Final Environmental Impact Statement

Fargo-Moorhead Flood Risk Management Project

Minnesota Department of Natural Resources

MNDNR

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COVER SHEET

Final Environmental Impact Statement
Fargo-Moorhead Flood Risk Management Project

The Minnesota Department of Natural Resources (MNDNR) has prepared the Final Environmental Impact Statement (Final EIS) to evaluate the proposed project in accordance with the Minnesota Environmental Policy Act, Minnesota Statutes 2008, section 116D.

Abstract:
The proposed Fargo-Moorhead Flood Risk Management Project (the Project) includes a high hazard dam on the Red River and therefore requires by state law the preparation of an Environmental Impact Statement (EIS). The Project is located in four counties: Cass and Richland Counties, North Dakota, and Clay and Wilkin Counties, Minnesota. The EIS evaluates and discloses potential environmental and socioeconomic impacts and proposed mitigations for the Project and three other alternatives: Base No Action, No Action Alternative (with Emergency Measures), and the Northern Alignment Alternative. Examples of information on topics contained in the EIS includes, among others, stream stability, fish passage, Project hydrology, wetlands, cold weather impacts, cultural resources, agricultural impacts, land use, and Federal Emergency Management Agency (FEMA) regulations associated with the Project. The EIS also includes a cumulative potential effects analysis for impacts of the Project plus other area projects, a comparison of alternatives, and additional recommended mitigation. Intended as a full-disclosure document, the EIS does not recommend a final decision or alternative, but does provide valuable information to decision-makers for permitting and land use. Decisions about whether to proceed with the Project can only be made following completion of an EIS and, for the State of Minnesota, will involve a decision for a dam safety and work in public waters permit.

Public comment submittal:
Public comments submitted on the Final EIS will become part of the official record and as such, may be made available to the public. Comments and submittals will not be edited to remove any identifying or contact information; therefore, the MNDNR cautions against using any information that should not be publicly disclosed. Both mailed and emailed submittals will be accepted.

Email submittals should be directed to environmentalrev.dnr@state.mn.us and should include "Fargo-Moorhead Final EIS" in the subject line. Also include a full name and legal mailing address to be considered.

Mailed or faxed submittals should be directed to:

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Approved for issuance:

May 4, 2016
Date

Jill Townley
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Minnesota Department of Natural Resources

NOTES TO READERS

Final Environmental Impact Statement

Fargo-Moorhead Flood Risk Management Project

Thank you for taking time to review the Fargo-Moorhead Flood Risk Management Project Final EIS. We acknowledge the complexity of the Project and length and vastness of information contained within this document. To help you in your review of the Final EIS, we have included information below about major changes made to the EIS since the Draft EIS was released in September 2015 as well as any new additional information that should be noted. Major changes were made primarily in response to Draft EIS public comments received and to meet the requirements of Minnesota Rules for environmental review. This is not an exhaustive list that identifies all changes made to the EIS. The MNDNR encourages reviewers to review sections of interest in the Final EIS for revised or added text.

Major Changes

- *NEW-An “Areas of Controversy and Issues Yet to Be Resolved” discussion was added to the Executive Summary in accordance with Minnesota Rules part 4410.2300 that identifies minimum EIS content requirements. MNDNR identified areas of controversy and issues based on public comments received in EIS Scoping and on the Draft EIS.
- *NEW-Appendix L—Responses to Comments document. This appendix contains all the comment letters received during the public comment period (Appendix L, Attachment 1) and MNDNR responses to timely and substantive comments. Comments are summarized and arranged by topic.
- *NEW -Appendix M—Purpose & Need and Alternative Rescreen Report. MNDNR received many public comments stating the Project’s Purpose and Need was too narrowly-focused such that it improperly/inappropriately screened out other less impact alternatives. Additionally, MNDNR received numerous public comments that requested review of previously-screened (Scoping) alternatives, new alternatives or additional combinations of components of previously-screened (New/Combination) alternatives. In response to these public comments, MNDNR conducted an “Alternative Rescreen Exercise”. The Alternative Rescreen Exercise process of evaluation was developed to concurrently address the Purpose and Need comments as well as the New/Combination Alternatives.
- *NEW -Appendix N—Hydrologic Methodology Review. This appendix was developed in response to public comment concern about the USACE’s use of the Expert Opinion Elicitation Panel hydrology. The appendix reviews and discusses other possible hydrology methodologies to determine which methodology would be appropriate.
- *NEW -Appendix O—Takings, Flowage Easements and Acquisition Processes. Many questions were raised in public comments regarding the properties that would be acquired as part of the Project mitigation and acquisition process that would be employed to undertake the acquisition. This memo is intended to clarify the takings, flowage easement and acquisition mitigation requirements set forth in both the Federal EIS and the State EIS. The Executive Summary was updated to include a table (ES Table 1) summarizing major differences between the Project and the Northern Alignment Alternative.
- Executive Summary Tables 2-20 were updated to include additional potential Project impacts, proposed and recommended mitigation measures.
- Chapter 1 was updated to include a description of Federal Executive Order 11988 regulations and procedures.

- Chapter 3, Section 3.1-Hydrology and Hydraulics, includes a new table (Table 3.3) and text related to downstream impacts, a clarification regarding "wet cycle and dry cycle", and refinements to the Project operation description.
- Chapter 3, Section 3.4-Wetlands includes revisions to text in subsection 3.4.3-Proposed Mitigation and Monitoring Measures that more correctly discusses the USACE's wetland mitigation plan approach.
- Chapter 3, Section 3.7-Potential Environmental Hazards. Text was added to acknowledge potential environmental hazards that could be spread by way of flood waters.
- Chapter 3, Section 3.9-Wildlife and Wildlife Habitat, includes a brief description on temporary and permanent flood impacts to trees.
- Chapter 3, Section 3.12-Cultural Resources was updated to reflect the most current survey and report findings (up to January 1, 2016) as well as updates on National Register of Historic Places eligibility findings in consultation of Minnesota and North Dakota State Historic Preservation Offices. Text has been updated to reflect information from the Draft Cemetery Mitigation Plan (USACE 2015) (Appendix H). A discussion on St. Benedict's Cemetery impacts under the Northern Alignment Alternative has been added.
- Chapter 3, Section-3.13-Infrastructure and Public Services includes a revised discussion on the proposed Comstock ring levee and Project operation impacts to roadways, ditches and culverts.
- Chapter 3, Section 3.14- Land Use Plans and Regulations. The MNDNR met with Wilkin County, Buffalo-Red River Watershed District the City of Fargo; and corresponded with all other Local Government Units with regulatory authority regarding the Project to verify information provided in the Draft EIS text was accurate. Text has been updated to reflect the outcome of those conversations.
- Chapter 3, Section 3.15—Minnesota Dam Safety and Public Waters Regulations and Permitting, was updated to include more details on the work in public waters permit and to reflect that a combined (dam safety and work in public waters) permit application has been received for the Proposed Project.
- Chapter 3, Section 3.16—Socioeconomics, includes an added discussion on the North Dakota State University (NDSU) Initial Assessment of the Agricultural Risk of Temporary Water Storage for FM Diversion (NDSU 2015); and expanded discussion on flood impacts to traditional and organic agricultural land (Project and all alternatives), a new subsection on social and economic impacts to cemeteries (Project and all alternatives); and updated text on Proposed Mitigation and Monitoring.
- Chapter 5—Comparison of Alternatives, updated to reflect changes made in Chapter 3.
- Chapter 6 —Proposed and Recommended Mitigation. Revisions, updates, and added new potential impacts and proposed/recommended mitigation have been added to most of the tables within this Chapter (particularly the FEMA, Cultural and Socioeconomics tables).
- Chapter 7—Consultation and Coordination, updated to reflect Draft EIS public comment period.
- Appendix H was updated with Attachment 3: Minnesota and North Dakota State Historic Preservation Office Correspondence.

<u>Other Information</u>

- Project cost estimates are constantly being updated; therefore, the cost estimates listed in this EIS do not reflect the most recent cost estimates announced by the USACE and Diversion Authority in April 2016.

Table of Contents Summary

Table of Contents
Acronyms
Definitions
Executive Summary

1.0 Introduction
2.0 Proposed Project and Alternatives
3.0 Affected Environment and Environmental Consequences
4.0 Cumulative Potential Effects
5.0 Comparison of Alternatives
6.0 Proposed and Recommended Mitigation and Monitoring
7.0 Consultation and Coordination
8.0 List of Preparers
9.0 References

Table of Contents

ACRONYMS ...... **XIX**

DEFINITIONS FOR TERMS AS USED IN THIS ENVIRONMENTAL IMPACT STATEMENT ...... **XXI**

EXECUTIVE SUMMARY **ES-1**

1.0 INTRODUCTION **1-1**

1.1 EIS Organization 1-1
1.2 About the Project Proposer 1-2
1.2.1 Other Parties Involved 1-2
1.3 Need For a State of Minnesota Environmental Impact Statement 1-2
1.3.1 Federal Environmental Review 1-3
1.4 Project Purpose and Need 1-3
1.5 Government Approvals and Federal Regulatory Program and Law Requirements. 1-5
1.5.1 United States Army Corps of Engineers 1-8
1.5.1.1 Section 404 Clean Water Act 1-8
1.5.1.2 Rivers and Harbors Act of 1899 – Sections 9 and 10 1-9
1.5.1.3 Executive Order 11988: Floodplain Management 1-9
1.5.1.4 Section 7 Endangered Species Act Consultation with U.S. Fish and Wildlife Service 1-11
1.5.1.5 Section 106 National Historic Preservation Act Determination for Historic Properties 1-11
1.5.2 Federal Emergency Management Agency 1-11
1.5.2.1 Conditional Letter of Map Revision 1-11
1.5.2.2 Letter of Map Revision 1-12
1.5.3 Natural Resources Conservation Service 1-12
1.5.3.1 Prime and Unique Farmlands 1-12
1.5.4 North Dakota Game and Fish Department 1-12
1.5.4.1 Aquatic Nuisance Species Rule 1-12
1.5.5 North Dakota Department of Health 1-12
1.5.5.1 Section 401 Water Quality Certification 1-13
1.5.5.2 National Pollutant Discharge Elimination System (NPDES) Permits 1-13
1.5.5.3 NPDES/SDS General Stormwater Discharge Permit for Construction Activity 1-13
1.5.6 North Dakota Department of Transportation 1-13
1.5.7 North Dakota State Water Commission/North Dakota Office of the State Engineer 1-13
1.5.7.1 North Dakota Office of State Engineer Construction Permit 1-13
1.5.7.2 North Dakota Waters Drain Permit 1-14
1.5.7.3 North Dakota Office of State Engineer Sovereign Lands Permit 1-14
1.5.8 Minnesota Department of Natural Resources 1-15
1.5.8.1 Infested Water Permit 1-15

Table of Contents (cont.)

1.5.8.2 Invasive Species ... 1-15
1.5.8.3 Dam Safety Permit ... 1-15
1.5.8.4 Work in Public Waters Permit ... 1-15
1.5.8.5 Burning Permit ... 1-15
1.5.8.6 Water Appropriations Permit ... 1-15
1.5.9 Minnesota Pollution Control Agency ... 1-16
1.5.9.1 Section 401 Water Quality Certification ... 1-16
1.5.9.2 NPDES/SDS General Stormwater Discharge Permit for Construction Activity ... 1-16
1.5.10 Local Government Approvals ... 1-16
1.5.10.1 Zoning Variance, Conditional Use Permit ... 1-17
1.5.10.2 Zoning Amendment ... 1-17
1.5.10.3 Wetland Conservation Act ... 1-17
1.5.10.4 Floodplain Permit ... 1-18
1.5.10.5 Shoreland Permit ... 1-18
1.5.11 Other Jurisdictions ... 1-18

2.0 PROPOSED PROJECT AND ALTERNATIVES ... 2-1

2.1 Proposed Project Overview ... 2-1
2.1.1 Detailed Project Description ... 2-2
2.1.1.1 Dam ... 2-2
2.1.1.2 Red River and Wild Rice River Control Structures ... 2-3
2.1.1.3 Connecting Channel ... 2-4
2.1.1.4 Diversion Inlet Control Structure ... 2-4
2.1.1.5 Staging Area ... 2-5
2.1.1.6 Diversion Channel ... 2-6
2.1.1.7 Maple River and Sheyenne River Aqueducts ... 2-8
2.1.1.8 Lower Rush River and Rush River Rock Ramps ... 2-9
2.1.1.9 Inlets, Ditches, and Smaller Control Structures ... 2-10
2.1.1.10 Oxbow/Hickson/Bakke Ring Levee ... 2-10
2.1.1.11 Comstock Ring Levee ... 2-11
2.1.1.12 Floodwalls and In-Town Levees ... 2-12
2.1.1.13 Transportation and Utility Features ... 2-12
2.1.1.14 Project Operation ... 2-13
2.1.1.15 Non-structural Project Features ... 2-15
2.1.1.16 Recreation Features ... 2-16
2.2 Alternatives ... 2-17
2.2.1 Alternatives Evaluation Summary ... 2-17
2.2.1.1 Process Overview ... 2-17
2.2.1.2 Screening Analysis ... 2-18
2.2.1.3 Alternatives Considered But Dismissed From Further Evaluation 2-20
2.2.2 Project Alternatives Analyzed in the EIS ... 2-26
2.2.2.1 No Action Alternatives ... 2-26
2.2.2.2 Northern Alignment Alternative ... 2-35

Table of Contents (cont.)

3.0 AFFECTED ENVIRONMENT AND ENVIRONMENTAL CONSEQUENCES 3-1

3.1 Hydrology and Hydraulics 3-1
3.1.1 Affected Environment 3-1
3.1.1.1 Hydrologic and Hydraulic Evaluation for Project Design 3-2
3.1.2 Environmental Consequences 3-8
3.1.2.1 Proposed Project 3-8
3.1.2.2 Base No Action Alternative 3-13
3.1.2.3 No Action Alternative (with Emergency Measures) 3-14
3.1.2.4 Northern Alignment Alternative 3-14
3.1.3 Proposed Mitigation and Monitoring Measures 3-18
3.2 FEMA Regulations and the CLOMR Process 3-19
3.2.1 Affected Environment 3-19
3.2.1.1 Flood Hazard Areas 3-20
3.2.1.2 National Flood Insurance Program Map Revisions 3-20
3.2.1.3 Floodplain Management Requirements 3-21
3.2.2 Environmental Consequences 3-21
3.2.2.1 Proposed Project 3-21
3.2.2.2 Base No Action Alternatives 3-22
3.2.2.3 No Action Alternative (with Emergency Measures) 3-22
3.2.2.4 Northern Alignment Alternative 3-22
3.2.3 Proposed Mitigation and Monitoring Measures 3-23
3.2.3.1 Mitigation for Impacts to Structures 3-23
3.2.3.2 Changes to Flood Hazard Mapping Designations 3-23
3.3 Stream Stability 3-24
3.3.1 Affected Environment 3-26
3.3.1.1 Geomorphic Stream Classification 3-27
3.3.1.2 Riparian Vegetation Analysis 3-27
3.3.1.3 Hydrologic Assessment 3-30
3.3.1.4 Stability Analysis 3-30
3.3.1.5 Sediment Transport and Channel Bed Stability 3-33
3.3.2 Environmental Consequences 3-34
3.3.2.1 Proposed Project 3-35
3.3.2.2 Project Area 3-35
3.3.2.3 Base No Action Alternative 3-40
3.3.2.4 No Action Alternative (with Emergency Measures) 3-40
3.3.2.5 Northern Alignment Alternative 3-40
3.3.3 Proposed Mitigation and Monitoring Measures 3-41
3.4 Wetlands 3-42
3.4.1 Affected Environment 3-43
3.4.1.1 Existing Conditions 3-43
3.4.1.2 Regulatory Framework 3-45
3.4.2 Environmental Consequences 3-46
3.4.2.1 Proposed Project 3-46
3.4.2.2 Base No Action Alternative 3-50

Table of Contents (cont.)

3.4.2.3 No Action Alternative (with Emergency Measures) 3-50
3.4.2.4 Northern Alignment Alternative 3-51
3.4.3 Proposed Mitigation and Monitoring Measures 3-52
3.4.3.1 Forested Wetlands 3-53
3.4.3.2 Non-Forested Wetlands 3-54
3.5 Cold Weather Impacts on Aqueduct Function and Biotics 3-57
3.5.1 Affected Environment 3-58
3.5.1.1 Cold Regions Research and Engineering Laboratory Report Maple River Hydrology and Meteorology 3-58
3.5.1.2 Sheyenne River Hydrology and Meteorology 3-60
3.5.1.3 Maple and Sheyenne Rivers Habitat Assessments- Current Conditions 3-60
3.5.2 Environmental Consequences 3-60
3.5.2.1 Proposed Project 3-61
3.5.2.2 Base No Action Alternative 3-67
3.5.2.3 No Action Alternative (with Emergency Measures) 3-68
3.5.2.4 Northern Alignment Alternative 3-68
3.5.3 Proposed Mitigation and Monitoring Measures 3-68
3.5.3.1 Fish and Biological Connectivity 3-68
3.6 Cover Types 3-69
3.6.1 Affected Environment 3-69
3.6.2 Environmental Consequences 3-70
3.6.2.1 Proposed Project 3-70
3.6.2.2 Base No Action Alternative 3-73
3.6.2.3 No Action Alternative (with Emergency Measures) 3-73
3.6.2.4 Northern Alignment Alternative 3-73
3.6.3 Proposed Mitigation and Monitoring Measures 3-74
3.7 Potential Environmental Hazards 3-75
3.7.1 Affected Environment 3-76
3.7.1.1 2010 Moorhead Environmental Site Assessment 3-76
3.7.1.2 2010 Fargo Environmental Site Assessment 3-77
3.7.1.3 2012 Supplemental Environmental Site Assessment 3-77
3.7.1.4 2013 In-Town Levee Environmental Site Assessments 3-78
3.7.1.5 2014 Oxbow/Hickson/Bakke Environmental Site Assessment 3-78
3.7.2 Environmental Consequences 3-79
3.7.2.1 Proposed Project 3-79
3.7.2.2 Base No Action Alternative 3-82
3.7.2.3 No Action Alternative (with Emergency Measures) 3-83
3.7.2.4 Northern Alignment Alternative 3-83
3.7.3 Proposed Mitigation and Monitoring Measures 3-83
3.8 Fish Passage and Biological Connectivity 3-86
3.8.1 Affected Environment 3-87
3.8.1.1 Habitat Assessment 3-87
3.8.1.2 Macroinvertebrates 3-88

Table of Contents (cont.)

3.8.1.3 Sensitive and Significant Species 3-89
3.8.1.4 Index of Biotic Integrity 3-91
3.8.2 Environmental Consequences 3-98
3.8.2.1 Proposed Project 3-98
3.8.2.2 Base No Action Alternative 3-112
3.8.2.3 No Action Alternative (with Emergency Measures) 3-112
3.8.2.4 Northern Alignment Alternative 3-113
3.8.3 Proposed Mitigation and Monitoring Measures 3-114
3.8.3.1 Proposed Mitigation 3-114
3.8.3.2 Proposed Monitoring 3-118
3.9 Wildlife and Wildlife Habitat 3-119
3.9.1 Affected Environment 3-119
3.9.1.1 Prairie 3-121
3.9.1.2 Wetland-Nonforest 3-121
3.9.1.3 River Habitat 3-122
3.9.1.4 Forest-Lowland Deciduous 3-125
3.9.2 Environmental Consequences 3-125
3.9.2.1 Proposed Project 3-126
3.9.2.2 Base No Action Alternative 3-130
3.9.2.3 No Action Alternative (with Emergency Measures) 3-130
3.9.2.4 Northern Alignment Alternative 3-130
3.9.3 Proposed Mitigation and Monitoring Measures 3-131
3.10 State-Listed Species And Special Status Species 3-132
3.10.1 Affected Environment 3-133
3.10.1.1 State Listed Species in the Project Area 3-133
3.10.2 Environmental Consequences 3-134
3.10.2.1 Proposed Project 3-134
3.10.2.2 Base No Action Alternative 3-137
3.10.2.3 No Action Alternative (with Emergency Measures) 3-138
3.10.2.4 Northern Alignment Alternative 3-138
3.10.3 Proposed Mitigation and Monitoring Measures 3-138
3.10.3.1 Lake Sturgeon 3-138
3.10.3.2 Black Sandshell 3-138
3.10.3.3 Prairie Species (Burrowing Owl and Garita Skipper) 3-139
3.11 Invasive Species 3-139
3.11.1 Affected Environment 3-141
3.11.1.1 Aquatic Invasive Species 3-141
3.11.1.2 Terrestrial Invasive Species: Noxious Weeds 3-142
3.11.1.3 Existing Management Programs 3-142
3.11.2 Environmental Consequences 3-142
3.11.2.1 Proposed Project 3-143
3.11.2.2 Base No Action Alternative 3-145
3.11.2.3 No Action Alternative (with Emergency Measures) 3-145
3.11.2.4 Northern Alignment Alternative 3-145

Table of Contents (cont.)

3.11.3 Proposed Mitigation and Monitoring Measures ... 3-145
3.11.3.1 Construction ... 3-146
3.11.3.2 Operation ... 3-146
3.12 Cultural Resources ... 3-147
3.12.1 Affected Environment ... 3-149
3.12.1.1 Existing Conditions ... 3-149
3.12.1.2 Regulatory Framework ... 3-157
3.12.2 Environmental Consequences ... 3-157
3.12.2.1 Proposed Project ... 3-157
3.12.2.2 Base No Action Alternative ... 3-165
3.12.2.3 No Action Alternatives (with Emergency Measures) ... 3-165
3.12.2.4 Northern Alignment Alternative ... 3-165
3.12.3 Proposed Mitigation and Monitoring Measures ... 3-167
3.13 Infrastructure and Public Services ... 3-170
3.13.1 Affected Environment ... 3-171
3.13.1.1 Roads and Bridges ... 3-171
3.13.1.2 Railroads ... 3-171
3.13.1.3 Utilities ... 3-171
3.13.1.4 Public Services ... 3-171
3.13.2 Environmental Consequences ... 3-172
3.13.2.1 Proposed Project ... 3-172
3.13.2.2 Base No Action Alternative ... 3-178
3.13.2.3 No Action Alternative (with Emergency Measures) ... 3-179
3.13.2.4 Northern Alignment Alternative ... 3-179
3.13.3 Proposed Mitigation and Monitoring Measures ... 3-181
3.13.3.1 Roads and Bridges ... 3-181
3.13.3.2 Railroads ... 3-183
3.13.3.3 Utilities ... 3-184
3.13.3.4 Public Services ... 3-184
3.14 Land Use Plans and Regulations ... 3-184
3.14.1 Affected Environment ... 3-184
3.14.1.1 Counties in Project Area ... 3-184
3.14.1.2 Affected Townships in the Project Area ... 3-187
3.14.1.3 Affected Cities in the Project Area ... 3-188
3.14.1.4 Other Local Government Units in the Project Area ... 3-189
3.14.1.5 Plans and Regulations in the Project Area ... 3-190
3.14.2 Environmental Consequences ... 3-199
3.14.2.1 Proposed Project ... 3-199
3.14.2.2 Base No Action Alternative ... 3-205
3.14.2.3 No Action Alternative (with Emergency Measures) ... 3-205
3.14.2.4 Northern Alignment Alternative ... 3-205
3.14.3 Proposed Mitigation and Monitoring Measures ... 3-206
3.15 Minnesota Dam Safety and Public Waters Regulations and Permitting ... 3-207
3.15.1 State Regulatory Framework and Process ... 3-208

Table of Contents (cont.)

