Fargo-Moorhead Metropolitan Area Flood Risk Management Project

Draft Adaptive Management and Mitigation Plan

May 2024

US Army Corps of Engineers®
St. Paul District

FM AREA DIVERSION

Document History

Version	Date	Description of Changes
2011 EIS Version (Attachment 6)	July 2011	NA
2019 SEA Version (Appendix G)	February 2019	NA
AMT Version #1	November 2021	First version with AMT consensus.
AMT Version #2	May 2024	With Adopted Changes from November 2022

DRAFT

Table of Contents

Document History....2
INTRODUCTION....7
1. OVERVIEW OF ADAPTIVE MANAGEMENT IMPLEMENTATION PROCESS....11
1.1. Introduction to Adaptive Management Approach....11
1.2. Project Adaptive Management and Monitoring Plan Participation....12
1.3. Goals, Objectives, and Performance Standards....13
1.4. Development and Implementation of Monitoring Plans....13
1.5. Resource Management Team Process....14
1.6. Adaptive Management Team Process....15
1.7. Consideration of the Adaptive Management Team Recommendations by Non-Federal Sponsors and the USACE....18
2. PROJECT IMPACTS AND MITIGATION NEEDS....20
2.1. Aquatic Habitat....21
2.2. Floodplain Forest....22
2.3. Wetlands....23
2.4. Geomorphology....23
2.5. Invasive Species Management....24
2.6. Aquatic Connectivity....24
3. PROJECT MITIGATION....26
3.1. Aquatic Habitat....26
3.1.1. Aquatic Habitat Mitigation in Minnesota....26
3.1.2. Aquatic Habitat Mitigation in North Dakota....27
3.2. Forests....28
3.3. Wetlands....29
3.3.1. Wetland Impacts Addressed in the US Army Corps of Engineers Permit No. NWO-2013-1723-BIS....29
3.3.2. Wetland Impacts Addressed in the US Army Corps of Engineers Permit No. NWO-2014-0236-BIS....29
3.3.3. Wetland Impacts from the Southern Embankment and Associated Infrastructure....29
3.4. Aquatic Connectivity....30
3.5. Additional Considerations to Minimize Impacts and Mitigation Needs....31

4. MONITORING, PERFORMANCE STANDARDS, and TRIGGERS 35
4.1. Aquatic Habitat and Connectivity 36
4.2. Floodplain Forest Habitat 42
4.3. Wetland Habitats 44
4.4. Geomorphic 48
4.5. Water Quality 54
4.6. Invasive Species Monitoring 55
4.7. Fish Stranding 56
4.8. Drayton Dam 61
4.9. Additional monitoring needs 61
5. Costs and Schedules 62
5.1. Monitoring Schedule and Costs 62
6. Data Storage 67
7. References: 68

DEFINITIONS FOR ABBREVIATIONS AND TERMS USED IN THE AMMP

Abbreviation/Term	Definition
2011 FEIS	Final Feasibility Report and Environmental Impact Statement, Fargo-Moorhead Metropolitan Area Flood Risk Management, July 2011
2013 SEA	Supplemental Environmental Assessment, dated September 2013
2016 MN EIS	Final Environmental Impact Statement by the Minnesota Department of Natural Resources
2019 SEA	Supplemental Environmental Assessment #2
AAHU	Average Annual Habitat Unit
Ac	acre
ADCP	Acoustic Doppler Current Profiler
AMMP	Adaptive Management and Mitigation Plan
AMT	Adaptive Management Team
BRRWD	Buffalo-Red River Watershed District
BWSR	Minnesota Board of Water and Soil Resources
CEQ	Council on Environmental Quality which includes the NEPA Task Force
DBH	Diameter (of tree) at breast height
DOC	Dissolved Organic Carbon
EPA	U.S. Environmental Protection Agency
GMP	Geomorphic Monitoring Plan
GMT	Geomorphic Monitoring Team
HEP	USFWS Habitat Evaluation Procedures
HSI	Habitat Suitability Index
HU	Habitat Unit
IBI	Index of Biotic Integrity
LOTR	Lower Otter Tail River
MnDNR	Minnesota Department of Natural Resources
MnPCA	Minnesota Pollution Control Agency
MnRAM	Minnesota Routine Assessment Method
NEPA	National Environmental Policy Act
NDDEQ	North Dakota Department of Environmental Quality, previously the North Dakota Department of Health
NDDWR	North Dakota Department of Water Resources, previously the North Dakota State Water Commission
NDGF	North Dakota Game and Fish
NDSWC	North Dakota State Water Commission
Non-Federal Sponsors	City of Fargo, North Dakota; City of Moorhead, Minnesota; and Metro Flood Diversions Authority
NNI	Native, non-invasive Species
NRCS	Natural Resources Conservation Service
OHB	Oxbow-Hickson-Bakke
O&M	Operations and Maintenance

Abbreviation/Term	Definition
OMRR&R	Operations, Maintenance, Repair, Rehabilitation, and Replacement
Post-construction	Once the Project has received all approvals and is officially operational the status of the Project will be considered post-construction.
PRAM	Property Rights Acquisition Mitigation
Project	Fargo-Moorhead Metropolitan Area Flood Risk Management Project
Project Operation	Operation of the Red River Structure, Wild Rice River Structure, and Diversion Inlet Structure in response to a flood that generated a combined Red River and Wild Rice River flow exceeding 21,000 cfs, as measured at the Red River at Enloe, ND, and Wild Rice River at Abercrombie, ND, USGS gages.
Section 404 Permit	Permits issued in accordance with Section 404 of the federal Clean Water Act
SIR	USGS Scientific Investigation Reports
TOC	Total Organic Carbon
USACE	St. Paul District, U.S. Army Corps of Engineers
USFS	U.S. Forest Service
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey
WCA	Minnesota Wetland Conservation Act
WQM	Water Quality Monitoring Study
WRRDA	Water Resources Reform and Development Act of 2014

INTRODUCTION

The Fargo-Moorhead Metropolitan Area Flood Risk Management Project (Comprehensive Project) was authorized by Section 7002 of the Water Resources Reform and Development Act of 2014 (WRRDA). The purpose of the Project is to reduce flood risk, flood damages, and flood protection costs related to flooding in the Fargo-Moorhead metropolitan area. The Project is led by the St. Paul District, United States Army Corps of Engineers (USACE), and the non-federal sponsors of Fargo, North Dakota; Moorhead, Minnesota; and the Metro Flood Diversion Authority (Authority) (collectively Non-Federal Sponsors). The Authority was formed as the lead Non-Federal Sponsor and is the point of contact for the Non-Federal Sponsors.

The Comprehensive Project is located in the Fargo-Moorhead Metropolitan Area (Figure 1). The Comprehensive Project consists of:

- Stormwater Diversion Channel System and Associated Infrastructure (SWDCAI): Delivered by the Red River Valley Alliance, the P3 developer for the project, the SWDCAI includes a 30-mile Diversion Channel, a Diversion Outlet, and aqueducts on the Maple and Sheyenne Rivers. There also will be 14 drainage inlets, three railroad crossings, two interstate crossings, and 12 county road crossings.

- Southern Embankment and Associated Infrastructure (SEAI): Delivered through the USACE and contractors, the SEAI includes a 20-mile Southern Embankment and three gated control structures: the Diversion Inlet Structure, Wild Rice River Structure, and Red River Structure. Each structure will have large radial-arm gates that will raise and lower during project operations to control flooding. The SEAI also involves constructing several transportation features, including an I-29 bridge crossing, county and township road crossings, and a 4-mile grade raise on I-29.

- Local Entity Flood Protection and Associated Infrastructure (LFPAI): City and county governments are working on in-town protection measures, including levees, floodwalls and stormwater lift stations as well as some road work throughout Cass and Clay Counties and in the cities of Fargo and Moorhead.

- Mitigation Features and Associated Infrastructure (MFAI): The USACE as well as city and county governments are responsible for numerous mitigation features for the Comprehensive Project. This includes the Upstream Mitigation Area where flowage easements will be acquired, property/structures will be removed, and cemeteries will undergo mitigation to protect the property and viewshed. Additionally, levees will be built for Oxbow-Hickeson-Bakke and Christine. Wetland mitigation projects as well as the Lower Otter Tail River Restoration project also will occur.

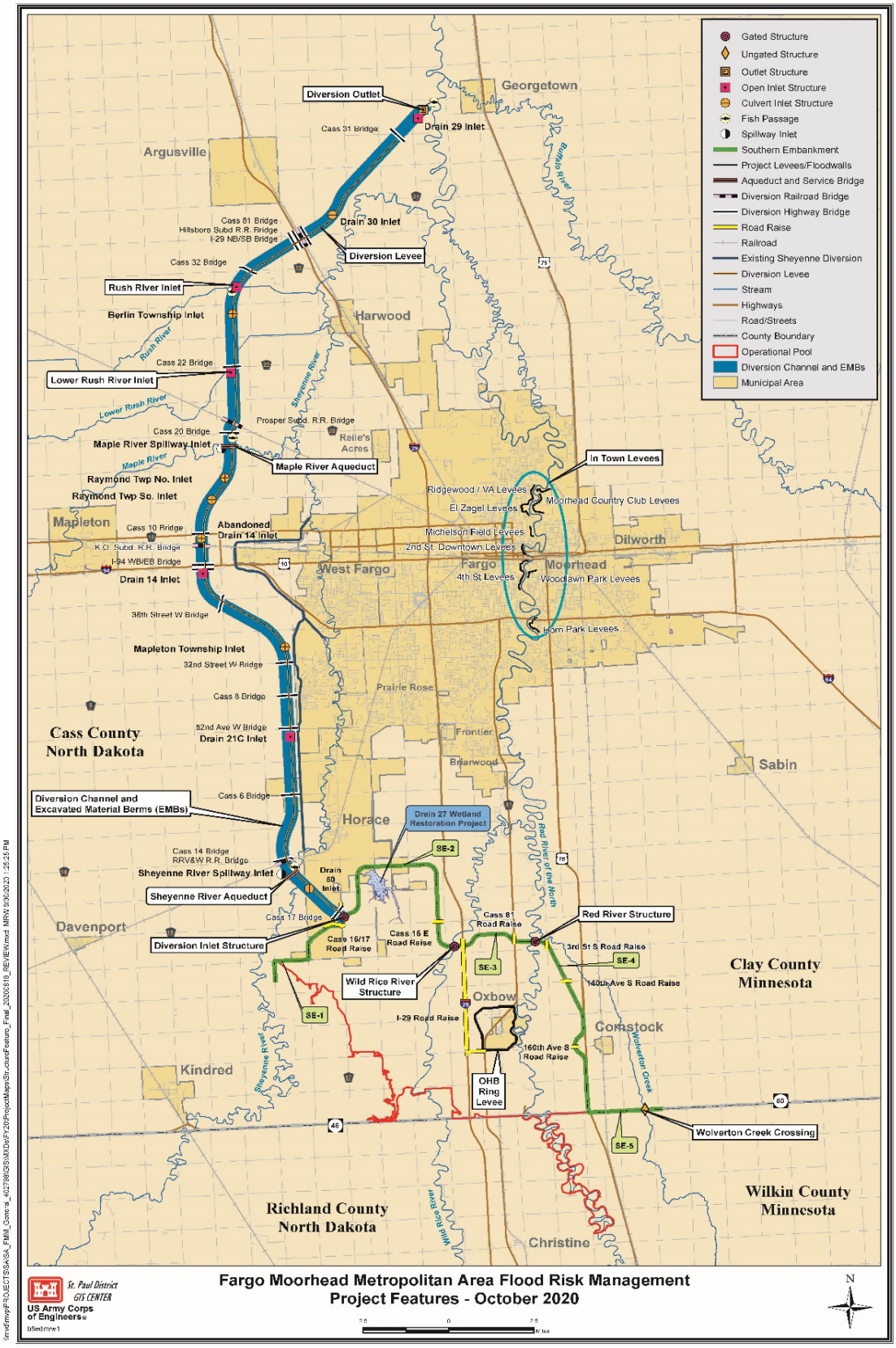

Figure 1. Map of the Project area.

The Project originated as a recommendation from the Final Feasibility Report and Environmental Impact Statement (FEIS), Fargo-Moorhead Metropolitan Area Flood Risk Management, July 2011. As outlined within the FEIS, the Project would have various environmental effects. Some of the identified effects were significant enough to warrant mitigation. These impacts and mitigation needs were updated through the Supplemental Environmental Assessment, dated September 2013 (2013 SEA), and the Supplemental Environmental Assessment #2 (2019 SEA). The Project with all proposed modifications included in the 2013 SEA and the 2019 SEA since the FEIS is referred to as "Plan B." Based on the current NEPA analysis, environmental impacts requiring mitigation would include impacts to aquatic habitat, riparian forest, and wetland resources. For these impacts, mitigation will be implemented to offset these adverse effects to the greatest extent practicable. Mitigation is also being included to address concerns of state natural resource agencies regarding biological connectivity. Conversely, other resource types or functions were not deemed to have significant impacts but warrant monitoring to ensure impacts stay within those outlined in the NEPA analysis. These include monitoring of river geomorphology, water quality, and fish stranding. Mitigation of nonenvironmental impacts, such as property right mitigation, are not addressed in this document. A property rights acquisition mitigation plan (PRAM) has been developed for the Project and provides details on property rights mitigation.

Summary of Adaptive Management and Mitigation Plan Sections

The NEPA analysis included impact analyses of changes in habitat quality and quantity. The NEPA analysis also included mitigation measures for to reduce significant adverse impacts. The purpose of this Adaptive Management and Mitigation Plan (AMMP) is to provide a dynamic framework and adaptive approach to monitoring potential impacts over time and mitigation associated with the Project. The AMMP also discusses possible approaches if mitigation measures do not result in projected conditions, or if unforeseen impacts arise from implementation of the Project.

Section 1 provides an overview of the adaptive management and implementation process, including the collaboration process with the Non-Federal Sponsors, USACE, State of North Dakota, State of Minnesota, and federal natural resource agencies.

Section 2 provides an overview of Project impacts and mitigation needs focusing on habitat-based assessments of impacts and mitigation needs for aquatic habitat, forest, and wetland resources.

Section 3 provides an overview of the Project mitigation approach, a summary table of mitigation needs, mitigation accomplished to date, and remaining mitigation needed. Specific mitigation sites have not been fully finalized for all impact needs as the Project design details have not been completed. The USACE has identified several mitigation projects, as described in Section 3, and will continue to refine specific mitigation plans during detailed Project design.

Section 4 describes specific monitoring activities that will be completed pre- and post-construction, performance standards, and triggers for event-specific monitoring and adaptive management. This section also includes overviews on contingency processes where corrective action could be pursued if mitigation proves to be less effective than anticipated.

Section 5 provides the anticipated cost and schedule of monitoring and mitigation efforts.

Section 6 addresses the storage and accessibility of data collected by the monitoring activities.

Collectively, this AMMP will drive the implementation of mitigation, and the data collection and review processes to confirm the effectiveness of the mitigation. Monitoring results will be compared to the environmental changes that would occur due to Project implementation with mitigation to verify whether the impacts of the Project have been appropriately offset. In addition, this AMMP will remain flexible to adapt to the needs of the Project over time. As such, this document is open to change throughout the life of the Project.

1. OVERVIEW OF ADAPTIVE MANAGEMENT IMPLEMENTATION PROCESS

1.1. Introduction to Adaptive Management Approach

Adaptive management is based upon clearly identified outcomes, as described in environmental documentation, monitoring to determine if the desired outcomes occur, and, if not, facilitating management changes to either meet or re-evaluate the projected outcomes (DOI, 2018). Adaptive Management is a requirement of Minnesota Dam Safety & Public Waters Work Permit number 2018-0819 ("MnDNR Permit No. 2018-0819") and USACE Policy Guidance for those civil works programs that require environmental mitigation. This Adaptive Management and Monitoring Plan recognizes that recommendations generated by the Adaptive Management Approach remain subject to federal and state laws, permit conditions, and the permit amendment/regulatory oversight process is expressly reserved to permitting agencies having jurisdiction over various elements of the Comprehensive Project.

Adaptive management is a "learning by doing" management approach which promotes flexible decision making that can be adjusted when there are uncertainties that will become more defined as outcomes from management actions and other events become better understood (National Academy of Sciences, 2004). It is used to address the uncertainties often associated with complex, large-scale projects. In adaptive management, a structured process is used so that the "learning by doing" is not simply a "trial and error" process (Walters, 1986).

The basic elements of an adaptive management process are: (1) assess; (2) design; (3) implement; (4) monitor; (5) evaluate; and (6) adjust. In practice, adaptive management is implemented in a non-linear sequence, in an iterative way, starting at various points in the process and repeating steps based on improved knowledge.

Application of adaptive management should occur in two phases. A setup phase would involve the development of key components, and an iterative phase would link these components in a sequential process. Elements of the setup phase include stakeholder involvement, defining management or mitigation objectives, identifying potential management or mitigation actions, identifying or building predictive modeling or assessment tools, specifying performance measures and/or risk endpoints, and creating monitoring plans. In addition, values for the monitored measures that would trigger adaptive management should be determined in this phase. The second iterative phase uses these elements in an ongoing cycle of learning about system structure and function, followed by managing based on what is learned from data collected. The elements of the iterative phase include recommendations, follow-up monitoring, collaborative approaches on future actions, and subsequent assessment.

Adaptive management is not necessarily the only decision-making process. Adaptive management provides a systematic methodology that could lead to enhanced benefits and effective outcomes (DOI, 2018).

