mussel and Forest Management Alternative was selected as the TSP, a more refined cost was developed and is documented in greater detail in this section of the report. The TSP is shown in Figure 18 and Figure 19.

7.2 Cost Estimates

Table 18 presents the project first cost. Quantities and costs may vary during final design. A full description of the cost estimate, including all related elements, can be found in *Appendix J- Cost*.

Table 18: Project Design and Construction Cost (2024 Price Level)

Account	Measure	Project First Cost
01	Lands and Damages	$0
06	Fish and Wildlife Facilities	$11,645,000
30	Planning, Engineering, and Design	$4,961,000
31	Construction Management (S&A)	$1,650,000
	Project Cost Estimate	$18,256,000

- Figures in table rounded to the nearest thousand and are Class 3 Cost Estimates. Total includes 19.8% contingency.

As there is no funding request associated with this PIR and the NESP has already been authorized, a class four cost estimate has been prepared for this project. A class four cost estimate is a rough cost developed with a high level of reliance on cost engineering judgment, parametric costs, and historical costs of similar projects. Separate from this PIR, at a programmatic level, the NESP is cost certified every two years.

The annualized costs and AAHUs were used to calculate a total annual cost per average annual habitat unit (Table 19). The total annual cost per habitat unit is $2,104.

The costs used for analysis purposes include total project costs, IDC, and annualized O&M, adaptive management, and monitoring costs.

Table 19: Total Annual Cost Per Habitat Unit

Item	Cost
Construction Cost ($)	$17,683,000
IDC,2-year Construction 2.75% ($)	$ 488,000
Total Project Costs ($)	$18,171,000
Average Annual Construction Cost ($)	$ 673,000
Average Annual O&M ($)	$ 74,000
Total Average Annual Costs ($)	$ 747,000
Net AAHUs Gain	355
Total Average Annual Cost/AAHU ($)	$ 2,104

* Figures in table rounded to the nearest thousand. Oct24 Price Level, 2.75% Interest Rate, 50-year Period of Analysis

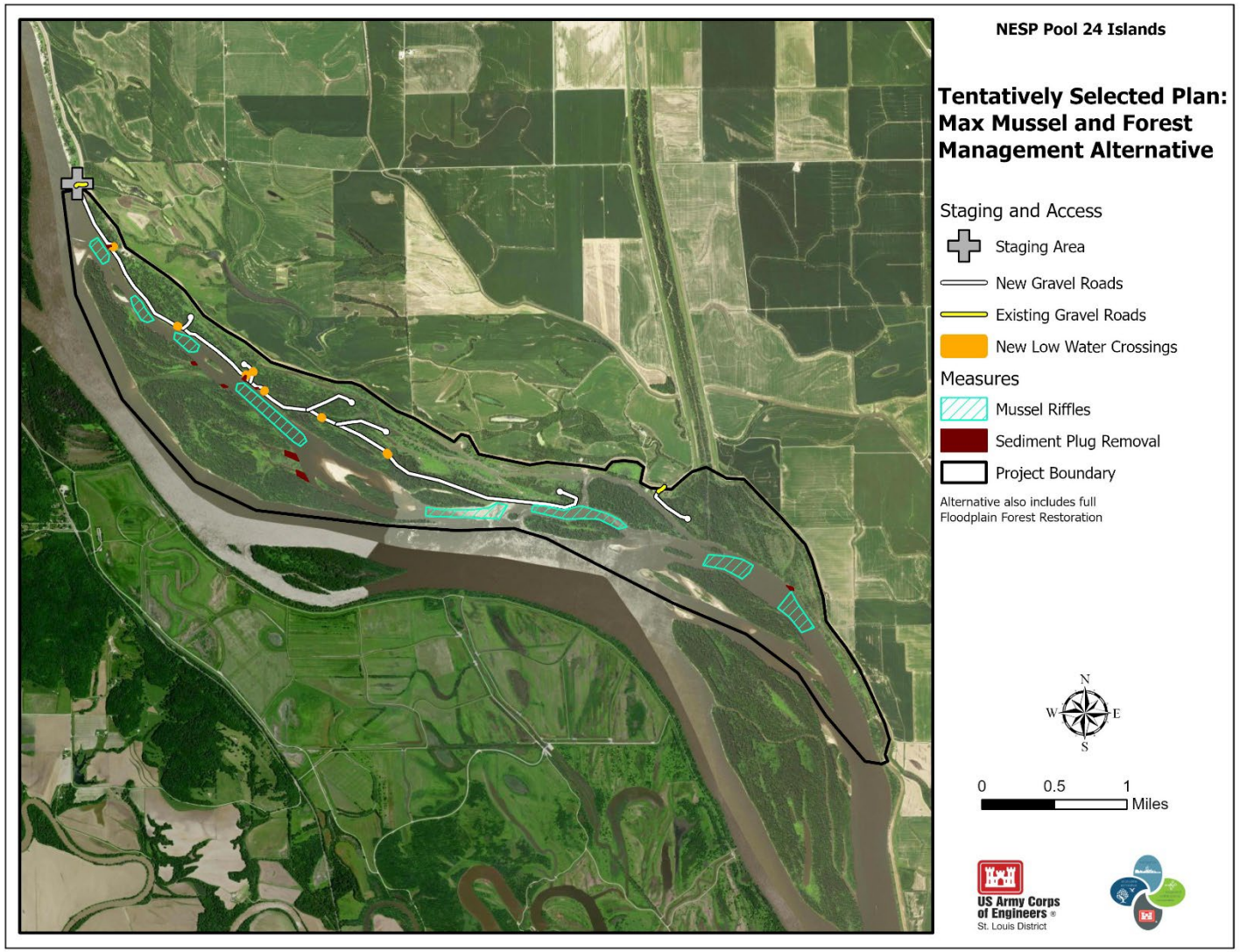


Figure 18: Tentatively Selected Plan: Maximum Mussel and Forest Management Alternative