3.15.1.1 MNDNR Dam Safety and Work in Public Waters Permitting Process and Permit Decision Criteria 3-209
3.15.2 Affected Environment 3-211
3.15.3 Environmental Consequences 3-212
3.15.3.1 Proposed Project 3-212
3.15.3.2 Base No Action Alternative 3-215
3.15.3.3 No Action Alternative (with Emergency Measures) 3-215
3.15.3.4 Northern Alignment Alternative 3-215
3.15.4 Proposed Mitigation and Monitoring Measures 3-216
3.16 Socioeconomics 3-217
3.16.1 Affected Environment 3-218
3.16.1.1 Socioeconomic Conditions 3-219
3.16.1.2 Population 3-219
3.16.1.3 Educational Attainment 3-220
3.16.1.4 Housing 3-221
3.16.1.5 Employment and Income 3-221
3.16.2 Environmental Consequences 3-225
3.16.2.1 Modeling and Evaluation Approach 3-226
3.16.2.2 Socioeconomics Report 3-226
3.16.2.3 Proposed Project 3-231
3.16.2.4 Base No Action Alternative 3-262
3.16.2.5 No Action Alternative (with Emergency Measures) 3-270
3.16.2.6 Northern Alignment Alternative 3-273
3.16.3 Proposed Mitigation and Monitoring Measures 3-287
3.16.3.1 FEMA/USACE Coordination Plan Mitigation 3-288
3.16.3.2 USACE and Diversion Authority – Other Proposed and Required Mitigation 3-289
3.16.3.3 Property Acquisition and Estimated Costs 3-292

4.0 CUMULATIVE POTENTIAL EFFECTS 4-1

4.1 Cumulative Potential Effects Screening Summary 4-1
4.1.1 State and Federal Cumulative Potential Effects Definitions and Differences 4-1
4.1.1.1 Minnesota Cumulative Potential Effects Definition 4-1
4.1.1.2 Federal Cumulative Effects Analysis 4-2
4.1.1.3 Primary Differences Between Federal (CEQ) and State (EQB) Cumulative Potential Effects 4-3
4.1.2 Minnesota State Cumulative Potential Effects Analysis Methodology4-3
4.1.2.1 Selecting the Cumulative Potential Effects Categories 4-3
4.1.2.2 Defining the Environmentally Relevant Areas 4-3
4.1.2.3 Identifying the Reasonably Foreseeable Projects 4-3
4.1.2.4 Cumulative Potential Effects Screening Analysis 4-4
4.1.3 Results of the Cumulative Potential Effects Methodology 4-4
4.1.3.1 Cumulative Potential Effects Categories 4-4
4.1.3.2 Cumulative Potential Effects Reasonably Foreseeable Projects 4-6

Table of Contents (cont.)

4.2 Discussion of reasonable Foreseeable Projects 4-8
4.2.1 Hydrology and Hydraulics 4-9
4.2.1.1 Affected Environment/Environmentally Relevant Area 4-9
4.2.1.2 Environmental Consequences 4-9
4.2.2 Stream Stability 4-11
4.2.2.1 Affected Environment/Environmentally Relevant Area 4-11
4.2.2.2 Environmental Consequences 4-11
4.2.3 Wetlands 4-13
4.2.3.1 Affected Environment/Environmentally Relevant Area 4-13
4.2.3.2 Environmental Consequences 4-14
4.2.4 Fish Passage and Biological Connectivity 4-16
4.2.4.1 Affected Environment/Environmentally Relevant Area 4-16
4.2.4.2 Environmental Consequences 4-17
4.2.5 Wildlife and Wildlife Habitat 4-18
4.2.5.1 Affected Environment/Environmentally Relevant Area 4-18
4.2.5.2 Environmental Consequences 4-20
4.2.6 Cultural Resources 4-21
4.2.6.1 Affected Environmental/Environmentally Relevant Area 4-21
4.2.6.2 Environmental Consequences 4-22
4.2.7 Socioeconomics 4-23
4.2.7.1 Affected Environment/Environmentally Relevant Area 4-23
4.2.7.2 Environmental Consequences 4-24

5.0 COMPARISON OF ALTERNATIVES 5-1

5.1 Reasonable Alternatives 5-1
5.1.1 Base No Action Alternative 5-2
5.1.2 No Action Alternative (with Emergency Measures) 5-2
5.1.3 Northern Alignment Alternative 5-2
5.2 Comparison of Alternatives Evaluation 5-3
5.3 Using Comparison of Alternatives Information 5-3

6.0 PROPOSED AND RECOMMENDED MITIGATION AND MONITORING 6-1

6.1 Introduction 6-1
6.2 Regulatory Considerations 6-3
6.3 Types of Mitigation 6-3
6.3.1 Adaptive Management 6-3
6.3.1.1 USACE Adaptive Management 6-4
6.3.1.2 Environmental Impact Statement Draft Adaptive Management and Monitoring Plan 6-5
6.3.1.3 Contingency Mitigation Funding 6-5
6.3.2 Structure Mitigation 6-6
6.3.3 Other Mitigation 6-7
6.4 Proposed Mitigation and Monitoring, Recommendations, and Other Requirements 6-8

Table of Contents (cont.)

7.0 CONSULTATION AND COORDINATION 7-1
- 7.1 Agency Coordination 7-1
  - 7.1.1 Minnesota Department of Natural Resources 7-1
  - 7.1.2 Diversion Authority 7-1
  - 7.1.3 United States Army Corps of Engineers 7-1
- 7.2 Public Involvement 7-1

8.0 LIST OF PREPARERS 8-1

9.0 REFERENCES 9-1

LIST OF TABLES

Table 1.1 Summary of Permits, Approvals, and Federal Regulatory Programs and Laws Related to the Project 1-6
Table 2.1 Residual Peak 100-year Flood Stage, Discharge, and Approximate Existing Frequency Conditions. 2-24
Table 2.2 Fargo - Completed Flood Damage Reduction Projects. 2-29
Table 2.3 Fargo – Construction-In-Progress Flood Damage Reduction Projects 2-30
Table 2.4 Fargo – Planned Flood Damage Reduction Projects 2-31
Table 2.5 Moorhead – Completed Flood Damage Reduction Projects 2-32
Table 2.6 Moorhead – In-Progress Flood Damage Reduction Projects. 2-33
Table 2.7 Moorhead – Funded Future Flood Damage Reduction Projects 2-33
Table 3.1 Peak Flow and Stage Data - USGS Gage 05054000 Red River at Fargo, ND 3-3
Table 3.2 Historic Flood Events – USGS Gage 05054000 Red River at Fargo, ND 3-4
Table 3.3 Sampling of Downstream Impacts 3-10
Table 3.4 National Flood Insurance Program Participating Communities Affected by the Project With Flood Insurance Rate Maps 3-19
Table 3.5 FEMA/USACE Coordination Plan Structure and Land Mitigation Categories and Descriptions 3-24
Table 3.6 Aerial Imagery Source Dates 3-28
Table 3.7 Rosgen Level III Riparian Vegetation Summary 3-29
Table 3.8 Cross Section Geometry Source Dates 3-31
Table 3.9 Cross Section Geometric Change Rates 3-32
Table 3.10 Reach Averaged Channel Velocity and Shear Stress for Bankfull Conditions 3-33
Table 3.11 Threshold Values for Shear Stress and Velocity 3-34
Table 3.12 Predicted Geomorphology Impacts Resulting from Locally Preferred Plan Diversion Channel Alternative[1] 3-35
Table 3.13 Wetland Types, using the Eggers & Reed and Circular 39 Classification Systems, Present in the Project Footprint 3-43
Table 3.14 MnRAM Functional Assessment Ratings 3-45
Table 3.15 Estimated Direct Wetland Impacts by Wetland Type 3-48
Table 3.16 Estimate of Indirect Wetland Impacts from New Inundation During the 100-year Flood 3-49

Table of Contents (cont.)

Table 3.17 Estimate of Indirect Wetland Impacts from New Inundation during the 100-year Flood 3-51
Table 3.18 Estimated Direct Wetland Impacts Associated with Tieback Embankment in Minnesota 3-56
Table 3.19 Summary of Gage Data Records 3-58
Table 3.20 Coldest Periods of Temperature Record 3-59
Table 3.21 Summary of Simulations 3-63
Table 3.22 Insulation Impacts on Ice Volume 3-66
Table 3.23 Heat Impacts on Ice Volume 3-66
Table 3.24 Comparison of Heat Application and Insulation 3-67
Table 3.25 Cover Types Present in the Project Footprint 3-69
Table 3.26 Cover Types: After Construction and Operation of the Project 3-71
Table 3.27 Cover Types Impacted by New Inundation During NAA Operation For the 100-year Flood . 3-74
Table 3.28 Summary of Recognized Environmental Conditions Identified in the 2010 Fargo ESA 3-77
Table 3.29 Summary of Recognized Environmental Conditions Identified in 2013 In-town Levee ESAs 3-78
Table 3.30 Summary of Potential Environmental Consequences from Identified Recognized Environmental Conditions 3-80
Table 3.31 Summary of Environmental Consequences from Potential Additional Recognized Environmental Conditions 3-82
Table 3.32 Summary of Potential Mitigation Measures for Potential Recognized Environmental Conditions 3-85
Table 3.33 Qualitative Habitat Evaluation Index 3-87
Table 3.34 Qualitative Evaluation Index Average Rankings of Project Area Rivers and Streams 3-88
Table 3.35 Summary of Macroinvertebrate Diversity, Most Common Species and Percent Abundance within the Project Area 3-89
Table 3.36 MPCA Fish IBI Sensitive Species Collected in the Project Area 3-90
Table 3.37 MPCA Fish Index of Biotic Integrity Categories for the Red River in Minnesota 3-92
Table 3.38 Red River Fish Index of Biotic Integrity Scores Using the MPCA Southern Rivers Scoring Protocol[1] 3-93
Table 3.39 Wolverton Creek Monitoring Data 3-95
Table 3.40 Fish Index of Biotic Integrity Scores from NDDH Monitoring Efforts in the Project Area 3-96
Table 3.41 Fish IBI Scores from USACE Monitoring Efforts in the Project Area 3-97
Table 3.42 Impacts to Aquatic Habitat on the Red River from Construction of the Project 3-99
Table 3.43 Impacts to Aquatic Habitat on North Dakota Tributaries from Construction of the Project ... 3-108
Table 3.44 Stream Restoration Projects to Serve as Mitigation for Impacts to Aquatic Habitat3-115
Table 3.45 Comparison of Minnesota and North Dakota Habitat Classification Systems 3-120
Table 3.46 Minnesota State Listed Species in the Project Area ... 3-134
Table 3.47 State and Federal Regulations Pertaining to Invasive Species ... 3-140
Table 3.48 Listed Noxious Weeds Potentially Present in the Project Area ... 3-142
Table 3.49 Inventoried Cultural Resources within Proposed Project APE ... 3-158
Table 3.50 Additional Inventoried Cultural Resources within Northern Alignment Alternative APE ... 3-166
Table 3.51 NAA Infrastructure Impacts[1] ... 3-180
Table 3.52 Summary of North Dakota County Land Use Management within the Project Area 3-185
Table 3.53 Summary of Minnesota County Land Use Management within the Project Area 3-186
Table 3.54 Summary of North Dakota Township Land Use Management within the Project Area 3-187

Table of Contents (cont.)

Table 3.55 Summary of Minnesota Township Land Use Management within the Project Area....... ...3-187
Table 3.56 Summary of North Dakota City Land Use Management within the Project Area........... ...3-188
Table 3.57 Summary of Minnesota City Land Use Management within the Project Area 3-189
Table 3.58 Summary of Other Local Government Units Land Use Management within the Project Area ...3-189
Table 3.59 Summary of Plans and Regulations ...3-191
Table 3.60 Local Government Permitting and Approvals That May Be Needed for Project Construction or Operation ...3-206
Table 3.61 Estimated Maximum Loss of Life in the Benefited Area - Existing Conditions Due to Levee Overtopping or a Levee Failure [1] ...3-214
Table 3.62 Estimated Maximum Loss of Life in the Benefited Area – Project Condition Due to a Levee Breach of the Storage Area ...3-215
Table 3.63 Historical Population Trends: National, State, County, and City ...3-220
Table 3.64 Highest Educational Attainment 2010-2012 ...3-220
Table 3.65 Total Housing Units ...3-221
Table 3.66 Available Housing Units ...3-221
Table 3.67 Civilian Labor Force Estimates – 2010-2012 ...3-222
Table 3.68 Unemployment Rate (%): National, State, County, and City (2002-2012) ...3-222
Table 3.69 Per Capita Income ...3-223
Table 3.70 Median Household Income (2000 & 2010) ...3-223
Table 3.71 Components of Personal Income, in Millions of Dollars (2012)[1 2] ...3-224
Table 3.72 Model Frameworks for Fargo Moorhead SE Report Socioeconomic Analysis ...3-227
Table 3.73 SE Report HAZUS Modeling Level of Effort ...3-228
Table 3.74 Estimated Project Construction Cost ...3-231
Table 3.75 Proposed Project Economic Impacts from Construction, Operation and Maintenance ($Millions) ...3-232
Table 3.76 Summary of Utility Relocation Costs for the Proposed Project ...3-234
Table 3.77 Proposed Project Nearest Healthcare Facilities Outside of Inundation Area (Comstock/ Oxbow) ...3-235
Table 3.78 Structures Impacted by the Proposed Project During the 10-year, 25-year, 50-year, 100-year, and 500-year Floods[1] ...3-237
Table 3.79 Proposed Project Estimated Residual Damages to Buildings and Contents; and Vehicles..3-239
Table 3.80 Proposed Project Summary of Estimated Cost of Land Acquisition and Damages ...3-240
Table 3.81 Proposed Project Property Acquisitions, Easements, and Costs ...3-241
Table 3.82 Proposed Project Number and Type of Structures Impacted under 10-year, 25-year, 50-year, 100-year, and 500-year Floods within the Upstream Inundation Area[1 2 3 4 5 6] ...3-242
Table 3.83 Proposed Project Number of Parcels Impacted under 10-year, 25-year, 50-year, 100-year, and 500-year Floods within the Upstream Inundation Area[1 2 3 4 5 6] ...3-244
Table 3.84 Proposed Project Annual Impacts from Loss of Building Function ($ Millions) ...3-245
Table 3.85 Organic Farms Located Within the Vicinity of the Proposed Project Inundation Areas During the 100-year Flood[1] ...3-256
Table 3.86 Organic Farm Acreage By 100-Year Flood for Proposed Project[1 2 3 4] ...3-257
Table 3.87 Structures Impacted under the Base No Action Alternative During the 10-year, 25-year, 50-year, 100-year, and 500-year Floods ...3-264

Table of Contents (cont.)

Table 3.88 Base No Action Alternative Estimated Damages to Buildings and Contents; and Vehicles ($ Millions) ... 3-265
Table 3.89 Base No Action Alternative Summary of Average Annual Impacts from Loss of Building Function ($ Millions) ... 3-267
Table 3.90 Organic Farm Acreage By 100-Year Flood for Base No Action Alternative[1 2 3 4] ... 3-269
Table 3.91 Estimated Northern Alignment Alternative Construction Cost ... 3-274
Table 3.92 Northern Alignment Alternative Economic Impacts from Construction, Operation and Maintenance ($ Millions) ... 3-275
Table 3.93 Summary of Utility Relocation Costs for the Northern Alignment Alternative ... 3-276
Table 3.94 Structures Impacted by the Northern Alignment Alternative During the 10-year, 25-year, 50-year, 100-year, and 500-year Floods[1] ... 3-276
Table 3.95 Northern Alignment Alternative Estimated Residual Damages ($ Millions) ... 3-278
Table 3.96 Northern Alignment Alternative Summary of Estimated Cost of Land Acquisition and Damages ... 3-279
Table 3.97 Northern Alignment Alternative Property Acquisitions, Easements, and Costs ... 3-279
Table 3.98 Northern Alignment Alternative: Number and Type of Structures Impacted under 10-year, 25-year, 50-year, 100-year, and 500-year Floods within the Upstream Inundation Area[1 2 3 4 5 6] ... 3-280
Table 3.99 Northern Alignment Alternative Number of Parcels Impacted under 10-year, 25-year, 50-year, 100-year, and 500-year Floods within the Upstream Inundation Area[1 2 3 4 5] ... 3-282
Table 3.100 Northern Alignment Alternative Summary of Annual Impacts from Loss of Building Function ($ Millions) ... 3-283
Table 3.101 Organic Farm Acres Located Within the Vicinity of the Northern Alignment Alternative Inundation Areas During the 100-year Flood[1] ... 3-286
Table 3.102 Organic Farm Acreage By 100-Year Flood Event for the Northern Alignment Alternative[1 2 3 4 5] ... 3-286
Table 3.103 FEMA/USACE Coordination Plan Structure and Land Proposed Mitigation Categories and Descriptions ... 3-289
Table 3.104 Summary of Estimated Cost of Land Acquisition and Damages ... 3-293
Table 4.1 Summary of Potential Cumulative Effects Categories ... 4-5
Table 4.2 Reasonably Foreseeable Projects ... 4-6
Table 5.1 Summary of Environmental and Socioeconomic Effects and Mitigation for Proposed Project and Northern Alignment Alternative ... 5-5
Table 6.1 Summary of Hydrology and Hydraulics Proposed and Recommended Mitigation and Monitoring ... 6-9
Table 6.2 Summary of FEMA Regulations and the CLOMR Process Proposed and Recommended Mitigation and Monitoring ... 6-9
Table 6.3 Summary of Stream Stability Proposed and Recommended Mitigation and Monitoring ... 6-10
Table 6.4 Summary of Wetlands Proposed and Recommended Mitigation and Monitoring – Forested Wetlands ... 6-14
Table 6.5 Summary of Wetlands Proposed and Recommended Mitigation and Monitoring – Non-Forested Wetlands ... 6-16
Table 6.6 Summary of Wetlands Proposed and Recommended Mitigation and Monitoring – Oxbow/Hickson/Bakke Ring Levee Wetlands ... 6-17

Table of Contents (cont.)

Table 6.7 Summary of Wetlands Proposed and Recommended Mitigation and Monitoring – Inundation Wetlands 6-17
Table 6.8 Summary of Cold Weather Impacts on Aqueducts Function and Biotics Proposed and Recommended Mitigation and Monitoring 6-18
Table 6.9 Summary of Cover Types Proposed and Recommended Mitigation and Monitoring 6-18
Table 6.10 Summary of Potential Environmental Hazards Proposed and Recommended Mitigation and Monitoring 6-19
Table 6.11 Summary of Fish Passage and Biological Connectivity Proposed and Recommended Mitigation and Monitoring 6-19
Table 6.12 Summary of Wildlife and Wildlife Habitat Proposed and Recommended Mitigation and Monitoring 6-22
Table 6.13 Summary of State Listed Species and Special Status Species Proposed and Recommended Mitigation and Monitoring 6-23
Table 6.14 Summary of Invasive Species Proposed and Recommended Mitigation and Monitoring 6-24
Table 6.15 Summary of Cultural Resources Proposed and Recommended Mitigation and Monitoring 6-25
Table 6.16 Summary of Infrastructure and Public Services Proposed and Recommended Mitigation and Monitoring 6-26
Table 6.17 Summary of Land Use Plans and Regulations Proposed and Recommended Mitigation and Monitoring 6-27
Table 6.18 Summary of Dam Safety and Work in Public Waters Proposed and Recommended Mitigation and Monitoring 6-29
Table 6.19 Summary of Socioeconomics Proposed and Recommended Mitigation and Monitoring 6-29
Table 7.1 Public Meetings 7-2
Table 8.1 List of Preparers 8-1

Table of Contents (cont.)

LIST OF ILLUSTRATIONS

Illustration 2.1 Control Structure 2-4
Illustration 2.2 Diversion Inlet Control Structure 2-5
Illustration 2.3 Diversion Channel Design 2-6
Illustration 2.4 Diversion Channel Outlet 2-7
Illustration 2.5 Diversion Channel Cross Section 2-8
Illustration 2.6 Maple and Sheyenne Rivers Aqueduct Design 2-9
Illustration 2.7 Rush River Rock Ramp Design 2-10
Illustration 3.1 Proposed Project Zone Location Map 3-13
Illustration 3.2 Northern Alignment Alternative Zone Location Map 3-18
Illustration 3.3 Riparian Vegetation Conditions along Sheyenne River 3-39
Illustration 3.4 Typical Diversion Channel Cross Section 3-54
Illustration 3.5 Fish Species Migration Periods on the Red River and Otter Tail River 3-103
Illustration 3.6 Typical Diversion Channel Cross Section 3-105
Illustration 3.7 Example of a fish passage dam project on the Red River at the Riverside Dam, Grand Forks, North Dakota. 3-117

LIST OF GRAPHS

Graph 3.1 Proposed Project Flood Hydrograph and Flood Elevation Data – Zone A 3-11
Graph 3.2 Proposed Project Flood Hydrograph and Flood Elevation Data – Zone B 3-11
Graph 3.3 Proposed Project Flood Hydrograph and Flood Elevation Data – Zone C 3-12
Graph 3.4 Proposed Project Flood Hydrograph and Flood Elevation Data – Zone D 3-12
Graph 3.5 Northern Alignment Alternative Flood Hydrograph and Flood Elevation Data – Zone A 3-16
Graph 3.6 Northern Alignment Alternative Flood Hydrograph and Flood Elevation Data – Zone B 3-16
Graph 3.7 Northern Alignment Alternative Flood Hydrograph and Flood Elevation Data – Zone C 3-17
Graph 3.8 Northern Alignment Alternative Flood Hydrograph and Flood Elevation Data – Zone D 3-17
Graph 3.9 Range of daily winter flows in the Maple River for 1995–2012 3-59
Graph 3.10 Upstream Water Levels for Water Year 1996 for Different Scenarios and for Open Water 3-64
Graph 3.11 Average Stage at the Spillway Location for Each Day of the Winter Season Under Each Scenario.[1] 3-66
Graph 3.12 Comparison of Flow Exceedance at the Fargo Gage on the Red River by Month 3-101

Table of Contents (cont.)

LIST OF FIGURES

Figure 1 Proposed Project Location Map
Figure 2 Proposed Project Features
Figure 3 Proposed Project 100-year Flood Inundation and Staging Area
Figure 4 Proposed Project – 100-year Flood Inundation Area
Figure 5 Oxbow/Hickson/Bakke Ring Levee Plan
Figure 6 Comstock Ring Levee Preliminary Conceptual Design
Figure 7 Proposed Project and Northern Alignment Staging Areas
Figure 8 City of Fargo: Levee Protection Locations 2011
Figure 9 City of Fargo: Flood Damage Reduction Projects: Completed, In Progress, and Planned as of July 2015
Figure 10 City of Moorhead: Flood Damage Reduction Projects: Completed, In Progress, and Planned as of March 2014
Figure 11 Base No Action Alternative 100-year Flood Inundation Area
Figure 12 No Action Alternative (with Emergency Measures) 100-year Flood Inundation Area
Figure 13 Northern Alignment Alternative 100-year Flood Inundation Area
Figure 14 Proposed Project 100-year Flood Inundation, Flow, and Stage Elevations
Figure 15 Proposed Project 500-year Flood Inundation, Flow, and Stage Elevations
Figure 16 Stream Reaches Evaluated in the Geomorphology Report
Figure 17 United States Environmental Protection Agency Index of Biotic Integrity Sites With Quality Ratings
Figure 18 Fish Index of Biotic Integrity Sampling Locations
Figure 19 Red River Control Structure Fill Area
Figure 20 Wild Rice River Control Structure Fill Area
Figure 21 Areas Surveyed for Cultural Resources as of January 1, 2016
Figure 22 Proposed Project Transportation Improvement Plan Study Areas
Figure 23 Proposed Project Transportation Improvement Plan (North) - March 2012
Figure 24 Proposed Project Transportation Improvement Plan (South) - October 2013
Figure 25 Socioeconomics Report Study Area
Figure 26 Proposed Project MNDNR Structure Count Analysis 100-Year Flood Impacted Structures
Figure 27 Proposed Project MNDNR Structure Count Analysis 100-Year Flood Impacted Parcels
Figure 28 Northern Alignment Alternative MNDNR Structure Count Analysis 100-Year Flood Impacted Structures
Figure 29 Northern Alignment Alternative MNDNR Structure Count Analysis 100-Year Flood Impacted Parcels
Figure 30 Project Area Ground Elevation
Figure 31 Final FEMA/USACE Coordination Plan (April 2015) Areas of Interest
Figure 32 Proposed Project Total 100-year Depth
Figure 33 Cumulative Potential Effects: Reasonably Foreseeable Projects Identified

Table of Contents (cont.)