Adaptive management should not be used where decisions can only be changed in a limited manner or cannot be changed due to permit requirements. Federal permits include the Section 404 Permit, Rivers and Harbors Act of 1899 Sections 9 and 10 Permit, Programmatic Agreement under the National Historic Preservation Act Section 106, U.S. Fish and Wildlife Coordination Act Report

compliance, and Prime and Unique Farmlands Protection Act Consultation Compliance. North Dakota permits include Section 401 Permit, North Dakota Sovereign Lands Permit, North Dakota Construction Permits, North Dakota Dewatering Permits, and North Dakota stormwater pollution prevention plan permits. Minnesota permits include MnDNR Permit No. 2018-0819 and Minnesota stormwater pollution prevention plan permits. In addition, the Non-Federal Sponsors have permits and agreements with local agencies and entities that manage land use, flood control, transportation, and utilities along the construction corridor (Local Permits). This AMMP does not address compliance with Local Permits.

The overall adaptive management process generally includes:

- Identification of Project Adaptive Management and Monitoring Plan Participation
- Establishment of Goals, Objectives, and Performance Standards – specifically for those items that are not fully defined in the environmental documentation due to future uncertainties
- Development and Implementation of Monitoring Plans – to determine realization of goals and objectives as defined in the environmental documentation
- Resources Monitoring Team Process – to provide a group of technical experts to review monitoring plan results; compare with goals, objectives, and performance standards; and develop recommendations based upon scientific analyses
- Adaptive Management Team Process – to review the results of the Resources Monitoring Team recommendations to determine "next steps" to achieve goals, objectives, and performance standards
- Consideration of the Adaptive Management Team Recommendations by the USACE and Non-Federal Sponsors
- In accordance with MnDNR Permit No. 2018-0819, the Adaptive Management Team will meet within 30 calendar days of the identification of a trigger set forth in this Adaptive Management and Monitoring Plan and provide a corrective action recommendation within 30 calendar days of the meeting of the Adaptive Management Team.

1.2. Project Adaptive Management and Monitoring Plan Participation

Staff from multiple state and federal resource agencies have been involved in the planning process for the Project dating back to 2009. Agency input has been instrumental in the calculation of Project impacts, the identification and design of mitigation efforts, and the development of monitoring procedures. Individuals that attended meetings on the AMMP eventually became known informally as the Adaptive Management Team (AMT).

Agencies that have participated in AMT meetings include, but are not limited to, the following:

- U.S. Army Corps of Engineers (USACE),
- Non-Federal Sponsors (Metro Flood Diversion Authority, City of Fargo, and City of Moorhead),
- U.S. Fish and Wildlife Service (USFWS),
- U.S. Geological Survey (USGS),
- U.S. Forest Service (USFS),

- Environmental Protection Agency (EPA),
- Natural Resources Conservation Service (NRCS),
- North Dakota Game and Fish (NDGF),
- North Dakota Department of Environmental Quality (NDDEQ), previously the North Dakota Department of Health (NDDoH),
- North Dakota Department of Water Resources (NDDWR), previously North Dakota State Water Commission (NDSWC),
- Minnesota Department of Natural Resources (MnDNR),
- Minnesota Pollution Control Agency (MPCA), and
- Minnesota Board of Water and Soil Resources (BWSR).

Several smaller groups of technical experts were eventually formed to discuss monitoring and adaptive management in greater depth with the intent of providing focused recommendations to the AMT. Those teams included the Geomorphic Monitoring Team, the Water Quality Monitoring Team, Wetlands Monitoring Team, Forestry Monitoring Team, and the Biotic Monitoring Team.

1.3. Goals, Objectives, and Performance Standards

Clearly focused and quantitative goals and objectives are essential to adaptive management. They should be logically linked to mitigation actions, performance standards, and monitoring activities. Goals and objectives will be specifically identified during detailed monitoring and mitigation planning.

Performance standards will be used during two adaptive management processes: plan evaluation (evaluation of performance measures and metrics like those described above to predict Project impacts) and assessment of actual plan performance (assessment of performance measures following Project implementation). In many cases, these processes would be the same, allowing predictions to be compared to actual responses.

Performance standards are further discussed in Section 4. This includes metrics for quantifying impacts following Project construction, identification of trigger values that would indicate the need for adaptive management, and how effectiveness of future changes will be measured. These standards have been developed based on the best available information and input from the AMT. Additional data and changes in design may lead to further development or modification of performance standards. At a minimum, the goal of mitigation that has been identified as of the date of the AMMP will be to replace the habitat lost through Project impacts. Future monitoring may include additional minimum goals related to Project impacts, including but not limited to, geomorphology, fish stranding, and invasive species. Performance standards will allow for the evaluation of mitigation effectiveness.

1.4. Development and Implementation of Monitoring Plans

The Council on Environmental Quality (CEQ) NEPA Task Force (CEQ 2003) suggests that the effectiveness of adaptive management hinges upon an effective monitoring program to establish objectives, thresholds, and baseline conditions. This will be achieved through a stepwise process that includes, as appropriate, pre-construction and post-construction studies. It is recognized that

Project level monitoring by the USACE during construction may be limited due to the availability of federal funds based on Congressional appropriations; the Non-Federal Sponsors acknowledge that in the event that the USACE does not receive Congressional appropriations, monitoring at the expense of the Non-Federal Sponsors will be required by the permits. Post-project construction monitoring will be a part of Project implementation, with monitoring required from the Non-Federal Sponsors as a part of Project operation and maintenance.

Following the adaptive framework of this document, changes would be monitored over time, and performance of measures would be assessed to determine whether additional avoidance, minimization, or mitigation measures are needed. Post-project monitoring results will provide information that can be compared with pre-project monitoring to assess the extent of impacts from the Project features and evaluate the effectiveness of mitigation. Monitoring activities, including review of results, will be performed collaboratively with the AMT.

Pre- and post-project monitoring is discussed in greater detail below in Section 4. Specific proposed sampling methodologies have been designed with input from the AMT to address the performance standards outlined.

1.5. Resource Management Team Process

Several resource areas have been identified for monitoring and adaptive management through the development of the AMMP. Each of these resource areas is very complex and technical expertise will be needed to assist the AMT in making recommendations. Resource monitoring teams for geomorphology, biotic, wetlands, forests, and water quality will meet when data related to the performance standards/metrics listed in Section 4 have been collected and are ready for evaluation or when adaptive management triggers have been reached. Each team will be responsible for making recommendations to the AMT. It is recognized that any individuals participating on behalf of MnDNR as part of a resource monitoring team will not be providing recommendations and/or ratings, but may provide comments and observations.

In the State of Minnesota, MnDNR is responsible for ensuring any mitigation proposed by the Metro Flood Diversion Authority based upon recommendations by the AMT, meets the requirements of Minnesota law and is in compliance with MnDNR Permit No. 2018-0819. Participation by any individuals participating on behalf of MnDNR in a consensus process is not compatible with regulation of the Project by MnDNR. Any determinations on whether mitigation is needed or sufficient under MnDNR Permit No. 2018-0819 is at the sole discretion of MnDNR. MnDNR will use data generated from the AMMP process to determine if any additional mitigation is needed under MnDNR Permit No. 2018-0819. Any mitigation proposed by the Non-Federal Sponsors as a result of a recommendation by the AMT will also be evaluated for compliance with MnDNR Permit No. 2018-0819.

Recommendations from the resource monitoring teams will follow a five-point consensus rating system. Individuals participating in the resource monitoring teams will rate recommendations from 1 through 5 based on the acceptability of the actions being proposed, with a rating of 1 being unacceptable and 5 being full support. Only recommendations that receive ratings of 3 or higher from each individual participating in the discussion can move to the AMT for consideration. This

process provides a steppingstone to in-depth discussion. Individuals that provide ratings of 1 or 2 will be asked to provide rationale for those ratings and solutions that could raise their scores to an acceptable level. The intent of the process is to encourage active feedback and resolution of individual concerns. The resource monitoring team will document recommendations that were not fully supported (by members that provide ratings of 1 or 2) prior to submission of the recommendation to the AMT. The documentation of the process would be provided to the AMT, along with the final rating of each member.

1.6. Adaptive Management Team Process

Features of the Project are located solely in both North Dakota and Minnesota and along the Red River channel in both North Dakota and Minnesota. Numerous entities with various interests at several levels of government have been involved in shaping the AMMP, as listed in Section 1.2, Project Adaptive Management Team. It is important to maintain collaboration among these entities to ensure the continued integrity in the adaptive management approach. However, there is also a need to make site-specific implementation recommendations at various locations within the Project area.

The following describes a process that allows for continued collaboration but allows AMT recommendations to be made by a subset of individuals based on input from regulatory and management agencies. The initial AMT participants will be selected by each entity and will discuss recommendations to present to the Non-Federal Sponsors and the USACE (during Project construction) for decisions to change Comprehensive Project implementation or the need for changes to mitigation measures. MnDNR will select its AMT participants, but those individuals selected by MnDNR will not participate in the consensus poll regarding rating or creating recommendations of the AMT, and may, but are not required to, provide opinions and/or comments to proposed recommendations.

Changes to the AMMP will be the result of recommendations from the AMT, using the process described below. It will be each AMT members responsibility to coordinate proposed changes within their own organization and report any concerns to the AMT. Changes AMMP will undergo a similar process to the initial agency approved AMMP in September 2021.

Table 1. Initial Adaptive Management Team Representatives

Adaptive Management Team	
Agency Category	**Entities**
Non-Federal Sponsors	Metro Flood Diversion Authority City of Fargo City of Moorhead
Federal Agencies	USACE USFWS EPA
State of North Dakota	NDDWR NDDEQ NDGF
State of Minnesota	MnDNR (Non-rating observer status) MPCA BWSR

The AMT can use a process for discussion and evaluation of recommendations that includes, but is not limited to the following steps:

- Use the consensus rating tool to determine the position that AMT has regarding support of the recommendations form the resource monitoring teams, such as through the use of a five-point consensus rating system. Under such a consensus rating system, individuals participating in the discussion would rate recommendations from 1 through 5 based on the acceptability of the actions being proposed, with a rating of 1 being unacceptable and 5 being full support. Only recommendations that receive all ratings of 3 or higher would move forward as recommendations for the AMT. This process provides a steppingstone to in-depth discussion. Individuals that provide ratings of 1 or 2 would be asked to provide rationale for those ratings and solutions that could raise their scores to 3 or higher. This information would be used to document items that are not fully supported (by members that provide ratings of 1 or 2) or modify the recommendations.
- Recommendations that receive unanimous ratings of 5 from the resource monitoring team will be placed on a consent agenda by the AMT chair. If all ratings are 4 or 5, the resource monitoring team may, by affirmative vote by all attending members, add the item to the consent agenda. AMT members can request any consent agenda item be moved to the regular discussion. Agenda items not on the consent agenda will have more detailed discussions and AMT members can rate the recommendations set for regular discussion as outlined above.
- The AMT may also bring additional criteria to evaluating recommendations other than those criteria advanced by the science-based technical teams. The AMT may identify essential criteria (including SMART – Specific to goal; Measurable; Attainable under conditions, capacity, feasibility; Relevant to the problem and needs to be done; Timely – can be undertaken in time to achieve the goal) / and other filters they agree on for recommendation approval.

- If a recommendation is revised by the AMT in a manner that may impact technical aspects of the recommendation, the AMT may consider requesting the appropriate Resource Management Team's input to assure it still achieves the recommendation goals.
- Recommendations forwarded to the Non-Federal Sponsors and the USACE should include information regarding:
    - Each AMT participant's final rating of the recommendation, including any concerns as appropriate
    - Resources required (personnel, time, costs, and other resources special to Project)
    - Consequences (expected impact or outcome of the action if accomplished)
    - Obstacles (for example: specific conflicts of interest of stakeholders or regulatory requirements or lack of local support that may need to be resolved, or specific lack of resources preventing accomplishment of the action)

The AMT members would have the following responsibilities and commitments.

Responsibilities

- The AMT chair, who will be appointed by the Non-Federal Sponsors, will be responsible for preparing meeting announcements, agendas, and preparing minutes of AMT meetings. Meeting announcements will be required at least 14 calendar days in advance of any meeting, and agendas will be required 7 calendar days prior to the meeting.
- Entity representatives will make every possible effort to attend AMT meetings. In the event that an entity's official representative is unable to participate, the entity or their representative may designate another staff member to serve in that capacity on a substitute basis. If an entity's representative, or designated substitute, does not attend a meeting where a voting matter has been identified in the meeting agenda, votes from that entity will be forfeited.
- The Non-Federal Sponsors are responsible for monitoring and analysis of monitoring data. The Non-Federal Sponsors shall provide individuals with technical expertise, when specific subject-matter expertise is deemed necessary, to present and discuss the analysis of the monitoring data when it is ready for AMT review.
- All entities participating in AMT discussions will be responsible for all costs associated with its participation in AMT meetings and activities.

Commitments

- AMT representatives must be committed to communicate and be willing to share challenges and lessons learned as well as successes
- AMT representatives must strive to create an environment of trust and to foster insightful, non-threatening discussion of ideas and experiences
- AMT representatives must distribute leadership responsibilities and collectively share in the management of the community
- AMT representatives are practitioners, contributing to the community through their experiences, skills, and time

- AMT representatives must agree to be respectful and use appropriate language in group discussions and to listen and respond to each other with open and constructive minds
- AMT representatives must not be afraid to respectfully challenge one another by asking questions
- AMT representatives must openly express their agency's objectives when working to promote them
- AMT representatives must participate to the fullest extent possible
- AMT representatives must commit to search for opportunities for consensus or compromise and for creative solutions
- AMT representatives must contribute to an atmosphere of problem solving rather than stating positions
- AMT representatives must attempt to build on each member's strengths and help each other improve areas in need of further development

AMT recommendations must support the continued operation of the Comprehensive Project to protect the communities in North Dakota and Minnesota from flooding. It is recognized that specific operational considerations may be modified; however, as a fundamental portion of the AMT charter, the ability to operate the Comprehensive Project in accordance with existing permits must and shall be maintained to provide for public health and safety. The AMT will meet within 30 calendar days of the triggers identified in Section 4 of this document and corrective actions will be identified within 30 calendar days of that meeting. This will ensure that actions move forward in a timely manner.

The AMT will also meet within 90 calendar days after every Comprehensive Project operation has been completed to discuss any adjustments needed to the AMMP. For proposes of the AMMP, Comprehensive Project operation means operation by the Authority of the Red River Control Structure or the Wild Rice River Control Structure to restrict flow into the Fargo-Moorhead Metropolitan Area.

1.7. Consideration of the Adaptive Management Team Recommendations by Non-Federal Sponsors and the USACE

As discussed in Section 1.1, adaptive management should not be used if recommendations conflict with permit requirements. It is recognized that adaptive management is a condition of MnDNR Permit No. 2018-0819. Therefore, the AMMP would not be used for implementation of specific permit conditions, including but not limited to permit conditions in the Section 404 Permit, Rivers and Harbors Act of 1899 Sections 9 and 10 Permit, Programmatic Agreement under the National Historic Preservation Act Section 106, U.S. Fish and Wildlife Coordination Act Report compliance, Prime and Unique Farmlands Protection Act Consultation Compliance, North Dakota Sovereign Lands Permit, North Dakota Construction Permits, North Dakota Dewatering Permits, and permits and agreements with local agencies and entities that manage transportation and utilities. With respect to these permit-related decisions, changes would be developed by consultation with the permit agencies and the USACE and Non-Federal Sponsors prior to completion of Project construction and with the Non-Federal Sponsors post-construction.

For all non-permit related decisions, recommendations from the AMT will be considered in a collaborative manner to develop changes in implementation methods, monitoring protocol, performance standards, and, if necessary, objectives and goals. Prior to completion of Project construction, the collaborative process will occur between the AMT, the USACE, and Non-Federal Sponsors. The decision will be made by the Non-Federal Sponsors and the USACE. Post-construction, the collaborative process will continue to occur between the AMT and the Non-Federal Sponsors with the decisions being made by the Non-Federal Sponsors.

2. PROJECT IMPACTS AND MITIGATION NEEDS

The previous NEPA documentation for the Project evaluated potential impacts to a wide range of resource types. The FEIS and the subsequent SEAs from 2013 and 2019 are source documents for this AMMP which set forth the discussion of impact quantification and rationale for impacts warranting mitigation. Project designs were compared with aerial photographs, available data, and in-field observations to estimate the amount, quality, and value of potential habitats impacted by all Project features. The USACE reviewed this information, collaborated with agency partners, and made a final determination on whether or not these losses warranted mitigation. Based on those conversations, the USACE determined to require mitigation for lost aquatic riverine habitat; wetlands; and forests. In addition, MnDNR permit 2018-0819 required that mitigation for fish passage take place at Drayton Dam and that any impacts to geomorphology, fish stranding, and cold weather impacts at the aqueducts also be monitored and mitigated, if necessary.

Since completion of the FEIS, impacts and mitigation needs were updated for several key reasons. Project designs and operations updated from those previously assessed in the FEIS were evaluated in the subsequent SEAs. In addition, collection of additional field data has allowed for a better understanding of both existing habitat quantity and quality. Finally, the North Dakota and Minnesota state permitting processes have included more detailed monitoring and/or mitigation requirements.

USACE policy requires that any potential mitigation planning considers habitat quality as part of the impact determinations. The FEIS estimated habitat quality based on best available information at that time. For example, as described in the FEIS, the quality of floodplain forest impacted was quantified by using a series of USFWS Habitat Evaluation Procedures (HEP) habitat models. These models were used to compute an average habitat suitability index (HSI) score between 0.0 and 1.0 to measure habitat quality. From the qualitative and quantitative determinations, the standard unit of measure, the Habitat Unit (HU), is calculated using the formula: HSI score x acres impacted = HUs.

Another aspect to assessing lost habitat and mitigation needs is how conditions could change over time within impact areas. Mitigation value could also change over time. For example, floodplain forest mitigation must consider that it takes a considerable amount of time for floodplain forest to grow and mature to full functionality. To characterize habitat changes over time, HUs are calculated for target years and averaged over the life of the Project (50 years) to determine what is known as the Average Annual Habitat Units (AAHUs).