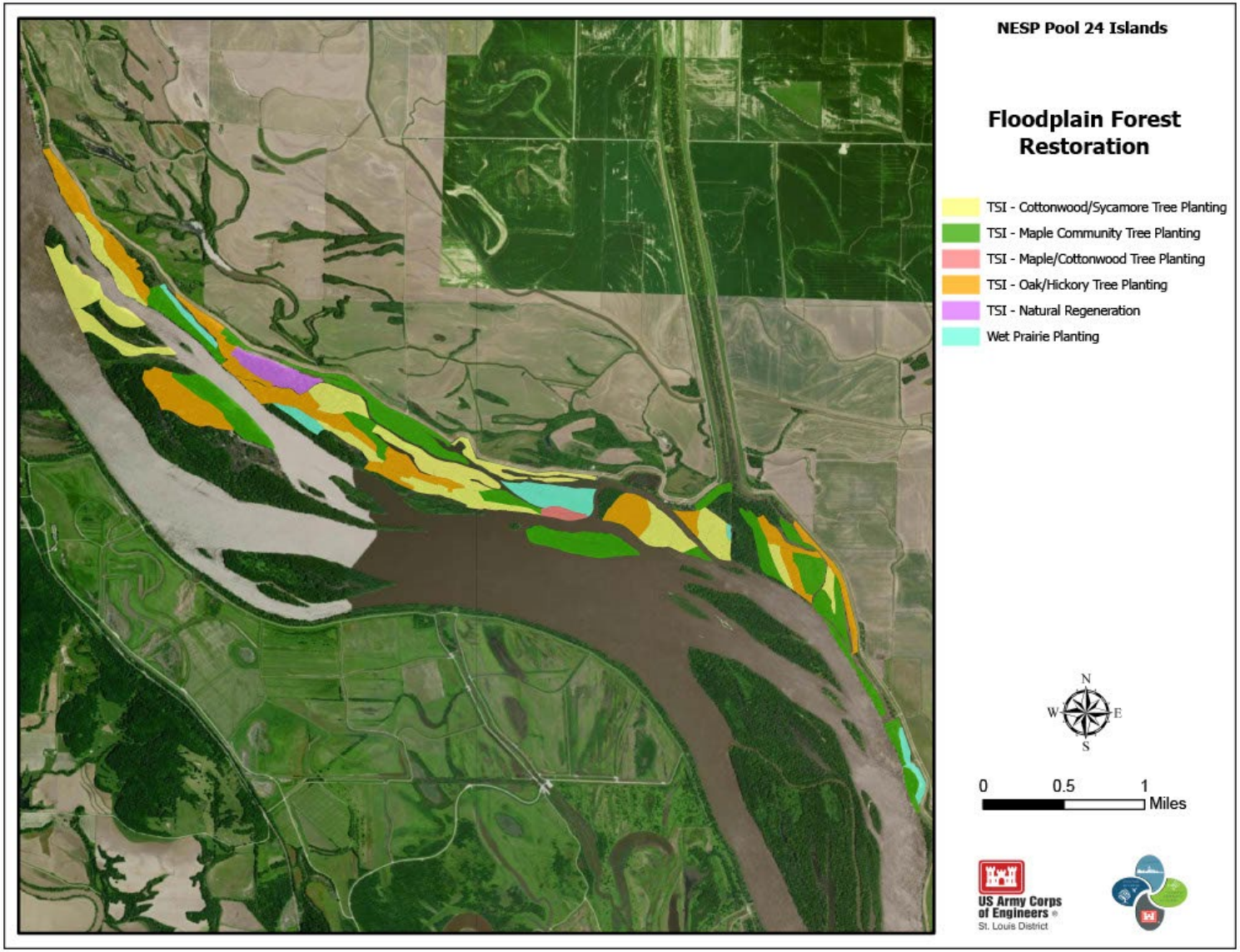


Figure 19: Tentatively Selected Plan- Floodplain Forest Restoration Measure

7.3 Design Considerations

7.3.1 Overview

Design for the island complex is anticipated to be initiated for the entire project up to approximately the 35% level of design. This will be used to develop and refine the contract acquisition plan, validate assumptions from feasibility, and otherwise determine the path forward for major design decisions. After the plan is refined, the design refinements will be broken up by contract, and the first contract will proceed with the remainder of design, and then into contract acquisition. Once the first contract package is submitted to contracting, the subsequent contract package is assumed to commence with the remaining design tasks. If broken into more than two contract packages, subsequent contract packages will follow the same process. Any lessons learned during early construction stages will be applied to subsequent design packages, and/or result in implementation of one or more Adaptive Management strategies.

7.3.2 Surveys

Coordination for collection of survey data has been initiated during the Planning phase and will be conducted as water levels allow. The upland features will be captured utilizing existing Light Detection and Ranging (LiDAR) data from 2021, supplemented as needed by land survey and/or photogrammetry collected from Unmanned Aerial Survey (UAS) systems. Determination of the survey needs are ongoing, but the estimates were created assuming two days of land-based data collection. Bathymetry will be collected using a combination of single-beam and multi-beam sonar, with acquisition occurring when adequate water levels are present.

7.3.3 Geotechnical and Environmental Explorations

The PDT does not anticipate the need for either Geotechnical or Environmental Exploration and testing; however, given the proximity to one of the Sny Levee Systems, some level of exploration may be determined to be necessary to ensure no impacts to the levee. HTRW and Clean Water Act compliance are likewise not anticipated to require exploration and testing at this time, but if construction activities are not determined to fall under Nationwide Permits and/or existing environmental permits/NEPA coordination, additional information may be needed. Design estimates included a conservative estimate of the cost for conducting these activities, if necessary.

7.3.4 Hydraulics and Hydrology

The aquatic features implemented in the TSP include removing sediment plugs in backwaters and laying down suitable substrate for mussel riffle habitats. Design of these measures will require input from hydraulic engineers. Additional hydraulic modeling may also be utilized to inform design.

7.3.5 Civil Design

Planning Level of Design

The Planning process did not include Civil design of any measures beyond a conceptual level. Measures were quantified using a combination of 2-dimensional lines and shapes, and by manipulation of the existing conditions terrain to mimic channel excavation. Quantities were extrapolated from this minimal information to provide an approximation

of 10%-20% level of design. After PDT review of the sediment plug removal quantities, it was determined that these need to be scaled down to minimize the quantity of material removed in order to limit the impacts to existing wetlands, and to water quality when the material is side-cast along the bank or within the channel. After discussion of risks associated with the current conceptual design of the sediment plugs, it was determined that this task should be completed early in Design, and no further refinements would be needed to complete the report while managing the associated risks. The determining factor leading to this decision was that the potential reduction in quantity was not significant enough to change TSP selection. The remaining measures will also be designed and adjusted as needed to reduce impacts, manage construction costs, and maximize potential habitat benefits.

Access road conceptual alignments were placed to utilize existing trails identified by the Rivers Project Office team to minimize impacts, and adjusted where necessary to avoid tree clearing, or to provide direct access to construction measures. All access roads, excepting those marked as temporary haul roads, are anticipated to be constructed by grading the alignment, compacting the subgrade, placing a non-woven geotextile, and then placing multiple courses of limestone aggregate, and are intended to remain in place to facilitate Operations, Maintenance, Repair, Rehabilitation, and Replacement (OMRR&R) of the project measures, as well as Monitoring and Adaptive Management (MAM). Several access roads cross low-lying swales and similar measures in the island and will use hardened-at-grade crossings to provide stable access while minimizing changes to flow within the island topography. These crossings will be composed of excavation, subgrade compaction, nonwoven geotextile, bedding gravel, and a riprap or similar armor stone gradation that will be selected during design to provide smooth driving surface while resisting any velocity from flooding/runoff. The estimate included use of a surface gravel to choke any voids in the driving surface. Design will look at methods to reduce loss of this material due to localized scouring.

Staging areas vary between alternatives, but are placed to limit disturbance to existing habitats, provide appropriate access to transfer materials and equipment to and from floating plant, and/or utilize existing operational areas. Alternatives that do not include large-scale channel excavation and placement in areas to elevate future floodplain forest habitat are anticipated to have minimal staging area requirements. The requirements of establishing reliable access for crews to conduct TSI and OMRR&R activities will be determined during PED.

Scope of Design Phase
After additional survey data is collected, an updated Existing Conditions Terrain model will be created for use by Civil Design and Hydraulics. This data will be used to model the proposed measures for use in the hydraulics model(s), develop detailed quantity estimates, and for generating construction drawings.

All measures from the recommended plan will be designed based on this terrain, aerial imagery, and site visits to the measure locations to identify potential design conflicts and opportunities. All measures will be designed in detail, and adjusted as needed from

Planning to reduce impacts, manage construction costs, and maximize potential habitat benefits during Design.

Details on draft limitations for floating plant, and equipment assumptions and associated water surface elevations for establishing reliable access to Denmark Island will also need to be determined during Design.

7.3.6 Cultural

A review of the Illinois Department of Natural Resources cultural resource database revealed that two archaeological surveys (PK-1090 and PK-12823) had previously surveyed portions of the study area. Neither survey identified historic properties.

The recommended plan will require a cultural resource survey of the tree planting areas. Due to the size of the survey area, the cultural resource survey will take place following NEPA compliance. The Illinois State Historic Preservation Office (SHPO) and consulting tribal nations have been consulted via letters (July 20 and 21, 2023) and a virtual meeting (October 18, 2023) pertaining to a programmatic agreement (PA) in order for the St. Louis District to complete Section 106 compliance following NEPA.

All correspondence and meeting minutes are in Appendix A – Coordination.

7.4 Construction Considerations

The District identified several construction considerations in the study area. A summary of critical construction considerations is provided in the following sections.

7.4.1 Protected Species

7.4.1.a. Bald Eagles

Consideration (in coordination with the USFWS) would be given during design preparation to sequence construction activities in a manner that minimizes impacts. No forestry measures would be utilized within a buffer of at least 100 feet of a known Bald Eagle nest location. At least a 330 feet buffer would be utilized during the nesting season for Timber Stand Improvement (TSI) in locations where the eagle nest is not visible through a forested buffer. A 660 feet buffer would be utilized under instances of direct line of site during the active nesting season according to the National Bald Eagle Management Guidelines. Staging of equipment would not be allowed within a 660 feet buffer of a known active nest. Additional coordination with the USFWS would be conducted during the design phase to account for changes in conditions in the study area relative to proposed project measures prior to or during construction.