LIST OF APPENDICES

A. Draft Operation Plan – Fargo-Moorhead Metropolitan Area Flood Risk Management Project (USACE) – December 5, 2014
B. Minnesota Environmental Impact Statement: Draft Adaptive Management and Monitoring Plan (MNDNR) – May 2016
C. Draft EIS Review Version - Distributed Storage Alternative Screening Analysis (MNDNR) – February 17, 2015
D. Distributed Storage Alternative Final Report (Wenck) – July 2014
E. Final Technical Memorandum – Adequacy of Hydrology and Hydraulic Modeling Completed for the Fargo-Moorhead Flood Risk Management Project (Wenck/MNDNR) – July 2014
F. Final FEMA/USACE Coordination Plan – April 14, 2015
G. Programmatic Agreement Between USACE, ND SHPO, and MN SHPO – Fargo-Moorhead Metro Flood Risk Management Project, Final – 2011
H. Fargo-Moorhead Metro Area Flood Risk Management Project Cemetery Mitigation Plan (Draft Report) (USACE) - June 2015
I. Fargo-Moorhead Area Diversion Project Socioeconomics Technical Report In Support Of Minnesota EIS (HMG) (Includes Appendix A – Final Technical Memorandum: Opinion of Probable Construction Cost of the Northern Alignment Alternative (HMG, January 2015) – April 2015
J. Draft Ag Impacts Mitigation Plan (Diversion Authority) – January 8, 2015
K. Technical Memorandum - Organic Farms Inventory (Wenck) – May 4, 2015
L. Responses to Comments on the Draft EIS (MNDNR) – April, 2016
M. Purpose & Need and Alternatives Rescreen Report (MNDNR)—March 20, 2016
N. Technical Memorandum - Fargo-Moorhead EIS Hydrologic Methodology Review (MNDNR)—February 19, 2016
O. Takings, Flowage Easements and Acquisition Processes (MNDNR)—March 28, 2016

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Acronyms

(°) degrees
(ABA) Architectural Barriers Act
(ACMs) Potential Asbestos Containing Materials
(ADA) Americans with Disabilities Act
(AEP) Annual Exceedance Probability
(AIS) Aquatic Invasive Species
(AMP) Adaptive Management Plan
(AMMP) Adaptive Management and Monitoring Plan
(AMT) Adaptive Management Team
(APE) Area of Potential Effect
(APHIS) USDA Animal and Plant Health Inspection Service
(ASTs) Aboveground Storage Tanks
(ATV) All-terrain Vehicles
(AUAR) Alternative Urban Areawide Review
(BFEs) Base Flood Elevations
(BMPs) Best Management Practices
(BNSF) Burlington Northern Santa Fe Rail Lines
(BRRWD) Buffalo-Red River Watershed District
(Btu) British thermal unit
(BWSR) Minnesota Board of Water and Soil Resources
(CCJWRD) Cass County Joint Water Resource District
(CEQ) Council on Environmental Quality
(cfs) cubic feet per second
(CLOMR) Conditional Letter of Map Revision
(CRREL) United States' Army Corps of Engineers' Engineer Research and Development Center Cold Regions Research and Engineering Laboratory
(CUP) conditional use permits
(CWA) Clean Water Act
(DELT) Deformities, Eroded Fins, Lesions, or Tumors
(DFIRM) Digital Flood Insurance Rate Maps
(DSA)Distributed Storage Alternative
(DSC) Downstream Control
(DU) Ducks Unlimited
(EA) Environmental Assessment
(EAW) Environmental Assessment Worksheet
(ECS) Ecological Classification System
(EIS) Environmental Impact Statement
(EMB) Excavated Material Berm
(EOEP) Expert Opinion Elicitation Panel
(ESA) Environmental Site Assessment
(EQB) Environmental Quality Board
(F) Fahrenheit
(FDR) Flood Damage Reduction
(FEMA) Federal Emergency Management Agency
(FIRMs) Flood Insurance Rate Maps
(FIS) Flood Insurance Study
(FFREIS) Final Feasibility Report and Environmental Impact Statement
(F-M) Fargo-Moorhead
(FRP) Federally Recommended Plan
(ft) feet
(ft^2) foot squared
(GIS) Geographic Information System
(H and H) hydrologic and hydraulic
(HEC-FDA) Hydrologic Engineering Center Flood Damage Reduction Analysis
(HEC-HMS) Hydrologic Engineering Center Hydrologic Modeling System
(HEC-RAS) Hydrologic Engineering Centers River Analysis System
(hr) hour
(HUR) Halstad Upstream Retention Study
(HTRW) Hazardous, Toxic, and Radioactive Wastes
(I-29) Interstate Highway 29
(I-94) Interstate Highway 94
(IBI) Index of Biotic Integrity
(IMPLAN) IMpact Analysis for PLANning Model
(I-O) input-output analysis
(IRT) Interagency Review Team
(LBP) Lead Based Paint
(LGU) Local Government Unit
(LiDAR) Light Detection and Ranging
(LOL) Loss of Life
(LOMR) Letter of Map Revision

(LPP) Locally Preferred Plan
(MDA) Minnesota Department of Agriculture
(MEPA) Minnesota Environmental Policy Act
(MN) Minnesota
(MNDNR) Minnesota Department of Natural Resources
(MNRAM) Minnesota Routine Assessment Methodology for Evaluation of Wetland Functions
(MPCA) Minnesota Pollution Control Agency
(NAA) Northern Alternative Alignment
(NAVD) North American Vertical Datum
(ND) North Dakota
(NDDA) North Dakota Department of Agriculture
(NDDH) North Dakota Department of Health
(NDGF) North Dakota Game and Fish Department
(NDNHI) North Dakota Natural Heritage Inventory
(NEPA) National Environmental Policy Act
(NFIP) National Flood Insurance Program
(NHIS) Minnesota Natural Heritage Information System
(NHPA) National Historic Preservation Act
(NLCD) National Land Cover Dataset
(NRCS) Natural Resources Conservation Service
(NRHP) National Register of Historic Places
(NWI) National Wetlands Inventory
(O&M) Operations & Maintenance
(OHB) City of Oxbow, Village of Hickson, and Bakke Subdivision
(OHV) Off-Highway Vehicle
(OHWL) Ordinary High Water Level
(OMRR&R) Operations, Maintenance, Repair, Rehabilitation, and Replacement
(OSE) Other Social Effects
(PAHs) Poly Aromatic Hydrocarbons
(PCBs) Polychlorinated Biphenyls
(PFSAA) *FM Diversion Post-Feasibility Southern Alignment Analysis* (HMG, 2012)
(POC) Point of Contact
(PWI) Public Waters Inventory
(QA) Quality Assurance
(QC) Quality Control
(QHEI) Qualitative Habitat Evaluation Index
(RECs) Recognized Environmental Conditions
(RG) River Gage
(RGU) Responsible Government Unit
(ROD) Record of Decision
(ROW) Right-of-Way
(RRJWD) Red River Joint Water Resource District
(RRWMB) Red River Watershed Management Board
(RS) River Stage
(SE) Socioeconomics
(SEAW) Scoping Environmental Assessment Worksheet
(SFHAs) Special Flood Hazard Areas
(SGCN) Species of Greatest Conservation Need
(SHPO) State Historic Preservation Office
(SoCP) Species of Conservation Priority
(SOW) Scope of Work
(SSTS) Subsurface Sewage Treatment Systems
(STS) Storm Sewer
(LS) Lift Station
(SWAPS) State Wildlife Action Plans
(T138 R48) Unnamed Tributary to the Red River
(TCPs) Traditional Cultural Properties
(URS) URS, Corporation
(U.S.) United States
(USACE) United States Army Corps of Engineers
(U.S.C.) United States Code
(USDA) United States Department of Agriculture
(USEPA) United States Environmental Protection Agency
(USFWS) United States Fish and Wildlife Service
(USGS) United States Geological Survey
(USPS) United States Postal Service
(USTs) Underground Storage Tanks
(WCA) Wetland Conservation Act
(WD) Watershed Districts
(WRAPS) Minnesota Pollution Control Agency Watershed Restoration and Protection Strategy

Definitions for Terms as Used in This Environmental Impact Statement

0.2-percent chance flood: A flood event that has the statistical average of occurring once every 500 years. See also 500-year flood.

1-percent chance flood: A flood event that has the statistical average of occurring once every 100 years. See also 100-year flood.

10-percent chance flood: A flood event that has the statistical average of occurring once every 10 years. See also 10-year flood. This would result in an approximate flow of 17,000 cubic feet per second at the Fargo stream gage.

10-year flood: A flood event that has the statistical average of occurring once every 10 years or has a 10-percent chance of occurring or being exceeded in any given year. See also 10-percent chance flood.

100-year flood: A flood event that has the statistical average of occurring once every 100 years or has a 1-percent chance of occurring or being exceeded in any given year. See also 1-percent chance flood.

500-year flood: A flood event that has the statistical average of occurring once every 500 years or has a 0.2-percent chance of occurring or being exceeded in any given year. See also 0.2-percent chance flood.

Accessibility: Refers to the ability to access a property from an adjacent roadway.

Accreditation: An accredited levee system is a system that Federal Emergency Management Agency (FEMA) has determined can be shown on a Flood Insurance Rate Map (FIRM) as providing a 100-year flood or greater level of flood protection. This determination is based on the submittal of data and documentation required by 44 CFR Section 65.10 which must be certified by a Professional Engineer. The area landward of an accredited levee system is shown as a moderate-risk area, labeled Zone X (shaded), on the DFIRM except for areas of residual flooding, such as ponding areas, which will be shown as high-risk areas, called Special Flood Hazard Areas (SFHAs). Flood insurance is not mandatory in Zone X (shaded) areas, but is mandatory in SFHAs. (http://www.fema.gov/media-library-data/20130726-1600-20490-4180/lv_accredit_checklist_nov08.pdf)

Action Threshold: The point at which data and information indicate criteria have been met requiring steps to address impacts or potential impacts.

Activity Hubs: Key locations along the proposed trail system offering recreational amenities, such as trail access or interpretive signs.

Activity Nodes: Similar to activity hubs but provide less intensive site-specific activities and could serve as secondary access points to the trails.

Adaptive Management: A process wherein management actions can be changed in response to a monitored result or impact. An adaptive management plan proposes pre-construction and post-construction studies of biota and physical habitat for both impact sites and mitigation sites, including a framework for evaluation and response actions.

Adaptive Management Team/Adaptive Management and Monitoring Team: A decision-making body for the Adaptive Management and Monitoring Plan composed of local, state, and federal agency personnel working collaboratively to address adaptive management needs. The USACE would be the lead for the Adaptive Management Team (or the Adaptive Management and Monitoring Team as referred to in the Draft Adaptive Management and Monitoring Plan included as Appendix B to this document) until the Project would be turned over to the non-Federal sponsor at which time the non-Federal sponsor would be responsible to lead the team.

Adverse Effect: A harmful or undesired effect from the Proposed Project on the environment.

Aggradation: To raise the grade or level of (a river valley, a stream bed, etc.) by depositing detritus, sediment, or the like. (http://dictionary.reference.com/browse/aggradation)

Anthropogenic: Relating to or resulting from the influence of human beings on nature.

Associated Facilities: Components of the Project that are not primary, but are necessary for Project construction and operation. Associated facilities for the Project include, for example, utilities and access roads.

Aqueduct: Structures, resembling a bridge, that carry water over other features. For the Project, aqueducts would be used to carry the Maple River and Sheyenne River flows over the diversion channel during flood and non-flood events.

Bankfull: The elevation of the floodplain adjacent to the active channel.

Bankfull Flow: The discharge at channel capacity or the flow at which water fills the channel without over-topping the banks. On average, recurrence of bankfull is 1.5 years. But it ranges from 1.1 to 1.8 for streams in Minnesota.

Base Flood Elevation (BFE): The elevation of surface water resulting from a flood that has a 1- percent (1%) chance of equaling or exceeding that level in any given year. The BFE is shown on the Flood Insurance Rate Map (FIRM) for zones AE, AH, A1–A30, AR, AR/A, AR/AE, AR/A1– A30, AR/AH, AR/AO, V1–V30 and VE. (https://www.fema.gov/national-flood-insurance-program/definitions)

Base Flow (Q_{Base}): The component of streamflow not directly attributed to stormwater runoff. Base flow defines low flow conditions for maintaining viable habitat for stream organisms. While base flow does not transport large amounts of sediment it can be important in maintaining a low-flow channel needed by stream organisms when water levels drop in the summer and fall.

Base No Action Alternative: Project alternative that includes the potential flood risk reduction impact of already completed and currently funded projects such as levee construction and property buyouts.

Benthic Biodiversity: The variety or measure of many different kinds of organisms living on the bottom of a body of water, such as mussels or other bottom-dwelling species.

Berms: An artificial hill or wall of dirt or sand used as a barrier to separate two areas.

Best Management Practices (BMPs): The schedule of activities, prohibition of practices, maintenance procedures, and other management practices to avoid or minimize pollution or habitat destruction to the environment. BMPs can also include treatment requirements, operating procedures and practices to control runoff, spillage or leaks, sludge or waste disposal, or drainage from raw material storage.

Biological Assessment: Biological assessments are evaluations of the condition of waterbodies using surveys and other direct measurements of resident biological organisms (macroinvertebrates, fish, and plants). Biological assessment results are used to answer the question of whether waterbodies support survival and reproduction of desirable fish, shellfish, and other aquatic species -- in other words, if the waterbodies meet their designated aquatic life uses.

Biological Community: All the interacting organisms living together in a specific habitat of varying sizes, larger biological communities may contain smaller communities.

Biota: Flora (plants) and fauna (animals) of a particular location

Biotic: Of, relating to, or caused by living organisms

Biotic Community: A group of interdependent organisms inhabiting the same region and interacting with each other.

Biotic Connectivity: The quality, state or capability of the flora and fauna (i.e., organisms) or biotic processes of a region being connected or being able to move unimpeded.

Blue Books: United States Fish and Wildlife Service habitat assessment models.

Brush/Grassland: Grassland areas dominated by graminoid or herbaceous vegetation and shrub/scrub areas dominated by shrubs less than five meters tall with shrub canopy typically greater than 20 percent of total vegetation, including true shrubs, young trees in an early successional stage, or trees stunted due to harsh environmental conditions. Includes those areas in the Eastern United States that commonly are called brush lands (Anderson et al., 1976).

Buffalo-Red River Watershed District (BRRWD): The Buffalo-Red River Watershed District is a political local government unit which issues permits for a wide variety of construction activities that affect the water resources of the District. Located in northwest Minnesota, the district covers approximately 1,785 square miles that is one of the ten major watersheds in the Red River Basin. (http://www.brrwd.org/).

City of Oxbow, Village of Hickson, and Bakke Subdivision (OHB) Ring Levee: A ring levee that encompasses the City of Oxbow, the Village of Hickson, and the Bakke Subdivision.

Class I Dam: A dam (defined in Minnesota Rules, part 6115) whose failure, misoperation, or other occurrences or conditions would probably result in any loss of life or serious hazard, or damage to health, main highways, high-value industrial or commercial properties, major public utilities, or serious direct or indirect, economic loss to the public. (https://www.revisor.mn.gov/rules/?id=6115.0340)

Collector Roadway: Provides a less highly developed level of service at a lower speed for shorter distances by collecting traffic from local roads and connecting them with high-capacity arterial roads. (http://www.fhwa.dot.gov/environment/publications/flexibility/ch03.cfm)

Comstock Ring Levee: A ring levee that would be constructed around the city of Comstock, Minnesota, to provide protection from flood inundation as a result of Project operation. Applies to the Project scenario only.

Concrete Baffle: A concrete portion of a water control structure that dissipates energy in the water flowing through the structure.

Conditional Letter of Map Revision (CLOMR): A CLOMR is the Federal Emergency Management Agency's (FEMA) comment on a proposed project that would, upon construction, affect the hydrologic or hydraulic characteristics of a flooding source and thus result in the modification of the existing regulatory floodway, the effective BFEs, or the Special Hazard Area (SFHA). The letter does not revise an effective National Flood Insurance Program (NFIP) map; it does indicate whether the project, if built as proposed, would be recognized by FEMA.

Conditional Use Permit: A conditional use permit is a document a regulatory unit of government issues to grant a conditional use when the general and specific ordinance standards have been met by the applicant. The use is allowed by the permit only if the special concerns are addressed as set forth in the zoning ordinance. Conditional use permits are authorized under state law. (http://www.lmc.org/media/document/1/conditionalusepermits.pdf?inline=true)

Connecting Channel: The connecting channel between the Red River of the North and the diversion inlet control structure.

Construction Footprint: Portions of the Project that would result in a direct impact from disturbance during Project construction, such as excavation, piling of earthen material, and equipment movement. In general these areas include the diversion channel, connecting channel, excavated material berms, and embankments.

Control Structure: A structure in the water management system that conveys water, controls the direction or rate of flow, maintains a desired water surface elevation, or measures water.

Cover Type: A general term referring to the specific land cover of an area.

Cropland: Land used for growing crops, which are typically associated with cultivated, agricultural crops, such as corn and soybeans.

Cubic Feet Per Second (cfs): The rate of flow representing a volume of one cubic foot passing a given point in one second.

Cumulative Potential Effects: The effect on the environment that results from incremental effects of the Project in addition to other projects in the environmentally relevant area that might be reasonably expected to affect the same environmental resources. This includes planned future projects or for which a basis of expectation has been laid, regardless of what person undertakes the other projects or what jurisdictions have authority over the projects (Minnesota Rules part 4410.0200 subpart 11a).

Cyprinids: Any of numerous, often small, freshwater fishes of the family Cyprinidae, which includes the minnows, carps, and shiners.

Dam: Any artificial barrier, together with appurtenant works (required components), capable of impounding water, typically with a height greater than six feet and a storage capacity in excess of 15-

acre feet (Minnesota Rules, part 6115.0320). Under the Project and Northern Alignment Alternative scenarios, the dam is considered the three control structures (structures designed to control flood waters), an earthen tieback embankment, and overflow embankment.

Dam Owner: The owner or lessee of the property to which the dam is attached, unless the dam is sponsored by a governmental agency which would be responsible for operation and maintenance of the dam, in which case that sponsoring agency shall be considered the owner (Minnesota Rules, part 6115.0320) (https://www.revisor.mn.gov/rules/?id=6115.0320). For the Project, the Diversion Authority and/or non-Federal Sponsor would be the dam owner. The dam owner is responsible for all operation, maintenance, repair, rehabilitation and replacement of the dam. The non-Federal sponsor would apply for any applicable permits that are required for construction and would be responsible for implementing required mitigation.

Degradation: Erosion of the quality of natural environment caused, directly or indirectly, by human activities. (http://www.businessdictionary.com/definition/environmental-degradation.html)

Detritivorous: Of an organism (as an earthworm or a fungus) that feeds on dead and decomposing organic matter.

Drain 14: A drainage ditch which runs generally south to north from Davenport, North Dakota to the Maple River.

Drayton Dam: A dam on the Red River located near Drayton, North Dakota, approximately 125 miles downstream of the project area.

Easement: An interest in land owned by another that entitles its holder to a specific limited use.

Ecological Classification System (ECS): Developed by the Minnesota Department of Natural Resources (MNDNR) and United States Forest Service, ecological land classifications are used to identify, describe, and map progressively smaller areas of land with increasingly uniform ecological features, including climate, geology, topography, soils, hydrology, and vegetation.

Electronic Data Access (EDA): The Minnesota Pollution Control Agency's database system that allows users to view and download environmental data that is collected and stored by the agency and its partner organizations.

Embankment: A mound or earthen material, typically created from placement and compaction of soil, sand, clay and/or rock, to form a barrier to water seepage. Embankments can be used to form dams or created to form walls on the outside of man-made water channels. The Project would include the overflow embankment along Cass County Highway 17 and the tieback embankment to form the staging area.

Endangered Species: A species that is threatened with extinction throughout all or a significant portion of its range.

Energy Dissipation Chambers: A device constructed in a waterway to reduce the kinetic energy of fast flowing water. (Technical Manual: Outlet Works Energy Dissipaters: Best Practices for Design, Construction, Problem Identification and Evaluation, Inspection, Maintenance, Renovation, and Repair. FEMA P-679/June 2010.)

Environmental Assessment Worksheet (EAW): Provides information about a project that may have the potential for significant environmental effects. The EAW is prepared by the Responsible Governmental Unit (RGU) or its agents to determine whether an Environmental Impact Statement should be prepared. If and EIS is to be prepared, the EAW serves as the basis to begin the scoping process for the EIS and becomes known then as the Scoping EAW. (https://www.revisor.leg.state.mn.us/rules/?id=4410.1000).

Excavated Material Berms (EMB): A small hill or mound of dirt or sand created from earthen material that was excavated for creation of the diversion channel.

Exceptional Use Threshold: High quality waters with fish and invertebrate communities at or near undisturbed conditions.

Extirpation: To destroy or remove completely, as a species from a particular area, region, or habitat. Compare to Extinction. (http://www.ecologydictionary.org/EXTIRPATION)

Fargo Gage: United States Geological Survey stream gage in Fargo, North Dakota.

Fargo-Moorhead Metropolitan Area: The urbanized and rural area within and surrounding the cities of Fargo and Moorhead specific to the United States Army Corps of Engineers' and Diversion Authorities' study and focus area for the Fargo-Moorhead Metro Flood Risk Management Feasibility Study. This area, which would include all of Cass and Clay counties, is larger area than the Fargo-Moorhead urban area.

Fargo-Moorhead urban area (F-M urban area): The urbanized area within and surrounding the cities of Fargo and Moorhead.

Fee acquisition: Purchase of land or of an interest of land for a monetary amount.

Federal Emergency Management Agency (FEMA) Region V: FEMA Region V is comprised of Illinois, Indiana, Michigan, Minnesota, Ohio, and Wisconsin. (https://www.fema.gov/region-v-il-mi-mn-oh-wi)

FEMA Region VIII: FEMA Region VIII is comprised of Colorado, Montana, North Dakota, South Dakota, Utah, and Wyoming. (http://www.fema.gov/region-viii-co-mt-nd-sd-ut-wy)

Federally Recommended Plan (FRP): The FRP (Supplemental Environmental Assessment, USACE 2013) is the Locally Preferred Plan (LPP) described in the Final Feasibility Report/Environmental Impact Statement (USACE 2011) that was further modified in the Supplemental Environmental Assessment (USACE 2013). The FRP is presented as the Project within this Environmental Impact Statement.

Final Scoping Decision Document (FSDD): A companion to the Scoping EAW prepared for the Project. The purpose of a FSDD is to identify those project alternatives and environmental impact issues that would be addressed in the Environmental Impact Statement. The FSDD also presents a tentative schedule of the environmental review process. The State FSDD was completed on February 10, 2014.

Flap Gates: Gates that prevent water from backing up out of the diversion channel after the local peaks have passed.

Flood: A general and temporary condition of partial or complete inundation of two or more acres of normally dry land area or of two or more properties (at least one of which is the policyholder's property) from:

- Overflow of inland or tidal waters; or

- Unusual and rapid accumulation or runoff of surface waters from any source; or
- Mudflow. (https://www.fema.gov/national-flood-insurance-program/definitions)

Flood Crest Elevation: The highest stage or level of a flood as it passes a particular location. Gages along a river record the level of water, and the highest level record at each gage is the crest for that gage.

Flood Risk: The chance of an area to flood.

Flood Stage: An established gage height for a given location above which a rise in water surface level begins to create a hazard to lives, property, or commerce. The issuance of flood advisories or warnings is linked to flood stage. Not necessarily the same as bankfull stage.

Floodplain: Any land area susceptible to being inundated by flood waters from any source.

Floodplain Forest: A lowland forest deciduous habitat, included as a separate Type 1 wetland cover type.

Floodproofing: Any combination of structural and nonstructural additions, changes or adjustments to structures, which reduce or eliminate risk of flood damage to real estate or improved real property, water and sanitation facilities or structures with their contents.

Floodwalls: A wall built along a shore or bank to protect an area from floods.

Flowage Easement: A flowage easement provides the legal ability to inundate property as part of the operation of the Project. Value of a flowage easement on an individual property would follow the Federal/United States Army Corps of Engineers (USACE) process and would be determined by appraisal. Factors that would be considered are depth, duration, frequency of additional flooding, and the highest and best use of the property. USACE policy defines a flowage easement as a one-time payment made at the time that the easement is acquired.

Fluvial Geomorphology: The study of steam channels, substrate, bank stability, flow characteristics and features or events influential in altering the river and its floodplain.