Given the uncertainty with whether habitat conditions might generally improve or degrade in the future, or to what magnitude such changes would occur, the FEIS and subsequent SEAs assumed that conditions would remain constant over time when assessing impacts. It is recognized that habitat conditions likely will not remain constant. However, this approach hopefully minimizes the potential to either underestimate or overestimate potential Project impacts to aquatic and terrestrial habitat. For assessing mitigation benefits, consideration was given as to how long it may take habitat restoration projects to reach full effect.

The above approach was used to estimate habitat quality and mitigation needs for forests and wetland resources. However, habitat mitigation needs will be influenced by available opportunities

and requirements of the North Dakota and Minnesota permits for the Project. The following represents the Project impact and mitigation needs updated through the current design.

2.1. Aquatic Habitat

Impacts have been quantified through collection of pre-project fish and invertebrate data, resulting in Index of Biotic Integrity (IBI) scores. The original plan was to compare IBI scores before and after construction to verify resulting impacts. IBI scores were also to be generated for mitigation sites to help quantify the amount of mitigation created compared to the habitat lost through construction. This approach has been discontinued for two primary reasons. First, this approach is not consistent with the State of Minnesota's determination of mitigation needs via the MnDNR Dam Safety & Public Waters Work Permit (permit # 2018-0819) for lost aquatic habitat within their state. This will include any post-project monitoring needs. Second, mitigation for lost aquatic habitat in North Dakota will be mitigated via a combination of habitat restoration and fish passage implementation. Because of the challenge of quantifying fish passage benefits and combining them with benefits of site-specific mitigation, these mitigation needs will be met through a mutual agreement with the State of North Dakota. This agreement will be formalized with the State of North Dakota once the design and operation of features along the Comprehensive Project diversion channel near completion and a clearer understanding of mitigation needs can be established.

The IBI scoring system had previously been generated in the Red River Basin back in the 1990s to describe general biotic conditions (EPA 1998). This was used in the FEIS to estimate habitat quality, impacts and mitigation needs. However, the NDDoH subsequently developed both a fish and macroinvertebrate IBI for Red River Basin tributaries (NDDoH 2011a; 2011b). These two IBIs were utilized to calculate IBI scores for all rivers except the Red River. The Red River only utilized a specific fish IBI to calculate habitat quality for sites on this river. The reason is due to limitations with 2017 invertebrate sample collection and the resulting questionable invertebrate data for the Red River. For pre-project data collected to date, the NDDoH provided the IBI scoring results.

Impacts to aquatic habitat were quantified by calculating HUs, with the IBI scores identified above as the habitat quality. The IBIs calculate habitat condition to a score between 0.0 and 1.0, and are then multiplied by the impact area to calculate an amount of habitat lost via impact. This approach noted the potential HUs present within any newly constructed river channels to facilitate routing flow through Project features (e.g., water control structures, aqueducts, etc.).

Aquatic habitat lost through the latest Project designs, and associated proposed mitigation needs, are presented in Table 2.

Table 2. Aquatic habitat footprint impact areas being mitigated and corresponding habitat units for aquatic impacts by Project feature, updated for the most recent design.

Impact	Footprint Area (ac)	IBI Score*	Habitat Units (HUs) Lost
Red River Structure	12.9	0.52	6.7
Wild Rice River Structure	7.8	0.44	3.4
Sheyenne River Aqueduct	8.0	0.54	4.3
Maple River Aqueduct	10.0	0.57	5.7
Total	38.7		20.1

*IBI scores are an average of fish and invert IBI scores for 2012 and 2017 at the footprint sampling site. The Red River structure uses fish only given some of the challenges with sampling invertebrates on the Red River. Fish IBI scores are also higher than Invertebrate IBI for the Red River, providing a more conservative estimate.

2.2. Floodplain Forest

Some forested areas would need to be cleared for construction of the Project. Forest areas impacted by construction of Project features total 139 acres for the current design. The FEIS outlined a habitat evaluation process for existing floodplain forest in the Project area, which identified a habitat suitability factor of 0.51. This suitability factor is assumed to not have changed as no major changes have occurred in the areas forest composition or structure that would result in appreciable alteration of that suitability factor. Thus, 0.51 is applied to the acres impacted to identify the habitat units for lost forest habitat and the targeted amount for mitigation.

In terms of habitat conditions over the next 50 years, woodland extent, structure, and composition is assumed to remain fairly similar to existing condition. While habitat value for individual species may change over time as natural setback/succession processes occur on these established tracts, the overall habitat value for the riparian woodland community would remain essentially the same and be rated as fair with a HSI of 0.51.

The assumed HSI for an established floodplain forest is 0.51. It is also assumed that it could take a full 50 years for a created forest to reach its full functioning level. Over a 50-year planning horizon (the standard for the USACE planning activities), assuming a starting HSI of 0 and an ending HSI of 0.51, this amounts to an average HSI value of 0.25. Thus, approximately 283.4 acres of floodplain forest habitat would be needed to generate the 70.9 Habitat Units of mitigation needed to offset Project impacts.

Table 3. Estimated floodplain forest mitigation need based on forest habitat lost.

Impact	Footprint Area Lost (ac)		Existing Habitat Quality Score	Habitat Units Lost		Created Forest Habitat Quality Score	Mitigation Needs (ac)	
	ND	MN		ND	MN		ND	MN
Forest	124	15	0.51	63.2	7.7	0.25	252.8	30.6
Total	**139**		**0.51**	**70.9**		**0.25**	**283.4**	

2.3. Wetlands

Wetland areas would need to be filled or modified for construction of the Project. This includes areas for the diversion channel, southern embankment, and Oxbow-Hickson-Bakke (OHB) ring levee. The wetland impacts for the diversion channel and OHB are addressed by parallel Section 404 permitting efforts (referenced below). Wetland impacts for the remaining portions of the Project will be assessed through a Section 404(b)(1) analysis and mitigated appropriately. Wetland impacts for the Project are provided in Table 4. Minnesota Routine Assessment Method (MnRAM) wetland functionality assessment was used to determine mitigation for the Project. It was later decided that MnRAM is not a preferred method in Minnesota so mitigation in that state will follow the ratios in the Minnesota Wetland Conservation Act (WCA). Mitigation would target no net loss of wetland impacts.

Table 4. Estimated wetland impact based on current footprint of the Project.

Wetland Type	Wetland Impacts by Type					
	ND Ditched Wetlands	ND Non-Ditched Wetlands	ND Total Wetlands	MN Ditched Wetlands	MN Non-Ditched Wetlands	MN Total Wetlands
Farmed Seasonally Flooded Basin	0.44	1199.63	1200.07	0.40	15.40	15.80
Shallow Marsh	28.66	51.95	80.61	-	2.99	2.99
Shallow Open Water	-	4.97	4.97	-	-	-
Wet Meadow	73.56	93.06	166.62	16.73	0.83	17.56
Column Total	102.66	1349.61	1452.27	17.13	19.22	36.35
Total	1488.62					

2.4. Geomorphology

Potential effects to waterways, bank stability, erosion, and sedimentation within and outside the existing channel and floodplain (including newly inundated areas) have been discussed at length in the FEIS (geomorphic impacts discussion including Section 5.2) and subsequent SEAs. These impacts and related monitoring are also described in Section 3.3 and Appendix B of the MnDNR Final Environmental Impact Statement (2016 MN EIS), dated May 2016. Potential future conditions impacts were also outlined in geomorphic assessment reports completed by WEST Consultants in 2012, 2019, and 2021. As outlined in the FEIS, the 2016 MN EIS, and the WEST reports in 2012, 2019, and 2021, no significant adverse impacts are anticipated. The Project would not likely have a significant effect on stream stability and geomorphology throughout the potentially impacted/affected environment. Multiple features were incorporated to reduce the frequency at which the Project would operate in the future. This was done specifically to minimize potential adverse effects to multiple resource types, including geomorphology. With the updates to the Project operations in the 2019 SEA, no significant adverse effects are anticipated, and no mitigation was proposed. However, geomorphic conditions will be monitored as a part of the AMMP (outlined

in Section 4.4). The monitoring plan for geomorphology has been developed, and will be revised over time, as needed, to capture any new concerns. Pre-Project geomorphic monitoring was conducted in 2010/2011, 2018, and 2020. The scopes of work for the pre-Project geomorphic monitoring were developed through a collaborative effort with participating agencies.

2.5. Invasive Species Management

Preventing the spread of invasive species is always a concern during the construction of projects as equipment and materials are transported from other areas. To avoid the spread of invasive species (including Red River and its tributaries that are infested by zebra mussels), contractors will need to prepare an invasive species management plan prior to construction. All equipment that would be in contact with infested waters must be decontaminated prior to entering the water and before leaving the site. Methods for decontamination could include one or more of the following methods: a) Drain and treat all water from equipment; 2) Remove all visible aquatic remnants of plants, seeds, or animals; 3) Remove mud and soil; and/or 4) Hand scrape or power wash with hot water of at least 140° Fahrenheit for at least 10 seconds or use another acceptable treatment method. To avoid the spread of existing invasive vegetative species within the construction boundaries, the plan would delineate existing weed infested areas and include methods to: a) Minimize disturbance; b) Clean equipment before leaving the infested areas; and/or c) Separate stockpile and removed vegetation piles from the infested areas as compared to the non-infested areas. Soil placed in water bodies would not include solid wastes, hazardous materials, or aquatic invasive species.

Construction within Minnesota will require that contractors prevent the spread of invasive species based on MnDNR publication, "Best Practices for preventing the spread of aquatic invasive species;" Minnesota Administrative Rules Chapters 84D and 6216 which address aquatic, terrestrial, and vegetative invasive species; and U.S. Department of Agriculture publication “A guide to Nonnative Invasive Plants Inventoried in the North by Forest Inventory and Analysis” (2017, C. Olson and A. Cholewa).

Construction totally within North Dakota will requires that contractors prevent the spread of invasive species based upon North Dakota Century Codes 4.1-47-02 and 36-26 which address aquatic, terrestrial, and vegetative invasive species; and, within Cass County, additional compliance with *Identification and Control of Invasive and Troublesome Weeds in North Dakota* by North Dakota State University. Within the construction boundaries of the diversion channel construction project, invasive and/or non-native species control would consist of a combination of mowing, burning, disking, and/or mulching or approved use of biocontrol and/or herbicide treatments developed for each invasive or non-native species.

Construction projects that extend into both Minnesota and North Dakota, such as along the Red River, will require compliance with all of the above regulations and guidance.

2.6. Aquatic Connectivity

Previous Project plans and resulting analyses identified potential impacts to biological connectivity and proposed mitigation actions to offset these impacts (2011 FEIS; 2013 SEA). As discussed in the 2019 SEA, Plan B further reduces adverse impacts to connectivity. As outlined within the SEA, the disruption to upstream connectivity in the Red River system would generally be about 10 to 14 days

whenever the Project operates, which would only occur for floods with a combined discharge of greater than 21,000 cfs on the Wild Rice River and Red River upstream of the dam (approximately a 20-year event). As stated in the 2019 SEA, "While disruptions to connectivity would still occur with Plan B modifications, it is most likely that these disruptions would be infrequent enough, short enough in duration, and early enough in the season that broad, measurable, long-term impacts to Red River fish communities would not be expected.". No additional mitigation in addition to the minimization measures for impacts to connectivity is required by the USACE. Not all resource agencies concurred with this interpretation of impacts.

MnDNR, as a part of its permitting process, is requiring construction of Drayton Dam fish passage. The Project is moving forward as a requirement of MnDNR permit 2018-0819. The permit states that: "The Permittee shall work with DNR on the design of the Drayton Dam Project to ensure that it satisfies the mitigation requirements of this permit." USACE and the Non-Federal Sponsors have worked continuously with MnDNR over the years to develop Drayton Dam fish passage Project designs. This has recently included a design workshop and several phone conversations and email exchanges to complete Project designs in preparation for a contract advertisement in the near future. The Drayton Dam Project designs have essentially included most, if not all, DNR design requests relevant to fish passage and include the most current design standards that MnDNR uses on its own fish passage projects.

While significant impacts to connectivity were not identified due to construction/operation of the aqueducts on the Maple and Sheyenne Rivers, there is uncertainty around this conclusion. Monitoring activities, including evaluation criteria, are discussed below in Section 4, Monitoring, Performance Standards, and Triggers, to help confirm if the aqueducts are functioning adequately for biological connectivity.

3. PROJECT MITIGATION

The following discussions outline the mitigation approach to meet the mitigation needs identified in Section 2 of this AMMP.

Tables 5 through 8, at the end of this section, provide a summary of mitigation needs, mitigation accomplished to date, and remaining mitigation needs. These tables will be updated over time in subsequent versions of the AMMP and will demonstrate where the USACE and the Non-Federal Sponsors are in relation to meeting their mitigation commitments.

A database for tracking Project mitigation observations and monitoring data is in development. The database will be accessible to the USACE, the Non-Federal Sponsors, AMT, and resource monitoring team members.

3.1. Aquatic Habitat

Mitigation approaches will be developed based upon the location of the resources and the geographical extent of the impacts in Minnesota and North Dakota. MnDNR permit 2018-0819 mandates mitigation to be completed for impacts to aquatic habitat in waters of the State of Minnesota. This includes half of the lost aquatic habitat on the Red River. All remaining lost aquatic habitat (including the remaining half of lost Red River habitat) occurs within the State of North Dakota and is addressed separately.

3.1.1. Aquatic Habitat Mitigation in Minnesota

Restoration of the Lower Otter Tail River (LOTR) has been considered by a number of resource agencies in recent years. The LOTR forms the headwaters of the Red River. Sections of this river, which flows entirely within Minnesota, have been channelized for flood control purposes below Orwell Dam, near Fergus Falls, Minnesota. There is a large extent of habitat that could be considered for restoration, including several meander bends that have been disconnected from the main channel. Restoration measures potentially include reconnecting isolated oxbows, bank stabilization, reconnecting the river to the floodplain, grading, and other features to recreate more natural and stable river habitat. However, constraints to future restoration projects include limitations due to potential increased water surface elevations and landowner participation from properties adjacent to the Project. The USACE and the Buffalo-Red River Watershed District (BRRWD) completed an ecosystem restoration feasibility study for the Lower Otter Tail River in 2022, as authorized by Section 1135 of the USACE Continuing Authorities Program. The design and implementation of measures identified in that study are being pursued.

Per condition 27 of the MnDNR permit 2018-0819 for the Project, “The Permittee shall fund the Lower Otter Tail Restoration Project to a dollar amount that would ensure replacement of all ecological resource values and functions of the public waters impacted by the Project. Ecological resource values will be calculated by the DNR…” The MnDNR determined that $8.28M would be the appropriate amount of funding to offset aquatic habitat impacts. The Non-Federal Sponsor has executed a memorandum of understanding with the BRRWD and is finalizing a funding transfer

agreement in 2022. Funding received to mitigate impacts of the Comprehensive Project will be implemented separately from funds provided by the USACE Section 1135 project.

3.1.2. Aquatic Habitat Mitigation in North Dakota

In the State of North Dakota, extensive work and collaboration has been done to identify potential river restoration projects to serve as mitigation for Project impacts. This has included meetings and site visits with natural resource agencies, county representatives, watershed coordinators, and other stakeholders. To date, the best candidate projects for aquatic habitat mitigation focus on the Sheyenne River and include components listed below. For additional description on the Sheyenne River mitigation, see Attachment A.

Restoration of the Sheyenne River Oxbow

A meander bend of the Sheyenne River within the Comprehensive Project area has experienced a meander bend cutoff. This cutoff is located between Horace and West Fargo, North Dakota, immediately to the east of Sheyenne Street/Highway 17. The Project under consideration includes reconnecting the isolated oxbow, potentially with additional channel work, grading, and other features to recreate more natural river habitat. The area is relatively small, and a project would need to work within potential constraints of the adjacent highway and residences. The restoration of this meander would not be able to take place until after the Comprehensive Project is operational to avoid potential impacts to water surface elevations. While the amount of mitigation that could be credited here is small, it does provide an opportunity for some direct aquatic habitat mitigation on an impacted water body within North Dakota.

Improve Connectivity in the Sheyenne River

Two existing flood risk management projects near the Fargo metropolitan area have resulted in unfavorable natural resource conditions in the Sheyenne River. The existing Horace to West Fargo Diversion includes a culvert structure that restricts high flow through the natural Sheyenne River channel and diverts flows over a baffle structure into a 7+ mile long diversion channel. The Horace to West Fargo Diversion flows into the West Fargo Diversion. The West Fargo Diversion is a 6.5+ mile diversion channel that operates when gated structures near Interstate 94 and 12th Avenue North are closed to divert water around West Fargo. The structures used to operate the projects inhibit fish passage and decrease connectivity. Restoration would include the removal and modification of existing structures. Removal of the gated structures would substantially improve connectivity throughout the natural channel, while modification of the diversion inlets would also improve passability for fish. The existing projects provide flood risk management and modifications to any of the structures would need to take place after the Project is operational (to ensure that existing flood risk management benefits are sustained) and the Letter of Map Revisions (LOMR) floodplain mapping is complete. Other connectivity improvement projects would consider methods to modify or remove a low-head dam that exists adjacent to a railroad bridge just north of where Main Avenue West crosses the Sheyenne River in West Fargo.