7.4.1.b. Gray Bat, Indiana Bat, Northern Long-Eared Bat, and Tricolored Bat.

Any construction work requiring tree clearing activities must have tree clearing operations scheduled within the bats inactive season from October 1 to March 31. Continued coordination with USFWS will occur through future project phases if tree clearing would be done during the roost season. During clearing, dead trees, split trees, trees that have cavities, and trees with exfoliating bark would be favored for retention

where possible. Design of forestry measures would aim to improve foraging habitat and promote development of long-term roost tree sites.

7.4.2 Migratory Wildlife

In accordance with Executive Order 13186, take of migratory birds protected under the Migratory Bird Treaty Act should be avoided or minimized, to the extent practicable, to avoid adverse impact on migratory bird resources. Tree clearing during winter would avoid impacts to nesting migratory wildlife.

7.4.3 Air Quality

Diesel emissions and fugitive dust during project construction may pose environmental and human health risks and should be minimized. Applicable protective measures as outlined in USEPA's "Construction Emissions Control Checklist" would be followed.

7.4.4 Permits

Laws of the United States and State of Illinois have assigned the USACE and Illinois with specific and different regulatory roles designed to protect the waters within and on the State's boundaries. Protecting Illinois waters is a cooperative effort between the applicant and regulatory agencies.

7.4.4.a Section 404/401 Compliance

The District is compliant with Section 404 and 401 of the Clean Water Act. See the 404(b)1 evaluation (*Appendix D – Clean Water Act)* Section 404(b)(1) Evaluation) for more details. Based on this evaluation, the project qualifies for a Nationwide 27 permit for Ecosystem Restoration. The Nationwide 27 permit includes general conditions that meet IDNR Section 401 water quality certification requirements. Therefore, the necessary Section 401 water quality certification would be achieved through the associated Nationwide 27 permit conditions.

7.4.4.b National Pollutant Discharge Elimination System (NPDES)

A storm water discharge or NPDES permit for construction activities may be required. Effective March 10, 2003, the NPDES storm water discharge permit is required when a construction activity disturbs more than one acre. The construction contract for the study area may trigger the need for the contractor to apply for this permit. The contractor would be required to prepare an erosion control plan to ensure that unprotected soil is not allowed to leave the study area work limits. The contractor would be required to comply with all local codes and permit requirements.

7.5 Construction Schedule Constraints

Scheduling of construction contracts would depend on availability of funds. The following documents constraints related to construction:

- Flooding has the potential to limit site access.
- No clearing of trees shall be allowed between April 1 and October 1, to avoid impacts to bat summer roosting habitat.
- During waterfowl season construction activities may be limited to certain areas.

- Construction staging and access points to project measures would be defined during Plans and Specifications to avoid and minimize potential impacts to wetland resources.
- Coordination with IDNR personnel is required prior to working during hunting seasons.
- No clearing of trees where roosting or occupied nests exist shall be allowed when bald eagles are present in the area. There are known active bald eagle nests within the study area. Construction activities and other sources of disturbance would be avoided within a 660-foot buffer area from the nest, when active.
- In accordance with Executive Order 13186, Responsibilities of Federal Agencies to Protect Migratory Birds, take of migratory birds protected under the MBTA should be avoided or minimized, to the extent practicable, to avoid adverse impact on migratory bird resources.

7.6 Construction Sequencing

The details of construction sequencing will be developed during Design, but the following are the assumptions developed by the PDT and Cost Engineering.

Land-based work and river-based work will be completed under a minimum of two separate contracts, which may be sequenced in any order. Land-based work will include access roads, staging areas, sediment plug removals on Drift Island, and timber stand improvements (TSI). The sediment plug removals are assumed to be completed by land-based equipment, but given access constraints (soft soils, wet conditions, adjacent forests), a modular floatation system may be required to complete the work. Sediment plug removals will occur before the majority of TSI activities to ensure that the areas are drained prior to forest plantings, though some areas identified may be completed prior if they are not drained by the swales receiving sediment plug removal. Sediment plug removals on Denmark Island will require small-scale floating plant and may be included in either contract.

Mussel riffles are assumed to be conducted by river-based equipment, using typical floating plant under shallow draft conditions (either performing work during high-flows, or using light barges to limit draft), though the contractor may elect to use specialized equipment to perform the work during lower-water periods.

7.7 Construction Access and Staging

Administrative staging areas are assumed to be utilizing existing parking areas for the site, with minimal disturbance required. Materials staging areas are assumed to be minimal as the materials (aggregate and geofabric for roads, and revetment for low-water crossings) should be delivered to their placement site during placement operations, and will have negligible and temporary impacts if needed.

The river-based work is assumed to not require additional access and staging areas. The majority of the work will be done by floating plant, and office trailers are assumed to be set up in parking areas or similar areas in the northwest portions of Drift Island.

Access on Denmark Island is limited to equipment and personnel that will access the site by small watercraft, which are assumed to not need access roads or significant staging areas but may require a boat dock or similar structure for mooring boats and loading/unloading personnel and equipment. The boat dock or other transfer point is assumed to be minimal cost, and will be developed during Design. Sediment plug removals are assumed to be performed using some form of low-draft floating plant for equipment access, or may be completed by low-pressure or similar land-based equipment.

Access and Staging areas on Drift Island will include significant access roads, to include several low-water crossings (hardened, at-grade stone structures) where the roads cross existing swales. These roads will be used by crews constructing the TSI and Sediment Plug removal measures and will remain in place after construction for use by the Rivers Project Office staff for OMRR&R and Monitoring and Adaptive Management.

Roads will not be passable during high-water conditions and may require closure gates and/or other warnings to prevent access by the public.

7.8 Real Estate Considerations

No LERRDS were anticipated to construct the Project measures. Measures are below the ordinary high water mark and therefore no real estate acquisition was identified.

7.9 USACE Responsibilities

7.9.1 OMRR&R

Operations and Maintenance activities will include Site Visit / Inspections of all measures each year for the first five years, then approximately every five years. These may be completed annually on a rotating cycle, so that each measure will be inspected within the five-year cycle, but different measures are inspected each year.

Access roads are assumed to require supplemental aggregate to replace surfacing that is washed out or rutted from traffic within the site. For cost estimating purposes, 15% of the construction quantity of aggregate is assumed to need to be placed every 10 years.

Tree planting areas will be required to be mowed and sprayed with herbicide to manage invasive species and ensure all planted trees out-compete surrounding vegetation. This is assumed to be performed annually for the first seven years after tree planting operations. For tree mortality occurring outside of the warranty period of one-year post-construction, replacement trees may be required to be planted; it is assumed that 10% of the trees will require replacements at around years 15 and 30 post-construction. Any excessive mortality noted within years 2-10 post-construction will be assessed and addressed as part of Adaptive Management.

Wet Prairie areas will require controlled burns to manage invasive species and maintain healthy communities that would naturally undergo wildfire regeneration. This is assumed to be performed annually for one-third of the wet prairie managed areas, such

that every area is burned every three years. For planting mortality occurring outside of the warranty period of one-year post-construction, replacement plantings may be required to be planted; it is assumed that 10% of the vegetation will require replacements at around years 15 and 30 post-construction. Any excessive mortality noted within years 2-10 post-construction will be assessed and addressed as part of Adaptive Management.

Replacement stone for training structures and mussel substrate are not anticipated to be required within the project life, so no cost is included for these items. If losses are noted within the first 10 years post construction, these will be covered under Adaptive Management actions.

Additional excavation of the sediment plug removal sites is not anticipated to be required or achievable within the project life, so no cost is included for these items. If excessive sedimentation is noted within the first 10 years post construction, additional sediment removal will be covered under Adaptive Management actions.