Formal Section 7 Consultation: The Endangered Species Act directs all federal agencies to work to conserve endangered and threatened species and to use their authorities to further the purposes of the Act. Section 7 of the Act, called "Interagency Cooperation," is the mechanism by which Federal agencies ensure the actions they take, including those they fund or authorize, do not jeopardize the existence of any listed species. **(**http://www.fws.gov/midwest/endangered/section7/section7.html**)**

Freeboard: An additional amount of height above the Base Flood Elevation (BFE) used as a factor of safety (e.g., 2 feet above the Base Flood) in determining the level at which a structure's lowest floor must be elevated or flood proofed to be in accordance with state or community floodplain management regulations.

General Use Threshold: Waters with good fish and invertebrate communities that meet or should meet minimum goals.

Glochidia: Larvae expelled from a female mussel, which find a host fish where they attach to fish gills or fins.

Headcutting: the process of a stream to create an erosional feature where an abrupt vertical drop occurs, which typically resembles a very short cliff or bluff. If left to natural processes, the headcut would likely migrate upstream.

Historic Building: Any building that is:

- Listed individually in the National Register of Historic places (a listing maintained by the Department of the Interior) or preliminarily determined by the Secretary of the Interior as meeting the requirements for individual listing on the National Register; or
- Certified or preliminarily determined by the Secretary of the Interior as contributing to the historical significance of a registered historic district or a district preliminarily determined by the Secretary of the Interior to qualify as a registered historic district; or--Individually listed in a state inventory of historic places in states with preservation programs that have been approved by the Secretary of the Interior; or--Individually listed on a local inventory of historic places in communities with historic preservation programs that have been certified either:
  - By an approved state program as determined by the Secretary of the Interior; or
  - Directly by the Secretary of the Interior in states without approved programs.

Historic Property: Any prehistoric or historic district, site, building, structure, or object included in, or eligible for inclusion in, the National Register of Historic Places maintained by the Secretary of the Interior. This term includes artifacts, records, and remains that are related to and located within such properties. The term includes properties of traditional religious and cultural importance to an Indian tribe that meet the National Register criteria (36 CFR 800.16(l)(1)).

Hydrology: The science dealing with the origin, distribution, and circulation of waters of the earth such as rainfall, streamflow, infiltration, evaporation, and groundwater storage.

Impact: Any change to the environment, whether adverse or beneficial, resulting from an activity (can be direct or indirect).

Impacted Areas: A location that would experience change to the environment, whether adverse or beneficial, resulting from the Project.

Impervious Surfaces: Mainly artificial surfaces—such as pavements (roads, sidewalks, driveways and parking lots) that are covered by impenetrable materials such as asphalt, concrete, brick, and stone--and rooftops. (http://encyclopedia.thefreedictionary.com/Impervious+surface)

In-Town Levees: Floodwalls and levees located in the cities of Fargo, North Dakota and Moorhead, Minnesota.

Index of Biotic Integrity (IBI): The stream IBI integrates information from individual, population, community, and ecosystem levels into a single ecologically based index of water resource quality (Karr, 1981). The IBI is a numerical index that is comprised of various measures of the biological community (called metrics) that are assigned a score (typically 0-10) based on their deviation from reference and summed to provide an integrative expression of site condition. It has been used to express the condition of fish, macroinvertebrate, algal, and terrestrial assemblages throughout the U.S. and in each of five major continents. (http://www.pca.state.mn.us/index.php/view-document.html?gid=21164)

Infrastructure: The basic equipment and structures necessary for economic activity and development. Public infrastructure includes roads, power and water supplies, and other structures that provide utility, such as pipelines, bridges, and buildings.

Inundation: To flood, cover, or overspread with water. (http://www.merriam-webster.com/dictionary/inundation)

Inundation Area: Applies to any flooded area, regardless of depth, under existing, Project or Northern Alignment Alternative (NAA) conditions within the project area.

Invasive Species: A broad term used to define animal or aquatic plant species that is non-native and have been found to be invasive, under the federal definition or are regulated under invasive species law, to the ecosystem under consideration and whose introduction causes or is likely to cause economic or environmental harm or harm to human health (Executive Order 13112, Appendix 1, 1999) and encompasses all species, including plants and animals, terrestrial or aquatic.

Junk Vehicles: An abandoned, non-functional vehicle.

Jurisdictional: The United States Army Corps of Engineers (USACE) determines jurisdiction by documenting: connections of waters and wetlands to downstream navigable waters; interstate commerce connections; and adjacency of wetlands to other waters. Waters of the United States are protected under the Clean Water Act of 1972.

Key Habitat: Those habitats that are most important to Minnesota's Species of Greatest Conservation Need (SGCN) and are identified with discrete ecological boundaries. Specifically, those habitats 1) used by the greatest number of SGCN, 2) changed the most over the past 100 years, 3) having a high percentage of habitat specialist SGCN, or 4) having been identified as important stream segments by The Nature Conservancy. Key Habitats are equivalent to Landscape Components in North Dakota.

Keystone Species: A plant or animal species that plays a unique and crucial role in the way an ecosystem functions. Without keystone species, the ecosystem would be dramatically different or cease to exist altogether. (http://education.nationalgeographic.org/encyclopedia/keystone-species/)

Lands and Damages, and Construction Costs: Expenses related to land acquisitions, damage compensation, and construction of the Project and as applicable to Project alternatives.

Landscape Component: Areas in North Dakota that historically support Species of Conservation Priority and are identified with discrete ecological boundaries. Landscape Components are equivalent to Key Habitats in Minnesota.

Left-Bank: Left side of a stream channel when facing downstream.

Less Than Significant Effect: An effect that is predicted to be below an identified threshold and/or an effect that was determined by the lead agencies to not have a magnitude that is great based on the context and intensity of that effect.

Letter of Map Revision (LOMR): An official amendment to the currently effective Federal Emergency Management Agency (FEMA) map. It is issued by FEMA and changes flood zones, delineations and elevations. (https://www.fema.gov/letter-map-revision)

Levee: An embankment or structure used to prevent flood waters from affecting a specific location. (http://www.merriam-webster.com/dictionary/levee)

Level I Species: Species having a high level of conservation priority because of declining status either in North Dakota or across their range; or a high rate of occurrence in North Dakota constituting the core of the species' breeding range, but are at-risk range wide, and funding other than State Wildlife Grants is not readily available to them. (http://gf.nd.gov/magazines/north-dakota-species-conservation-priority/level-1)

LiDAR: Light Detection and Ranging (LiDAR) is a remote sensing technology that collects 3-dimensional point clouds of the Earth's surface. The technology is used for a wide range of applications including high-resolution topographic mapping and 3-dimensional surface modeling as well as infrastructure and biomass studies. (https://lta.cr.usgs.gov/LIDAR)

Lithophile: Simple lithophilic spawners are fish that require clean coarse substrates for spawning. Their absence or low numbers indicates the quality of the substrates is degraded, likely due to siltation. (Konrad Schmidt and Philip Talmage. Minnesota Department of Natural Resources. Special Publication No. 156, Oct 2001. "Fish Community Surveys of Twin City Metropolitan Streams")

Littoral Zone: The portion of a lake that is less than 15 feet in depth (MNDNR/MPCA); extends from the shoreline of a lake and continues to depth where sufficient light for plant growth reaches the sediments and lake bottom (University of Minnesota Extension).

Locally Preferred Plan (LPP): The LPP is the plan that, in the opinion of the non-Federal sponsors, best met the needs of the local community. The LPP was presented as the ND20K Diversion in the Final Feasibility Report/Environmental Impact Statement (FFREIS) (USACE 2011) and became the USACE's Selected Plan during the development of the FFREIS. The Supplemental Environmental Assessment (USACE 2013) identified the LPP (the Selected Plan) as the Federally Recommended Plan (FRP) for the USACE which was modified and further evaluated in the Supplemental Environmental Assessment (USACE 2013) as the Southern Alignment Alternative. The Project has since has been further modified during the earlier development of the Minnesota environmental impact statement (EIS) and is presented as the Project in this EIS.

Local Sponsor: Synonymous with "non-Federal sponsor" or "non-Federal interest", the preferred term being "non-Federal sponsor" by the United States Army Corps of Engineers (USACE). The USACE defines the "non-Federal sponsor" as a 1) a legally constituted public body (including a federally-recognized Indian tribe); or 2) a nonprofit entity with the consent of the affected local government that has full authority and capability to perform the terms of its agreement and to pay damages, if necessary, in the event of failure to perform. As of the production of this EIS, the "non-Federal sponsors" are the City of Moorhead, City of Fargo, and Flood Diversion Board of Authority.

Macroinvertebrate: An animal without a backbone living in one stage of its life cycle, usually the nymph or larval stage, that can be seen with the naked eye.

Map Revision: A change in the Flood Hazard Boundary Map (FHBM) or Flood Insurance Rate Map (FIRM) for a community which reflects revised zone, base flood or other information. (Federal Emergency Management Agency)

Meander: Turn or winding of a stream. (http://www.merriam-webster.com/dictionary/meander)

Mobility: The ability to move or be moved freely and easily.

Minnesota Pollution Control Agency Index of Biotic Integrity (IBI) Metric: multiple measures of a biological community which reflect aspects of the structure, function, or some other measurable characteristic of the biotic community that responds in a predictable manner to stressors **(**http://www.pca.state.mn.us/index.php/view-document.html?gid=6882**)** (Fausch, K.D., J. Lyons, J.R.

Karr, and P.L. Angermeier. 1990. Fish communities as indicators of environmental degradation. American Fisheries Society Symposium 8:123-144)

Mortality: Death as a result of construction or operation of the Project.

National American Vertical Datum (NAVD) of 1988: A vertical datum is the starting point for measuring elevations. Datums help determine the height differences between points in the ground. There are five different vertical datums at various bench marks across the earth—NAVD88 is one of the five bench marks datums and stands for the North American Vertical Datum of 1988. (National Oceanic and Atmospheric Administration and Federal Emergency Management Agency)

National Flood Insurance Program (NFIP): The program of flood insurance coverage and floodplain management administered under the Act and applicable federal regulations promulgated in Title 44 of the Code of Federal Regulations, Subchapter B. (Federal Emergency Management Agency)

National Geodetic Vertical Datum (NGVD) of 1929: National standard reference datum for elevations, formerly referred to as Mean Sea Level (MSL) of 1929. NGVD 1929 may be used as the reference datum on some Flood Insurance Rate Maps (FIRMs). (Federal Emergency Management Agency)

National Heritage Database: A database containing information on rare plants, animals, native plant communities, and other rare features. (http://www.dnr.state.mn.us/nhnrp/nhis.html)

National Pollutant Discharge Elimination System /State Disposal System (NPDES/SDS) Permit: An NPDES/SDS Permit is a document that establishes the terms and conditions that must be met when a facility discharges wastewater to surface or groundwater of the state. The permit is jointly issued under two programs. The NPDES is a federal program established under the Clean Water Act, aimed at protecting the nation's waterways from point and nonpoint sources. In Minnesota, it is administered by the Minnesota Pollution Control Agency (MPCA) under a delegation from the United States Environmental Protection Agency (USEPA). The SDS is a state program established under Minnesota Statutes 2008, section 115. In Minnesota, when both permits are required they are combined into one NPDES/SDS Permit administered by the state. The permits are issued to permittees discharging to a surface water of the state.

Natural Levees: A deposit of sand or mud built up along, and sloping away from, either side of the floodplain of a river or stream. (http://dictionary.reference.com/browse/natural+levee)

Newly Inundated: Applies to areas that do not flood under existing conditions, but are predicted to flood under Project or NAA conditions.

No Action Alternative (with Emergency Measures): Similar to the Base No Action Alternative, but also assumes that emergency measures currently being pursued in the project area would continue to be implemented as necessary due to flooding. Emergency measures, include, but are not limited to, sandbagging and temporary levees.

Non-Federal Sponsor: The United States Army Corps of Engineers (USACE) defines the "non-Federal sponsor" as a 1) a legally constituted public body (including a federally recognized Indian tribe); or 2) a nonprofit entity with the consent of the affected local government that has full authority and capability to perform the terms of its agreement and to pay damages, if necessary, in the event of failure to perform. As of the production of the environmental impact statement, the "non-Federal sponsors" are the City of Moorhead, City of Fargo, and Flood Diversion Board of Authority.

Non-Residential Building (including hotel/motel): This is a commercial or non-habitational building or a mixed-use building that does not qualify as a residential building. This category includes but is not limited to: small businesses, churches, schools, farm buildings (including grain bins and silos), garages, pool houses, clubhouses, recreational buildings, mercantile buildings, agricultural and industrial buildings, warehouses, nursing homes, licensed bed and breakfasts and hotels and motels with normal room rentals for less than six months. (Federal Emergency Management Agency)

Non-Structural Features: Features or measures used to reduce flood risk or provide mitigation, such as buyout, relocation, or raising individual structures. Non-structural features modify the structures being impacted by floods rather than modifying the flooding itself.

Non-Degradation Standards: Minnesota water quality standards (Minnesota Rules, part 7050) include four general components: beneficial uses; numeric standards; narrative standards; and nondegradation. The nondegradation standards provide extra protection for high quality or unique waters and outstanding resource value waters (ORVW) to keep them from being degraded.

Noxious weed: A specific regulatory definition applied to invasive plant species. Noxious weeds refer to invasive/non-native terrestrial plant species regulated by local and state noxious weed laws. **OHB Ring Levee:** See City of Oxbow, Village of Hickson, and Bakke Subdivision (OHB) Levee.

Operation and Maintenance (O&M) Plan: Activities performed in accordance with the Operation, Maintenance, Repair, Rehabilitation, and Replacement (OMRR&R) Manual to operate, maintain and inspect all components of the Project.

Operation, Maintenance, Repair, Rehabilitation, and Replacement (OMRR&R) Manual: A document providing specific standards and requirements for operation, maintenance, repair, rehabilitation and replacement of the Project that would be developed by the United States Army Corps of Engineers (USACE) prior to Project operation. This manual would be followed by the non-Federal sponsor for the life of the Project.

Orifice: an opening in a wall or dam through which flow occurs. Orifices may be used to measure or control rates of flow.

Outfall: The discharge point of a waste stream into a body of water; alternatively it may be the outlet of a river, drain or a sewer where it discharges into a lake or other body of water.

Overflow Embankment: The structure to be constructed south of the diversion inlet control structure along Cass County Highway 17 at an elevation lower than the east/west portion of the dam. This portion of the dam would act as an emergency spillway for extreme events that exceed the 0.2-percent chance flood (i.e., 500-year flood) event design capacity of the Project. An overflow embankment structure would be included as part of the Northern Alignment Alternative as well. Design plans were not available during the development of the EIS, therefore not all direct and indirect impacts have been evaluated at this time.

Oxbow: A place where a river curves in the shape of a “U.” (http://www.merriam-webster.com/dictionary/oxbow)

Oxbow Basin: A place where a river curved in the shape of a “U” and then was cut off from the current river channel, forming a U-shaped depression.

Passage: The ability for fish and other aquatic organisms to migrate upstream or downstream, on rivers and tributaries.

Phase I Cultural Resources Survey: An archaeological survey conducted to locate and identify all archaeological sites within a survey area, estimate size and boundaries of identified sites, evaluate potential site significance and recommend treatment of identified sites.

Phase II Cultural Resources Evaluation: Further investigates a specific site identified in the Phase I survey, including site-specific archival research, intensive surface survey, site mapping and possibly excavation of test units for the purpose of evaluating that site's eligibility to the National Register of Historic Places.

Phase III Cultural Resources Mitigation: Typically involves data recovery of a National Register of Historic Places (NRHP) eligible site or other archaeologically important site that would be adversely impacted by a project. For NRHP-eligible architectural properties (buildings and structures), mitigation typically involves scaled drawings (elevations, planviews, cross-sections), large-format photographs (four inch by five inch negatives), and a detailed history of the building or structure.

Phase I Environmental Site Assessment (ESA): An investigation of a parcel of land and its associated structures for potential environmental issues.

Phase II Environmental Site Assessment (ESA): Provides a more detailed investigation, which involves chemical analysis of soil and groundwater to detect the presence of hazardous substances and/or petroleum hydrocarbons.

Piscivorous: Feeding on fishes. (http://www.merriam-webster.com/dictionary/piscivorous)

Planform: The outline of an object when viewed from above.

Pool-Riffle System: Deep and shallow portions of an undulating stream bed. Pools are most easily seen in a meandering stream where the outer edge of each meander loop is deep and undercut; riffles form in the shallow water of the short, straight, wide reaches between adjacent loops. The pools and riffles form sequences spaced at a repeating distance of about five to seven widths of the channel and often appear in stream development long before the stream produces visible meanders. These patterns are thought to be associated with a form of wave phenomenon and may be initiated by a single gravel patch in a channel; the first channel deviation requires an overcompensation of counter-deviation and sets off a chain reaction type of development. Pools and riffles are present in nearly all perennial channels where the size of the bed material is greater than coarse sand, and they are relatively stable in their position along the channel. At low water stages, the pools generally have a smooth surface while the riffles may show white water. Rapids, similar formations that show white water at all stages of flow, are common in bedrock channels, are generally composed of boulders, and are more random in distribution along channel. (http://www.britannica.com/science/pool-and-riffle)

Preferred Alternative: The United States Army Corps of Engineers (USACE) and Diversion Authority’s desired project (discussed as the Project in this Environmental Impact Statement (EIS) that meets the purpose and need, is feasible, and gives consideration of the effects to the environment. The Federal Council of Environmental Quality regulations require federal agencies to identify an agency-preferred alternative in the federal environmental review process. The Minnesota State EIS process does not identify a preferred alternative, but rather includes a proposed project, and applicable project alternatives for evaluation. This term is used in the federal environmental review process. The Minnesota State environmental impact statement does not identify a preferred alternative, but rather includes the Proposed Project and applicable Project alternatives.

Project: The Fargo-Moorhead Metropolitan Area Flood Risk Management Project, as currently designed at the time of the State EIS publication, includes the Project footprint and associated components, and the staging area.

Project Footprint: Comprised of the diversion channel, connecting channel, excavated material berms, shallow drainage ditches outside of the berms, tieback embankment, overflow embankment, control structures in the Red and Wild Rice Rivers, and aqueducts structures in the Maple and Sheyenne Rivers.

Propagules: A vegetative structure (e.g., a bud, sucker, or spore) that can become detached from a plant and give rise to a new plant (i.e., reproductive material).

Protected Area: The area within which flood risk is reduced, such as downstream of the tieback embankment (the F-M urban area) or within the Oxbow/Hickson/Bakke (OHB) ring levee.

Recognized Environmental Condition (REC): The presence or likely presence of any hazardous substances or petroleum products in, on, or at a property that have the potential to release into the environment, and therefore, pose a threat due to the potential for contamination of soil, groundwater, or surface water. (American Society for Testing and Materials (ASTM) 2013)

Red River Basin Commission (RRBC): An organization whose mission is to develop a Red River Basin integrated natural resources framework plan; to achieve commitment to implement the framework plan; and to work toward a unified voice for the Red River Basin. The RRBC has offices in Moorhead, Minnesota, and Winnipeg, Manitoba. The RRBC is not a local government unit. (http://www.redriverbasincommission.org/index.html)

Residual Risk: Exposure to loss that remains after structural or non-structural flood management measures have been countered, factored in. (http://www.businessdictionary.com/definition/residual-risk.html)

Return Period: The average number of years between floods of a certain size is the recurrence interval or return period. The actual number of years between floods of any given size varies a lot because of natural variability. (https://water.usgs.gov/edu/100yearflood.html)

Right Bank: Right side of stream channel when facing downstream.

Ring Levee: An embankment that is designed to surround a feature or specific area for preventing flooding to a given area. (http://www.merriam-webster.com/dictionary/levee)

Riparian Floodplain: A bottomland, deciduous or deciduous-conifer forest community occupying low-lying areas adjacent to streams and rivers of third order or greater, and subject to periodic over-the-bank flooding and cycles of erosion and deposition (i.e., floodplain forest).

Rock-ramps: A passage for surplus water to run over or around an obstruction (as a dam) created with rocks.

Rosgen Level II: A classification described as a morphological description of Stream types A1-A6 to G1-G6 developed by Dave Rosgen. (http://www.fgmorph.com/fg_4_21.php)

Rosgen Level III: A classification described as a Stream State or condition for Stream Types earlier characterized in Level 2 as developed by Dave Rosgen. (http://www.fgmorph.com/fg_4_22.php)

Schumm Stream Classification: Nine subclasses of river channels defined on the basis of channel stability and the dominant mode of sediment transport developed by S.A Schumm. (http://pubs.usgs.gov/circ/1963/0477/report.pdf)

Sensitive Species: Those species which are often the first to decline in environments that experience anthropogenic disturbance and associated environmental stressors (Sandberg, 2014).

Shear Stress: The force applied by flowing water parallel to the stream bed (or bank). (http://www.phillywatersheds.org/what_were_doing/waterways_assessment/FGM)

Sheyenne River Diversion: A system of two existing diversion channels that divert the Sheyenne River around Horace and West Fargo, North Dakota. (http://www.westfargond.gov/Home/Departments/PublicWorks/FloodInformation/SheyenneDiversion.aspx)

Significant effect: An effect that is predicted to be above an identified threshold and/or an effect that was determined by the lead agencies to have a magnitude that is great based on the context and intensity of that effect.

Significant Nexus: A connection affecting the biological integrity of an adjacent federal navigable water.

Sinuous: A stream pattern that appears to meander back and forth along its corridor in a wavy form. (http://www.merriam-webster.com/dictionary/sinuous)

Special Flood Hazard Area (SFHA): An area having special flood, mudflow or flood-related erosion hazards and shown on a Flood Hazard Boundary Map (FHBM) or a Flood Insurance Rate Map (FIRM) Zone A, AO, A1-A30, AE, A99, AH, AR, AR/A, AR/AE, AR/AH, AR/AO, AR/A1-A30, V1-V30, VE or V. For the purpose of determining Community Rating System (CRS) premium discounts, all AR and A99 zones are treated as non-SFHAs. (FEMA)

Species of Special Concern: Although the species is not categorized as endangered or threatened, it is extremely uncommon in Minnesota, or has unique or highly specific habitat requirements and deserves careful monitoring of its status. May include species that were once threatened or endangered but now have increasing or protected, stable populations.

Spoil Piles: excavated materials consisting of topsoil or subsoils that have been removed and temporarily stored during the construction activity. (https://www.michigan.gov/documents/deq/deq-wb-nps-sp_250905_7.pdf)

Staging Area: A defined area immediately upstream of the dam. When the Project is operated, water would be temporarily detained in the staging area to minimize impacts downstream. The staging area encompasses the area where the Project increases the 100-year flood water surface elevation by approximately one foot or more over existing conditions and encroachment must be prevented to preserve operability of the Project. The staging area is a Project component that is being used as a management tool for land use/development and application of mitigation by the United States Army Corps of Engineers (USACE), such as property acquisition, easements, and programmatic agreements, and it does not constitute the total area affected by Project operation.

Taxa: Species.

Temporal Loss: The time it takes to re-establish vegetation, such as floodplain, that was lost due to disturbance. Temporal loss is greater the longer it takes to re-establish previously established vegetation.

Threatened Species: Those likely to become endangered in the foreseeable future throughout all or a significant portion of its range within Minnesota.

Tieback Embankment: The embankment constructed between the diversion inlet control structure, the Wild Rice River control structure, the Red River control structure and high ground in Minnesota.

Tolerant: Species that can withstand a broader range of diversity conditions in comparison to a sensitive species. (http://www.epa.gov/caddis/pecbo_intro4.html)

Turbidity: The measure of the relative clarity of a liquid. (https://water.usgs.gov/edu/turbidity.html)

Uncontrolled Inlets: Inlets without flap gates.

Wadeable Stream: Streams, creeks and small rivers that are shallow enough to be sampled using methods that involve wading into the water. They typically include waters classified as 1st through 4th order (and sometimes 5th) in the Strahler Stream Order classification system (based on the number of tributaries upstream). (http://water.epa.gov/type/rsl/monitoring/streamsurvey/web_qa_06.cfm#1)

Waters of the State: Waters of the State for Minnesota regulatory agencies are defined in Minnesota Statute 2008, section 115.01, subdivision 22 as "*all streams, lakes, ponds, marshes, watercourses, …and all other bodies or accumulations of water…which are within…the state or any portion thereof..*" also referred to as Public Waters.

Watershed: A geographic area from which water is drained by a river and its tributaries to a common outlet. A ridge or drainage divide separates a watershed from adjacent watersheds.

Weir: A low wall or dam built across a stream or river to raise the level of the water or to change the direction of its flow.