The Sheyenne River Oxbow Restoration is the best candidate for aquatic mitigation in North Dakota. Restoration of the oxbow is in-kind with impacts from the Project, but restoration of the oxbow

alone would not be enough to offset the aquatic impacts in North Dakota. Discussions with the State of North Dakota have indicated that there is strong interest in also pursuing connectivity improvement projects to offset aquatic footprint impacts. Use of connectivity for mitigation of lost habitat is challenging in that it is difficult to quantify exactly "how much" connectivity must be restored to offset a certain loss of habitat. Improving connectivity in the Sheyenne River channel would have clear ecological benefits. A whitepaper on the Sheyenne River restoration measures listed above has been prepared by the USACE and describes the projects in further detail (Attachment A).

The North Dakota resource agencies and the local governments protected by the existing diversion channels have expressed their support of the Sheyenne River channel improvements, with the understanding that implementation would not occur until after the Project is operational and the LOMR process is complete. The State of North Dakota strongly supports these two projects to fulfill the mitigation needs for lost aquatic habitat in the State of North Dakota. The USACE and Non-Federal Sponsors will work with North Dakota agencies to continue Project coordination and document support.

3.2. Forests

Forest impacts and mitigation needs are outlined above in Table 4. The Project results in a need for approximately 70.9 habitat units of mitigation, which equates to 283 acres of newly created floodplain forest.

Work and collaboration to date has resulted in 13 acres (3.3 HUs) of forest mitigation already implemented (Table 8). Construction is currently underway on an additional 72.34 acres (18.1 HUs) of forest mitigation at the former site of the Oxbow Country Club. It is estimated an additional 198 acres (49.5 HUs) will be needed for mitigation. There are many other opportunities for implementing floodplain forest mitigation. The Non-Federal Sponsors have acquired several properties along the Red River and other tributaries that would be suitable for the establishment of floodplain forest. Additional coordination with the resource agencies and Non-Federal Sponsors will occur to prioritize, select, and design specific sites. These sites will be added to Table 8 as the designs become more defined.

In addition to the activities outlined above, forestry mitigation will include, based on agency input, the following actions:

- As outlined in the paragraph above, mitigation will be implemented based on the habitat analysis performed in the original FEIS. Based on this habitat analysis, a 2.1:1 mitigation ratio would be applied for floodplain forest impacts.

- Floodplain lands that are currently in agricultural production or were previously the site of building sites acquired along the rivers will be planted with native tree species. This would include restoring native floodplain forest and herbaceous vegetation. These areas would also provide wildlife habitat. Monitoring will be performed, as outlined in the next section, to verify floodplain forest response is as needed.

- The USACE would develop site restoration plans, including tree planting areas, and clearing, treatment, and management schedules for forest mitigation sites. A combination of direct seeding and seedling trees would be used as needed. Sites would be managed for effective forest growth. Sites may be protected and managed into perpetuity by an agreement for management as a wildlife management area by the MnDNR or NDGF.
- A forest restoration plan will be prepared with input from the Forest Resource Group and will be included as an appendix in a later version of the AMMP.

3.3. Wetlands

Wetland impacts are addressed through US Army USACE of Engineers Permit No. NWO-2013-1723-BIS for the diversion channel and OHB ring levee. Wetland impacts for the Southern Embankment were addressed through the environmental impact analysis in the FEIS and subsequent SEAs and in more detail in this AMMP.

3.3.1. Wetland Impacts Addressed in the US Army Corps of Engineers Permit No. NWO-2013-1723-BIS

Wetland impacts are outlined above in Table 4. Wetland losses due to the diversion channel will be mitigated via wetland replacement that will occur within the constructed diversion channel. These mitigation requirements have been outlined in US Army Corps of Engineers Permit No. NWO-2013-1723-BIS issued to the Non-Federal Sponsors on December 14, 2016, and modified on September 29, 2020. Wetland mitigation for the diversion channel will be addressed through this permit and therefore limited description will be provided in this AMMP.

3.3.2. Wetland Impacts Addressed in the US Army Corps of Engineers Permit No. NWO-2014-0236-BIS

Wetland impacts due to the construction of the OHB ring levee are being mitigated via wetland restoration at the Forest River and Oxbow Country Club sites, as well as the purchase of wetland credits through the Ducks Unlimited In-Lieu Fee Program. Wetland mitigation for the OHB ring levee is addressed in Army Permit No. NWO-2014-0236-BIS and therefore limited description has been provided in this AMMP.

3.3.3. Wetland Impacts from the Southern Embankment and Associated Infrastructure

Wetlands impacted through the construction of the Southern Embankment, which total approximately 261.7 acres, will be mitigated separately from those identified above. Ditched wetland losses will be mitigated with the creation of similar wetlands through the construction of the Project. The remaining wetland mitigation in North Dakota and Minnesota will be accounted for in each of the states separately. Mitigation for the 19.2 acres of non-ditched wetland impacts in Minnesota will be purchased as wetland credits. The remaining non-ditched wetlands in North Dakota that require mitigation total 142 acres and will be mitigated in North Dakota. For a summary of all wetland impacts associated with the Project, see Table 4.

There is a clear difference between the functions provided by the impacted wetlands. Early in Project planning, it was decided amongst the agencies that a function-based approach was

appropriate for determining compensatory mitigation requirements. MnRAM was used for determining compensatory mitigation requirements for impacts. The results of the MnRAM analysis suggested that farmed seasonally flooded areas be mitigated at a 0.88 acres of wetland credits for every 1 acre of impact, while all other wetland types be mitigated at a 1:1 ratio. However, Minnesota WCA rules set minimum replacement ratios that cannot be reduced based on a functional assessment. In addition, there are no state-adopted procedures or policies for using a functional assessment method to determine wetland replacement ratios.

Mitigation for the Southern Embankment wetland impacts in North Dakota would occur in the "Camel Hump" area where the Southern Embankment extends northward between the Diversion Inlet and the Wild Rice River Structure. Hydraulic modeling has indicated that this area will be prone to flooding more frequently after the Project is constructed. This will make the area less desirable for farming and presents an opportunity for wetland restoration along Drain 27. It is anticipated that the Drain 27 Wetland Restoration Project will provide enough wetland credits for the remaining mitigation needs in North Dakota. A contract for the Drain 27 Wetland Restoration Project was awarded in 2022 with construction occurring in 2022 and 2023.

For the nearly 19.2 acres of non-ditched wetland impacts estimated to occur in Minnesota, wetland mitigation credits will be purchased to offset the impacts. The has been collaborating with BWSR to purchase of wetland credits based upon ratios consistent with the Minnesota WCA (1:1 for ag land impacts, 2:1 for non-ag land impacts).

Agency representatives have noted that wetland replacement would incidentally result in wildlife habitat replacement when discussing the potential mitigation needs for wildlife habitat losses.

3.4. Aquatic Connectivity

Previous Project plans and resulting analyses identified potential impacts to biological connectivity and proposed mitigation actions to offset these impacts (2011 FEIS; 2013 SEA). With Plan B the adverse impacts to connectivity have been reduced even further. As stated in the 2019 SEA, "While disruptions to connectivity would still occur with Plan B modifications, it is most likely that these disruptions would be infrequent enough, short enough in duration, and early enough in the season that broad, measurable, long-term impacts to Red River fish communities would not be expected." No mitigation for aquatic connectivity impacts is required by the USACE.

The MnDNR permit for the Project requires their concerns for biological connectivity be addressed. Per condition 27 of MnDNR permit 2018-0819, "Within five (5) years of permit issuance and no later than the start of construction of the Red River Structure, the Permittee shall have a legally binding commitment to fund the Drayton Dam Mitigation Project, and construction shall have commenced within this same time period. The Drayton Dam Project, which includes the removal of the existing dam and construction of a rock arch rapids, shall serve as partial mitigation for impacts of the Project on the ecology of the Red River, including impacts to connectivity, fish passage, and aquatic resources. The Permittee shall work with DNR on the design of the Drayton Dam Project to ensure that it satisfies the mitigation requirements of this permit."

Drayton Dam is a low-head dam on the lower Red River at Drayton, North Dakota. It is the last fish barrier on the mainstem Red River within the United States. Several other low-head dams on the Red River have been retrofitted with rock rapids fishways to facilitate fish movement. Drayton is the last location without fish passage. It is also the most downstream dam within the United States that operates as a barrier to the watershed.

Plans and specifications were prepared for fish passage at Drayton Dam with input from the AMT. Fish passage experts, including the MnDNR, were directly involved in developing the design of this Project. A contract for the Drayton Dam Mitigation Project was awarded in 2022 with substantial construction occurring in August 2023.

3.5. Additional Considerations to Minimize Impacts and Mitigation Needs

Coordination with agency members during preparation of the 2019 SEA identified additional considerations to minimize impacts of the Project. The following recommendations will be performed to minimize adverse effects related to the Project:

- To the extent practicable, vegetation clearing activities would be done so as to avoid affecting nesting individuals.

- To the extent practicable, tree clearing on forested land would occur during the winter months in order to avoid impacts to listed bird species during their nesting and rearing periods.

- Wetland mitigation sites constructed for the Project are only anticipated in North Dakota, as wetland credits will be purchased in Minnesota. Wetlands would be managed for invasive species. Invasive and/or non-native plant species would be controlled for three full growing seasons at floodplain forest mitigation sites. Control would consist of mowing, burning, disking, mulching, biocontrol and/or herbicide treatments, as needed. By the third growing season, any planted areas one-half acre in size or larger that have greater than 50 percent areal cover of invasive and/or non-native species would be treated (e.g., herbicide) and/or cleared (e.g., disked) and then replanted with appropriate non-invasive plants. The areal cover percentage was arrived at through discussions with the resource agencies, most recently revisited in March 2020.

- When construction activities are complete, disturbed areas would be seeded with native plant species or other plant species per Project plans and specifications. After native species have been planted, the areas would be monitored and managed to maintain the native vegetation.

- The Non-Federal Sponsors would be responsible for noxious weed control on the whole Project as part of the Operations, Maintenance, Repair, Rehabilitation, and Replacement (OMRR&R).

Impact Tables

Table 5. Aquatic habitat impacts and mitigation.

Aquatic Riverine Habitat Impact	Habitat Lost (HUs)	Mitigation
Red River Control Structure	6.7	Mitigation on the Lower Otter Tail River was directed by the MnDNR as a permit condition for impacts within MN.
Wild Rice River Control Structure	3.4	Mitigation for all aquatic impacts in ND, including shared impacts on the Red River, will be provided through the removal/modification of flood risk management features and restoration on the Sheyenne River. Restoration would not occur until after the Project is operational.
Sheyenne River Aqueduct	4.3	
Maple River Aqueduct	5.7	
Total Aquatic Mitigation Need:	20.1	

Table 6. Forest impacts and mitigation.

Impact	Footprint Area Lost (ac)		Existing Habitat Quality Score	Habitat Units Lost		Created Forest Habitat Quality Score	Mitigation Needs (ac)	
	ND	MN		ND	MN		ND	MN
Forest	124	15	0.51	63.2	7.65	0.25	252.8	30.6

Table 7. Non-ditch wetland impacts and mitigation

Wetland Type	Diversion Channel Wetland Impacts	Mitigation	Southern Embankment Wetland Impacts (acres)	Mitigation
Farmed Seasonally Flooded Basin	1034.39	All wetland impacts associated with the construction of the Diversion Channel will be mitigated by the creation of wetlands within the Diversion Channel itself.	180.64	Mitigation for impacts ND were accounted for via mitigation projects and wetland credit purchases described in Table 8. Wetland mitigation in MN will be met by the purchase of credits.
Shallow Marsh	49.62		5.32	
Shallow Open Water	-		4.97	
Wet Meadow	61.68		32.21	
Total Acres	1,145.68		223.14	

Mitigation Tracking

Table 8. Project Mitigation Tracker

Mitigation Type	Site/Project Name	Site Location	Construction	Acres	Habitat Units	Description
Aquatic Habitat	Lower Otter Tail River Restoration	Breckinridge, MN	TBD	*	*	The MnDNR has determined that $8.28M will be provided by the Non-Federal Sponsor to fulfil permit condition
	Sheyenne Oxbow Restoration	West Fargo, ND	TBD	2	**	Restoration of oxbow adjacent to Co Rd 17.
	Sheyenne Connectivity	West Fargo/Horace, ND	TBD	TBD	**	Improved connectivity associated with Sheyenne River Flood Control Project
Forest	Red River site	Oxbow, ND	2017	13	3.3	Restoration of ag row crop area with modifications to hydrology.
	Oxbow Country Club	Oxbow, ND	Construction: 2022	72.34	18.1	Restoring wetland of a historic Red River oxbow.
	TBD	TBD	Varies	198	49.5	Floodplain forest areas are being prioritized. Sites will be determined by AMT.
Wetland	Diversion Channel	Fargo, ND	Construction: 2022	TBD	TBD	Amount of mitigation dependent on impacts of final design.
	Oxbow Golf Course	Oxbow, ND	Construction: 2021 Establish veg: 2026	18.8	12.26	Restoring wetland features for an old Red River oxbow. Includes: 10.62 acres of wet meadow/ shallow marsh; 8.18 acres of upland buffer

Mitigation Type	Site/Project Name	Site Location	Construction	Acres	Habitat Units	Description
	Forest River	Briarwood, ND	Complete	6	6	Restoration of wetlands near Briarwood, ND
	DU In-Lieu Fee Credits	NA	NA	NA	17.27	Purchased for work on OHB
	Drain 27 Wetland Restoration	Stanley Township, ND	Construction: 2022 Establish veg: 2027	320	169.8	Mitigation for wetland impacts for the Southern Embankment and Associated Infrastructure in ND
	MN Wetland Bank Credits	NA	NA	NA	23.03	The purchase of wetland credits may occur at several iterations. The first purchase of 0.5 credits is anticipated in August of 2021.
Connectivity	Drayton Dam Modification	Drayton, ND	Construction: 2022/2023	*	*	Mitigation to fulfil MnDNR permit condition

*The MnDNR prescribed this mitigation as a permit condition.

**Mitigation amount needed for impacts within North Dakota will be developed through the AMMP with North Dakota and the USACE/Sponsors. This agreement will be formalized with correspondence.

4. MONITORING, PERFORMANCE STANDARDS, and TRIGGERS

Monitoring methodologies, performance standards, and adaptive management triggers will be used to better characterize pre-project conditions for key resources, identify changes following Comprehensive Project implementation, verify resulting Comprehensive Project impacts, and verify whether mitigation is offsetting these Comprehensive Project impacts.

Monitoring and adaptive management of resources impacted by the Comprehensive Project and mitigation projects is the responsibility of the Non-Federal Sponsors.

Monitoring

Monitoring helps capture the state of a resource at a particular point in time and can help to track changes that a resource experiences. Monitoring methodology and frequency have been collaboratively established with input from natural resource agencies.

Monitoring activities will be focused on key resources of concern. These include:

- Connectivity Mitigation for Aquatic Habitat (mitigation)
- Floodplain Forest (mitigation)
- Wetlands (mitigation)
- Aqueduct Connectivity (resource of concern)
- Geomorphic (resource of concern)
- Water Quality (resource of concern)
- Fish Stranding (resource of concern)

Monitoring for aquatic habitat, floodplain forest, and wetlands is associated with impacts warranting mitigation. Geomorphic and water quality impacts were not deemed to be significant and therefore no mitigation was required. Geomorphology and water quality have been or will be further monitored prior to and after construction or Comprehensive Project features to verify these assumptions. Similarly, fish stranding following Project operations was not considered as a significant impact but will be monitored, with potential mitigation needs pending results.

Monitoring plans were developed for each resource based on the information available at the time this AMMP version was written. The monitoring approaches outlined below will need to remain flexible to adapt to changing conditions (either pre- or post-project); alternative technologies or techniques that become available for monitoring; and refinement of specific Project features or mitigation actions. Revisions to monitoring plans would require AMT approval. In addition, many of the monitoring schedules may overlap with each other. Where this occurs, it is highly recommended that the resource agencies attempt to coordinate field surveys concurrently so that data can be compared and utilized efficiently.

Pre-construction monitoring efforts are led by the USACE and the Non-Federal Sponsors. In 2023, monitoring and adaptive management would be the responsibility of the Non-Federal Sponsors except for pre-construction monitoring efforts for the Sheyenne River Mitigation Project. Monitoring results will be shared with the AMT when the data is processed and ready for distribution.

Performance Standards

Performance standards are measurable criteria set to help determine the success of mitigation efforts. Where specified, monitoring can be concluded once performance standards are met. If performance standards are not met within a defined amount of time, adaptive management of that resource or alternative mitigation options may be necessary.

USACE regulations require that projects develop and use criteria for determining ecological success of mitigation and to ensure Comprehensive Project impacts are offset. The metrics used to measure impacts and mitigation effectiveness are described below. Even with the use of metrics, it is recognized that conclusions on Project impacts and mitigation success will need to include detailed review of data and collaboration amongst the AMT. Even then, opinions may differ on the questions at hand. However, the discussion below provides guidance on the metrics that will be used to verify Comprehensive Project impacts and mitigation effectiveness. These metrics will provide the primary measure of whether or not mitigation has proven effective.

Triggers

Triggers are predetermined values that serve as thresholds for specific actions or further evaluation of a resource. Triggers fall into one of two categories: 1) monitoring triggers or 2) adaptive management triggers.

Monitoring triggers are events that cause additional monitoring to occur. For the Comprehensive Project, several monitoring triggers have been identified in particular resource areas for significant flood events. Pre-project monitoring triggers will help to expand the baseline data so there is a better understanding of existing flood impacts which are more suitable for comparison after Comprehensive Project operation. After Comprehensive Project construction, monitoring triggers will provide data that can help to assess the actual impacts of the Comprehensive Project. Resource areas with monitoring triggers are identified in the text below.

Adaptive management triggers are measurable changes to a resource that leads to a defined response or further evaluation. Evaluation will consider monitoring data and any additional underlying circumstances that could have influenced the triggers to be met. The result of evaluation may lead to modification of a particular feature, changes in the management of a resource, or even no action if it is determined that changes were the result of something other than the Project. Adaptive management triggers for the Comprehensive Project can be found in the resource area descriptions in the text below.