7.10 Environmental Effects*

Based on the comparisons and screening of alternatives as explained above in Section 6, the Maximum Habitat Benefit Alternative, the Maximum Terrestrial Alternative, the Minimum Habitat Benefit Alternative, and the Mussel and High Priority Forest Alternative were deemed to no longer be reasonable alternatives for the project, and therefore were not carried forward for further environmental effects analyses under NEPA.

The following sections describe the potential environmental effects (both adverse and beneficial) that No Action and the Tentatively Selected Plan may have on the resources addressed in Section 2, *Assessment of Existing Conditions*. General assumptions and effects of the No Action, or Future without Project Conditions are also included in Section 3.0, *Future Without Project Conditions* above. The effects described in the following sections may be temporary or long-term in duration. Minor effects are typically considered negligible, while moderate adverse effects may be either avoided or counteracted by other actions that further enhance or benefit the resource. According to NEPA guidance, the meaning of significant effects varies with the context (where the action occurs) and intensity (how much damage or improvement the action causes). Non-significant effects mean there is no substantial change to the resource, while significant effects may be beneficial or adverse. Resources that are anticipated to experience negligible or no effects from either the No Action Alternative or the Tentatively Selected Plan have been omitted from the summaries below, and are listed in Table 20 below. The effects of the Tentatively Selected Plan may furthermore occur immediately because of the action (direct), occur later in time, or removed in distance in response to the action (indirect), or may be reasonably expected to occur, given similar restoration actions within the UMRB (cumulative). Please refer to Table 20 below for a summary and comparison of the environmental effects anticipated with the TSP. No significant negative effects are expected from the TSP.

Table 20: Summary and Comparison of Environmental Effects of the Tentatively Selected Plan

	Insignificant effects	Insignificant effects as a result of mitigation*	Resource unaffected by action	Positive effects
Aesthetics	☒	☐	☐	☐
Air quality	☒	☐	☐	☐
Aquatic resources/wetlands	☐	☐	☐	☒
Invasive species	☐	☐	☐	☒
Fish and wildlife habitat	☐	☐	☐	☒
Threatened/Endangered species/critical habitat	☐	☐	☐	☒
Historic properties	☒	☐	☐	☐
Other cultural resources	☒	☐	☐	☐
Floodplains	☐	☐	☐	☒
Hazardous, toxic & radioactive waste	☐	☐	☒	☐
Hydrology	☐	☐	☐	☒
Land use	☐	☐	☒	☐
Navigation	☐	☐	☒	☐
Noise levels	☒	☐	☐	☐
Public infrastructure	☐	☐	☒	☐
Socio-economics	☐	☐	☒	☐
Environmental justice	☒	☐	☐	☐
Soils	☐	☐	☒	☐
Tribal trust resources	☒	☐	☐	☐
Water quality	☐	☐	☐	☒
Climate change	☐	☐	☐	☒

Short-Term Construction effects. Under the No Action alternative, there would be no Construction effects.

Construction of the Tentatively Selected Plan would take place completely on federal lands. No measurable change in floodplain storage would occur as a result of the Tentatively Selected Plan, and the project would not directly induce additional development/construction within the floodplain. Additional information is provided in *Appendix D – Clean Water Act, and Appendix G – Hydrology and Hydraulics*.

Staging areas and access to the site for construction would occur on publicly owned land within the study area. Much of the access would be by water, but

some land-based access is anticipated as well. Use of existing roads and trails would be utilized to reduce additional potential environmental impacts. Temporary disruption of traffic may occur related to increased travel for staging and construction but would return to pre-construction conditions following construction completion.

Minor and temporary increases in turbidity, dust, and noise because of construction activities will occur. Additionally, wildlife may be temporarily disturbed during construction. Benthic and aquatic organisms may be lost and/or relocated within the footprint of excavation and substrate enhancement operations. Native seed would be used to revegetate disturbed terrestrial areas after construction. Restoration of hydrologic conditions after construction completion will result in the rapid recolonization of benthic organisms. Due to the potential presence of several USFWS and Illinois State threatened and endangered species, seasonal construction restrictions would be implemented to avoid and minimize potential impacts. Additional information is provided in *Appendix C – Biological Assessment*

- **Aquatic and Wetland Resources.** Under the No Action Alternative, assuming a sediment deposition rate of approximately 0.8 inch/year continuing in the backwaters into the future, approximately 3.4 feet of deposition would be anticipated over a 50-year span. This rate of deposition would cause the sedimentation/siltation of the side channels surrounding Drift Island and Denmark Island and they would become part of the bankline. If a 0.8 inch/year deposition rate is too high (which is very possible given the limited data), it would still be anticipated that the habitat in both side channels would have severely degraded due to deposition within 50 years, causing shallower depths, higher temperatures, and decreased dissolved oxygen levels.

  Construction of the Tentatively Selected Plan will result in temporary, short-term negative impacts to backwaters, side channels, and emergent wetland / wet meadow resources due to construction activities. These temporary impacts would include localized increases in turbidity, disturbance to aquatic wildlife, and local aesthetics. In the long-term, the Tentatively Selected Plan would benefit 218 acres of aquatic habitat, both directly and indirectly, through an increase in backwater connectivity, side channel connectivity, and wetland structure and function. Staging of equipment is expected to occur primarily by floating plant, but consideration of placement and staging will be given to any land-based access during design.

  Existing wet meadows within the upper and middle portions of the pools are presently not in a desired state due to conversion to reed canary grass, over-mature forest, and reduced percentage and limited distribution of less flood tolerant species. Island dissection has increased the amount of lotic habitat in some areas at the expense of floodplain terrestrial wet meadow, isolated wetlands and lentic areas (McCain, Schmuecker, & De Jager, 2018). Under the no action alternative, the wet meadow portions of islands within the study area

are anticipated to experience further degradation over time due to sedimentation, extended hydroperiod, and invasive species encroachment.

With the proposed measures under the TSP such as invasive species treatments and native plantings, the wet meadows on Denmark and Drift Island are expected to rebound and provide much needed aquatic vegetation functional class that many species rely upon within the UMRS. Through the habitat evaluation and quantification process, the wet prairie and wet meadow habitat considered for the Marsh Wren HSI model generated 67 net AAHU with the Tentatively Selected Plan (for more details refer to *Appendix B – Habitat Evaluation and Quantification*).

Freshwater mussel habitat within the study area includes the side channels found across the Denmark and Drift Island complex. Approximately 1,130 acres of side channels and main channel border habitats provide important resources for lotic-dependent riverine species. The Tentatively Selected Plan includes measures that will enhance the substrate, flow, connectivity, and bathymetric diversity to restore spawning, rearing, foraging, and refugia habitats within the side channel and main channel borders of the study area. Through the habitat evaluation and quantification process, the side channel habitat improvements considered for the General Freshwater Mussel Habitat model generated 121 net AAHU with the Tentatively Selected Plan (for more details refer to *Appendix B – Habitat Evaluation and Quantification*). Therefore, these measures would have a positive effect on aquatic resources.

- **Floodplain Forest Habitat.** Under the No Action Alternative, without intervention in the form of forest management and elevation manipulation, the forest resources of the project area would continue to degrade. The water retention issue would continue to put undue stress on terrestrial areas and convert floodplain forest to swamp shrubland. Invasive species would continue to increase and outcompete native vegetation. Japanese Hops readily occupy newly created canopy gaps and would prevent the establishment of new forest. Aquatic areas would continue to experience increased siltation and provide minimal fish and mussel habitat. Lack of adequate depth and flow would continue to be a problem.

  Floodplain habitat within the study area consists of floodplain forest resources throughout the ridge and swale topography in the Denmark and Drift Island complex. In all, approximately 1,018 acres of forested habitats occur within the study area.

  The Tentatively Selected Plan includes floodplain forest restoration measures such as timber stand improvement (TSI), early successional forest enhancement, Oak-Hickory tree plantings, Maple and Cottonwood tree plantings, Maple community enhancement, and natural regeneration. Also included is the measure of sediment plug removal to facilitate improved drainage of the island swale areas and reducing impacts to prolonged impounding on forest resources in the

active growing season, which will improve overall forest health. Through the habitat evaluation and quantification process, the floodplain forest habitat considered for the UMRS Floodplain Forest model generated 215 net AAHU with the Tentatively Selected Plan (for more details refer to *Appendix B – Habitat Evaluation and Quantification*). Therefore, these measures would have a positive effect on forested resources.