Wetlands: Lands transitional between terrestrial and aquatic systems where the water table is usually at or near the surface or the land is covered by shallow water.

Executive Summary

Table of Contents

Introduction **ES-1**

Environmental Review Process **ES-3**

Environmental Impact Statement Participants/Preparers **ES-7**

Description of the Proposed Project **ES-8**

Description of the No Action Alternatives **ES-24**

Alternatives Considered and Evaluated in the Environmental Impact Statement **ES-25**

Summary of Major Differences Between Alternatives **ES-30**

Proposed and Recommended Mitigation and Monitoring **ES-37**

Areas of Controversy and Issues Yet to be Resolved **ES-61**

Permits and Approvals **ES-65**

Organization and Content of the Environmental Impact Statement **ES-68**

Tables

ES Table 1 Summary of Environmental and Socioeconomic Impacts Between EIS Alternatives ES-31
ES Table 2 Summary of Hydrology and Hydraulics Proposed and Recommended Mitigation and Monitoring ES-39
ES Table 3 Summary of FEMA Regulations and the CLOMR Process Proposed and Recommended Mitigation and Monitoring ES-40
ES Table 4 Summary of Stream Stability Proposed and Recommended Mitigation and Monitoring ES-42
ES Table 5 Summary of Forested Wetlands Proposed and Recommended Mitigation and Monitoring ES-44
ES Table 6 Summary of Non-Forested Wetlands Proposed and Recommended Mitigation and Monitoring ES-46
ES Table 7 Summary of OHB Levee Wetlands Proposed and Recommended Mitigation and Monitoring ES-46
ES Table 8 Summary of Inundation Area Wetlands Proposed and Recommended Mitigation and Monitoring ES-47
ES Table 9 Summary of Cold Weather Impacts on Aqueducts Function and Biotics Proposed and Recommended Mitigation and Monitoring ES-47
ES Table 10 Summary of Cover Types Proposed and Recommended Mitigation and Monitoring ES-47
ES Table 11 Summary of Potential Environmental Hazards Proposed and Recommended Mitigation and Monitoring ES-48

ES Table 12 Summary of Fish Passage and Biological Connectivity Proposed and Recommended Mitigation and Monitoring ES-49
ES Table 13 Summary of Wildlife and Wildlife Habitat Proposed and Recommended Mitigation and Monitoring ES-51
ES Table 14 Summary of State-Listed Species and Special Status Species Proposed and Recommended Mitigation and Monitoring ES-51
ES Table 15 Summary of Invasive Species Proposed and Recommended Mitigation and Monitoring ES-52
ES Table 16 Summary of Cultural Resources Proposed and Recommended Mitigation and Monitoring ES-53
ES Table 17 Summary of Infrastructure and Public Services Proposed and Recommended Mitigation and Monitoring ES-54
ES Table 18 Summary of Land Use Plans and Regulations Proposed and Recommended Mitigation and Monitoring ES-55
ES Table 19 Summary of Minnesota Dam Safety Regulations and Permitting Proposed and Recommended Mitigation and Monitoring ES-56
ES Table 20 Summary of Socioeconomics Proposed and Recommended Mitigation and Monitoring ES-56
ES Table 21 Permit and Approvals ES-65

Figures

ES Figure 1 Project Location Map ES-2
ES Figure 2 Project Features ES-11
ES Figure 3 Oxbow/Hickson/Bakke Ring Levee Plan ES-19

Diagrams

ES Diagram 1 Environmental Impact Statement Process ES-3

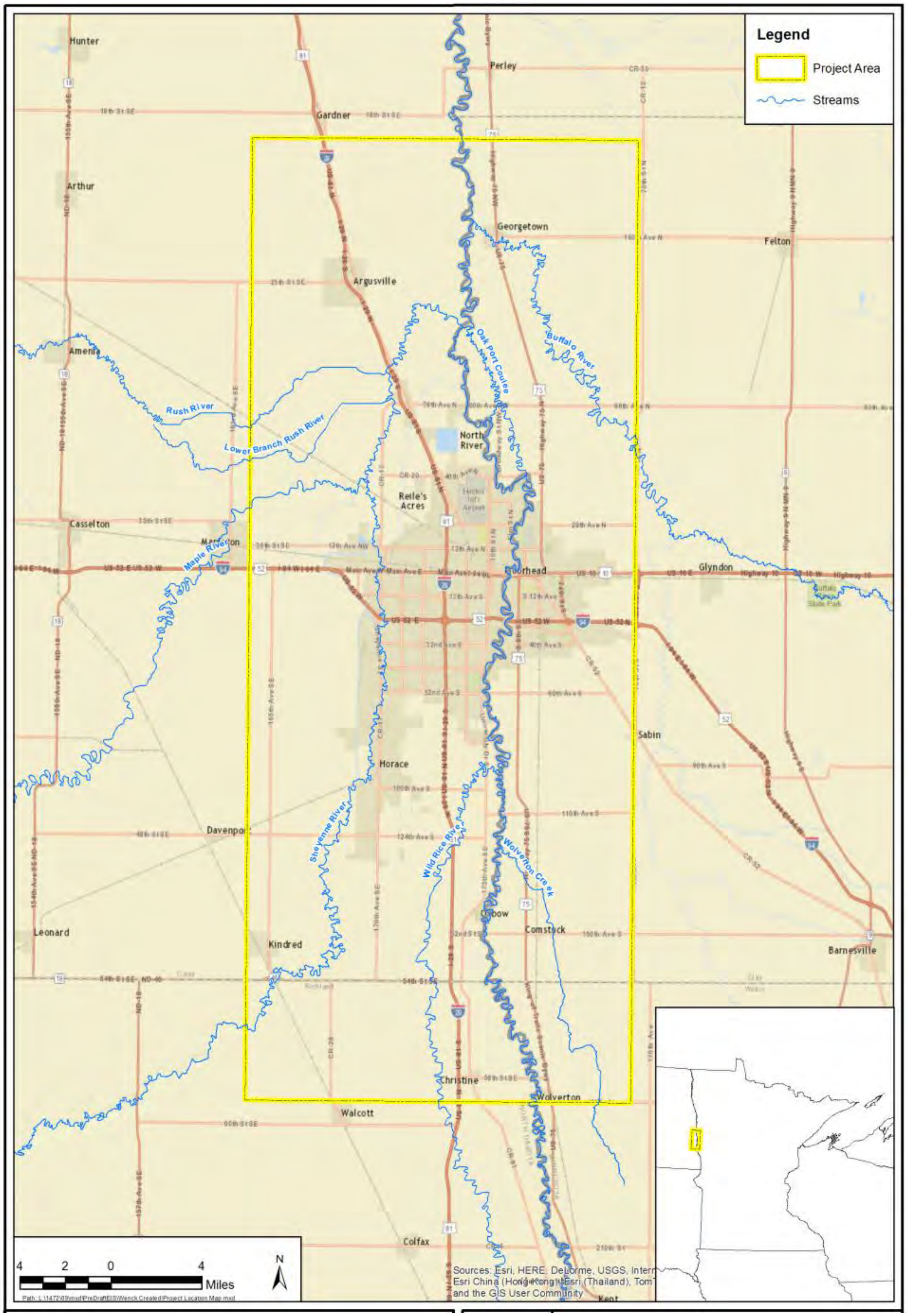
Illustrations

ES Illustration 1 Control Structure Design for the Red River ES-13
ES Illustration 2 Diversion Inlet Control Structure ES-13
ES Illustration 3 Diversion Channel Design ES-15
ES Illustration 4 Diversion Outlet Structure ES-16
ES Illustration 5 Diversion Channel Cross Section ES-16
ES Illustration 6 Maple and Sheyenne Rivers Aqueduct Design ES-17
ES Illustration 7 Rush River Rock Ramp Design ES-18

Introduction

The Flood Diversion Board of Authority (Diversion Authority) is proposing to construct the Fargo-Moorhead Flood Risk Management Project (Project) with an estimated cost of $1.8 billion (October 2011 dollars). The Project is an approximately 30-mile long diversion channel on the North Dakota side of the Fargo-Moorhead (F-M) urban area (cities of Fargo, Moorhead, and surrounding high-population density cities), including a 6-mile long connecting channel, an overflow embankment, and tieback embankment with control structures on the Wild Rice River and Red River. The Project also consists of environmental mitigation projects, which would be located inside and outside the project area (ES Figure 1). When operated, the Project would divert a portion of the Red River flow upstream of the F-M urban area, intercept flow at the Wild Rice, Sheyenne, Maple, Lower Rush and Rush Rivers, and return it to the Red River downstream of the F-M urban area. Project operation would result in an approximately 32,000-acre upstream staging area. Because the Project includes the construction of a Class I dam (i.e., embankment system and control structures), an environmental impact statement (EIS) is required under Minnesota Rules, part 4410.4400, subpart 18.

This Executive Summary (ES) describes the process of developing the EIS, including other alternatives to the Project that were considered based on evaluation criteria, environmental analysis, and in accordance with Minnesota Rules, part 4410.2300. The ES provides an overview of the Project, its alternatives, potential environmental and socioeconomic effects, and mitigation and monitoring measures proposed or recommended to minimize potential environmental impacts.



ES Figure 1 Project Location Map

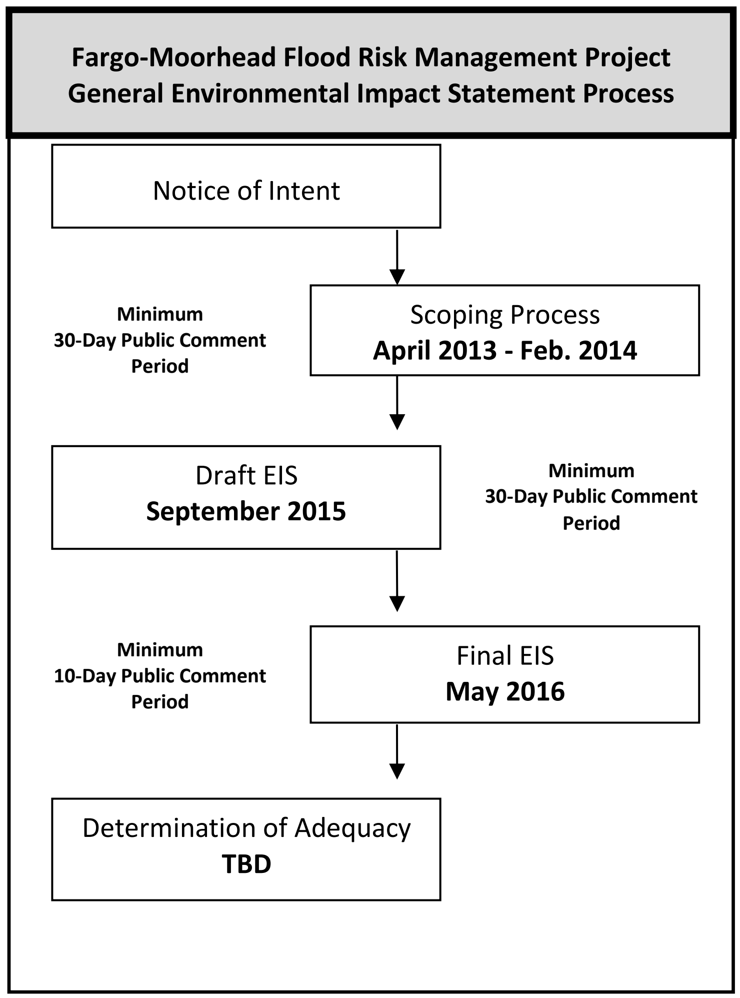
Environmental Review Process

What is the need for this Environmental Impact Statement?

An EIS is mandatory for the Fargo-Moorhead Flood Risk Management Project (Project) pursuant to Minnesota Rules, part 4410.4400, subpart 18, which requires preparation of an EIS for proposed construction of a Class I dam. The control structures and embankment features of the Project meet the definition of a Class I dam under Minnesota Dam Safety program rules (Minnesota Rules, part 6115.0340). Any embankment upstream of the control structure that is at or below the elevation of the top of the dam and impounds water due to the presence of the control structure would be considered to be part of the dam.

The Minnesota Department of Natural Resources (MNDNR), as the Responsible Governmental Unit (RGU), has prepared an EIS to evaluate the proposed project in accordance with the Minnesota Environmental Policy Act (MEPA), Minnesota Statutes, section 116D. This EIS was developed to meet applicable requirements of Minnesota Rules, part 4410 (Environmental Quality Board; Environmental Review Program) that govern Environmental Review in Minnesota.

ES Diagram 1 Environmental Impact Statement Process



The purpose of an EIS is to:

- Evaluate the project's potentially significant environmental effects;
- Consider reasonable alternatives;
- Explore mitigation measures for reducing adverse effects;
- Provide information to the public and project decision-makers; and
- To aid in making permit decisions.

The EIS is intended to provide information to units of government on the environmental and socioeconomic impacts of a proposed project before approvals or necessary permits decisions are made and to identify measures necessary to avoid, reduce, or mitigate adverse environmental effects. The EIS is not a means to approve or disapprove a project; however, the EIS needs to be completed and determined to be adequate prior to permit approvals.

Minnesota Rules require that an EIS include at least one alternative of each of the following types, or provide an explanation of why no alternative is included in the EIS (Minnesota Rules, part 4410.2300, item G): alternative sites, alternative technologies, modified designs or layouts, modified scale or magnitude, and alternatives incorporating reasonable mitigation measures identified through public comments. The alternative of no action is also required to be addressed in the EIS. The Project alternatives are evaluated in the EIS.

What is the public's role in this environmental review process?

Public comment periods are included as part of the EIS process that allow public and local governments the opportunity to participate in the EIS process. This Final EIS was published and circulated in accordance with the rules and requirements of Minnesota Rules (EQB Rules), part 4410. Citizens, organizations, tribal entities, and government entities are given a comment period (slightly over 30 days) in which to submit written comments on the Fargo-Moorhead Flood Risk Management Project Draft EIS. Additionally, a public meeting was held in Moorhead, Minnesota on October 14, 2015 to present information on the Draft EIS, answer questions, and provide a forum for oral and written public comments. Substantive comments received have been taken into account in assessing potential Project impacts and potential mitigation for the EIS. Responses to substantive comments have been prepared and are included in the Final EIS. The MNDNR will receive comments on the adequacy of the EIS during a second, minimum 10-day public comment period, after which, the MNDNR will make a determination of EIS adequacy.

Environmental Impact Statement Development

MNDNR, as the Responsible Governmental Unit (RGU), developed and prepared this EIS, which evaluated the Project in accordance with the Minnesota Environmental Policy Act (MEPA) (Minnesota Statutes 2008, section 116D), and the rules governing the environmental review process, included in Minnesota Administrative Rules, part 4410. Utilization of the existing federally prepared environmental review documents was done as required by Minnesota Rules, part 4410.3900, subpart 3, which allows for the substitution of federal documents for state environmental review documents, insofar as the applicable documents satisfy the state level environmental review information needs as established through Minnesota Rules, part 4410 and the EIS scoping process.

In July 2011 the USACE, with cooperation from the City of Fargo and the City of Moorhead (non-Federal sponsors), issued a Final Feasibility Report and Environmental Impact Statement (FFREIS) for the Project. The USACE's Record of Decision (ROD) was issued in April 2012. The USACE designated the Locally Preferred Plan (LPP) as its Selected Plan, or Federally Recommended Plan. The MNDNR submitted comments on the federal Draft EIS, federal Supplemental Draft EIS and the FFREIS.

In April 2013, the MNDNR issued the Scoping Environmental Assessment Worksheet (SEAW) and Draft Scoping Decision Document (DSDD) for the Project (ES Diagram 1). Public review of and comment on the Scoping EAW and DSDD was conducted in accordance with Minnesota Rules, part 4410.2100. The scoping documents were made available for public comment from April 15 to May 15, 2013, with a notice of availability in the April 15, 2013, EQB *Monitor*. A public information meeting was held in Moorhead on May 8, 2013. The comments received during the scoping period were considered in making revisions to the DSDD prior to the MNDNR issuing the Final Scoping Decision Document (FSDD) on February 2014.

In September 2015, the MNDNR issued the Draft EIS for the Project (ES Diagram 1). Public review and comment on the Draft EIS was conducted in accordance with Minnesota Rules, part 4410.2600. The Draft EIS was made available for public comment from September 14 through October 28, 2015, with a notice of availability in the September 14, 2015 EQB *Monitor*. A public information meeting was held in Moorhead on October 14, 2015. Comments received during the Draft EIS comment period were considered when completing the Final EIS. Responses to substantive comments are included as Appendix L.

The FSDD serves as the "blueprint" for preparing the EIS for the Project. The FSDD defines what topics have been adequately addressed in previous reviews and those that will be included for further analysis in the EIS. Topics carried forward in the EIS include those that require additional information but are not likely to be significantly impacted and those topics where there is the potential for significant impacts.

In preparing the FSDD, the MNDNR considered all substantive comments received during the scoping period to develop the FSDD. Information in the federal Supplemental EA was also incorporated as applicable as well as any supplemental data or data updates provided from the Project Proposer so that potential environmental and socioeconomic effects that were identified in the SEAW and DSDD were described in greater detail in the FSDD. To determine which topics should be included for further analysis in the EIS, potential issues from the state scoping process were reviewed and compared to the FFREIS to determine which, if any, additional scoped issues required further evaluation.

The Draft EIS was released for public review on September 14, 2015. The public comment period closed on October 28, 2015. During the public comment period, a public informational meeting was held on October 14, 2015 in Moorhead, Minnesota at the Courtyard by Marriott Hotel Conference Center.

Topics Adequately Analyzed in Previous Documents

The following topics were considered to be adequately analyzed in the FFREIS, Supplemental EA and the MNDNR's Scoping EAW, including documentation submitted by the project proposer or the USACE after the USACE Record of Decision. Either the topic is not relevant, the potential impact is so minor that it will not be addressed in the EIS, or the topic is significant but the FFREIS adequately addresses the Project's potential impacts.

- Water surface use
- Vehicle related air emissions
- Stationary source air emissions
- Water use
- Erosion and sedimentation from construction activities
- Water quality: surface water runoff
- Water quality: wastewaters
- Geological hazards and soil conditions
- Solid wastes, hazardous wastes, storage tanks
- Traffic
- Odors, noise and dust
- Visual impacts

No Significant Impacts Expected

The MNDNR determined that the following topics are not expected to present potentially significant impacts, but would be addressed in the EIS using information beyond that in the FFREIS, Supplemental EA, and Scoping EAW. These topics include:

- Potential environmental hazards due to past site uses
- Cover types
- Fish passage and biological connectivity
- State listed species and special status species
- Wildlife resources
- Cultural resources
- Project hydrology
- Socioeconomics analysis
- Dam safety and public waters regulations and permitting

Potentially Significant Impacts

The MNDNR identified the following topics in the FSDD that may result in potentially significant impacts and therefore, this EIS will provide additional information beyond what was previously provided in the FFREIS, Supplemental EA, and Scoping EAW:

- Stream stability
- Wetlands
- Cold weather impacts on aqueduct function and biotics
- FEMA regulations and the CLOMR process

Environmental Impact Statement Participants/Preparers

The Project Team

A project team was established early on in the environmental review process. The Project Team is comprised of the MNDNR, Diversion Authority, and USACE. The intent of the Project Team was to provide a coordinated effort between the entities in gathering, reviewing, preparing, and disseminating data and information during the state environmental review process. The MNDNR served as the RGU in preparing the EIS and facilitating the state EIS process. The Diversion Authority and USACE provided data and information to help inform the EIS. The Project Team reviewed and commented on data and analyses, EIS evaluations, and draft versions of the EIS document prior to publication and formal public review.

> ***The Project Team is comprised of the MNDNR, Diversion Authority, and USACE. The MNDNR served as the lead agency in preparing the EIS and facilitating the state EIS process.***

The Project Team also provided a direct line of communication between the entities, who met on a regular basis throughout the environmental review process. This collaboration allowed for issue discussion and regular exchange of data and information.

The Project Proposer

The project proposer is the Diversion Authority. The USACE has partnered with the Diversion Authority to plan, secure funding for, and construct the Project. Operation and future maintenance of the Project would be the responsibility of the Diversion Authority and/or other potential non-Federal sponsors.

The Diversion Authority was created by a joint powers agreement between the Cities of Fargo, North Dakota and Moorhead, Minnesota, along with Cass County, North Dakota, Clay County, Minnesota, the Cass County Joint Water Resources District, and the Buffalo-Red River Watershed District effective July 11, 2011. The Diversion Authority is led by nine board members from the stakeholder entities. The purpose of the Diversion Authority is to build and operate a flood diversion channel along the Red River to reduce the flood risk of the stakeholder communities and counties. Additional information on the Diversion Authority is available on their website: www.fmdiversion.com.

The Non-Federal Sponsor

Prior to formation of the Diversion Authority, the USACE was brought in by the Cities of Fargo and Moorhead to help them determine what could be done to reduce flood risk in the metropolitan area. Together, they worked to create the Fargo-Moorhead Metro Flood Risk Management Feasibility Study (Feasibility Study) to develop the flood diversion channel project. In order to further advance the diversion channel concept, the Cities officially partnered with USACE as a non-Federal sponsor and proceeded with federal environmental review.

The Diversion Authority should not be confused with "local sponsor," which is synonymous with "non-Federal sponsor." The USACE defines the non-Federal sponsor as 1) a legally constituted public body (including a federally recognized Indian tribe); or 2) a nonprofit entity with the consent of the affected local government that has full authority and capability to perform the terms of its agreement and to pay damages, if necessary, in the event of failure to perform. Fargo and Moorhead were the two non-Federal sponsors during the Project feasibility study and for the original Design Agreement (executed September 12, 2011). A Design Agreement Amendment #1 was executed on December 19, 2013 which added the Diversion Authority as a non-Federal sponsor. Thus, as of the production of the EIS, the non-Federal sponsors are considered the City of Moorhead, City of Fargo, and the Diversion Authority.

Description of the Proposed Project

What is the purpose and need of the Project?

The following purpose and need statements were developed by the Diversion Authority to meet the needs of the state environmental review process and are not the same as those used in the FFREIS. The purpose of the Project is to reduce flood risk, flood damages, and flood protection costs related to flooding in the F-M Metropolitan area. To the extent technically and fiscally feasible, the Project will:

> ***The purpose of the Project is to reduce flood risk potential on local streams, qualify substantial portions of the F-M urban area for 100-year flood accreditation, and reduce flood risk for floods exceeding the 100-year flood or greater.***

1. Reduce flood risk potential associated with a long history of frequent flooding on local streams including the Red River, Sheyenne, Wild Rice (North Dakota), Maple, Rush and Lower Rush Rivers passing through or into the F-M metropolitan area,
2. Qualify substantial portions of the F-M metropolitan area for 1-percent chance flood (i.e., 100-year flood) accreditation (i.e., meets the standard to be shown on Flood Insurance Rate Maps as providing protection) by the Federal Emergency Management Agency (FEMA) under the National Flood Insurance Program; and
3. Reduce flood risk for floods exceeding the 100-year flood or greater, given the importance of the F-M metropolitan area to the region and recent frequencies of potentially catastrophic flood events.

The need for the Project is due to the high risk of flooding in the F-M metropolitan area. The Red River, Wild Rice River, Sheyenne River, Maple River, Lower Rush River, and the Rush River all contribute to the flood risk. Average annual national economic flood damages in the F-M metropolitan area are estimated to be more than $51 million. Flooding in the F-M area typically occurs in late March and early April as a result of spring snowmelt. Flooding poses a significant risk of damage to urban and rural infrastructure and disrupts transportation throughout the metropolitan area. The F-M urban area is a regional center for healthcare, education, government, and commerce. Infrastructure at risk in the F-M urban area includes several regional medical centers, three college campuses, and city and county government offices.

The Red River has exceeded the National Weather Service flood stage of 18 feet at the United States Geological Survey (USGS) gage in Fargo (Fargo gage) in 52 of the past 114 years (1902 through 2015), and recently every year except 2012 from 1993 through 2013. The record-setting Red River flood stage in 2009 at Fargo was 40.82 feet on the Fargo gage. The hydrologic record of the Red River shows a trend of increasing magnitude and frequency of flooding in recent decades.