4.1. Aquatic Habitat and Connectivity

Mitigation needs for lost aquatic habitat in waters of Minnesota have been directed by MnDNR via their permit. In a letter dated May 19, 2021, the MnDNR indicated that funding of $8.28M toward restoration of the Lower Otter Tail River was the appropriate amount of mitigation necessary to offset aquatic impacts in Minnesota. In the same letter, the MnDNR also determined that monitoring will not be required on the Lower Otter Tail River.

Mitigation needs for lost aquatic habitat in waters of North Dakota will be accomplished via a set of projects on the Sheyenne River. This includes restoration of a Sheyenne River oxbow and improvements in biotic connectivity via modification to the Sheyenne River Flood Control Project, as well as a small dam in West Fargo. As outlined above, the State of North Dakota has agreed that this is adequate mitigation for aquatic habitat losses in their state. However, to confirm these projects are effectively working, monitoring activities will be performed. These monitoring activities will be done in concert with evaluation of whether fish are able to effectively move across the Sheyenne River aqueduct which is immediately upstream of the Sheyenne River connectivity mitigation project. The exact monitoring activities are still under discussion, and may include a combination of netting, hydroacoustic observations, radio telemetry, and other techniques. The specifics will be added to this subsection once identified and approved by the AMT.

The following discussion on the Sheyenne River Mitigation Project will include an overview for evaluation of connectivity through the Sheyenne River and Maple River aqueducts. These are similar discussions, with Sheyenne aqueduct performance critical to the effectiveness of the Sheyenne River Mitigation Project.

Performance Standards and Metrics

Red River Structure Monitoring Activities

The Non-Federal Sponsors will observe average cross section velocities through the Red River Structure at discharges close to 2,900 cfs, 8,100 cfs, and 10,700 cfs, which are equal to the 50%, 10%, and 5% annual exceedance probability flows, respectively, through the Red River Structure, as reported in the 2019 SEA. A reasonable surrogate for determining Red River Structure discharges prior to operations is the USGS gage on the Red River at Hickson, ND. This is to verify velocities that generally align with those identified in the 2019 SEA (approximately 2 fps at a discharge of 10,700 cfs). These results will be coordinated and discussed with the Biotic Resource Management Team and the AMT to determine if any additional actions are warranted. Given the general consistency of results from both computer modeling and physical modeling for the Red River Structure, it is unlikely that actual velocities will differ substantially from those predicted.

Minnesota Mitigation

Standards and metrics associated with aquatic habitat for impacts and mitigation in Minnesota will be done in accordance with the MnDNR and associated Project permit. This includes restoration on the Lower Otter Tail River and will include direct collaboration on design with the MnDNR. Because these actions will ensure that impacts are offset, no monitoring is proposed at this time for this aquatic habitat mitigation.

North Dakota Mitigation

Sheyenne River Mitigation and Aqueduct Connectivity Evaluation Methodology

Habitat benefits of the Sheyenne Mitigation Project will be evaluated to confirm an acceptable level of improvement for offsetting lost aquatic habitat in North Dakota due to the Project. This will be

done in concert with an evaluation of connectivity through the Maple River and Sheyenne River aqueducts also to be constructed as a part of the Project.

Participation and Timing

The evaluation will be performed by the Project Non-Federal Sponsors as a part of the AMMP and the Project's O&M requirement. Resource agencies (i.e., NDGF, MnDNR, and USFWS) will be invited and involved with this process to the full extent they are willing/able to do so. Note that the precise timing of an evaluation will be dependent on completion of construction. At this time, the aqueducts would not be completed and functioning until 2025. Sheyenne River Mitigation will not be constructed until the entire Project is operational and the LOMR process is complete. Given this timing, and the fact that an evaluation of both the mitigation and aqueduct will likely be strongly related, full evaluation may not occur for seven to eight years, or more. With likely improvements in science and technology to track and observe fish in turbid environments, the proposed methodology here can and should be revisited as the timing for evaluation draws closer. The following is intended to provide an overview of an evaluation process and a commitment by Non-Federal Sponsors to evaluate the effectiveness of the mitigation project and confirm whether or not the aqueducts are effectively passing fish. Note that designs are not currently available for any of these features, which is part of the reason why the following methods are proposed and not finalized.

Goals and Objectives of Mitigation

Goal 1: Improve connectivity on the lower Sheyenne River

Objective 1.1: Remove instream structural features to restore in-channel connectivity

Objective 1.2: Improve connectivity through diversion channels through installation of nature-like fishways across upstream control weirs

Key Questions to Answer:

- Are resulting hydraulics at rock rapids similar to what was designed?
- Do fish enter the Sheyenne aqueduct bypass channels, especially with the rest of the channel open?
- Do fish reach the rock rapids?
- Do fish successfully pass the rock rapids?
- Do fish pass the concrete weir adjacent to the railroad bridge north of Main Avenue West in West Fargo?
- Do IBI metrics in project area improve with improved connectivity?

Performance Standards to Measure Success

- Where instream structures are removed, return the channel to the same dimensions and channel substrates as adjacent areas upstream and downstream.
- Rock rapids fishways in bypass channels that would be implemented for the Sheyenne River Mitigation Project will employ the latest design standards for rock ramp fishways.

Successfully meeting this standard means maintaining the following design criteria. This will be done to the fullest extent allowed by site hydraulics. This includes:

- <3% slope down centerline of fishway
- <0.7ft drop between individual rock boulder weirs
- Use of alternating sine wave weirs
- Boulder pools between weirs of at least 3ft of depth
- Pool widths should be at least 30ft between the widest points of alternating sine waves
- No smooth sills should extend above adjacent rock at the crest maintain upstream water elevations

- If a rock rapids fishway is used at the weir near the Main Avenue West railroad bridge, achieve and maintain the exact same design criteria as those outlined above for rock ramp fishways in the bypass channels.

Monitoring Activities

Methods discussed here are preliminary and need to be developed further based on what the final design of the mitigation project will be. Effort also will be made to incorporate evaluation of connectivity across the Sheyenne River aqueduct with evaluation of Sheyenne River mitigation effectiveness. Potential integration of those two efforts is discussed later.

Pre-Project

***Fish Collection*.** Anecdotal observations have noted fish presence in the Sheyenne River Flood Control Project diversion channels. If practicable, perform cursory monitoring to confirm fish use of the diversion channels and presence below existing weirs on the West Fargo Diversion, and Horace to West Fargo Diversion. This will include notes for species diversity and size. Sampling should occur in or near the weir tailrace during springs when the diversion channels have been conveying water. Sampling could include seining or electroshocking. Sampling should occur bi-weekly during the period April through June during at least one event prior to Project construction.

***IBI Methodology*.** An evaluation of river health via IBI methodology has already been performed pre-project with observations from 2012 to 2017. This included measurements of both fish and macroinvertebrate IBI. Observations were made at several points on the lower Sheyenne River, including areas relatively close to the proposed oxbow restoration. At this time, no further pre-project data is recommended.

Post Project

These future studies are described generally; detailed experimental designs will be developed in consultation with agency partners during preparation of plans and specifications for project implementation. The monitoring noted would most likely be a part of a broader evaluation of connectivity across the Sheyenne River aqueduct. As these designs are not yet available, and construction is several years away for Sheyenne River fish passage mitigation, a revised study plan will be developed. It is likely that technology improvements in the technique outlined would want to be captured with the final study design.

- ***Field Survey of Fish Passage Structures.*** For any rock ramp fishway, perform surveys every five years post-construction to ensure the above design criteria performance standards are maintained. These structures are within the area of protection and should not experience flows above a 2-year flood event. As such, post flood surveys should not be needed.

- ***Passive Adaptive Management Monitoring: IBI Methodology.*** Utilize the Index of Biotic Integrity protocol (fish and macroinvertebrate) to survey locations on the Sheyenne River. Protocol for use will be that used previously in 2012 and 2017 with the IBI assessment for the Sheyenne and other rivers of concern in the Project area. Locations will be the same as those surveyed in 2012 and 2017. This should include a minimum of two sampling events after the Sheyenne River fish passage mitigation project has been completed. This should likely happen at least two years following completion of the Sheyenne River mitigation project. Results will help reflect on the effectiveness of fish passage of both the mitigation project, as well as the aqueducts, on improving river health in the area.

- ***Passive Adaptive Management Monitoring: Fish Capture.*** Fish capture sampling in the tailwater of at least one of the bypass channel rock rapids fishways will provide information on the species composition and size structure of fish below the fishway. Fish passing through the fishway will also be monitored with capture nets placed at the upstream exit of the rock rapids fishway. Results will not be compared to any specific performance targets and will be made as a cursory evaluation of fish occurrence and use around the structure. Sampling should occur bi-weekly during the period of April through June during at least one seasonal period post-project construction. Final methods will be developed closer to Project implementation.

Goal 2: Restore Sheyenne River aquatic habitat via oxbow restoration

Objective 2.1: Return flow through identified historic oxbow and return the channel to likely dimensions pre-disturbance, maintaining long-term stability

Key Questions to Answer:

- Is oxbow functioning as natural channel?

Performance Standards to Measure Success

- Return flow to the historic channel and maintain channel stability.

Monitoring Activities

Post Project

- ***Geomorphology.*** Utilize geomorphic assessments, using the protocol outlined in the Geomorphic Monitoring Plan (Attachment B), to confirm that the channel is stable and functioning as a natural channel. This should include a minimum of two sampling events after the oxbow restoration project has been completed. This methodology can be revised in the future if simpler methods would be adequate to confirm channel stability.

Aqueduct Evaluation and Associated Triggers

Biological connectivity through the Project aqueducts is important for river health and function. Connectivity through the Sheyenne River aqueduct is especially critical to work in concert with the Sheyenne River connectivity mitigation project. Following is the evaluation approach for aqueduct connectivity.

Goals and Objectives of Aqueduct Design

Goal: Maintain connectivity on the lower Sheyenne and Maple Rivers through the planned Project features

Objective: Maintain the ability for the full range of species and size diversity to move through the aqueducts at a level similar to existing conditions

Key Questions to Answer:

- Are resulting hydraulics in the aqueducts adequate to allow fish passage?
    - Are velocities generally adequate to allow fish passage across the majority of flow conditions?
    - Are roughness elements incorporated adequate to promote velocities pattern that promote effective fish movement?
- Do fish of all species and sizes enter the aqueduct?
- Do most fish that enter the aqueduct exit the upper end of the aqueduct?

Triggers to Measure Impact Levels

The following criteria are in draft and will need refinement. Criteria need to be appropriately developed in-line with the capabilities of available methods and technologies. In particular, the ability to make biological measurements makes similar criteria difficult to employ.

The USACE and the Non-Federal Sponsors will coordinate during the development of the design concept for the aqueducts to maintain connectivity. This will likely include some form of the following:

- Fish that arrive at the downstream end of the aqueduct are able to successfully pass for flows up to the 50 percent annual flow event.
- Maintain water velocities conducive to biological connectivity up to project operation.
- Incorporate roughness elements in the aqueduct of similar design/pattern as that outlined in the USACE/Non-Federal Sponsors physical flume study of the Maple River aqueduct.

Monitoring Activities

At this time, the aqueduct design concepts have not been fully developed. The Sheyenne River and Maple River aqueducts across the diversion channel will be designed to convey winter flows through the aqueducts and control ice formation to prevent ice from impeding the hydraulic capacity or performance of the system and to resist ice and debris without damaging, reducing capacity, or

reducing function of the aqueducts (October through April). At each aqueduct, flows will be measured to determine the flows upstream of the spillway into the diversion channel, flows entering the aqueduct, and flows exiting the aqueduct.

The most specific methods for monitoring fisheries conditions in the aqueduct will be developed with agency input as aqueduct designs progress. Some methods that are being considered include the use of an acoustic doppler current profiler (ADCP), fish collection, hydroacoustic monitoring systems (e.g., DIDSON or ARIS camera), Passive Integrated Transponder (PIT) tagging, and acoustic tagging.

Mitigation Contingency

Should monitoring suggest that Sheyenne River mitigation or either aqueduct performance is not meeting the mitigation Performance Standards, or triggers are met, the Non-Federal Sponsors will meet with natural resource agencies to discuss whether modifications to Project features are possible, or if additional mitigation is needed to further offset Project impacts.

- Features such as rock rapids at the existing Sheyenne River diversions channels could be relatively easy to modify. If field surveys reveal fish passage features fall out of the design criteria, the Non-Federal Sponsors will modify Sheyenne fish passage structures to meet design criteria.

- If the Sheyenne oxbow channel restoration is no longer stable, the Non-Federal Sponsors will meet with the resource agencies to consider on-site modifications to improve channel stability and on-site habitat conditions.

- Final determinations on acceptability of the effectiveness of the Sheyenne River mitigation project, and whether any there are any additional mitigation needs, would ultimately fall to agreement between NDGF and the Non-Federal Sponsors. All resource agencies would be able to provide input on that decision.

- Modifications to the aqueducts could be much more difficult if performance triggers are not met. If this occurs, the Non-Federal Sponsors will meet with the natural resource agencies to discuss potential options to address the issue. This could include modifications such as addition or alteration of the roughness elements. It could also include additional mitigation actions to improve fish passage elsewhere on the Sheyenne River. The scope and scale of potential actions due to aqueduct triggers is much more difficult to project and will have to be dealt with as it arises.

4.2. Floodplain Forest Habitat

The majority of baseline data needed to quantify existing habitat value of floodplain forest impact areas has been collected (please see Appendix F of 2011 FEIS). No additional floodplain forest surveys are planned prior to construction. Following construction, monitoring will be performed to determine the condition of these habitat types and the overall effectiveness of their mitigation.

Vegetation will be monitored annually for the first five years following planting using stratified random sampling. At each randomly generated point within the areas planted, plots of 0.01 acre will be surveyed according to USACE standard forest inventory procedures. An average of at least one plot per acre will be surveyed. Tree survival and composition will be monitored every ten years.

The goal of the floodplain forest habitat is to provide the area and quantity needed to offset the loss of forest habitat through footprint impacts. The following performance standards will be used to measure when forest mitigation has reached full effectiveness. The metric will be the habitat unit adjusted for quality over time against when the standards below are met.

Forest Performance Standards:

- Restore native floodplain forest and herbaceous vegetation. The floodplain forest should include green ash, cottonwood, black willow, hackberry, quaking aspen, American elm, American basswood, and bur oak.
- Restore stand density with an average of 300 trees per acre over 80 percent of the mitigation site(s) with diameter at breast height (DBH) of 2 inches within 10 years if using seedling plantings, direct seeding, or natural seeding. This tree density is typical for the Red River Basin floodplain forest in the Project vicinity. If using container trees, an average of 90 trees per acre over 80 percent of the mitigation site(s) with diameter at breast height (DBH) of 4 inches within 10 years.
- Restore floodplain forest community with a target species composition of at least 10 percent by number of individual trees to be bur oak and hackberry, with the rest a mix of green ash, cottonwood, black willow, boxelder, American elm, and American basswood.
- Allow some regeneration of native herbaceous plants, shrubs, and trees from locally produced propagules on 20 percent of the mitigation land area, to create diversity in forest and herbaceous vegetation in the mitigation area.
- Protect and manage the site(s) in perpetuity.

Trees will be replanted as needed to meet the target vegetation cover. Invasive, noxious and/or non-native species will be controlled for three full growing seasons. Control will consist of mowing, burning, disking, mulching, biocontrol and/or herbicide treatments, as needed. By the third growing season, any planted areas one-quarter acre in size or larger that have greater than 50 percent areal cover of invasive and/or non-native species will be treated (e.g., herbicide) and/or cleared (e.g., disked) and then replanted with trees.

The monitoring results will be compiled, interpreted, and described in letter reports. The monitoring reports will be provided to the AMT. The AMT will decide if additional forest monitoring is needed at the conclusion of the five-year monitoring period for floodplain forest.

The monitoring approach identified above is targeted for establishing new forests. Sites would be monitored for tree survival annually for five years, then tree survival and composition at ten years. Tree survival and composition would be monitored every five years thereafter until it can be demonstrated that value of the forest habitat lost has been replaced through mitigation. As the forest sites age, monitoring beyond the first five years, if recommended by the AMT, may be adjusted to evaluate mature forests. At that point, forestry monitoring may be performed using the

USACE St. Paul District's Forest Inventory Phase II Protocol (available upon request), adapted as needed for monitoring in the Project area. The Non-Federal Sponsors would be responsible for providing this justification and receiving approval from the AMT.

Adaptive management would be used to manage the mitigation sites. Monitoring would include measurement of the performance standards and the implementation of corrective actions would be carried out if the standards were not being met.

4.3. Wetland Habitats

A wetland delineation has been conducted along the alignments for the diversion channel and Plan B Southern Embankment. A MnRAM functionality assessment had been performed to determine mitigation needs in North Dakota. This information was used to verify the mitigation approach for these wetlands. Surveys of the diversion channel will be performed after construction to verify that the wetland type and function present are offsetting wetland areas lost through construction.

Post-construction monitoring shall be conducted annually to determine the type, quality, and amount of wetlands created as compensatory mitigation for the unavoidable impacts. The purpose of the monitoring is to provide information to determine if the site is successful in meeting its performance standards. The monitoring period for wetlands shall be five years. This period may be shortened if the monitoring reports demonstrate that the mitigation site(s) has met vegetation and hydrology performance standard(s) in two consecutive reports and the AMT concurs that additional monitoring is not required.