- **Geology and Soils.** Under the No Action alternative, no effect to geology and soils are anticipated as natural riverine accretion and erosive processes would continue as they have in the past.

  The current geology and soils within the study area have been altered by natural riverine accretion and erosion through time, with historical agricultural activities in the vicinity of the study area. Temporary, minor impacts to geology and soils would be expected due to construction activities and Project measures. The backwater sediment plug removal measure would alter existing topography and drainage. However, beneficial impacts to soils would be anticipated over the long-term as restored habitats mature or undergo succession.

  No impacts to acres that qualify as prime farmland, nor any conversion of farmland to nonagricultural uses are expected within the study by the proposed project. Therefore, negligible impacts overall to geology and soils are anticipated as a result of the project.

- **Wildlife.** Under the No Action alternative, sedimentation is anticipated to result in further conversion of vital backwater habitats and side channels into more terrestrial habitat which would have long term adverse impacts to the aquatic wildlife that rely on these backwaters and side channels for spawning, rearing, and foraging. Terrestrial wildlife would also likely see a decline in quality available habitat due to increase inundation and tree mortality.

  Large river floodplains, such as the UMRS, provide a mosaic of forest, grassland, islands, backwaters, side channels, and wetlands. In all, the UMRS supports over 550 vertebrate species, and nearly 50 species of mussels (Guyon L. D., 2012). There are over 300 species of bird that migrate along the Mississippi Flyway. The study area is located near the confluence of the Mississippi and Salt Rivers and is an important link along the Mississippi Flyway migratory corridor. Without the project, sedimentation is anticipated to result in further conversion of vital backwater habitats into terrestrial habitat, with a continual degradation, loss and conversion of vital floodplain forest resources, which would have long term adverse impacts to the wildlife. Through the habitat evaluation and quantification process, and the application of the HSI models, the Tentatively Selected Plan is expected to generate 355 net AAHU across the study area, (for more details refer to *Appendix B – Habitat Evaluation and Quantification*). Therefore, the Tentatively Selected Plan will restore and enhance vital habitats for a net positive uplift for the wildlife that live in, use, and migrate through the study area.

- **Bald Eagle.** There are known bald eagle nests within the study area as well as numerous other mature trees fitting this description that occur elsewhere in the study area. The no action alternative would have no effect on Bald Eagles. Minor and temporary increases in turbidity, dust, and noise from construction activities will occur with the Tentatively Selected Plan; however, the project measures are expected to have an overall positive effect on Bald Eagles by improving habitat used by their primary food resources.

  To comply with the BGEPA, the PDT will continue coordination with USFWS as construction limits and timelines develop with enough detail to properly coordinate any potential effects to Bald Eagles within and/or adjacent to the study area.

- **Federally Threatened or Endangered Species.** Under the No Action alternative, sedimentation is anticipated to result in further conversion of vital backwater habitats and side channels into more terrestrial habitat which would have long term adverse impacts to any T&E species that may utilize these backwaters and side channels for spawning, rearing, and foraging. T&E Bats would likely benefit in the short term from more available habitat due to increase inundation and tree mortality.

  In accordance with the Endangered Species Act, an updated list of federally threatened and endangered species was obtained from the USFWS on November 8, 2023. This satisfies the “request for species list requirements” for ESA Section 7 Consultation. The Gray Bat, Indiana Bat, Northern Long-eared Bat, Tri-colored Bat, Spectaclecase mussel, Decurrent False Aster, and Eastern Prairie Fringed Orchid are listed as federally threatened or endangered; and the Monarch butterfly is a candidate species. USACE prepared a biological assessment (*Appendix C – Biological Assessment*) that will be made available to USFWS for concurrent review during the public comment period. Based on the information obtained, USACE has determined the Project *May Affect, but is Not Likely to Adversely Affect* the Gray Bat, Indiana Bat, Northern Long-Eared Bat, Tricolored Bat, Decurrent False Aster, Eastern Prairie Fringed Orchid, and Monarch butterfly.

- **Invasive Species.** Under the No Action alternative, it is anticipated that the invasive species previously identified would have ample opportunity to establish and proliferate in the project area unchecked. This would be a detriment to the native species within the area.

  The effect of the Tentatively Selected Plan on invasive species distribution and abundance were considered throughout the planning process. The District has weighed the benefits that this Project will have on invasive species, as well as to the native communities that it is intended to sustain and support.

  The TSP includes measures that will actively reduce the presence and effects of invasive plant species such as Reed Canary Grass (*Phalaris arundinacea*) and

Japanese Hops (*Humulus japonicus*). Floodplain Forest Restoration activities include treatment of invasives and tree planting over those areas to out compete them into the future, with monitoring and adaptive management measures in place to address any potential future encroachment by invasives. Please refer to *Appendix E-Monitoring and Adaptive Management Plan*, for a full description of monitoring requirements and adaptive management measures to address invasive species.

- **Water Quality.** Under the No Action alternative, sedimentation is anticipated to result in shallower backwater habitats which would lead to overall decline in water quality by means of higher summer temperatures, higher turbidity from wave action, and decreased dissolved oxygen levels.

  Short-term minor increases in turbidity are expected to occur due to construction activities of the TSP within the study area. Avoidance and minimization were utilized in development and analysis of alternatives and would continue to be utilized through implementation. Best management practices would be required during construction to reduce movement of sediments and nutrients within aquatic areas. As a result, these effects would be less than significant.

  After construction, the proposed Project measures improve water management capabilities and restore emergent wetland, floodplain forest, and floodplain woodland communities, resulting in minor improvements to water quality in the study area. These restored communities will filter nutrients and reduce sediment inputs to the Mississippi River. Overall, the Tentatively Selected Plan will have a positive effect on water quality; additional information is provided in *Appendix D – Clean Water Act Section 404(B)(1) Evaluation*.

- **Greenhouse Gas Emissions and Climate Change.** Carbon dioxide (CO_2) is the primary greenhouse gas emitted from human activities, primarily through the 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 surface and ultimately changes to some ecosystems. Vegetation such as trees, grasses, shrubs, and herbaceous wetland plants are known to reduce the amount of CO_2 in the atmosphere by sequestering the gas during photosynthesis and returning oxygen to the atmosphere as a byproduct.

  Under the No Action Alternative, there is no expected change from existing conditions. Across all the alternatives evaluated, it was anticipated that the varying levels of required construction operations per alternative would reflect the varying levels of habitat restoration and benefit. For example, the volumes of excavated material found across the evaluated alternatives are in lockstep with acres of restored habitat across those alternatives; therefore, the greenhouse gas emissions (GHG) expected from construction activities would also follow suit with carbon sequestration gained out of each alternative, proportionately.

Under the Tentatively Selected Plan, the Project construction would result in short-term construction-related emission release of GHG as construction equipment burns fossil fuels. Construction GHG would be substantially less than the federal reporting threshold. This minor short-term adverse effect would be offset by long-term beneficial effects from wet prairie and wet meadow enhancements and forest restoration realized through TSI, plantings, natural succession, and invasive species management. Approximately 1,018 acres of forested island habitat would be restored as part of the TSP. Using the March 2022 EPA estimate of 0.84 metric tons of CO_2/acre/year from an average U.S. Forest, this reforestation would result in an additional 855 metric tons of CO_2 sequestered each year, which equates to over 42,700 metric tons of CO_2 sequestered over the 50-year period of analysis (https://www.epa.gov/energy/greenhouse-gas-equivalencies-calculator). This carbon sequestration is in addition to other habitat benefits realized through forest stand improvements, wetland restoration, island creation and side channel habitat improvements accomplished across the approximately 3,320-acre study area. Overall, the Tentatively Selected Plan would provide a net benefit rather than an adverse impact to climate change.