Official estimates vary for the 1-percent chance flood (100-year flood) flow and stage. Up until recently, the base flood stage (100-year flood) established by the Federal Emergency Management Agency (FEMA) corresponded to a flood stage of 38.3 feet on the Fargo gage. FEMA has recently revised the 100-year flood stage of 39.3 feet. However, FEMA's effective 100-year flood flow of 29,300 cfs is based on hydrology that dates to the 1970s. An updated standard hydrologic analysis would increase the 100-year flood flow from 29,300 cfs to 33,000 cfs, which would increase the 100-year flood stage to something between 40.7 feet and about 41.5 feet, the exact value depending on levee effectiveness and a more detailed analysis than has been completed to date for a flow of 33,000 cfs.

The USACE went beyond a standard hydrologic analysis by engaging a panel of experts (Expert Opinion Elicitation Panel, or EOEP) in hydrology and climate change to discuss flooding trends in the Red River basin. The panel concluded that the hydrologic record showed a “dry” period in the early decades of the 20th century and a “wet” period in later years continuing to the present and recommended developing revised flow frequency curves separately for the dry and wet periods. The EOEP use of the terms “wet cycle” and “dry cycle” were not intended to imply wet or dry climatic conditions. Rather, the EOEP used those terms to identify periods of generally lower and higher river flows. The EOEP did not reach any conclusion about why flows on the Red River at Fargo have been higher since the 1940s. Flood discharge frequency data (e.g., the 100-year flood discharge) are based on statistical analyses of historical gage station records when those data are available – not precipitation data.

What is the Proposed Project?

The Project would be located in the F-M area, within an area approximately 12 miles west to six miles east of the Red River and from 20 miles north to 20 miles south of Interstate 94. The Project primarily consists of a dam and diversion channel system including the following major components: a tieback embankment and overflow embankment; excavated channels; diversion inlet control structure; aqueducts on the Maple and Sheyenne Rivers; control structures on the Red and Wild Rice Rivers; an upstream flood water staging area (staging area); inlet control structures on tributaries; a rock ramp diversion outlet structure; the City of Oxbow, Village of Hickson, Bakke Subdivision (OHB) ring levee; Comstock ring levee; levees and floodwalls in the F-M urban area; non-structural features (such as buyout, relocation, or raising individual structures); and recreation features (such as multipurpose trails). The Project also consists of environmental mitigation projects, which would be located inside and outside the project area.

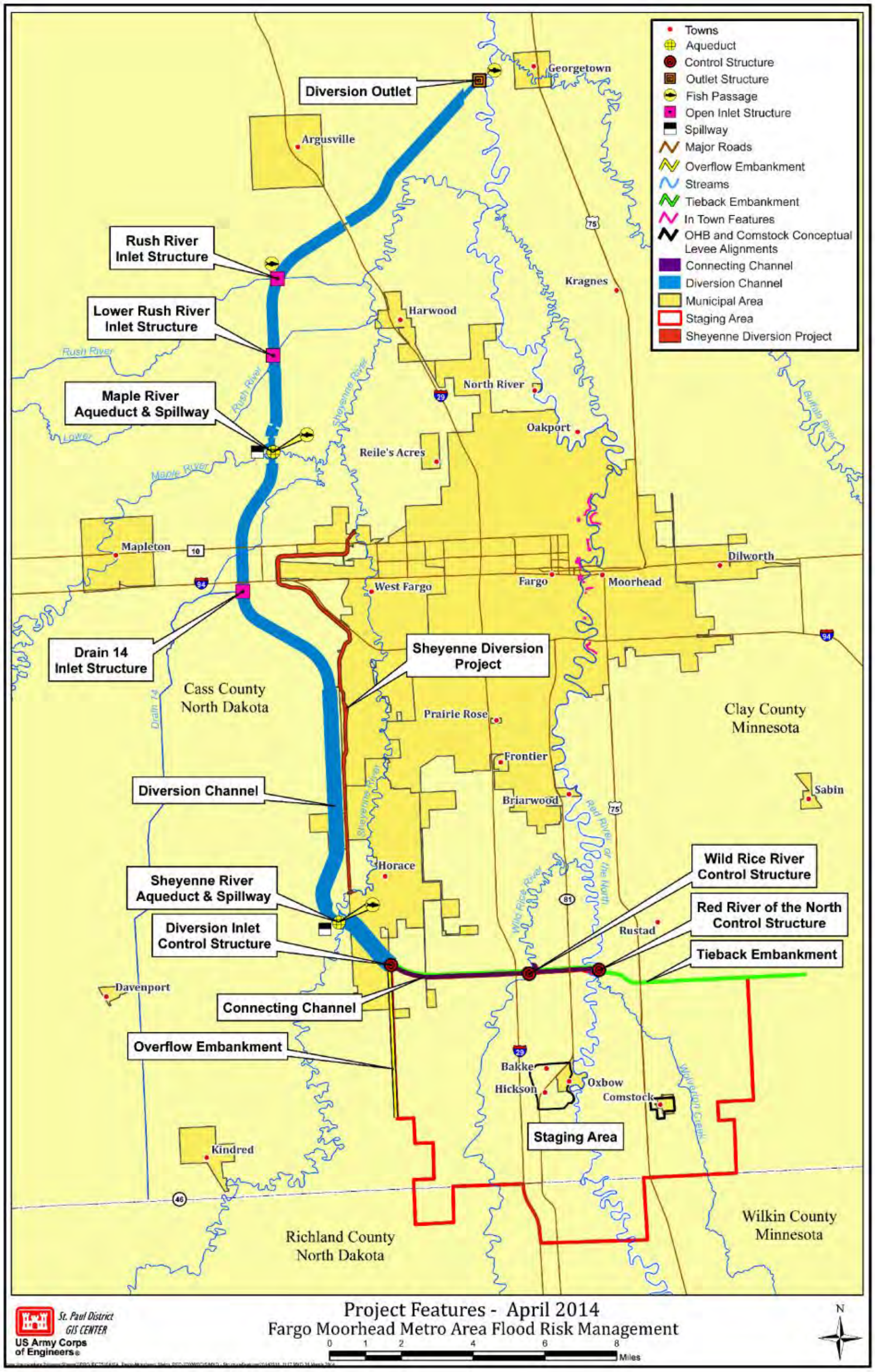
The Project would create a 30-mile long diversion channel on the west side of the Fargo-Moorhead urban area with a tieback embankment and control structures spanning the Wild Rice River and Red River. Project operation would divert a portion of water flow from upstream rivers and streams into the channel, while creating a staging area upstream of the embankment.

The dam would extend from high ground in Minnesota to high ground in North Dakota and would be constructed to connect the Red River, Wild Rice River, and diversion inlet control structures. The dam and control structures would impound water in the inundation areas and meet the definition of a Class I dam under Minnesota Rules, part 4410.4400, subpart 18. The dam would be designed to meet USACE dam safety standards.

As proposed, the Project would create a 30-mile long diversion channel on the North Dakota side of the F-M area. There would be a 6-mile long connecting channel between the Red River and the diversion inlet control structure. When operated, the Project would divert a portion of the Red River flow upstream of the F-M urban area, intercept flow at the Wild Rice, Sheyenne, Maple, Lower Rush and Rush Rivers, and return it to the Red River downstream of the F-M urban area.

Operation of the Project would occur when it becomes known that a stage of 35.0 feet would be exceeded at the Fargo gage. At this stage, the flow through Fargo would be approximately 17,000 cubic feet per second (cfs). A flow of 17,000 cfs at the Fargo gage is approximately a 10-percent chance flood (10-year flood). Operation begins by partially closing the gates at the Red River and Wild Rice River control structures. Once the gates are partially closed, water would begin to accumulate in the inundation areas, south of the tieback embankment. Water would not be released through the diversion inlet control structure gates until the Red River and Wild Rice River control structures are partially closed. The diversion inlet control structure gates would be opened only after the initial diversion tributary (Sheyenne River, Maple River, Lower Rush River, and Rush River) flow peaks have made it to the diversion.

The Project would be federally-sponsored and would be designed and constructed to federal standards. The Project would be owned and operated by the non-Federal sponsors. Project operation, maintenance, and monitoring would be the responsibility of the non-Federal sponsors.
With continual, sufficient funding, construction is expected to take a minimum of eight and one half years.



ES Figure 2 Project Features

Description of the Proposed Project (continued)

The Project would reduce flood damages and flood risk in the F-M urban area, but it would not completely eliminate flood risk. The Project would reduce flood stages on the Red River in the cities of Fargo and Moorhead and would also reduce stages on the Wild Rice, Sheyenne, Maple, Rush and Lower Rush Rivers between the Red River and the diversion channel. With the Project operational, the stage from a 100-year flood on the Red River would be reduced from approximately 42.1 feet (assuming emergency levees confine the flow) to 35.0 feet at the Fargo gage. The following provides a description of the Project components.

Dam

The dam includes the three control structures (i.e., Red River, Wild Rice, and Diversion Inlet) and embankments. The control structures are gated structures that span the river to control the flow of water downstream. The embankments are raised structures constructed of soil and include the tieback embankment and the overflow embankment.

The length of dam between high ground in Minnesota to the diversion inlet control structure would be approximately 12 miles (six miles in Minnesota and six miles in North Dakota) and would be generally in an east/west direction. A four-mile long overflow embankment would be built south of the diversion inlet control structure along Cass County Highway 17 (a north/south configuration). This portion of the dam would act as an emergency spillway for extreme events that exceed the 0.2-percent chance (i.e., 500-year flood).

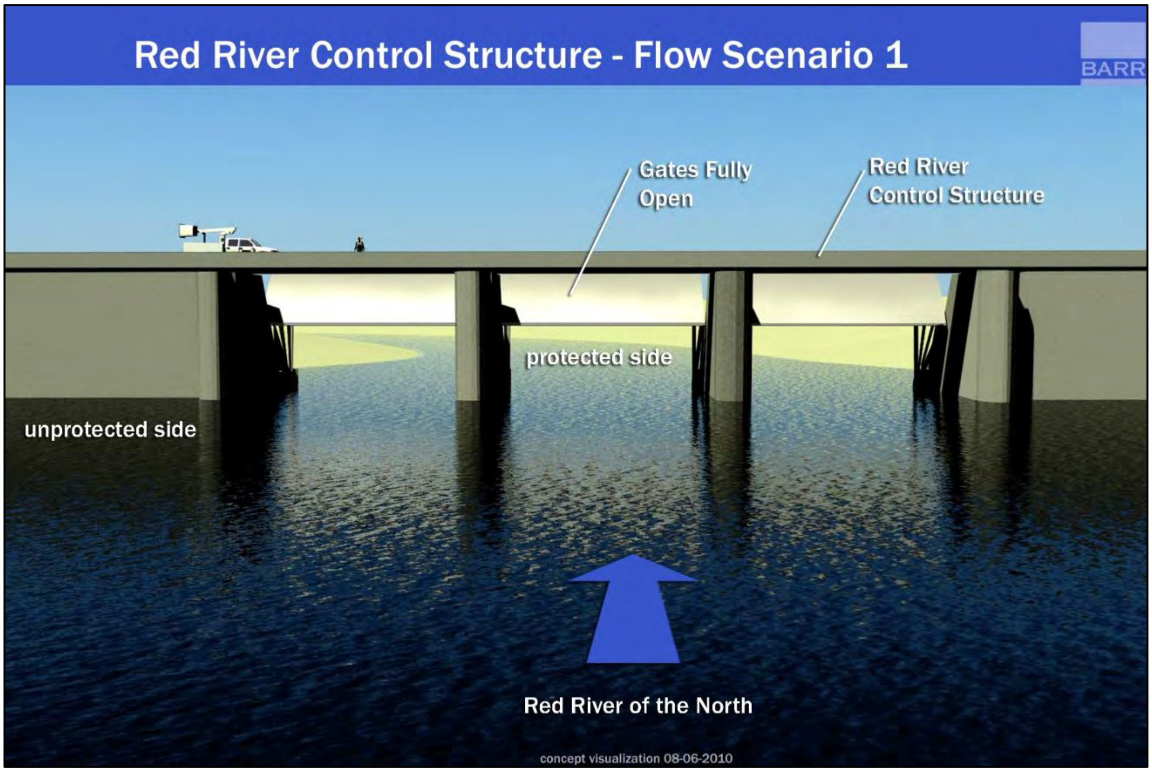
Red River and Wild Rice River Control Structures

A gated control structure (ES Illustration 1) would be constructed adjacent to the Red River in Holy Cross Township (Clay County), Minnesota. A similar control structure would be constructed adjacent to the Wild Rice River in Pleasant Township (Cass County), North Dakota. The structures would be constructed adjacent to the existing channels in order to keep the sites dry during construction.

Once the control structures are built, the Red River and Wild Rice River would be rerouted through the control structures. When operated during flood events, these structures would limit flows downstream in the natural channels and cause the water to accumulate in the inundation areas.

Description of the Proposed Project (continued)

ES Illustration 1 Control Structure Design for the Red River

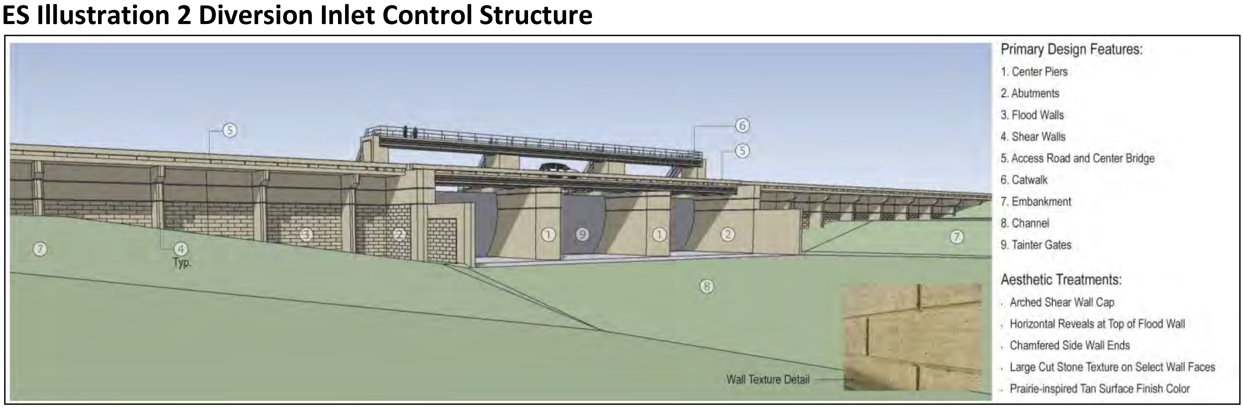


Source: Diversion Authority, 2015

<u>Connecting Channel</u>
The Project would include a six mile long connecting channel between the Red River and the diversion inlet control structure. The connecting channel bottom width would be approximately 100 feet and would slope toward the Wild Rice and Red Rivers to drain the inundated areas when flood flows have receded.

<u>Diversion Inlet Control Structure</u>
The diversion inlet control structure would be located near Cass County Highway 17 and consist of a 135-foot wide spillway with operable gates to control flows going into the diversion channel (ES Illustration 2).

ES Illustration 2 Diversion Inlet Control Structure



Source: Diversion Authority, 2015

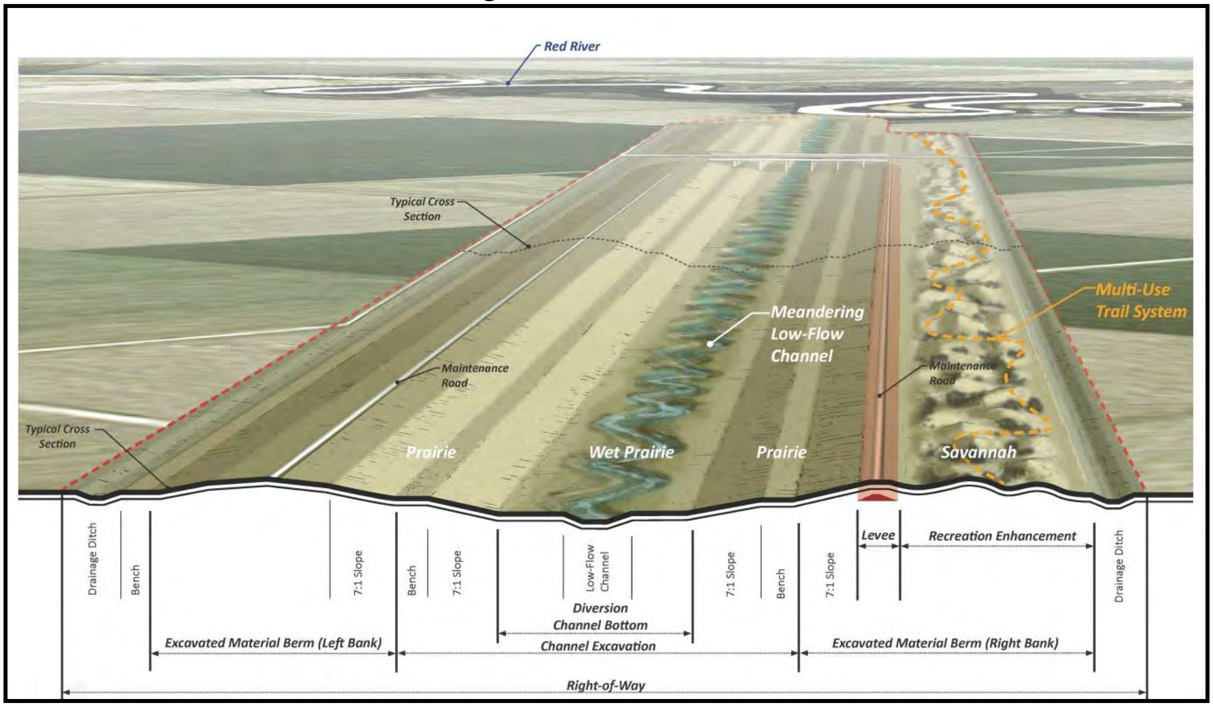
Description of the Proposed Project (continued)

Staging Area
The staging area boundary contains 75,000 acre-feet of existing floodplain storage for the 100-year flood. In order to minimize downstream impacts, an additional 150,000 acre-feet of storage would be needed. 225,000 acre-feet is the total amount of storage in the staging area for both the 100-year and the 500-year floods.   Roughly 32,000 acres would be required for the storage needed for Project operation. This required area is generally referred to as the staging area. Water would begin to pool and inundate behind the dam when the Red and Wild Rice River control structure gates are partially closed to limit flows through the F-M urban area. Red River and Wild Rice River control structures would be operated to raise water surface elevations to approximately 922.2 feet (North American Vertical Datum (NAVD) 88) at the diversion inlet for all events up to a 500-year flood. The staging area would be regulated so that the required volume is maintained.

The perimeter of the inundated area within the staging area would experience additional flood depths of zero to one foot, while the majority of the land within the staging area would see additional depths greater than one foot. There are some areas within the staging area that would not become inundated during Project operation. In contrast, there are areas outside of the staging area that would become newly inundated or would experience additional depths of flooding as a result of Project operation. The majority of these inundated areas outside the staging area boundary would experience less than one foot of additional flood depth and are not considered as part of the required volume for Project operations. The term “staging area” is used when referring to a Project component as in discussing where mitigation applies. The term “inundation area(s)” is used to describe any land that becomes flooded, regardless of depth. “Inundation area” is not tied to use with any specific flood event or to the Project or Project alternatives.

Diversion Channel
The diversion channel (ES Illustration 3) would start from the diversion inlet control structure near Cass County Highway 17 and extend approximately 30 miles downstream to its outlet north of the confluence of the Red and Sheyenne Rivers. The diversion channel would route west of Horace, North Dakota and then continue north, crossing the Sheyenne, Maple, Lower Rush and Rush Rivers.

ES Illustration 3 Diversion Channel Design

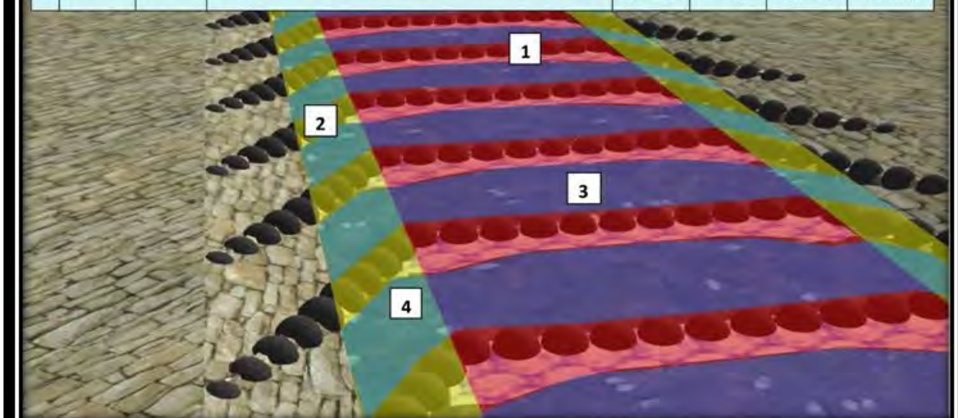


Source: Diversion Authority, 2015

The diversion outlet structure, located where the diversion channel returns to the Red River in Wiser Township (Cass County), North Dakota, would consist of a rock ramp with a crest width of 300 feet designed to allow fish passage (ES Illustration 4).

ES Illustration 4 Diversion Outlet Structure

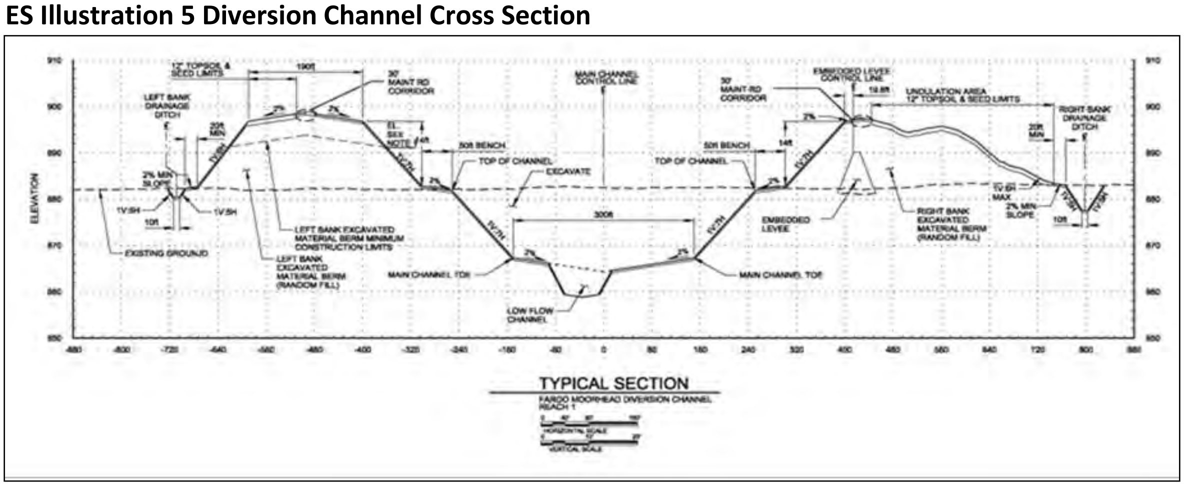
	Location	Feature	Description	Peak Velocities			
				100 cfs	1000 cfs	7000 cfs	20000 cfs
1	Center	Weir	High velocity area at the center of the channel through the boulder weirs which can accommodate passage for fish with stronger ***maximum burst speeds***	5.5 ft/s	8.5 ft/s	10.8 ft/s	3.6 ft/s
2	Fringe	Weir	Fringe area through boulder weirs with moderate velocity to accommodate fish passage for ***a full range of burst speeds***	4 ft/s	5 ft/s	6.4 ft/s	2.4 ft/s
3	Center	Pool	Pool area at the center of the channel with velocities in the range of ***sustained swim speeds*** for most flows	0.4 ft/s	2.2 ft/s	6.3 ft/s	3.3 ft/s
4	Fringe	Pool	Fringe areas of the pools with low velocities for ***resting***	0.3 ft/s	1 ft/s	2.7 ft/s	2.3 ft/s



Source: Diversion Authority, 2015

The diversion channel is designed to receive 20,000 cfs for the 100-year flood at the diversion inlet control structure and additional water from drainages intersected downstream of the inlet control structure. The diversion is designed to keep the 100-year flood flows below existing ground elevations as much as practicable to limit impacts to drainage outside the channel. The diversion channel would have a bottom width of 300 feet and a variable-width, low-flow channel that has been sized based on sediment transport considerations (ES Illustration 5). The low-flow channel would meander within a 200-foot belt width within the 300-foot bottom width from just upstream of the diversion channel outlet to just downstream of the Maple River aqueduct. The meandering portion of the low-flow channel would also serve as a way of substituting for the aquatic habitat lost due to the diversion channel construction in the Lower Rush and Rush River channels between the diversion channel and the Sheyenne River.