Monitoring reports shall be concise and effectively provide the information necessary to assess the status of the compensatory mitigation project. Monitoring shall commence the first full growing season after completion of construction (construction includes earth moving, excavation, and other physical work as well as planting and seeding), approximately May 1. Best Management Practices will be employed between planting and the start of monitoring. Annual monitoring reports shall be submitted on or before December 31 for each of the required monitoring years and will be provided to the AMT.

Monitoring reports shall contain the following information and any additional information necessary to evaluate the performance of the mitigation site:

- Name of party responsible for conducting the monitoring and the date(s) the inspection was conducted;
- A brief paragraph describing the mitigation acreage and type of aquatic resources authorized to compensate for the aquatic impacts;
- Written description of the location of the compensatory mitigation project including information to locate the site perimeter(s) and coordinates of the mitigation site (expressed as latitude, longitudes, UTMs, state plane coordinate system, etc.);
- Dates the compensatory mitigation project commenced and/or was completed;
- Short statement on whether the performance standards are being met;
- Summary data, including photo documentation, to substantiate the success and/or potential challenges associated with the compensatory mitigation project;

- All plant species along with their percent cover, identified by meandering through each vegetative community, including upland buffers, and list commonly encountered, or dominant and co-dominant, species observed. In addition, the presence, location, and percent areal cover of invasive, noxious and/or non-native species in any of plant communities will be noted
- Vegetation cover maps at an appropriate scale will be submitted for each reported growing season
- Photographs showing all representative areas of the mitigation site taken at least once each reported growing season during the period of July 1 to September 30. Photographs will be taken from a height of approximately five to six feet from at least one location per acre. Photos will be taken from the same reference point and direction of view each reporting year. Location of the photographs should be mapped on a GPS unit
- Surface water and groundwater elevations in representative areas. The location of each monitoring site will be shown on a plan view of the site
- Precipitation data to address the 50 percent chance or "normal growing season." Can use the following website: http://agacis.rcc-acis.org/

- Maps showing the location of the compensatory mitigation site relative to other landscape features, habitat types, locations of photographic reference points, transects, sampling data points, monitoring well locations, and/or other features pertinent to the mitigation plan;
- A summary of the amounts and type of wetlands restored, enhanced, and created at the mitigation site identified by wetland plant community types based on Wetland Plants and Plant Communities of Minnesota and Wisconsin (Eggers and Reed);
- Dates of any recent corrective or maintenance activities conducted since the previous report submission;
- Specific recommendations for any additional corrective or remedial actions; and
- If non-compliance activities are occurring on the site, the activity will be noted, photographed, and mapped on a GPS unit. Best professional judgment would be used to determine if the activity is not compliance with easement or mitigation site plan.

The final monitoring report shall also include a wetland delineation completed in accordance with the *Regional Supplement to the USACE of Engineers Wetland Delineation Manual: Great Plains Region*.

Over two-thirds of the wetlands that are impacted are seasonally flooded wetlands or farmed wetlands; these wetlands have very poor function. It is not environmentally preferable to compensate for impacts to degraded wetlands by deliberately providing degraded compensatory mitigation projects. A compensation project should result in high quality wetlands that provide optimum functions within its landscape context, taking into account unavoidable constraints. Even though the wetlands impacted by the Project are generally highly degraded, they should be mitigated for by restoring equal acres of wetland or by restoring functions that are lacking in the Red River Basin watershed. Wetland mitigation in North Dakota will be evaluated with a functional assessment tool (MnRAM) to factor in wetland quality and functional value and ensure that mitigation is adequate.

In addition to the monitoring activities outlined above, wetland monitoring will include, based on agency input, the following actions:

- Adaptive management would be used to monitor any project-specific mitigation sites. Monitoring would include measurement of performance standards and the implementation of corrective action measures if the standards were not being met.

- The MnRAM wetland assessment method or other agreed upon methods would be used to assess the adequacy with which the mitigations replaced lost wetland function.

The goal of the wetland mitigation is to the area and functional value to offset the loss of such habitat through footprint impacts. It is anticipated that all wetland impacts in Minnesota will be mitigated through the purchase of wetland banking credits and therefore performance standards for those banks have already met those established by BWSR and the Minnesota WCA. The following performance standards were developed in coordination with North Dakota natural resource agencies and will be used to measure when wetland mitigation has reached the appropriate functional value. The metric will be the acre meeting functional value as measured by MnRAM.

Wetland Performance Standards:

Definitions:

***InNN*:** invasive and/or non-native plant species

***NNI*:** native, non-invasive plant species

***Relative areal cover*:** the proportion (percentage) of the total absolute areal cover by an individual plant species, or group of plant species (e.g., hydrophytes), within a reference area or plot; sum of all proportions equals 100 percent

Wet Meadow/Wet Prairie

Fresh (wet) meadows, sedge meadows, wet prairies, and seasonally flooded plant communities (Type 1 and Type 2 wetlands) will be monitored separately and shall each achieve a species composition that includes 10 or more species of native/non-invasive grasses, sedges, ferns, rushes and/or forbs by the end of year 5. Relative areal cover of native, non-invasive species (NNI) versus invasive, non-native species (InNN) of ≥60% NNI and relative areal cover by hydrophytes of ≥70%. Alternatively, a MnRAM vegetative diversity and integrity score of "high quality" by the end of year 5 would also satisfy this performance standard.

Marsh

Shallow and deep marsh plant community types shall be combined. Marsh plant community types with a species composition that includes 6 or more native OBL hydrophytes and any floating or submergent species by the end of the 5th full growing season. The threshold for relative areal cover NNI versus InNN should be 50 percent. A MnRAM vegetative diversity

and integrity score of “high quality” for each these plant communities will also satisfy this performance standard.

Upland Buffer

Restored tallgrass prairie in the upland buffer with a species composition that includes 15 or more species of native non-invasive grasses, sedges, rushes, forbs and/or ferns, with approximately 80 percent or greater areal coverage of the total buffer area having NNI species by the end of year 5.

Hydrophytes

Relative areal cover by hydrophytes shall be more than 50 percent within the wetland communities of the mitigation site.

Invasive Species

Invasive and/or non-native plant species will be controlled within each wetland mitigation site. Control could include mowing, burning, disking, mulching, biocontrol and/or herbicide treatments. By the third growing season, any areas one-quarter acre in size or larger that have greater than 50 percent areal cover of invasive and/or non-native species would be treated (e.g., herbicide) and/or cleared (e.g., disked) and then reseeded. Follow-up control of invasive and/or non-native species shall be implemented as stated above.

Hydrology Performance Standards:

The minimum wetland hydrologic criteria for wetland hydrology are 14 or more consecutive days of inundation or saturation during the growing season with a 50 percent chance (or more) annual probability of occurrence.

- Hydrology will be measured within each wetland type.
- The number of monitoring wells and/or staff gauges necessary for monitoring the hydrology of a compensation site varies with size and complexity of the site. For the Drain 27 mitigation site, staff gauges will be installed between elevations 899 – 901 at four different locations. Shallow groundwater monitoring wells will be installed at elevations 906.5 and 908 at three separate transect locations.
- The frequency of water level readings must be sufficient to determine whether performance standards are met.
- Duration of monitoring hydrology at compensation sites is generally two growing seasons but can be increased or decreased due to site-specific conditions and goals/objectives.
- Monitoring wells should be installed and data collection begun as soon as frost is out of the ground. If this is not feasible, monitoring wells should be installed, and data collection begun as early in the growing season as possible. The “growing season” for a particular monitoring year is determined in accordance with the Regional Supplement to the USACE of Engineers Wetland Delineation Manual: Great Plains Region.
- Staff gauges with cameras can be used to record water level readings.

4.4. Geomorphic

The Red River and tributaries are dynamic river systems that naturally show movement of their mobile boundaries. The Geomorphic Monitoring Team (GMT) collaboratively developed comprehensive Geomorphic Monitoring Plan (GMP), which is included as Attachment B to this AMMP. The bullet points below present a brief summary of the GMP. Because this AMMP contains only a summary of the GMP, in the event the language in the GMP and this AMMP are in conflict, the GMP shall govern, unless otherwise agreed to by the AMT.

- Purpose: Ensure the Project does not result in detrimental geomorphic impacts relative to the pre-project dynamics of the system and the reference reaches and if such impacts occur to implement beneficial mitigation measures.

- Goal: Monitor streams in the Project area vicinity for geomorphic changes and, if geomorphic changes are deemed by the GMT to have been caused by the Project, to identify Project operation adjustments and/or mitigation measures to meet established GMT and Project goals.

- The GMP includes Geomorphic Assessment Locations and Methods (future efforts can be adjusted as appropriate by the GMT and AMT):
    - Monitor 39 Geomorphic Monitoring Stations (GMSs) pre-Project (with locations shown in Figure 2) and at least 247 GMSs post-Project cross-sections.
    - Collect cross-sectional data at long-term monitoring cross sections. Cross-section data collection would include top-of-bank, bankfull, and water surface elevations along a straight line of site trajectory between monuments and along a hydraulic modeling trajectory (model reaches).
    - Collect longitudinal profiles to collect bed topography data in the down-channel direction within the extents of each GMS.
    - Leverage bathymetry with/from other sampling efforts in the Project vicinity when available to assess channel bed conditions especially outside the monitoring stations.
    - Collect both instream and bed and bank sediment samples only if significant changes are apparent with respect to the historical data.
    - Complete Rosgen Level II assessments while also collecting data for select Rosgen Level III worksheets as the standard Level III assessment is not entirely applicable to the Red River. Assessments should be completed by practitioners with at least ten years of experience in riverine geomorphic measurements and analysis.
    - Conduct specific gage analysis for all USGS gages in the Project vicinity.
    - Evaluate changes in surveyed cross section geometry.
    - Evaluate changes in surveyed longitudinal profile.
    - Evaluate bank movement, sinuosity, channel (meander) migration and erosion rates, and meander amplitude and frequency using aerial photography. Aerial imagery has been historically collected every few years and used to capture trends in the land surface, including use and observations of impacts from the Project and other causes.

During construction and post-construction, the intervals should be conducted to occur before scheduled geomorphological field assessments (scheduled every 5 years) to inform the assessment scope of work. The aerial surveys could continue to be conducted more frequently as determined by the local agencies which use the aerial information for other purposes.

- Evaluate trends in sedimentary features (in-stream sediment bars), changes in large woody debris (LWD), and changes in riparian vegetation type.
- Evaluate the degree of channel incision.
- The USACE worked with WEST to evaluate video footage methods to document unstable banks, erosion, deposition, and other changes that could occur due to the Project or other items. The study considered technical and economic factors related to the use of drone-mounted LiDAR, multiple cameras mounted on boats, multi-beam sonar (especially along the Red River), and other methods. Following the study, the results were presented to the AMT.
- During the next geomorphic study, these methods will be analyzed in more detail for further consideration to improve data collection.

Geomorphic adaptive management triggers were discussed with the AMT and GMT during a series of meetings spanning April through June 2021, April through May 2022, and October through November 2023. The selected adaptive management triggers are data-driven and technically justified and establish triggers that, if exceeded, require additional action to be taken by the GMT and AMT. These actions are detailed in the attached Geomorphic Monitoring Plan. An overview of the selected geomorphic adaptive management triggers is presented in the following paragraphs. It is noted that if it is the GMT's judgment that other significant change is occurring throughout the system and is not being captured by the currently established triggers, the GMT can recommend to the AMT that additional action is needed without exceedance of one of the pre-established geomorphic triggers.

Geomorphic Adaptive Management Trigger 1: Entrenchment Ratio

Table 9 displays the Entrenchment Ratio action triggers for each GMS in the Project vicinity. The methodology that will be used to calculate Entrenchment Ratios in post-Project geomorphic assessments for the purposes of comparing to these action triggers is outlined in the Geomorphic Monitoring Plan attachment.

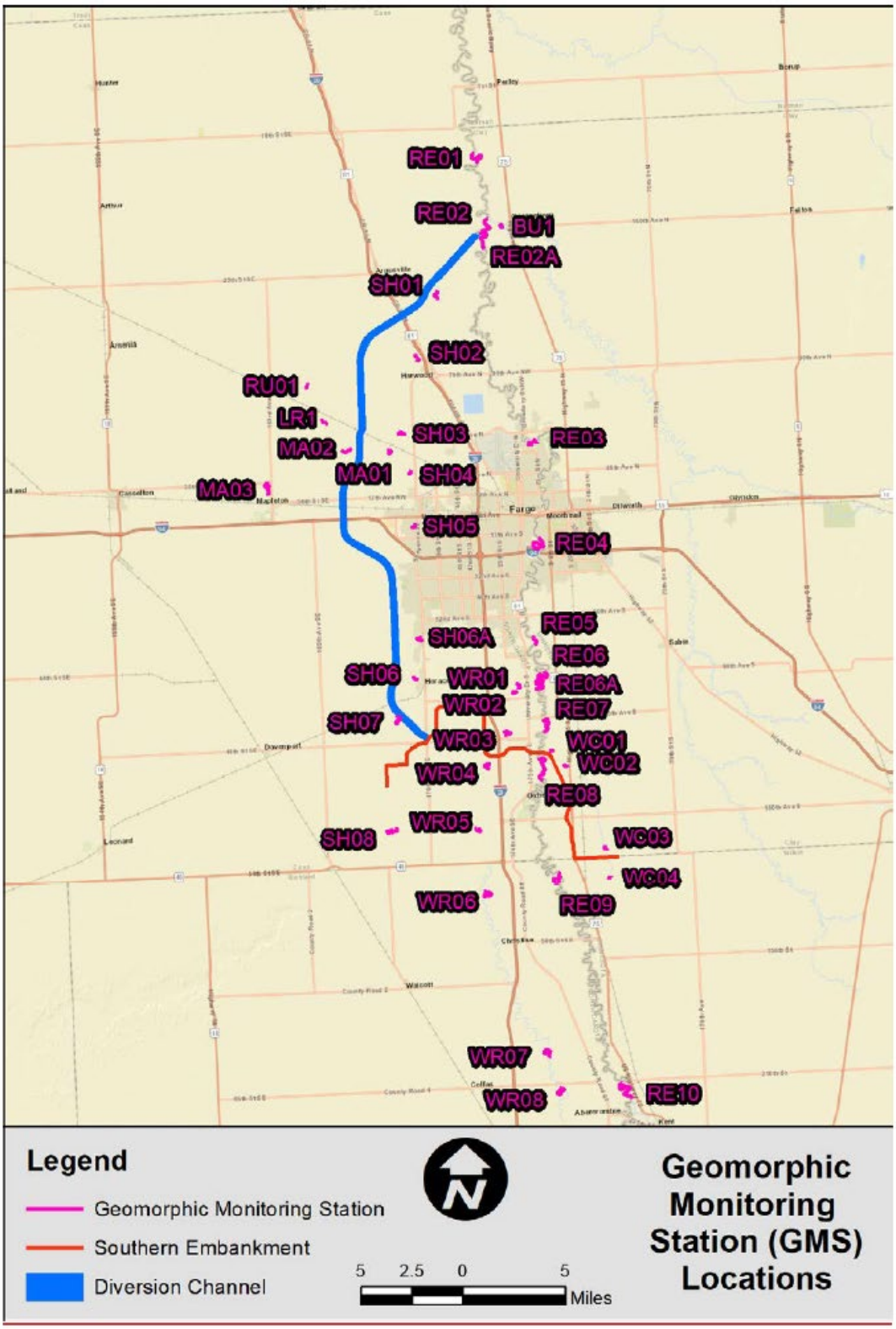

Figure 2. Geomorphic Monitoring Station Locations.

Table 9: Entrenchment Ratio Action Triggers by GMS

GMS	Action Trigger	GMS	Action Trigger	GMS	Action Trigger
BU01	<2.3	RE07	<2.3	SH08	<2.3
LR01	<2.3	RE08	<2.3	WC01	<1.8
MA01	<2.3	RE09	<2.3	WC02	<2.3
MA02	<2.3	RE10	<2.3	WC03	<2.3
MA03	<2.3	RU01	<2.3	WC04	<2.3
RE01	<2.3	SH01	<2.3	WR01	<2.3
RE02	<2.3	SH02	<2.3	WR02	<2.3
RE02A	<2.3	SH03	<2.3	WR03	<2.3
RE03	<2.3	SH04	<2.3	WR04	<2.3
RE04	<2.3	SH05	<2.3	WR05	<2.3
RE05	<2.3	SH06A	<2.3	WR06	<2.3
RE06	<2.3	SH06	<2.3	WR07	<2.3
RE06A	<2.3	SH07	<2.3	WR08	<2.3

Geomorphic Adaptive Management Trigger 2: Bank Height Ratio

Table 10 displays the Bank Height Ratio triggers for each GMS in the Project vicinity. The methodology that shall be used to calculate Bank Height Ratios in post-Project geomorphic assessments for the purposes of comparing to these action triggers is outlined in the Geomorphic Monitoring Plan attachment.