- **Socioeconomic Resources.** Under the No Action alternative, there are no anticipated effects to Socioeconomic Resources.

  No short-term or long-term impacts to the population growth of the neighboring communities or region are anticipated because of the Project. Some minor, temporary negative impacts to recreational uses may occur as a result of construction activities. However, recreational opportunities would be improved in the study area because of improved habitat diversity which would increase the attractiveness of the area for wildlife observation and hunting. Therefore, moderate, positive impacts on recreational opportunities are anticipated as a result of the proposed project.

  The study area is wholly located on federal lands; therefore, no residential property or land would be displaced. Additionally, no changes in property values or tax revenues would occur because of the Project. The Project would result in a minor, temporary increase in employment opportunities in the area during construction but would not directly affect employment of the labor force in nearby Illinois or Missouri counties. Overall, the Project would have no adverse impacts to socioeconomic resources.

  Environmental Justice. Under the No Action alternative, there are no anticipated effects to Environmental Justice.

  Environmental Justice is a national goal and is defined as the fair treatment and meaningful involvement of all people regardless of race, color, national origin, or income with respect to the development, implementation, and enforcement of environmental laws, regulations, and policies (see Section 2.20). Project goals and objectives were established to provide environmental restoration and

enhance the quality of the environment for all people. Public involvement, via public meetings and distribution of information concerning the proposed project, has and will continue to be an integral part of planning for this project to ensure that concerns of all people will be fully considered in the decision-making process. No differential impacts to underserved communities or populations are expected with any of the considered alternatives. Short-term increases in employment could be realized during construction but would then return to pre-construction conditions. Therefore, the considered action alternatives would have negligible effects on underserved communities and populations.

- **Man-Made Resources.** Under the No Action alternative, there are no anticipated effects to Man-Made Resources.

  The Project would not impact flood reduction levees within or adjacent to the study area. The Project would not result in any significant change in floodplain storage. There would be no impacts to navigation training structures on the Mississippi River. Impacts to navigation would not occur as a result of the Tentatively Selected Plan. Overall, the impacts to man-made resources as a result of the Tentatively Selected Plan would be negligible. Additional information is provided in *Appendix G – Hydrology and Hydraulics.*

- **Short-Term Versus Long-Term Productivity.** Under the No Action alternative, sedimentation is anticipated to result in shallower backwater and side channel habitats, which would lead to overall decline in productivity.

  Construction activities would temporarily disrupt wildlife and human use of the study area. Long-term productivity for natural resource management would benefit from construction of the Project. Long-term productivity would be enhanced through increased longevity of the enhanced wet prairie and wet meadows, enhanced forest structure and diversity, and by providing more dependable habitat to support migratory and resident wildlife species. The habitat changes and development that would occur as a result of the Project would benefit both game and nongame species. This would result in enhanced recreational opportunities for both consumptive and non-consumptive users. Negative long-term impacts are expected to be negligible for all ecosystems associated with the Project.

- **Irreversible or Irretrievable Resource Commitments.** Under the No Action alternative, there are no anticipated effects to Irreversible or Irretrievable Resource Commitments.

  The purchase of materials and the commitment of man-hours, fuel, and machinery to perform construction are irretrievable. None of the proposed actions are considered irreversible.

- **Cumulative Effects.** Under the No Action alternative, there would be no additional cumulative effects.

  Cumulative effects occur when a relationship exists between a proposed action and other actions which have occurred, are occurring, or are expected to occur in a similar location. The primary area considered in the cumulative effects analysis is limited to Alton Pool of the Illinois River and Pool 24 of the Mississippi River. The temporal boundary for the cumulative effects evaluation would begin in the early 20th century, when the Mississippi River was initially impounded, and extend through the completion of the construction phase of this proposed project, approximately the year 2030. There would be little to no cumulative effects to operation and maintenance of the nine-foot navigation channel, commercial traffic, and residential development, agricultural practices, and watershed management as a result of this Project or past and future UMRR projects. Overall, it is anticipated that the Project would include minor improvements to floodplain forests, floodplain woodlands, and emergent wetlands.

  Past Actions: The authorization, construction, and maintenance of the nine-foot navigation channel project has resulted in significant impacts to distribution, proportional cover, and acreage of floodplain habitats. Construction of the Locks and Dams in the UMRS and Illinois River raised water levels from their natural state in many areas. As a result, there was a conversion in habitat types. Emergent wetlands were converted to permanently inundated lakes and sloughs, many of the permanently inundated lakes have converted to open water habitats, and there was also a conversion of lower elevation forests to aquatic habitats. In addition, the hydrologic fluctuations and sediment transport processes were modified with construction of the lock and dam system. These altered conditions have resulted in reduced topographic diversity, floodplain vegetation diversity, vegetated wetlands, and a modified disturbance regime that only partially supports regeneration of hard-mast and early successional tree species such as Cottonwood.

  Present and Reasonably Foreseeable Actions: USACE will continue to operate and maintain the nine-foot navigation channel along the Illinois and Mississippi Rivers. This includes continuation of dredging, placement of material, and construction, operation, and maintenance of river training structures such as dikes. While maintenance dredging is fairly uncommon in Pool 24, the study team assumed that it may occur at some point in the future.

  Three NESP projects on the Illinois River are anticipated to be constructed in the near future. As of this writing, contracts have been awarded, and the construction of Moore's Towhead (RM 76), Wing Island (RM 40), and Fisher Island (RM 38) are anticipated to be complete by end of FY24. All three projects were designed to address erosion issues at the islands and mitigate some of the effects of the lock and dam system. In addition, flood damage repair to the Illinois riverside berm is anticipated around 2025.

Cumulative impacts of the proposed action are not expected to be significant. The Project should have a positive long-term benefit on floodplain forest, wetlands, side channels, and associated wildlife inhabiting the area. The Project, in concert with other proposed and/or constructed projects in the region, should counter some of the past, current, and foreseeable actions described earlier.

7.11 Compliance with Environmental Statutes

Status of compliance activities with environmental protection statutes, regulations, and guidelines is listed in Table 21 below. Remaining compliance activities will be completed as construction limits and timelines develop with enough detail to properly coordinate any potential effects related to the Tentatively Selected Plan within and/or adjacent to the study area.

Table 21: Relationship to Environmental Protection Statutes and Other Environmental Requirements

Federal Environmental Protection Statutes and Requirements	Applicability/ Compliance[1/2/3]
Archaeological and Historic Preservation Act, 16 U.S.C.	Partial
Clean Air Act, as amended, 42 U.S.C. 1857h-7, et seq.	Full
Clean Water Act, Sections 404 and 401	Full
Endangered Species Act of 1973, as amended, 16 S.C.	Partial
Environmental Justice (EOs 12898, 13985, 13990, 14008)	Full
Executive Order 11988 – Floodplain Management	Full
Executive Order 11990 - Protection of Wetlands	Full
Executive Order 13112 - Invasive Species	Full
Farmland Protection Policy Act. 7 U.S.C. 4201, et seq.	Full
Federal Water Protection Recreation Act, 16 U.S.C. 460-	Full
Fish and Wildlife Coordination Act, 16 U.S.C. 601, et seq.	Partial
Greenhouse Gases, CEQ Memorandum 18, Feb 2010	Full
Land and Water Conservation Fund Act, 16 U.S.C. 460/-	Full
National Environmental Policy Act, 42 U.S.C. 321, et seq.	Partial
National Historic Preservation Act, 16 U.S.C. 470a, et seq.	Partial
Rivers and Harbors Act, 33 U.S.C. 403, et seq.	Full
Watershed Protection and Flood Prevention Act, 16 U.S.C.	Full
Wild and Scenic Rivers Act, 16 U.S.C. 1271, et seq.	Full

1. Full Compliance = having met all requirements of the statute for the current stage of planning.
2. Partial Compliance = having met some requirements of the statute for the current stage of planning or anticipate full compliance at completion of planning (additional information below).
3. Not Applicable = no requirements for the statute or project does not contain resources applicable to the law.