ES Illustration 5 Diversion Channel Cross Section



Source: Diversion Authority, 2015

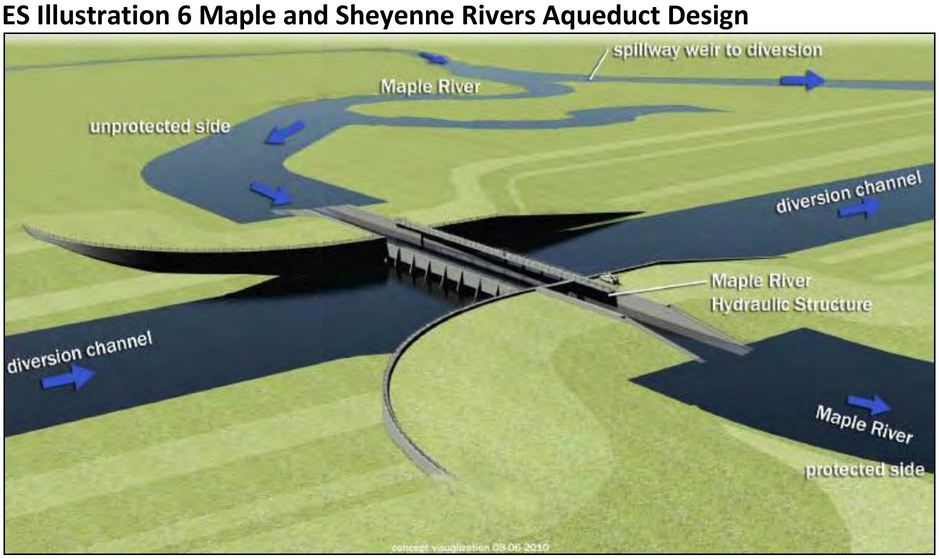
The depth of the diversion channel would range from 15 to 25 feet deep excluding the low-flow channel and 20 to 30 feet deep including the low-flow channel. The side slopes away from the 300-foot bottom width and would be one vertical step to seven horizontal steps. This includes geotechnical "benches" of 0 to 30 feet wide, as needed, to provide additional stability to meet the required factors of safety.

Soil excavated from the diversion channel would be placed into excavated material berms adjacent to the channel to a typical height of 16 feet. The excavated material berms would be as wide as necessary to contain the excavated material. Portions of the berms on the east side of the channel would be constructed to serve as levees when the water surface in the channel is higher than the natural grade. The maximum width of the footprint along the diversion channel would be approximately one half mile including the diversion channel and excavated material berms.

Drainage ditches adjacent to the berms would be necessary to intercept local drainage and direct it to the nearest downstream diversion inlet control structure. The drainage ditches would run along the exterior excavated material berm toe on both sides of the diversion channel.

<u>Maple River and Sheyenne River Aqueducts</u>
Aqueducts (bridge-like structures that convey water over the diversion channel) would be constructed for the Maple River (ES Illustration 6) and Sheyenne River that would allow for the continuous connectivity of these two rivers.

ES Illustration 6 Maple and Sheyenne Rivers Aqueduct Design

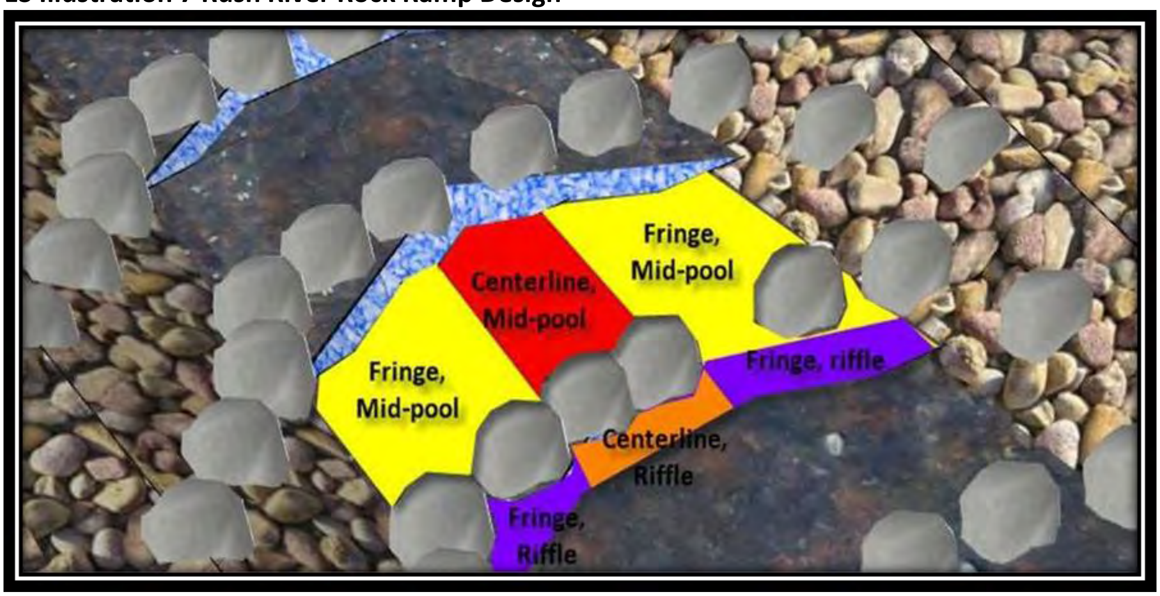


Source: Diversion Authority, 2015

During flood events, fixed-crest weir spillways would direct flood flows into the diversion channel and allow for flows in the diversion channel to pass underneath the aqueducts while allowing the existing river bankfull (i.e., flows at which water fills the channel without overtopping the banks – the average recurrence for the Maple River is 1.16 years and 1.67 years for the Sheyenne River (West 2012)) to continue downstream. The intent of the Sheyenne and Maple River aqueducts, as planned and operated, would be to maintain biological connectivity and fish passage in the rivers. The two aqueducts are similar in concept; each includes a grade control structure to prevent headcutting on the tributary, an inlet structure to control diversion of tributary flows, heating components for cold weather operation, and an aqueduct to pass a limited flow over the diversion channel to maintain the desired downstream flow. The aqueducts would be constructed off-channel with the river diverted across the aqueduct upon completion.

<u>Lower Rush River and Rush River Rock Ramps</u>
At the Lower Rush River and Rush River, rock ramps (ES Illustration 7) would be used to continuously divert the entire flow into the diversion channel. The Lower Rush River and Rush River would be diverted into the diversion channel and no longer would flow into the Sheyenne River downstream.

ES Illustration 7 Rush River Rock Ramp Design



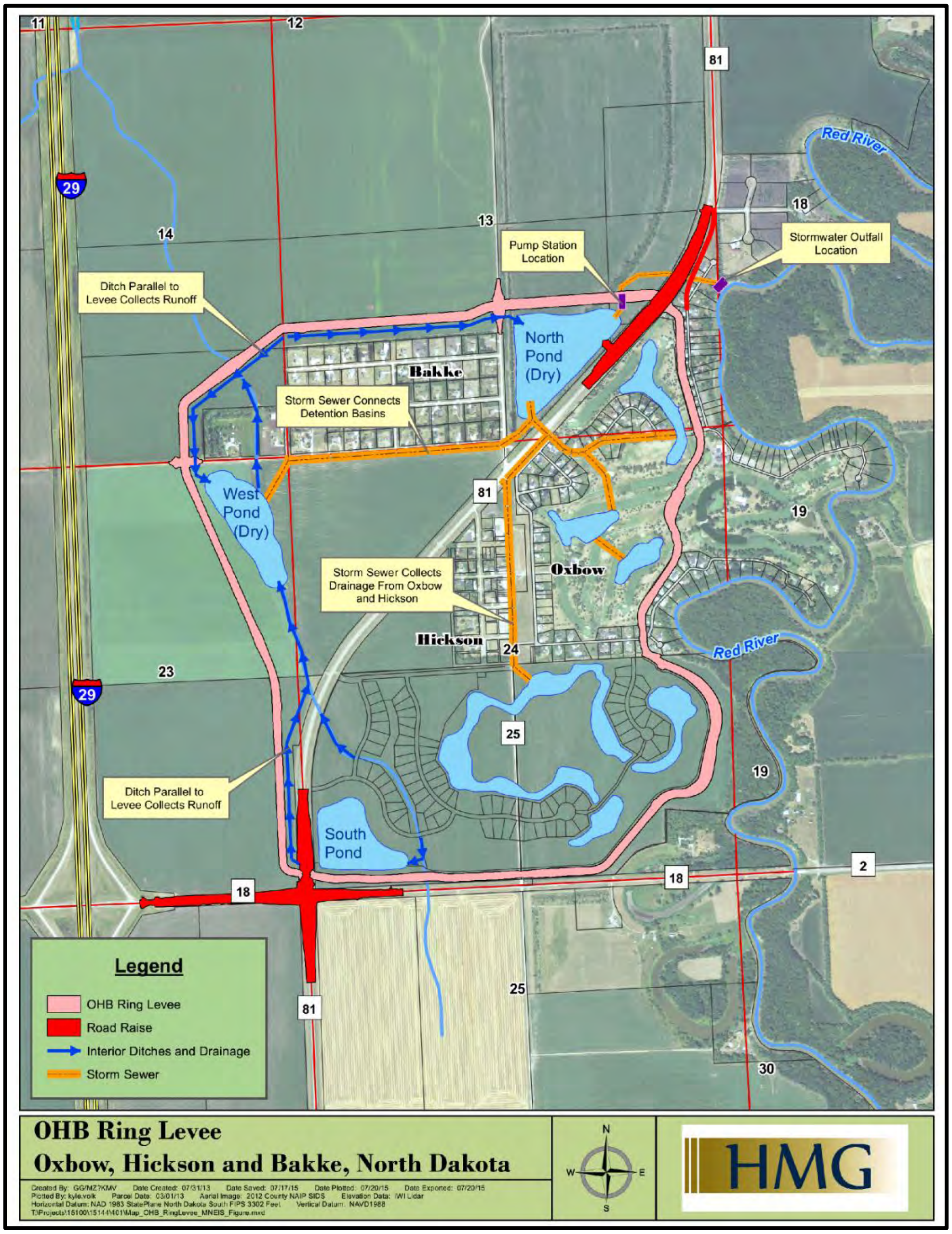
Source: Diversion Authority, 2015

<u>Inlets, Ditches, and Smaller Control Structures</u>
Ditches and smaller control structures would be required to accept existing drainages intersected by the diversion channel. Ditches running outside and parallel to the diversion channel would direct local drainage to a reasonable number of inlet structure locations. Existing ditches, field swales, and drain tile would be directed into these parallel ditches. The larger inlet structures would be open with concrete drop structures or rock ramps like the Lower Rush River and Rush River. The smaller inlet structures would be culvert structures with flap gates at the outlet to prevent backflow from the diversion channel after peak flows.

Uncontrolled inlet structures (inlet structures without backflow prevention) would be placed at drainages that have either natural or manmade levees which would prevent widespread flooding from diversion channel backflow for events up through the 100-year flood. The project design purpose is to maintain the existing 100-year flood floodplain in adjacent upstream drainages.

<u>Oxbow/Hickson/Bakke Ring Levee</u>
Under Project operation, the City of Oxbow, Village of Hickson, and Bakke Subdivision (OHB) in North Dakota would be inundated up to eight feet during the 100-year flood. A ring levee

around these communities was proposed by the USACE in the Supplemental EA as a modification to the Project to address these impacts. The OHB ring levee would be constructed to the Project operation elevation for the 100-year flood plus four feet of freeboard (ES Figure 3). OHB ring levee construction requires roadway modifications. The existing sanitary sewer system, water main, and storm sewer system would be modified to accommodate the ring levee and new residential areas.



Source: HMG, 2015

ES Figure 3 Oxbow/Hickson/Bakke Ring Levee Design

Comstock Ring Levee

A ring levee would be also constructed around the city of Comstock, Minnesota, which under existing conditions, is located outside of the 100-year floodplain. Operation of the Project would cause new inundation in this community during and above the 100-year flood. The design of the Comstock Ring Levee is conceptual at this time. The details that follow are subject to revision pending further design and coordination between the Diversion Authority and the City of Comstock. Clay County Highway 2 would be raised at both places where it crosses the ring levee. The Burlington Northern Santa Fe (BNSF) Moorhead Subdivision Rail Line on the north and south side would require protection measures above a 100-year flood.

Transportation and Utility Modifications

Interstate 29, U.S. Highway 75, and the BNSF Hillsboro Subdivision Rail Line near U.S. Highway 75 would be raised slightly above the 500-year flood elevation to maintain access during flood inundation. Other roads within the inundation areas, except OHB and Comstock ring levee access roads, would be allowed to flood when the Project operates. Utilities located in the inundation area would be evaluated during final Project design. Known utilities include, but are not limited to, electric power lines, rural water supply, and sewer facilities. Utilities that cannot withstand occasional flooding would be abandoned, modified or relocated, depending on the situation in accordance with applicable regulations.

Along the length of the diversion channel, 19 road crossings, including four railroad bridges, and highway relocations would occur at approximately three mile intervals, primarily for county roads. Other roads may be terminated at the diversion channel or rerouted to the local road network, which would be determined during final Project design. The four new railroad bridges would be needed where existing railroads intersect the diversion channel.

Project Operation

The gates at the Red River and Wild Rice River control structures would be fully open and the gates at the diversion inlet control structure would be fully closed when the Project is not operating. The decision, as to whether the Project would begin to operate or not, would be based on measurements at the USGS gages in Fargo, Enloe and Abercrombie. Project operation would start if the Fargo gage stage would exceed 35.0 feet of water which corresponds to a flow of 17,000 cfs. A flow of 17,000 cfs at the Fargo gage is approximately a 10-percent annual exceedance probability event using the updated EOEP hydrology.

The MNDNR utilized the recommendations of the EOEP in the EIS. Unless mentioned otherwise, all discussions in the EIS use EOEP hydrology. Similarly, all elevations are relative to NAVD 88, unless noted.

Operation would begin with partially closing the gates at the Red River and Wild Rice River control structures. Once the gates are partially closed (i.e., partially lowered), water would begin to accumulate upstream of the control structures. Water would not be released through the diversion inlet control structure gates until the Red River and Wild Rice River control structures are partially closed.

Project operation on the rising limb of the flood hydrograph (i.e., flood discharges are increasing) is based on minimizing downstream impacts, and therefore, the diversion inlet control structure gates would be opened only after the initial diversion tributary (Sheyenne River, Maple River, Lower Rush River, and Rush River) flow peaks have made it to the diversion.

Project operation on the falling limb of the flood hydrograph (i.e., flood discharges are decreasing) is based on minimizing the duration of upstream impacts without causing upstream stages to fall faster than what has been experienced during historic floods. If the staging area elevations drop too quickly, it could cause environmental concerns (e.g., fish stranding and streambank instability).

Flood stages through the F-M urban area and upstream of the control structures would depend on the peak discharge from the Red River and Wild Rice River hydrographs. As long as it is clear that 34,700 cfs would not be exceeded, the Fargo gage stage would be limited to 35.0 feet, the maximum flow allowed through the diversion inlet control structure would be 20,000 cfs, and there would be a maximum elevation of 922.2 feet in the staging area just upstream of the control structures.

If the forecasted peak flow at Fargo is greater than 34,700 cfs, the target stage at the Fargo gage would be increased from 35.0 feet up to 40.0 feet, depending on the flood forecast. Emergency flood fighting measures are required once the target stage is increased above 35.0 feet. The maximum target stage of 40.0 feet is comparable to the stage experienced during the 2009 flood. Since this operating procedure allows more flow to be passed through town (resulting in the higher stages), it allows the staging area to crest at 922.2 feet for 100-year through 500-year events. The maximum flow allowed through the diversion inlet control structure would be 20,000 cfs up through the 500-year flood.

For events greater than a 500-year flood, a stage of 40.0 feet would be maintained at the Fargo gage and the staging area elevation would be allowed to rise above 922.2 feet. The rise of the staging area would be minimized as much as possible by further opening the diversion inlet control structure gates to allow more flow into the diversion. At the point of minimum acceptable freeboard, flow out of the staging area would be maximized at the diversion inlet structure and over the overflow embankment along the west side of the staging area. Flow exiting the staging area via the overflow embankment would flow overland into the Sheyenne River basin.

An evacuation order would be issued for the F-M urban area as the staging area elevation approaches the minimum acceptable freeboard level. Once the upstream staging elevation reaches the point of minimum acceptable freeboard, the Red River and Wild Rice River control structure gates would be opened further to maintain the minimum freeboard and stages would rise above 40.0 feet at the Fargo gage.

The non-Federal sponsors would be responsible for all operations, maintenance, repair, rehabilitation and replacement (OMRR&R) of the Project. The cost share agreement between the USACE and the non-Federal sponsors requires the non-Federal sponsors to operate the Project in accordance with the Operation, Maintenance, Repair, Replacement, and Rehabilitation (OMRR&R) Manual to be prepared by the USACE.

<u>Floodwalls and In-Town Levees</u>

The Project would include floodwalls and levees in Fargo and Moorhead, which would allow more flows to pass through town and reduce Project operation frequency. The in-town levees would be such that FEMA would be able to accredit the levees for the 100-year flood once the Project is complete.

Non-structural Project Features

There are several non-structural mitigation measures included in the Project to address impacts of increased flooding within the inundation area. Examples of proposed mitigations include fee acquisitions or relocations, construction of accredited ring levees and the acquisition of flowage easements. The April 2015 FEMA/USACE Coordination Plan (the Coordination Plan) states that all impacts to insurable structures within the FEMA revision reach (i.e., where the Project would alter the Red River profile flood elevation by more than 0.5 feet) would be mitigated through agreed methods consistent with those specified by the National Flood Insurance Program based on the depth of flooding at each structure. In accordance with the FEMA/USACE Coordination Plan (April 2015) impacted homes, structures, and businesses that have greater than two feet of flooding for the 100-year flood with the Project are proposed to be purchased or relocated and those with up to two feet of flooding would be evaluated for non-structural measures such as accredited ring levees, relocation, or elevating structures. The FEMA revision reach includes the entire staging area as well as some areas upstream of the staging area.

Non-structural Project features include fee acquisitions, construction of ring levees, and acquisition of flowage easements. Each property would be analyzed throughout the inundation area to determine appropriate mitigation.

The Coordination Plan requires that the areal extent of flood inundation required for operation of the Project within the staging area be mapped as floodway in order to ensure that the required volume is available for the Project during the 100-year flood. Flowage easements are proposed to be obtained for all floodway designated areas. Any additional flood inundation within the FEMA revision reach that is outside of the staging area would be mapped as floodplain in order to portray the elevated flood risk outside of the required staging area.

Areas outside the FEMA revision reach (and thereby outside of the staging area) such as those along the Red River, Wild Rice River and connected drainages may also be affected by Project operation. Inundation outside of the designated staging area is estimated to be less than one foot of additional flood depth for a 100-year flood and would be impacted by the Project primarily in the spring. It is anticipated that for agricultural lands in most areas, farming could continue without significant impacts. The USACE has proposed performing an analysis to determine if a takings has occurred on a case-by-case-basis to define mitigation needs within this area. Flowage easements would be obtained for land and structures only where this analysis determines that an impact rises to the level of a taking under the Fifth Amendment of the U.S. Constitution[1] and applicable state laws (see Appendix O). This analysis would include evaluation of property impacts such as land value, water supply, and septic systems. Landowners would be compensated appropriately for any takings. In accordance with Minnesota Rules Chapter 6120 mitigation is required for existing insurable structures in Minnesota with any impact and Minnesota Rules, part 6115.0470 require a permittee to acquire all necessary interests or permissions prior to proceeding. Additional permit requirements may be needed from the North Dakota Office of the State Engineer for impacted properties in North Dakota. (See Section 3.2 –

[1] The 5th Amendment of the US Constitution requires just compensation when private property is taken for public use. CFR 49 Part 24 - Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970, PL 91-646, as amended, details benefits to the property owner and/or displaced residential renters for Federal and Federally Assisted Programs.

FEMA Regulations and the (Conditional Letter of Map Revision) CLOMR Process for more details on the takings).

Recreation Features

The conceptual recreation plan for the Project includes one concrete multi-purpose trail and one aggregate equestrian trail loop with a combined length of approximately 47-miles. These trails are in addition to the aggregate maintenance road that is included in the Project. In addition to the proposed trail system, other activities have been identified and planned for in key locations. These locations are known as Activity Hubs, which would function as primary trail access locations as well as recreation destinations. While the individual hubs would vary in character, recreation features would include parking, restrooms, trail way-finding signage, picnic facilities, drinking water, interpretative signage, fishing, and boat access. Activity Nodes are similar to hubs but provide less intensive site-specific activities and could serve as secondary access points to the trails. Landscaping of trees and shrubs at the trailheads, Activity Hubs and Nodes are proposed along with trees, native prairie grasses and forbs along the trail. All proposed recreation facilities would meet the guidelines for Americans with Disabilities Act (ADA) and the Architectural Barriers Act (ABA).

Description of the No Action Alternative

What is the No Action Alternative?

The No Action Alternatives provide the context for the potential environmental and socioeconomic effects that would occur if the Project is not developed. There are two No Action alternatives considered for the Project: 1) Base No Action Alternative; and 2) No Action Alternative (with Emergency Measures).

Base No Action Alternative

The Base No Action Alternative includes the potential flood risk reduction impact of already completed and currently funded projects such as levee construction and property buyouts and does not include the use of emergency measures.

> ***There are two No Action Alternatives considered for the Project: Base No Action and No Action (with Emergency Measures).***

No Action Alternative (with Emergency Measures)

The No Action Alternative (with Emergency Measures) is similar to the Base No Action Alternative, but also acknowledges the emergency measures currently being pursued in the project area and assumes that those would continue to be implemented as necessary due to flooding. Emergency measures have lower reliability, higher risk for loss of life than permanent flood risk reduction features and cannot be certified or accredited by the USACE or FEMA, respectively; and therefore, are being discussed under a second No Action Alternative option. Emergency measures are intended to temporarily protect specific areas from flooding that do not have permanent flood damage reduction (FDR) projects in place or enhance existing FDR projects, where there are gaps in levee protection between each of the individual FDR projects, for example. Where gaps in FDR project protection exist, a temporary levee may be constructed to tie into existing levees to reduce flood risk from occurring behind the levee or overtopping an existing levee.

Permanent FDR projects are a key component to both the Base No Action Alternative and the No Action Alternative (with Emergency Measures). Since the 1997 flood, the Cities of Fargo and Moorhead have implemented flood risk reduction measures, including acquisition of floodplain houses, constructing levees and floodwalls, raising and stabilizing existing levees, installing permanent pump stations and improving storm sewer lift stations and the sanitary sewer system. FDR projects have been designed for protection at the current, effective FEMA 100-year flood. Because of the difference between the FEMA hydrology and the EOEP hydrology, some of the FDR projects are at elevations above the EOEP 100-year flood elevation, but do not have sufficient freeboard and/or tie-in elevations for FEMA accreditation under the EOEP hydrology. This means there could be actual protection, but not accredited protection under the EOEP hydrology (see Appendix N for more discussion on the differences between flood elevations when applying different hydrology methodologies). For the purposes of EIS analysis, non-accredited structures are considered as flooded for the Base No Action Alternative.

Alternatives Considered and Evaluated in the Environmental Impact Statement

Pursuant to Minnesota Rules, part 4410.2300, item G, the EIS is required to include one or more alternatives of each of the following categories or provide a concise description of why no alternative in a particular category is included in the EIS.

- Alternative Sites
- Alternative Technologies
- Modified Designs or Layouts
- Modified Scale or Magnitude
- Alternatives that incorporate reasonable mitigation measures identified through the comment periods for EIS scoping or for the Draft EIS.

The MNDNR conducted an independent assessment of potential projects within the above categories, considering the alternatives discussed in the FFREIS and combining other measures with those alternatives. As part of the scoping, the MNDNR prepared the Alternatives Screening Report: Fargo-Moorhead Metropolitan Area Flood Risk Management Project (December 2012) (Alternatives Screening Report).