Table 10: Bank Height Ratio Action Triggers by GMS

GMS	Action Trigger	GMS	Action Trigger	GMS	Action Trigger
BU01	>1.4	RE07	>1.2	SH08	>1.5
LR01	>1.3	RE08	>1.4	WC01	>2.0
MA01	>1.3	RE09	>1.3	WC02	>1.6
MA02	>1.3	RE10	>1.2	WC03	>1.2
MA03	>1.2	RU01	>1.4	WC04	>1.2
RE01	>1.3	SH01	>1.4	WR01	>1.2
RE02	>1.4	SH02	>1.6	WR02	>1.2
RE02A	>1.3	SH03	>1.5	WR03	>1.2
RE03	>1.2	SH04	>1.5	WR04	>1.2
RE04	>1.2	SH05	>1.6	WR05	>1.2
RE05	>1.2	SH06A	>1.2	WR06	>1.3
RE06	>1.2	SH06	>1.3	WR07	>1.3
RE06A	>1.2	SH07	>1.4	WR08	>1.6

Geomorphic Adaptive Management Trigger 3: Bank Line Location

Triggers that would require the GMT and AMT to take further action regarding changes in bank line locations are outlined below:

- In the event any member of the GMT or AMT receives a complaint from the public stating that the Project is causing increased bank line movements in areas not within the immediate vicinity of a monitored cross section, the GMT member who is the recipient of the complaint and a Non-Federal Sponsor representative shall meet to evaluate the complaint and compare the observed bank line movement that resulted in the complaint against historically-observed movement within the same area and notify the GMT of the complaint and their screening analysis. If bank line movement appears to have occurred, the GMT shall meet to provide a consensus-based response to the AMT stating the following:
    - Whether the GMT judges the observed bank line movement that resulted in the complaint to be inside or outside the range of natural variability for that reach of the stream
    - If outside the range of natural variability, whether the GMT judges the observed bank line movement to be the result of the Project
    - If the result of the Project, the recommended corrective action
- Post-Project construction geomorphic assessments will evaluate bank line locations and any associated movement and apply judgment to highlight areas that may fall outside of normal ranges (referring to the WEST 2012, 2019, and 2021 reports as background). These areas will be further investigated by the GMT. The GMT will then provide a consensus-based response to the AMT stating the following:
    - Whether the GMT judges the observed bank line movement that resulted in the complaint to be inside or outside the range of natural variability for that reach of the stream
    - If outside the range of natural variability, whether the GMT judges the observed bank line movement to be the result of the Project
    - If the result of the Project, the recommended corrective action

Geomorphic Adaptive Management Trigger Exceedance

In the event a geomorphic adaptive management trigger is exceeded, the Geomorphic Monitoring Plan identifies specific actions the GMT will take. Generally, the GMT will first evaluate whether the trigger exceedance is attributable to the Project and, if possible, to what degree. If attributable, the GMT will then evaluate whether the impact is detrimental to stakeholders. If attributable and detrimental, the GMT will provide one or more recommended corrective actions for consideration to the AMT that are commensurate with the detrimental level of impact and with the level of attribution to the Project. The GMP has established a collaboration process and timelines for working through any trigger exceedance so as to allow for a maximum of 60 days to elapse between trigger notification and recommendation.

- Protocols and Standards:
    - A number of protocols are defined in the GMP related to all areas of geomorphic assessment, including calculation of entrenchment ratios, calculation of bank height ratios, determining aerial imagery-derived bank line locations, collecting survey data, analyzing sediment samples, and conducting Rosgen assessments.
    - Data will be made available in the RIVERMorph format and stored by the Non-Federal Sponsors in an electronic repository accessible by all GMT and AMT members via a web interface. The current storage location for this data is the Aconex site (https://us1.aconex.com/Logon).
- Geomorphic Assessment Schedule:
    - Pre-Construction: A total of three pre-construction geomorphic assessments were conducted. The three pre-construction geomorphic assessments were conducted in 2010/2011, 2018, and 2020. The GMT adapted the survey plan used in 2010/2011 with additional and revised cross section survey locations, longitudinal profiles, and overbank deposition assessments for a more complete pre-construction geomorphology monitoring survey plan that was implemented in the 2018 collection and further refined for the 2020 collection. After the 2021 assessment is completed, the GMT and AMT will refine the GMP as appropriate.

    - During Project Construction Prior to Operations: Pre-operation sampling event may occur during construction if a large flood events occurs that would have resulted in operation of the Red River and Wild Rice River structures if the Comprehensive Project construction was complete which is defined as an event when the combined flows at the USGS gages on the Red River at Enloe and on the Wild Rice River at Abercrombie exceed 21,000 cfs, equivalent to slightly less frequent than a 5% annual exceedance probability event. In the event of multiple successive years of project operation floods, the GMT will meet to recommend whether the second or later events are monitored and at what level of detail based on the data collected from the previous event(s). After successive events close in time, the GMT will meet to see if it can identify criteria for supporting the decision-making process related to future assessments.

    - Post-Construction: Conduct a total of three initial post-construction geomorphic assessments at five-year intervals following completion of Project construction. If no significant changes are noted after these initial three assessments, the assessment frequency may be reduced if the GMT and AMT deem that to be appropriate. After the third initial post-construction assessment is completed, the GMT and AMT will refine the GMP as appropriate.

    - Post Construction: If the Project is operated (which will occur only if the combined inflows at the USGS gages on the Red River at Enloe and on the Wild Rice River at Abercrombie exceed 21,000 cfs, equivalent to slightly less frequent than a 5% annual

exceedance probability event), a geomorphic assessment will occur as soon as possible following the event and the GMT may recommend the use of a post-operation assessment as a substitute for a regularly-scheduled geomorphic assessment. In the event of multiple successive years of project operation floods, the GMT will meet to recommend whether the second or later events are monitored and at what level of detail based on the data collected from the previous event(s). After successive events close in time, the GMT will meet to see if it can identify criteria for supporting the decision-making process related to future assessments.

- Communications:
    - AMT will be notified of all GMT meeting times, dates, agendas, and meeting notes.
    - GMT members are responsible for informing the AMT of upcoming personnel changes and provide an agency authorized alternate or replacement upon retirement or reassignment.
    - GMT will be notified by the AMT and/or Sponsors of geomorphic issues or concerns identified outside of the regular monitoring process as soon as possible.

4.5. Water Quality

A Water Quality Monitoring (WQM) Study has been set up to provide a baseline for water quality conditions and to monitor changes during and after Project construction.

The primary objective of this study is to sample and analyze water quality within the Project area before, during, and after construction to assess river response to the Project. Gages included in the WQM Study are to be monitored in a consistent manner. Statistical analyses of the data (e.g., load and trend analysis) are to be reported to the USACE, the GMT, and the AMT. Secondary objectives of this study are to leverage existing flow data, water quality data, personnel expertise, and on-going water quality programs within general Project area as the WQM Study foundation. The existing water quality data network will be used to fill in any data gaps for records collected before, during, and after construction to aid in assessing river response to the Project. The study personnel will proactively learn and share their understanding of the system and the monitoring network during the phased WQM Study to allow for betterment of future scopes-of-work under this program. The WQM Study is planned to be phased into three separate agreements with an initial three-year termed agreement started in FY 2019. The second agreement is planned to be adapted from findings of the first study and the construction progress and is planned to be executed at the contract end of the first agreement for an additional four years. The third agreement, again adapted as needed, is planned to be executed at the conclusion of the second agreement for an additional five years. At a minimum, it is anticipated that the third phase of the WQM Study will include a trend analysis comprising data collected during all three planned phases of the WQM Study.

Ten sampling locations are part of the monitoring program. Five locations are on the Red River of the North (Halstad, Georgetown, Harwood, Fargo, and Hickson), two locations on the Sheyenne River (Kindred and Harwood), two locations on the Wild Rice River (Abercrombie and St. Benedict), and one location on the Maple River (Below Mapleton). During times of normal flow conditions (i.e., non-flood event), a standard sampling protocol will be followed (eight samples per year).

All ten sites are sampled for major ions, trace metals, nutrients, TOC, DOC, bacteria, pesticides, and suspended sediment. Two sites on the Red River of the North (near Georgetown and Hickson) include continuous water quality monitors for water temperature, specific conductivity, pH, and dissolved oxygen.

Water Quality Flood Event Monitoring Triggers

During flood events, samples will be collected at the same locations as described above for the Maple, Sheyenne, and Wild Rice rivers. During construction, additional water quality sampling will not occur on the Red River because information from the continuous water quality monitors will be available for review. For the Maple and Sheyenne Rivers, a "flood event" is defined as occurring when the National Weather Service's forecasted peak flow at either the Maple River or Sheyenne River gage (shown in Table 1) exceeds the 10% annual chance exceedance (ACE) event flow. The 10% ACE definition of a flood event for these river systems was selected based on a review of hydraulic modeling results that indicated that flows begin to inundate the floodplain during events of this size. For the Wild Rice River, a flood event is defined as occurring when the summation of forecasted flows on the Wild Rice River and Red River exceeds 21,000 cfs at the Wild Rice and Red River gages, as indicated in Table 11.

Table 11. Monitoring Triggers for Defining a Flood Event

River System	WMS Study Gage	Flow Threshold (cfs) for Flood Event
Maple River	Below Mapleton (05060100)	6,280
Sheyenne River	Harwood (05060400)	4,190
Red River and Wild Rice River	Summation of Flows at: on Red River at Enloe (0505152130) and Wild Rice River at Abercombie (05053000)	21,000

Annual workshops are planned to keep stakeholders informed and allow for adaptive management of the monitoring regime. USGS Scientific Investigation Reports (SIRs) are expected at the end of the pre-project, construction, and post-construction periods. A Final SIR will compute trends and loads using R-QWTEND statistical analysis package.

4.6. Invasive Species Monitoring

Invasive species management is related to aquatic species and vegetative invasive species. During construction and post-construction, spread of invasive species at wetlands and other landscaping areas will require construction in accordance with specific criteria for Minnesota and North Dakota for aquatic and terrestrial invasive species, as described in Section 2.5.

Aquatic Invasive Species Monitoring

During construction and post-construction, contractors will operate in accordance with an approved aquatic invasive species management plan. The plan would require equipment that would be in contact with infested waters to be decontaminated prior to entering the water and before leaving

the site. Methods for decontamination could include one of the methods described in Section 2.5. Use and cleaning of equipment will be monitored and documented when equipment enters or leaves the water body.

Zebra mussel monitoring plates on the Red River Structure and Wild Rice River will be monitored on an annual basis. Mussel counts will be recorded and shared with the AMT to provide informal information to the resource agencies. No triggers or response actions would result from this data.

Vegetative Invasive Species Monitoring

Post-construction vegetative invasive species monitoring would occur in areas planted with native species, including wetlands habitats. The monitoring results will be compiled and described in monitoring reports to be provided to the AMT. Non-forested wetland habitat monitoring in the Diversion Channel will occur annually until the invasive and non-native species performance standards listed below are met for two consecutive years. The forest habitat would also be monitored for invasive and non-native species at the fifth and tenth year following planting, and every five years thereafter until the invasive and non-native species performance standards are met for two consecutive monitoring events.

Performance Standards:

By the third going season, areas one-quarter acre in size or larger that have greater than 50 percent areal cover of invasive and/or non-native species will be treated and replaced with native species in non-forested and forested habitats.

A combination of vegetation control methods would be used including, mowing, burning, disking, and/or mulching; or, if appropriate, biocontrol and/or herbicide treatments.

4.7. Fish Stranding

Fish stranding will be evaluated following Project operations. The evaluation will be for areas of the upstream staging area that are not otherwise flooded under without Project conditions. Please reference Figures 1, 2 and 3 in Attachment C. These provide inundation areas for both With and Without Project for the 4%, 2% and 1% annual flood probability. Maps provided in Attachment C and associated shapefiles will be the reference point for floods at or below the referenced magnitude (e.g., floods between the 4% and 2% will reference the 2% map with transects occurring in areas flooded with the Project that would not be flooded without).

The evaluation will be performed by the Non-Federal Sponsor as a part of the AMMP and the Project's O&M requirement. The Biotic Resource Monitoring Team will be contacted prior to or at the onset of Project operation and coordination will continue as waters recede. Team members will be invited to participate in field activities and will be involved with this process to the full extent they are able. Note that the precise timing of an evaluation will be dependent on hydrology and Project operations. Flexibility will be needed to perform the evaluation at an optimal time.

Monitoring fish stranding will use a two staged approach. The first is a Reconnaissance Stage to quickly evaluate if a fish stranding/kill event has occurred (MnDNR defines this as a Consequential

Fish Kill). If the Reconnaissance Stage identifies a stranding/kill event, the second stage is a Detailed Evaluation Stage to quantify/enumerate fish loss.

Note that a separate discussion is included in a later section for fish that may become trapped in the Drain 27 wetland mitigation complex. A separate sampling and rescue effort will be employed to remove fish from this feature and return them to the Wild Rice or Red Rivers.

- Reconnaissance Stage:

  When the Project operates, this first stage will be performed as water is receding from the upstream staging area. This stage will have a two-part, phased approach. The cumulative level of effort will be approximately one day, broken across approximately two half-day events.

- Reconnaissance Stage, Phase 1

  - Observe "field" sites within the upstream staging area. These are intended to be agricultural fields and other broad, open areas. Effort will be made to survey these areas within seven days of them generally being drained following Project operations, though flexibility is needed given that field conditions could be difficult for access and sampling.
  - Perform windshield surveys to quickly view areas and consider if there's an obvious fish stranding event.
  - Periodically along travel routes, and/or based on the windshield surveys, do on-site walking surveys in select areas where fish may be likely to strand.
  - It is assumed this phase would take approximately a half-day. Figure 4, 5, and 6 in Attachment C provide a suggested route to perform windshield surveys (based on the magnitude of flood). Staff will allocate enough time to walk areas of specific interest. This should include frequent stops along areas of concern (e.g., areas where dead fish may collect). Identified paths in Figures 4, 5 and 6 in Attachment C could also be used for walking assessments (along field edges and roadside ditches, or into fields if access available), but these will ultimately need to be adapted based on field conditions and access or available rights-of-entry.
  - Fish collected will be identified, measured when practical, and photographed. Data will be recorded on datasheets.

- Reconnaissance Stage, Phase 2

  - Observe "drainage path" sites for receding waters both along natural waterways and new drainage swales established in the staging area. These are intended to be corridors of flow where fish would presumably find their way back to the Red or Wild Rice Rivers, or down the diversion channel. Focus areas likely would include the borrow pit and borrow ditch (the dashed line in Figures 4, 5, and 6 in Attachment C), and potentially drainage swales within the staging area. Access to the borrow ditch would be available between the toe of the embankment slope and the borrow ditch where there will be a bench for maintenance access. Assessment could also occur in other drainage areas,

such as the swale leading to Drainage Ditch 27 and the drainage network leading to the borrow pit.
    - Agency representatives will be consulted to finalize the locations based on site access, field conditions and how the draining process has progressed. Based on modeling of the staging area, it is anticipated that Reconnaissance Phase 2 would occur from 4 to 8 days following Reconnaissance Phase 1 but is entirely dependent on conditions with that particular flood event.
    - Focus areas to stop and observe along drainage areas could include riffle-type locations, willows, beaver dams, etc. These areas tend to collect fish.
    - Fish collected will be identified, measured, and photographed. Data will be recorded on datasheets.

- Triggers that Require Second Stage Evaluation
  The following are identified as the triggers requiring a detailed evaluation (what MnDNR has defined as a Consequential Fish Kill).

    - 5 Lake Sturgeon of any size OR
    - 5 Channel Catfish >24" OR
    - 10 Walleye >15" OR
    - 10 other sport fish of public value as defined by Minnesota Rule 6133.0080, of the "Quality" size class or larger as defined by Gabelhouse 1984.

If triggers are met in Reconnaissance Phase 1, a detailed evaluation of the same broader staging area would occur. Similarly, if triggers are met in Reconnaissance Phase 2, a detailed evaluation of the drainage corridors would occur for areas leading from the staging area to the Red or Wild Rice Rivers, or diversion channel.

Results of the two Reconnaissance stages will be coordinated within a day of completion with NDGF, MnDNR, and USFWS.

- Detailed Evaluation Stage:

    - If a trigger is met, perform a detailed evaluation of either the broader staging area which would not have been inundated under the without Project conditions and/or the drainage paths leading out of the staging area.
    - Detailed evaluations will follow the protocol employed in American Fisheries Society Special Publication 35 (Southwick and Loftus, 2017). Evaluations of the broader staging area would generally follow the protocol for lakes sampling; evaluations for drainage paths would follow the protocol for rivers/streams sampling.
    - The USACE and the Non-Federal Sponsors will work with agencies and external experts to develop a sampling approach with a practical number of transects for estimation of total fish stranding/kill. Sampling must be able to be completed within 1-3 days for a crew of two people. Considerations to sampling approach should include field conditions, property access, and other factors that could influence access or efficiency for data collection. As such, transect number and location needs to be flexible and may only be partially planned in advance of the flood. Consideration will be given to aerial

surveys via drone technology as a potential tool for data collection, especially for detailed evaluations. While there are many limitations to doing the surveys remotely, techniques and technology will continue to improve and could be a viable option by the time fish stranding surveys would be needed (e.g., 2027 and beyond).

Number of Fish Stranding Evaluation Events

If the Project operates three times and the reconnaissance field surveys do not result in triggers for a Consequential Fish Kill, then it will be assumed that the Project does not result in substantial fish stranding and stranding evaluations will cease. This standard would be applied to both areas considered in the Reconnaissance phase (e.g., field sites and drainage path sites). Note that if the first three events are all small or similar sized events (e.g., 30-year events or less) the Non-Federal Sponsors will collaborate with the AMT to confirm if future monitoring should consider one more event if that event will be significantly different (e.g., a 50- or 100-year event). Also note that if the Project has operated three times without incident and no monitoring is planned, yet a fish kill or fish stranding is reported by the public or resource agency after a subsequent event, then the Non-Federal Sponsors will respond with a reconnaissance level investigation and move to the detailed evaluation phase if triggers are met.

Mitigation

Southwick and Loftus (2017) provides the technical approach to estimate numbers of fish lost due to stranding. They also provide guidance on applying monetary values on lost fish, based on species and size. This can be applied to estimate a monetary loss. The MnDNR and NDGF have agreed that restitution values for lost fish in the staging area will be split 50/50, with monetary values defined by Minnesota Rule 6133.0080. MnDNR retains statutory authority to assess penalties for fish kills in Minnesota resulting from project operations. In addition to a payment for lost fish, both states have expressed an interest in modifying field conditions, if possible, to minimize risk for future stranding events. This could range from a relatively easy, low-cost exercise (e.g., debris removal from culverts) to a much more expensive effort to improve drainage (e.g., extensive grading or upgrading culverts). If a Consequential Fish Kill occurs, the Non-Federal Sponsors will work with agency partners to identify the best approach to address the issue for the current fish mortality event, as well as in future years, using the monetary value of fish loss as a reference point or guide. This will need to include how any monetary payment is divided up between the states.