7.12 Post Construction Evaluation

This section summarizes the monitoring and adaptive management needed to assess the habitat changes resulting from the implementation of the proposed study. Project monitoring is designed to gauge progress toward meeting the project objectives. Section 1161 of WRDA 2016 requires that when conducting a feasibility study for ecosystem restoration, the proposed project includes a plan for monitoring the success of the ecosystem restoration as well as an adaptive management plan.

This monitoring and adaptive management plan (Table 22) was developed with input from the State and Federal resource agencies. Details on performance indicators, monitoring targets, time of effect, frequency of monitoring, adaptive management triggers, and responsibilities of monitoring and data collection are detailed in Appendix E-Monitoring and Adaptive Management. Per Section 1161 guidance, monitoring costs (not to exceed 10 years after project construction) were considered as part of project costs.

Table 22: Conceptual Post- Construction Monitoring and Adaptive Management of the Tentatively Selected Plan

	Monitoring Stage	Length of Time	Description
Post-Construction Evaluation	Performance Monitoring	10 years	For entire project, determine the degree to which the project is meeting the success criteria and for informing potential adaptive management decisions.
	Adaptive Management	10 years	Provides a process for making decisions in the face of uncertainty and learning from outcomes of management actions; may improve the performance of a designed construction measure that is not meeting performance criteria.
	Long-Term Performance Reporting	50 years	For entire project, demonstrates the ability to meet project success criteria through the period of analysis, inform O&M, and provide basic data for planning and NESP Program purposes.

The 2008 Implementation Guidance for Upper Mississippi River and Illinois Waterway System also indicates that NESP PIRs must consider the "degree to which the project contributes to learning in an adaptive management context…". Pool 24- Denmark and Drift Islands project contributes to learning in an adaptive management context through monitoring the long term success of the TSP measures including floodplain forest restoration, sediment plug removal and gravel placement. Adaptive management actions will be considered if measure performance is below desired threshold. If this is true this could be communicated to inform future NESP design. Other factors may be

considered to evaluate Project performance and success.

> From 2008 IG: *The adaptive management approach will focus on delivering meaningful navigation and restoration benefits as early as possible, scheduling projects to provide early benefits and learning that can be applied to future projects, scheduling projects recognizing their mutual dependency in realizing navigation and ecosystem restoration system benefits and phasing large projects to provide early benefits.*

7.13 Environmental Operating Principals (EOPs)

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

- foster sustainability as a way of life throughout the organization;
- proactively consider environmental consequences of all USACE 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 USACE, 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 USACE actions in a collaborative manner; and
- employ an open, transparent process that respects views of individuals and groups interested in USACE 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 for aquatic plants, migratory bird species, and floodplain forest habitat.

The USACE 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 USACE Campaign Plan https://www.usace.army.mil/About/Campaign-Plan/.

7.14 Risk and Uncertainty

At the feasibility level of planning, there is always uncertainty about the extent to which the recommended plan will meet the planning objectives. Even when project

performance uncertainty is negligible, there is some retained risks. In addition, there can be new or transferred risks associated with the recommended plan. It is important to evaluate, communicate, and manage the risks prior to beginning PED.

7.14.1 Study Risk

A class four cost estimate was created for the recommended plan, meaning there was a minimum level of scope and technical work done to generate a cost estimate. All potential management measures have recently been constructed in the District for other projects so minimal uncertainty regarding cost was identified. Additionally, an abbreviated risk analysis was performed to determine a single contingency value based on a simplified qualitative risk-based method. This contingency will be used to cover unknowns, uncertainties, and/or unanticipated conditions that are not possible to evaluate from the data used in this study but must be accounted for to cover identified risks.

A cultural survey will not be completed in time for the final report. The survey will be complete prior to construction. Coordination with SHPO and tribes is ongoing and development of a Programmatic Agreement (PA) for the NESP program is underway and will cover this project. The risk of changing the proposed plan based off of cultural coordination or survey findings is low. Risks may be realized during implementation. The risk can be managed through the design and placement of measures. If artifacts of significance are discovered, the location of the measure (tree planting) will be moved or simply not placed in that specific area. Risk to project cost is minimal and likely to reduce project cost overall if realized. Some surveys have been completed in the general vicinity and turned up nothing of significance.

A mussel survey is currently underway; however, reception of the data and the report from that survey will not likely occur in time for inclusion in the final report before it undergoes concurrent review. The survey data and report will be complete prior to construction and assist in informing the PED team. Risk to proposed project measures is low and can be managed through design and placement of measures (stone fields for aquatic habitat). If, in the unlikely scenario mussels are found to be in the area, the stone would be placed in areas with no mussels or not placed at all. The risk to project cost is minimal and likely to reduce project cost overall if realized.

7.14.2 Implementation Risk

Minimal risks associated with implementation were identified; however, to reduce the risk and associated schedule and cost delays, final design will be evaluated to ensure impacts to navigation and flood elevations do not occur.

High or low water levels were identified as a potential implementation risk limiting access during construction. The risk is low and can be addressed by extending the construction timeframe, and by the additional analyses that will be completed during PED.

Access to the construction sites, as described in 7.7 Construction Access and Staging, is an implementation risk that has been captured in the Cost and Schedule contingencies. The constraints will be further investigated during PED, and the risk mitigated to the extent practicable.

Design during planning was minimal, and as such material quantities used as the basis for the Cost Estimate have not been defined in detail. These will be defined in detail based on the design effort in PED, and this risk has been captured in the Cost contingency.

Additionally, the availability of construction funds for this project was identified as a low risk. The project would be prioritized as funding becomes available.

7.14.3 Performance Risk

While risks were reduced to a tolerable level by managing the uncertainty associated with project benefits, residual risks and the potential for new risks remain.

Flooding or drought was identified as a low risk that may adversely impact tree plantings. This risk can be managed by monitoring flow conditions and impacts to study area while phasing the forest implementation to mitigate risk.

The assumed sedimentation rate may be inaccurate, thereby posing potential risk impacting measure success. This is considered medium risk and could be managed through adaptive management to address excessive sedimentation.

8.0 PUBLIC INVOLVEMENT, COORDINATION, AND CONSULTATION

8.1 Coordination by Correspondence

The United States government has a unique legal relationship with federally recognized American Indian tribes based on recognition of inherent powers of Tribal sovereignty and self-government. Communication with 23 federally recognized tribes that have an interest within this area was initiated through a letter dated July 21, 2023. The letter informed the tribes of the proposed project; requested any information the tribe may have on traditional cultural properties, sacred sites, or other cultural resources; and requested to enter into a Programmatic Agreement (PA) with tribal nations. The Forest County Potawatomi Community Wisconsin (July 20, 2023) and The Osage Nation (July 24, 2023) requested to be consulting parties for this project. The Iowa Tribe of Kansas and Nebraska (July 20, 2023) stated that they had no concerns pertaining to this project. The Caddo Nation (July 28, 2023), Miami Tribe of Oklahoma (August 7, 2023), and Peoria Tribe (August 17, 2023) offered no objections to the project as none of the tribes had evidence directly linking them to the project area, but requested to be contacted if archaeological or human remains are identified during construction.

The Illinois State Historic Preservation Office (IL SHPO) was contacted on July 20, 2023 via a letter and email outlining the proposed project and requesting to enter into a PA with USACE. IL SHPO responded the same day accepting the invitation for a PA.

On August 25, 2023, the Caddo Nation, Forest County Potawatomi Wisconsin, Miami Tribe of Oklahoma, The Osage Nation, Peoria Tribe, and IL SHPO were invited to a virtual meeting to discuss the proposed project and the PA. The virtual meeting took place on October 18, 2023, between USACE, IL SHPO, and The Osage Nation.

Copies of all tribal correspondence and meeting minutes are provided in Appendix A - Coordination.

8.2 Public Review and Comments

In accordance with NEPA, the report with integrated EA and unsigned draft FONSI would be made available to interested members of public during a 30-day public review period, yet to be scheduled. The report would be made available on the USACE - St. Louis District's website along with a letter mailed to interested members of the public addressing where to find the report, how to provide comments, and the date of the public meeting/open house (provided in Appendix A - Coordination). Comments received during public review would be incorporated into the report where appropriate, and copies of written comments received would be provided in Appendix A - Coordination.