Drain 27 Wetland Complex

This wetland complex drains portions of the upstream staging area and includes a weir to maintain minimum water elevations during most years. This provides hydrology to support a wetland community implemented for mitigation, but also provides a barrier fish may not move downstream over. Fish could become trapped within this feature following floods. In addition, common carp that become trapped would likely uproot vegetation, limiting the ecological effectiveness of the mitigation feature.

Following operation of the Project, sampling will be done within the wetland to assess fish presence. A two-stage approach will be used, with an initial stage to determine fish presence, and a second to

remove fish and transport back to the Red River. Exact gear types and triggers for moving to a fish removal operation are still under development. Depending on location and conditions, this potential sampling could include electroshocking, fyke or trap netting, or other methods. The evaluation will be performed by the Non-Federal Sponsors as a part of the AMMP and the Project's O&M requirement. The AMT will be invited and involved with this process to the full extent they are willing/able to do so. The timing of this evaluation can be more flexible but should be performed within 30 days of the end of Project operations.

Specific gear types and level of effort will be fine-tuned in collaboration with the AMT once the wetland complex is built. Initial sampling is intended to take approximately a day to assess fish presence within the wetland. This could include a minimum of two hours of run-time for electrofishing; a set number of seine hauls; or set number of overnight fyke-sets.

Triggers that Require a Fish Removal Operation

Triggers will follow with those outlined above for fish stranding. These will need refinement and finalization. These will be based on the following level of effort:

- 1 hour of electroshocking
- 5 overnight sets of a fyke or trap net
- Other

Triggers for the above effort

- 5 Lake Sturgeon of any size OR
- 5 Channel Catfish >24" OR
- 10 Walleye >15" OR
- 10 other game fish as defined by the North Dakota 2020-2022 Fishing Proclamation, of the "Quality" size class or larger as defined by Gabelhouse 1984.

If the above triggers are met with the given level of effort, a fish removal operation will commence. If this occurs, it will continue via active sampling (e.g., shocking or other) until fewer than five of the target species (any size) are collected for the same level of effort for given gear types listed above. If a different active or passive collection method is used, the Non-Federal Sponsors will work with the AMT to develop a similar endpoint.

Any live fish collected during a removal operation will be transported and returned to the Red River using typical methods (e.g., stock truck or similar). The Non-Federal Sponsors will coordinate with the resource agencies on the appropriate transport methods. All results of the collection effort will be recorded and reported to the AMT.

The exception to the fish removal identified above is if the fish collected are common carp or any other invasive fish. If the only fish collected outside of the defined triggers are common carp or other invasive fish, the AMT will identify the best approach to manage/remove and dispose of remaining fish. This may occur outside of the specified 30-day window, and could include water level management, continued physical removal, chemical treatment (rotenone), predator fish stocking, or other actions.

4.8. Drayton Dam

Drayton Dam will be constructed as a MnDNR permit requirement for this Project. As directed in condition 27 of MnDNR permit 2018-0819, the design of the Drayton Dam Project was collaboratively worked on with the MnDNR, in addition to other resource agencies, to ensure effective fish passage. The design incorporates the best available design parameters for slope, weir alignment, pool depth, and head-loss across boulder weirs.

Monitoring Activities

Though not required in the permit, velocities through the Drayton Dam Project will be measured after the Project is complete, as requested by the DNR, to capture the "as-built" condition for water movement through rock ramps. Measurements will be taken in resting pools between weirs and in gaps between boulders across the entire cross-section. Measurements will occur within one year of Project completion and will be limited to a single sampling effort. Additional monitoring of the fish passage, or any modifications to the structure based on velocity or other observations, would be addressed in state and local permits, such as the individual Drayton Dam permit from the MnDNR.

4.9. Additional monitoring needs

Coordination with agency members during preparation of the 2019 SEA identified additional monitoring concerns for the Project. These include needs for species or biota of special concern, and invasive species. Monitoring will include the following activities:

- Bald eagle nests would be monitored every spring through the completion of all construction. The Project area would continue to be monitored during the upcoming construction years to ensure that no new nests would be impacted by Project construction.

- Similar to eagle surveys, there would be raptor nest surveys completed in the spring of the year preceding construction within or near any affected wooded areas.

- Monitoring would be completed on an annual basis in accordance with the OMRR&R and AMMP.

5. Costs and Schedules

5.1. Monitoring Schedule and Costs

Table 12 provides a summary of what monitoring has been completed and a tentative plan for additional monitoring prior to or during Project construction. Because of uncertainties with the Project schedule, annual funding, field conditions, and the results of earlier surveys, the need and timing of additional survey work could shift. Note that two of three events of aquatic biotic/habitat surveys have been completed for impact areas; all three geomorphic assessments have been completed. The schedule for surveys of aquatic habitat mitigation sites will be developed once mitigation plans are finalized.

Schedules for individual mitigation projects will be developed as they are designed and constructed. A general summary of the timing and information that will be collected for each category of mitigation project is provided in Table 12; additional description can be found in Section 4.

Table 12. Estimated scheduled for pre- and post-construction Project monitoring (in order of discussion)

Monitoring Event	Year	Status
Aquatic Biotic Monitoring		
Aquatic Biotic/Habitat, first round	2011 & 2012	Completed
Aquatic Biotic/Habitat, second round	2017	Completed
Sheyenne Fish Observation in Diversion Channels	2025*	Initial pre-design fish surveys completed in 2022. Additional surveys to be performed prior to construction
Sheyenne River Field Surveys of Rock Rapids Fishways for Sheyenne River Mitigation Project	TBD	To determine species composition and size structure of fish below the fishway.
Sheyenne River IBI Observations for Sheyenne River Mitigation Project	TBD	Post-construction surveys would occur at the same locations as monitored in 2012 and 2017.
Drayton Dam Velocity Measurements	2024	A single monitoring event will be conducted after construction to capture as-built conditions
Red River Structure Velocity Measurements	TBD	Average cross section velocities at the Red River Structure will be measured at discharges close to 2,900 cfs, 8,100 cfs, and 10,700 cfs
Maple River and Sheyenne River Fish Passage Aqueducts Acoustic Doppler Current Profiler	TBD	Determination of velocities in the aqueducts

Monitoring Event	Year	Status
Fish Stranding in the Upstream Staging Area	TBD	Reconnaissance Stage (Phase I) and possibly a Detailed Evaluation Stage (Phase II) after a flood storage event
FOREST MITIGTATION MONITORING		
Floodplain Forest, Post-Construction	2010-2031*	Forest mitigation areas will be monitored annually for the first 5 years after planting.
WETLANDS MITIGATION MONITORING		
Wetlands, Post-Construction	2010-2031*	Wetland mitigation areas will be monitored annually for the first 5 years after planting or once criteria has been met.
GEOMORPHIC MONITORING		
Geomorphic Assessment (Pre-construction, first round)	2010/2011	Completed with report finalized in October 2012
Geomorphic Assessment (Pre-construction, second round)	2018	Completed with report finalized in September 2019
Geomorphic Assessment (Pre-construction, third round)	2020	Monitoring complete, report finalzed in October 2021
Geomorphic Assessment (During Project, Construction Event)	Event dependent	Report to AMT within 1 year of completion of field investigation effort. (*USACE Until October 2022; Sponsor October 2022 and beyond.)*
Geomorphic Assessment (Post-Project, first round)	Within 1 year of Project Completion	Future TBD: Report final within 2 years to establish Post-FMM Project conditions.
Geomorphic Assessment (Post-Project, second round)	+ 5 years after Round 1	Future TBD: 2nd Post-Project Assessment
Geomorphic Assessment (Post-Project, third round)	+ 10 years after Round 1	Future TBD: 3rd Post-project Assessment. GMT initiate meetings to evaluate within 90 calendar days of finalization of third post-project Geomorphic Assessment Report. GMT provides summary and recommendations to AMT within 180 days.
WATER QUALITY MONITORING		

Monitoring Event	Year	Status
Water Quality Monitoring (Pre-construction) w/ Flood Event Monitoring	FY 2019-2022	3-year-term, completed Monitoring Plan adaptable following evaluation of first-term monitoring assessment. Including Flood event 2020. Final report finalized in early 2023.
Water Quality Monitoring (Construction) w/ Flood Event Monitoring	FY 2022-2026*	4-year term; Re-assess, evaluate, adapt.
Water Quality Monitoring (Post-Construction) w/ Flood Event Monitoring	FY 2026-2031*	5-year term; Re-assess, evaluate, adapt.
INVASIVE SPECIES MONITORING		
Inspect Zebra Mussel Monitoring Plate at Red River and Wild Rice Structures	Annually	Future TBD: Once the structures are constructed annual inspections will begin.
EAGLE AND OTHER RAPTOR MONITORING		
Eagle/Raptor Monitoring	Annual	Spring eagle and raptor surveys will occur in the Project area until construction is complete.

*Timing dependent on field conditions, logistical concerns, etc. Timing may shift as needed.
The number and timing of events for aquatic habitat mitigation sites will be set once the mitigation plans are finalized

The schedule for post construction surveys will be set once the Project is largely constructed.

Table 13 provides an estimate for pre- and post-construction monitoring costs. Specific line-item costs have not been included for observations for fish stranding or floodplain forest success as these activities would be likely be a relatively small efforts accomplished by the Non-Federal Sponsors. Invasive species monitoring will be included as a component of both forestry and wetlands monitoring. The estimate below will be revised as Project costs are updated to reflect current dollars as well as any necessary changes. Note that monitoring estimates for mitigation sites could increase or decrease depending on the number, location and type of mitigation and monitoring sites ultimately selected.

Table 13. Estimated monitoring costs for the AMMP (in order of discussion)

Project Phase	Studies	Cost (in 2020 dollars)
AQUATIC BIOTIC MONITORING		
Pre-Project	Sheyenne River Fish Observation in Diversion Channels	$50,000 (per year)
Post-Project	Field Surveys of Rock Rapids Fishways (Sheyenne mitigation) to ensure maintaining design criteria.	$10,000 (per event). Assumes each event monitoring two rock rapids fishways.

Project Phase	Studies	Cost (in 2020 dollars)
Post-Project	Sheyenne River IBI Observations.	$100,000 (per event)
Post-Project	Maple River and Sheyenne River Fish Passage Aqueducts Aqueduct Acoustic Doppler Current Profiler	$10,000 (per event, per aqueduct)
Post-Project	Fish Stranding Stage 1 (Recon)	$15,000 per event (includes Phase I and II).
Post-Project	Fish Stranding Stage 2 (Detailed Evaluation)	$25,000 per event (includes Phase I and II).
Post-Project	Drain 27 Fish Removal	$25,000 per event
Post-Project	Velocity measurements at the Red River Structure	$5,000 (per event)
Post-Project	Velocity measurements at Drayton Fish Passage	$15,000
FOREST MITIGATION MONITORING		
Post-Project	Forest Monitoring (annually for first 5 years)	$50,000 (per event)
Post-Project	Forest Monitoring (every 10 years or following major flood)	$50,000 (per event)
WETLANDS MITIGATION MONITORING		
Post-Project	Diversion Channel Wetlands Monitoring (5-10 years)	$200,000 (annually)
Post-Project	Drain 27 Wetland (5 years)*	$65,000 (annually)
GEOMORPHIC MONITORING		
Construction	Geomorphic Assessment (only if an event sufficient to initiate Project operations, if the Project were complete, occurs, since all regularly scheduled pre-Project monitoring is complete)	$1,000,000 (per event)
Post-Project	Geomorphic Assessment (3 rounds and re-evaluation). Currently anticipate assessments conducted in 2027, 2032, and 2037, with reports delivered to the AMT the following year. Timing of assessments beyond 2037 dependent upon AMT and GMT evaluation after 2037 assessment report is completed.	$1,000,000 (per round)
Post-Project	Geomorphic Post-Flood Event Assessment (only in the event Project operations occur)	$1,000,000 (per event)
WATER QUALITY MONITORING		
Construction	Water Quality Monitoring Term #2 Report delivered to AMT in 2027 covering water years 2023-2026. Effort may be adjusted by AMT after evaluation of Term #1 data.	$1,333,333 (total estimate for all four years at pre-construction monitoring levels)

Project Phase	Studies	Cost (in 2020 dollars)
Post-Project	Water Quality Monitoring (Term #3). Report delivered to AMT in 2032 covering water years 2027-2031. Effort may be adjusted by AMT after evaluation of Term #2 data.	$1,666,666 (total estimate for all 5 years at pre-construction monitoring levels)
INVASIVE SPECIES MONITORING		
Post-Project	Inspect Zebra Mussel Monitoring Plate at the Red River and Wild Rice River Structures	$500 (annually)
EAGLE AND OTHER RAPTOR MONITORING		
Construction	Annual spring monitoring for eagle and other raptor nests near construction sites	Cost part of construction costs

* This period may be shortened if the monitoring reports demonstrate that the mitigation site(s) has met its vegetation and hydrology performance standard(s) in two consecutive reports and the AMT concurs that additional monitoring is not required.

** Table does not include costs for items still needing further development, such as potential fish observations through the Sheyenne aqueduct and adjacent areas of the Sheyenne mitigation project.

The Non-Federal Sponsors are responsible for funding long-term operation and maintenance, including the monitoring costs and unforeseen mitigation needs that may arise due to Project operation. On June 10, 2021, the Metro Flood Diversion Authority and Cass County Water Resource District (CCJWRD) entered into a Master Indenture of Trust with the Bank of North Dakota serving as Trustee and the City of Fargo serving as Fiscal Agent. The Master Indenture of Trust establishes and controls multiple funds and accounts for the Project, including but not limited to the Operations and Maintenance Fund that will be used to fully fund operations and maintenance of the throughout the life of the Project. The Operations and Maintenance Fund is funded through a variety of revenue sources (as more fully set forth in the Master Indenture of Trust), including sales and use taxes from the City of Fargo and Cass County in North Dakota that would be in excess following payment of debt obligations issued for the capital cost of the Project, the imposition and levy by CCJWRD of Fargo-Moorhead Flood Risk Management District No. 1 maintenance levy upon benefitted lands in North Dakota, and the Storm Water Maintenance Fee collected within the City of Moorhead, Minnesota, and funds from Clay County, Minnesota.

6. Data Storage

The AMMP will generate substantial amounts of data, information, and reports over time. The data and subsequent reports should be accessible and shared to avoid redundancy and analysis purposes as well as stored as part of the monitoring record and for future data needs. The USACE and the Non-Federal Sponsors will work with the AMT to develop a repository for this information. This will likely be a web-based system, providing access to summary reports and potentially raw data. All AMMP work products will be shared with the AMT when requested.

As discussed in Section 4.4 and more extensively in the Geomorphic Monitoring Plan, the current storage location for geomorphic monitoring data is the Aconex site maintained by the Non-Federal Sponsors. The Aconex site can be accessed here: https://us1.aconex.com/Logon.

A database is being developed to track Project impacts, mitigation sites, and monitoring. Information the database would contain includes a brief overview of each project phase/feature, access to files and maps, inspection notes and schedules. The platform would allow photos and notes to be uploaded from the field. The database would be accessible to the USACE, the Non-Federal Sponsors, and agency team members.

7. References:

DOI 2018. Coordinating Adaptive Management (AM) and National Environmental Policy Act (NEPA). United States Department of the Interior. PEP – Environmental Statement Memorandum No. ESM 13-11. September 2018.

EPA 1998. Development Index of Biotic Integrity Expectations for the Lake Agassiz Plain Ecoregion. EPA 905-R-96-005. September 1998.

National Academy of Sciences 2004. Adaptive Management for Water Resources Project Planning. National Research Council of the National Academies.

NDDoH 2011a. Development of a Fish Index of Biotic Integrity (IBI) for Wadeable Streams of the Lake Agassiz Plain (48) Ecoregion. North Dakota Department of Health. April, 2011.

NDDoH 2011b. Macroinvertebrate Index of Biotic Integrity (IBI) for the Lake Agassiz Plain Ecoregion (48) of North Dakota. North Dakota Department of Health. May, 2011.

Southwick, R. I., and A. J. Loftus, editors. 2017. Investigation and monetary values of fish and freshwater mollusk kills. American Fisheries Society, Special Publication 35, Bethesda, Maryland.

USACE 2010. Regional supplement to the U.S. Army Corps of Engineers Wetland Delineation Manual: Great Plains Region (Version 2.0). March 2010.

USACE 2012. Mussel survey at Fargo-Moorhead diversion ditch footprints, biotic sampled sites, and areas to be abandoned by the diversion ditch, Cass Co., ND, Clay Co., MN, October 2011. Prepared by Dan Kelner. USACE, St. Paul District, January 2012.

Walters, 1986. Adaptive Management of Renewable Resources. Carl Walters. Macmillan Publishing Company. August 1986.

West 2012. Geomorphology Study of the Fargo, ND & Moorhead, MN Flood Risk Management Project. West Consultants, Inc. October 25, 2012. Prepared for US Army Corps of Engineers, St. Paul District.

West 2019. Geomorphology Monitoring of Rivers Potentially Affected By the Flood Risk Management Project located within the City of Fargo, Cass County, ND & City of Moorhead, Clay County, MN. September 2019. Prepared for US Army Corps of Engineers, St. Paul District.

West 2021. Geomorphologic Monitoring of Rivers Potentially Affected By the Fargo-Moorhead Metro Flood Risk Management Project. October 2021. Prepared for US Army Corps of Engineers, St. Paul District.