9.0 RECOMMENDATION

The Tentatively Selected Plan is the Maximum Mussel and Forest Management Alternative, which includes the following measures:

- Floodplain Forest Restoration,
- Sediment Plug Removal,
- Mussel Riffles

The estimated project first cost of the Tentatively Selected Plan is $18,256,000 (2024 price level) and the fully funded total project cost is $19,366,000. Upon completion, the USACE is responsible for O&M at an estimated cost of $74,000 per year.

The expected outputs of the Tentatively Selected Plan include restoration of 1,236 acres of habitat. The Tentatively Selected Plan will contribute 355 average annual habitat units over the 50-year period of analysis.

The District has weighed the outputs to be obtained from the full implementation of the Pool 24 – Denmark and Drift Islands project against its estimated cost and have considered the various alternatives proposed, impacts identified, and overall scope. The St. Louis District recommends that the Pool 24- Denmark and Drift Islands project be implemented as generally described in this report.

The Recommended Plan is consistent with the NESP ecosystem restoration program authorization in WRDA 2007 Section 8004 and will, in concert with other NESP ecosystem projects, ensure the environmental sustainability of the existing Upper Mississippi River and Illinois Waterway and address the cumulative environmental

impacts of operation of the system and improve the ecological integrity of the Upper Mississippi River and Illinois River.

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

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DRAFT FINDING OF NO SIGNIFICANT IMPACT*

NAVIGATION AND ECOSYSTEM SUSTAINABILITY PROGRAM
PROJECT IMPLEMENTATION REPORT
WITH INTEGRATED ENVIRONMENTAL ASSESSMENT

Pool 24 Islands – Denmark and Drift

POOL 24, UPPER MISSISSIPPI RIVER MILES 295 – 288

Pike County, Illinois

The U.S. Army Corps of Engineers, St. Louis District (Corps) has conducted an environmental analysis in accordance with the National Environmental Policy Act of 1969, as amended. The final Project Implementation Report and Integrated Environmental Assessment (FR/EA) dated **29 March 2024**, for the **Navigation and Ecosystem Sustainability Program Ecosystem Restoration Project: Pool 24 Islands - Denmark and Drift** addresses side channel and floodplain forest restoration opportunities and feasibility in Pike County, Illinois.

The Final FR/EA, incorporated herein by reference, evaluated various alternatives that would restore ecosystem function and diversity in the study area. The Tentatively Selected Plan is the National Ecosystem Restoration (NER) Plan and includes:

- Floodplain Forest Restoration Activities
- Mussel Riffles (large sporadically placed boulder fields)
- Sediment Plug Removal to promote island drainage.

In addition to a “no action” plan, four alternatives were evaluated (Refer to sections 5 and 6 for discussion on alternative formulation and selection). The alternatives included:

- No Action
- Maximum Habitat Benefit
- Maximum Terrestrial
- Maximum Mussel and Forest Management
- Minimum Habitat Benefit
- Mussel and High Priority Forest

Through the Corps planning process and screening of alternatives, the Maximum Habitat Benefit Alternative, the Maximum Terrestrial Alternative, the Minimum Habitat Benefit Alternative, and the Mussel and High Priority Forest Alternative were deemed to no longer be reasonable alternatives for the project, and therefore were not carried forward for further environmental effects analyses under NEPA (Refer to Section 6 for more details), and the Maximum Mussel and Forest Management Alternative was identified as the Tentatively Selected Plan.

For all reasonable alternatives, the potential effects were evaluated, as appropriate. A summary assessment of the potential effects of the Tentatively Selected Plan are listed in Table 1:

Table 1: Summary of Potential Effects of the Tentatively Selected Plan

	Insignificant effects	Insignificant effects as a result of mitigation*	Resource unaffected by action	Positive effects
Aesthetics	☒	☐	☐	☐
Air quality	☒	☐	☐	☐
Aquatic resources/wetlands	☐	☐	☐	☒
Invasive species	☐	☐	☐	☒
Fish and wildlife habitat	☐	☐	☐	☒
Threatened/Endangered species/critical habitat	☐	☐	☐	☒
Historic properties	☐	☐	☒	☐
Other cultural resources	☐	☐	☒	☐
Floodplains	☐	☐	☐	☒
Hazardous, toxic & radioactive waste	☐	☐	☒	☐
Hydrology	☒	☐	☐	☐
Land use	☐	☐	☒	☐
Navigation	☐	☐	☒	☐
Noise levels	☒	☐	☐	☐
Public infrastructure	☒	☐	☐	☐
Socioeconomics	☐	☐	☒	☐
Environmental justice	☒	☐	☐	☐
Soils	☐	☐	☒	☐
Tribal trust resources	☐	☐	☒	☐
Water quality	☐	☐	☐	☒
Climate change	☐	☐	☐	☒

All practicable and appropriate means to avoid or minimize adverse environmental effects were analyzed and incorporated into the Tentatively Selected Plan. Best management practices (BMPs) as detailed in the IFR/EA will be implemented, if appropriate, to minimize impacts as discussed in Chapter 7 of the IFR/EA. [1] No compensatory mitigation is required as part of the Tentatively Selected Plan.

Public review of the draft IFR/EA and FONSI is scheduled to begin April 15, 2024. All comments submitted during the public review period will be responded to in the Final IFR/EA and FONSI.

Pursuant to section 7 of the Endangered Species Act of 1973, as amended, the U.S. Army Corps of Engineers determined that the Tentatively Selected Plan may affect but is not likely to adversely affect the following federally listed species or their designated critical habitat: Gray Bat, Indiana Bat, Northern Long-eared Bat, Tricolored Bat, Spectaclecase mussel, Decurrent False Aster, Eastern Prairie Fringed Orchid, and Monarch butterfly. The U.S. Fish and Wildlife Service (FWS) concurred with the Corps' determination on May ___ 2024.

Pursuant to section 106 of the National Historic Preservation Act of 1966 as amended, the U.S. Army Corps of Engineers determined that historic properties would not be affected by the Tentatively Selected Plan. The Illinois SHPO concurred with this determination on August 2, 2023.

Pursuant to the Clean Water Act of 1972, as amended, the discharge of dredged or fill material associated with the Tentatively Selected Plan has been found to be compliant with section 404(b)(1) Guidelines (40 CFR 230). The Clean Water Act Section 404(b)(1) Guidelines evaluation is found in *Appendix D – Clean Water Act* of the FR/EA.

Pending information to be developed during the pre-construction engineering and design phase, a Nationwide 27 permit for *Ecosystem Restoration* will be obtained prior to construction and a letter stating that the Tentatively Selected Plan appears to meet the requirement therein. All conditions of the Nationwide 27 permit for *Ecosystem Restoration* shall be implemented in order to minimize adverse impacts to water quality.

All applicable environmental laws have been considered and coordination with appropriate agencies and officials has been completed.

Technical, environmental, and cost effectiveness criteria used in the formulation of alternative plans were those specified in the Water Resources Council's 1983 Economic and Environmental Principles and Guidelines for Water and Related Land Resources Implementation Studies. All applicable laws, executive orders, regulations, and local government plans were considered in evaluation of alternatives.[2] Based on this report, the reviews by other Federal, State and local agencies, Tribes, input of the public, and

[1] 40 CFR 1505.2(C) all practicable means to avoid and minimize environmental harm are adopted.
[2] 40 CFR 1505.2(B) requires identification of relevant factors including any essential to national policy which were balanced in the agency decision.

the review by my staff, it is my determination that the Tentatively Selected Plan would not cause significant adverse effects on the quality of the human environment; therefore, preparation of an Environmental Impact Statement is not required.[3]

_____ Date

_____
COL. Andy J. Pannier
U.S. Army Corps of Engineers
District Commander

[3] 40 CFR 1508.13 stated the FONSI shall include an EA or a summary of it and shall note any other environmental documents related to it. If an assessment is included, the FONSI need not repeat any of the discussion in the assessment but may incorporate by reference.