Reasonable alternatives were considered for their relevance to meet the proposer's defined Project purpose and need, as well as their feasibility to improve environmental and/or socioeconomic benefits, while reducing potential environmental impacts that may result. Alternative sites and alternative technologies were evaluated in the EIS. Other alternatives were considered, but dismissed from further evaluation in the EIS, include modified designs and layouts, and modified scale and magnitude. Alternatives incorporating reasonable mitigation measures were also evaluated in the EIS for each topic area as it related to the mitigation.

An alternative may be excluded from analysis in the EIS if it does not meet the underlying need for or purpose of the project; it would likely not have significant environmental benefit compared to the project as proposed; or another alternative of any type that is analyzed in the EIS would likely have similar environmental benefits but substantially less adverse economic, employment, or sociological impacts (Minnesota Rules, part 4410.2300, item G).

Was an alternative site evaluated?

Minnesota Rules, part 4410 requires an evaluation of site location alternatives. Minnesota Rules, part 4410 allows the RGU to exclude alternative sites if other sites do not have significant environmental benefit compared to the project as proposed, or if other sites do not meet the underlying need and purpose of the Proposed Project. The Alternatives Screening Report determined that the reasonably available alternate diversion sites in Minnesota and/or North Dakota do not produce benefits for environmental resources or socioeconomic factors, and therefore the EIS will not evaluate alternative sites.

What alternative technologies were analyzed?

Six potential technology alternatives were studied in the Alternatives Screening Report. Two of these alternatives, tunneling and Interstate 29 Viaduct, had a similar effectiveness to the Project but did not present a significant environmental benefit. In addition, they are expected to transfer potential impacts of the Project downstream, and they have excessive capital costs, and therefore will not be evaluated in the EIS.

Alternatives Considered and Evaluated in the Environmental Impact Statement (continued)

The remaining alternative technologies (non-structural measures; flood barriers; flood storage; and flood storage combined with a control structure) did not effectively meet the Project purpose by themselves. However, it was initially thought that a combination of these alternatives could potentially meet the Project purpose and present increased environmental benefit. Therefore the Distributed Storage Alternative, which is principally a modified design alternative that incorporates these alternative technology aspects, was further evaluated as part of the alternatives evaluation (see below Modified Design/Layout section).

What modified designs or layouts were evaluated?

The MNDNR considered two modified designs or layouts alternatives in the EIS: Northern Alignment Alternative (NAA) and Distributed Storage Alternative (DSA).

The NAA was conceptualized during the public comment and alternative screening process as part of the state environmental review for the Project. During the EIS scoping process, it was thought that moving the tieback embankment north of the proposed location might provide greater environmental and/or socioeconomic benefits than the proposed Project. The Alternatives Screening Report has details on the alternatives considered and the screening criteria used to select alternatives that could meet Project purpose while providing other potential benefits. As a result, the MNDNR included the NAA in the FSDD for further evaluation in the EIS.

The Distributed Storage Alternative (DSA) was conceptualized during the public comment and alternative screening process as part of the state environmental review for the Project. During the EIS scoping process, many public comments received suggested that distributed storage, or a similar approach, might provide greater environmental benefits than the proposed Project. As a result, the MNDNR included the DSA alternative in the FSDD for further screening to determine if it should be an alternative evaluated in the EIS.

Northern Alignment Alternative

The Northern Alignment Alternative components and operation are similar to those described for the Project and therefore the Project description should be referenced for details. The NAA would locate the tieback embankment and connecting channel north of the Project approximately 1.5 miles. The southern boundary of the NAA staging area is between approximately 1.5 miles and three miles north of the Project staging area southern boundary (EIS Figure 7).

Features of the NAA that result in design or operational changes from the Project include the location of the dam and control structures, staging area, Comstock ring levee, and NAA operation. Other features of the NAA would be similar to those described for the Project.

The Northern Alignment Alternative is a modified version of the Project design and layout, and was evaluated in the EIS.

Red River and Wild Rice River Hydraulic Structures

A gated control structure would be constructed adjacent to the Red River in Kurtz Township Clay County, Minnesota. A similar control structure would be constructed adjacent to the Wild Rice River in Stanley Township, Cass County, North Dakota.

Staging Area

In order to nearly eliminate downstream impacts, approximately 150,000 acre-feet of additional storage is required upstream of the dam and diversion channel inlet. The Red River and Wild Rice River control structures would be operated to raise water surface elevations to approximately 919.3 feet at the diversion inlet for all events up to a 500-year flood. The remaining features of the staging area would be the same as those described for the Project.

Comstock Ring Levee

The community of Comstock, Minnesota is located near the NAA inundation area; however, the community would not be impacted directly, and therefore a ring levee is not anticipated for the NAA. The lagoons for the community are located in the NAA inundation area and may require mitigation.

Northern Alignment Alternative Operation

Operation of the NAA would be similar to the Project with the exception of the upstream staging elevation. A maximum stage of 35.0 feet would be maintained at the Fargo gage until the upstream staging elevation reaches 919.3 feet, which is anticipated to occur with the 100-year flood event. The remaining NAA operational details would be the same as those described for the Project.

Distributed Storage Alternative- Screening Analysis and Determination of Non-inclusion to the EIS as a Project Alternative

MNDNR first evaluated the conceptualized DSA to determine if it would meet the Project purpose as defined by the Diversion Authority. Second, MNDNR evaluated the following two variations to the DSA to see whether they could provide additional benefits to meet the Project purpose: 1) the DSA in combination with a new Sheyenne River Diversion, and 2) the DSA in combination with other non-structural measures (e.g., wetland and grassland restoration).

The screening analysis of the DSA indicates:

1. The DSA is limited in meeting the project purpose;
    a. The DSA provides the communities on the Red River mainstem with limited protection from catastrophic events or from peak tributary flows;
2. The DSA is not a feasible or practical alternative to the proposed project; and
    a. Roughly 96 impoundment sites would be required to achieve the desired 20 percent flow reduction basin-wide. Since 1997, only three impoundment projects have been completed upstream of Halstad, Minnesota.
    b. It would be very challenging for the Diversion Authority or the USACE to work with all interested parties across the basin to implement this number of storage sites within a reasonable time period.

3. The DSA, in combination with other measures, does not substantially improve the performance of the alternative toward meeting the project purpose.
   a. Sheyenne Diversion: The addition of the Sheyenne Diversion has the potential to increase flood flows downstream of the F-M urban area; and the cost of adding the Sheyenne Diversion, while not a prime consideration, would decrease the feasibility of DSA.
   b. Wetland/Grassland Restoration: it is unlikely that adding wetland/grassland restoration to the DSA measures would have a sufficient impact to allow the DSA to meet the Project purpose as it relates to catastrophic flood events.

Distributed Storage is a positive basin-wide approach and should be pursued wherever feasible. Distributed Storage would provide both local and mainstem benefits to the region, and if considered in conjunction with the Project along with flood fighting efforts, the Project would have a greater chance of achieving 500-year flood protection. Additional upstream storage would greatly benefit many downstream communities in the Red River Basin, including Fargo and Moorhead, but individual communities would still need additional flood protection for large or catastrophic flood events.

The analysis of this alternative determined that the DSA: 1) does not fully meet the project purpose; and 2) is not a feasible or practical alternative to the proposed project. Minnesota Rules, part 4410.2300, item G allows for alternatives that were included in the EIS scope to be eliminated from further consideration based on information developed as part of the EIS.

Was scale or magnitude evaluated as an alternative?

The MNDNR considered one scale or magnitude alternative in the EIS: More Flows Through Town. The More Flows Through Town Alternative was first conceptualized in 2011 by the USACE as part of the FFREIS as a potential fish mitigation measure. Since then, the concept of sending more flows through town has been discussed many times between the USACE and MNDNR, including during development of this EIS. MNDNR technical staff suggested that the concept of sending more flows through town during Project operation might provide greater environmental and social benefits than the proposed Project. The MNDNR screened the concept to see if additional flow through town should be included as an alternative suitable for further evaluation in the EIS.

More Flows Through Town – Screening Analysis and Determination of Non-inclusion to the EIS as a Project Alternative

The analysis of the More Flows Through Town Alternative determined: 1) the alternative marginally meets the project purpose; and 2) the alternative is not a feasible or practical alternative to the Project. While this alternative would provide incremental environmental benefits, the social benefits are not substantial enough—the staging area footprint is projected to be the same, and mitigation (i.e., buyouts) would still be required. Therefore, it was determined that this alternative offers similar environmental benefits (an incremental benefit) but fails to provide substantially less social impacts. Therefore, the More Flows Through Town Alternative does not present a feasible and prudent alternative. Despite the fact that the More Flows Through Town Alternative will not receive full evaluation in the EIS, increasing flows does offer incremental environmental benefits and will be included as a recommended mitigation measure.

Alternatives Considered and Evaluated in the Environmental Impact Statement (continued)

Alternatives Carried Forward For Evaluation in the EIS:

- Modified designs and layouts
  - Northern Alignment Alternative
- Base No Action Alternative
- No Action Alternative (with Emergency Measures)

Alternatives Dismissed From Further Evaluation in the EIS:

- Modified designs and layouts
  - Distributed Storage Alternative
- Modified scale and magnitude
  - More Flows Through Town Alternative

Summary of Major Differences Between Alternatives

Unlike Federal Council of Environmental Quality (CEQ) regulations, which require federal agencies to identify an agency-preferred alternative, the State's statutes have no such requirement. As such, this EIS will not name a "preferred alternative." Rather, the purpose of environmental review is to provide information to the public and units of government on the environmental impacts of a project before approvals or necessary permits are issued. After projects are completed, unanticipated environmental impacts can be costly to undo, and environmentally-sensitive areas can be impossible to restore. Environmental review creates the opportunity to anticipate and correct these problems before projects are built (EQB, 2015*)*. While, as stated above, the EIS must be used a guide, the summary information presented in ES Table 1 (below) will add utility to the document as a guide in issuing, amending, and denying permits and carrying out other responsibilities of governmental units to avoid or minimize adverse environmental effects and to restore and enhance environmental quality.

The Summary of Impacts between EIS Alternatives (ES Table 1) goes further to serve the purposes of Minnesota Statutes, section 116D.04, subdivision 6 that states:

> *"Subdivision 6. Prohibitions. No state action significantly affecting the quality of the environment shall be allowed, nor shall any permit for natural resources management and development be granted, where such action or permit has caused or is likely to cause pollution, impairment, or destruction of the air, water, land or other natural resources located within the state, so long as there is a feasible and prudent alternative consistent with the reasonable requirements of the public health, safety, and welfare and the state's paramount concern for the protection of its air, water, land and other natural resources from pollution, impairment, or destruction. Economic considerations alone shall not justify such conduct."*

Regulatory authorities can use ES Table 1 to get a general sense of which alternative poses less environmental consequences and greater social/economic benefit. Full details of bulleted items in ES Table 1 can be referenced and reviewed in Chapter 3 under the respective topic subsection (Chapter 3 subsections listed under each topic name in the table) and in Chapter 5—Comparison of Alternatives. When weighing information presented in the table, economic considerations alone shall not be used a basis to deny or grant a permit. Similarly, environmental impacts should be taken in context when making the judgment of which alternative to permit (see Context & Comments column). When considering permit, regulatory authorities should also reference Chapter 6—Proposed and Recommended Mitigation and Monitoring, which identifies additional proposed mitigation measures that could reasonably eliminate or minimize environmental impacts of the Project.

ES Table 1: Summary of Environmental and Socioeconomic Impacts Between EIS Alternatives

Topic	Major Differences between Proposed Project and Northern Alignment Alternative	Context & Comments
Hydrology and Hydraulics (see Section 3.1)	Project: • 1,577.10 (1%) fewer total inundation acres in project area, 100-year flood. NAA: • 4,716.50 (26%) fewer newly inundated acres in project area, 100-year flood. • 6,293.60 (9%) fewer acres protected in Project area, 100-year flood.	• Flood elevations, depths, and duration would differ depending on location (i.e., moving staging area approximately 1.5-3 miles north minimizes inundation impacts in Richland and Wilkin Counties, but increases inundation impacts between the NAA and Project alignments).
FEMA Regulations and the CLOMR Process (see Section 3.2)	• No Major Differences.	• Flood inundation limits, exact structures mitigated and floodway/floodplain limits would differ depending on location (i.e., moving staging area approximately 1.5-3 miles north minimizes impacts in Richland and Wilkin Counties, but increases impacts between the NAA and Project alignments).
Stream Stability (see Section 3.3)	• No Major Differences.	• Impacts would be shifted 1.5-3 miles downstream of the Project. • Geomorphology Report relies on aerial photo and on-site surveys, so tree composition, root density and root depth could not be verified. Some studies have been completed; however, additional studies would need to be completed to determine role of vegetation and other aspects of bank stability conditions within the project area. • Final design details of the dam and dam components as well as a final operating plan are not available at this time; therefore, the potential effects of the Project on bed and channel scour are not known. • Monitoring the drawdown of the inundated area would help to determine extent of sedimentation impacts.
Wetlands (see Section 3.4)	NAA: • Estimated 8 fewer wetland acres (approximately 5 acres for Comstock levee and 3 acres indirect in inundation area; 0.4%) impacted.	• Wetlands between the Project and NAA alignments have yet to be field verified, so exact acreages are unknown. • About 84% of footprint wetlands are considered to be of low function, including the 8 acres that differ. • The majority of the mitigation will be in the bottom and side slopes of the diversion channel. • Drayton Dam: Most of the wetland areas within the footprint are along the MN bank.
Cold Weather Impacts on Aqueduct Function	• No Major Differences.	• If the aqueduct freezes, it is likely the natural channel would also freeze. • Maple River Aqueduct: The USACE Engineer Research and Development Center (ERDC) Cold

Summary of Major Differences Between Alternatives (continued)

Topic	Major Differences between Proposed Project and Northern Alignment Alternative	Context & Comments
and Biotics (see Section 3.5)		Regions Research and Engineering Laboratory (CRREL) completed a report, which included the analysis of different operating scenarios and applying predicted results from computer modeling and analysis. • Post-construction and Project operation monitoring efforts would be a key component in determining aqueduct impacts to the riverine systems and any adaptive management response.
Cover Types (see Section 3.6)	• Known differences include: ○ NAA: Less direct construction impact under NAA without Comstock ring levee.	• Cover Types between the Project and NAA alignments have yet to be field verified, so exact acreages are unknown. • Row crops would not be allowed on exterior embankments, but cutting/bailing of established grasses would be possible (permanent vegetation cover and associated roots are critical to soil strength and overall structural integrity). • The floodplain forest is the only natural forest habitat in the project area, with impacts totaling approximately 62 acres (less than one percent of all floodplain forest wetland acres in project area).
Potential Environmental Hazards (see Section 3.7)	• No Major Differences.	• Several Environmental Site Assessments (ESA) (assessments that investigate the potential for environmental hazards at a site) have been completed within the project area; however, these were completed utilizing earlier Project designs so more would need to be completed once Project designs are refined in Project impact areas (applies to NAA as well). • Results from ESAs would go informing the USACE or Diversion Authority as to what type of mitigation or remediation would be necessary. • Several structures within the footprint of the Project would need to be demolished or moved. Structure material would be evaluated for potential environmental hazards.
Fish Passage and Mortality (see Section 3.8)	NAA: • May have slightly less fish passage impacts on Wolverton Creek and slightly more impacts on Wild Rice River. • By shifting project 1.5-3 miles north, NAA would have slightly less impact to aquatic habitat on Wolverton Creek.	• Existing habitat for all streams in project area is rated as moderate to poor quality. • Impacts are dependent on Project operation, weather, final design of structures, and timing of operation with fish movement. • Fish Passage: NAA is located further away from the confluence of Wolverton Creek and Red River and closer to confluence of Wild Rice and Red Rivers, which could lower velocities on Red River and Wolverton during drawdown providing better fish passage. • Fish Stranding: This process naturally occurs during flood events. Dependent upon timing of receding water and drawdown velocity. • Aquatic Habitat: Impacts have potential to extend beyond the construction footprint through habitat and flow changes as a result of Project construction alterations or Project operation.

Summary of Major Differences Between Alternatives (continued)

Topic	Major Differences between Proposed Project and Northern Alignment Alternative	Context & Comments
Wildlife and Wildlife Habitat (see Section 3.9)	• No Major Differences.	• Sedimentation would likely occur incrementally over several decades, allowing vegetation communities to adapt in these conditions; however, could result in community and habitat changes or wetland type changes. • For floodplain forests, sites that are likely to be successful for restoration would be historic floodplains along rivers that are currently utilized for intensive agriculture. • Once construction and mitigation are completed, the proposed diversion channel is anticipated to have the potential to provide positive impacts by creating a potential new wildlife corridor and habitat in what is now used agriculturally. • Federal, state, and/or local permits that may be required could include provisions such as date restrictions for when construction can occur for particular Project features or other requirements to help avoid or minimize effects on wildlife or wildlife habitat based on the factors involved. • Adaptive management may need to be considered for those impacts that are unknown.
State Listed Species and Special Status Species (see Section 3.10)	• No Major Differences.	• Impacts to migration would depend on timing of migration (beginning, middle, and end), timing of project operation, and frequency of project operation. • The Project and NAA would mostly impact land that is used for agricultural purposes which does not provide the critical habitat needs for these species so impacts to these species is not likely or is anticipated to be minimal. The Project is not anticipated to cause long-term decline in species population.
Invasive Species (see Section 3.11)	• No Major Differences.	• Zebra mussels are present in the Red River. • Since most natural plant communities are limited to riparian areas in the project area, noxious weed spread into these areas is of particular concern. • A consequence of noxious weed spread could be increased herbicide use.

Cultural Resources
(see Section 3.12)
	• Known impacts include:
	  • Under NAA, potential impacts to 33 additional NRHP-recommended eligible sites, and 7 additional sites listed as NRHP-undetermined eligibility.
	  • 2 less cemeteries impacted under NAA (1 added from Project-Benefited Area and 3 dropped from Project staging area.)
		• Full comparison cannot be made due to incomplete information. There are several areas within the NAA area of potential effect that have not had cultural resource surveys completed and some within the Project area as well, so surveys would need to be conducted to fully compare NAA impacts. Site information current as of January 1, 2016.

Summary of Major Differences Between Alternatives (continued)

Topic	Major Differences between Proposed Project and Northern Alignment Alternative	Context & Comments
Infrastructure and Public Services (see Section 3.13)	NAA: • Cass Rural Water District Phase 1 Water Plant would be inundated and require mitigation .	• The Project would result in the modification of traffic patterns for local residences and farmsteads that are close to the alignment, and would affect connectivity and accessibility to various locations and properties in the project area. Roadways requiring improvements to maintain connectivity include, but are not limited to, I-29, U.S. Highway 81, I-94, U.S. Highway 52, U.S. Highway 75, and County Road 10 (See subsection 3.13.2.1.1 for a complete listing). • Improvements and/or modifications to the rail lines were not evaluated in the Transportation Plans. Any improvements/ modifications would be coordinated with Burlington Northern Santa Fe and the Red River Valley & Western Railroad. • The proposed road configurations and bridge locations were determined to not affect emergency response times.
Land Use Plans and Regulations (see Section 3.14)	NAA: • Fewer environmental land use (floodplain) impacts. • Less developable land south of Fargo and Moorhead. • Fewer land use and regulation impacts to Richland and Wilkin Counties, but more impact to Cass and Clay Counties.	• Under NAA, Comstock is not anticipated to have significant new inundation; therefore a ring levee may not be needed and is not included as a NAA Project component. • The 1.5 mile of floodplain between Project and NAA alignments would remain an active floodplain up to a 10-year flood under either alternative. For the NAA, this 1.5 mile stretch, during project operation, would not be a natural floodplain since it would experience additional depth/duration inundation from Project operation; however, it would still have floodplain benefits which wouldn't be realized under the Project. The 1.5 mile area between the NAA and Project alignments represent approximately 5% of the existing floodplain within the project area. • MPCA's Watershed Restoration and Protection Strategy (WRAPS) would be considered during Project review and permitting process. • Minnesota Drainage Law (103E) would be considered during Project review and permit application processes.
Minnesota Dam Safety Regulations and Permitting (see Section 3.15)	• No Major Differences.	• Both the Project and NAA include a dam feature. This would require a MNDNR dam safety permit. • A dam safety and work in public waters permit application for the Project has been received from the Diversion Authority in February 2015 and is currently under review by the MNDNR.
Socioeconomics (see Section 3.16)	Project: • Construction cost $81 million (4%) less. • 274 (214 non-residential and 60 residential; 33%) fewer structures impacted by flooding, 100-year event. • 75 (14%) fewer parcels impacted by	• Cost alone is not sufficient cause to dismiss an alternative in State environmental review. • The Project and NAA are anticipated to provide flood insurance costs saving to numerous property owners. • Under the Project, the Comstock ring levee could allow for relocations of displaced residences, which could increase the tax base for the City and the school district. • Under NAA, it is not anticipated that Comstock would require a ring levee; therefore, residents

Summary of Major Differences Between Alternatives (continued)

Topic	Major Differences between Proposed Project and Northern Alignment Alternative	Context & Comments
	flooding, 100-year event. • $71 million (35%) less business losses. NAA: • Higher cost of land acquisition and damages (approximately $68 million; 25%). • Approximately $1 million (13%) higher average annual relocation costs to ND. • 68 more structures require flood insurance. • Approximately 1,000 (42%) fewer acres of inundation to organic farms. • 2 less (50%) organic farms affected. • CR 16 impacted.	would not have as high of potential for stress, loss of economic vitality, or restricted future development. • Comstock population has been on the decline since 1930. • If flooding occurs prior to the growing season it is anticipated that there would not be impacts to agricultural properties. • NDSU Initial Ag Impact Study indicates that there is an 85% chance that the Project would not operate in any given year (more research yet to be completed). • Fargo and Moorhead share economic vitality. • All 4 organic farms in the project area are located in Minnesota.

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Proposed and Recommended Mitigation and Monitoring

The purpose of the environmental review process is to determine what potential environmental effects or impacts a proposed project could have on natural resources and the human environment. The MNDNR evaluated these potential impacts for the Project and its alternatives. Mitigation measures that could reasonably be applied to eliminate or minimize adverse environmental effects were identified in the EIS and were evaluated for their effectiveness of proposed mitigation (and monitoring, including adaptive management) to minimize or offset known and potential Project impacts. Additional recommendations for mitigation and/or monitoring are included in the EIS where applicable. Additionally, the Adaptive Management Plan concept presented in the FFREIS was further refined during this EIS process which resulted in a comprehensive Draft Adaptive Management and Monitoring Plan (Draft AMMP) that provides background information, proposed and recommended mitigation and monitoring measures, and outlines draft monitoring plan protocols. The Draft AMMP is provided as Appendix B to the EIS.

Two primary resources were used to develop the discussion on proposed and recommended mitigation and monitoring; Appendix B— Draft Adaptive Management and Monitoring Plan (Draft AMMP) and Appendix O—Takings, Flowage Easements, and Acquisition Processes (Appendix O). The Draft AMMP provides background information, proposed and recommended mitigation and monitoring measures, and outlines draft monitoring plan protocols. The Draft AMMP focuses on mitigation and monitoring for environmental impacts, whereas Appendix O provides a detailed legal discussion of proposed and recommended mitigation approaches specific to takings, flowage easements and acquisitions.

The MNDNR considered mitigation measures identified during the comment period on the draft scoping documents as well. These suggested mitigation measures were considered against the exclusionary criteria identified in Minnesota Rules, part 4410.2300, item G. Mitigation measures identified through public comments and carried forward in the EIS included:

- Monitoring diversion channel and flood water drawdown to reduce fish stranding in the diversion channel and inundation areas;
- incorporate invasive species monitoring and mitigation strategies into the Project operation plan;
- review existing Index of Biological Integrity (IBIs) for their potential to inform future monitoring of the aqueducts on the Maple River and Sheyenne River for freezing during low-flow and no-flow conditions; and
- assess the need for groundwater monitoring as part of the Draft Adaptive Management and Monitoring Plan.

Public comments received on the Draft EIS identified concerns pertaining to impacts, mitigation and monitoring on the following topics:

- Cemeteries
- Agricultural land
- Structures
- Roads, ditches and culverts
- Debris removal
- Takings process

Proposed and Recommended Mitigation and Monitoring (continued)

Many of the above concerns relate to takings, flowage easements and acquisitions. MNDNR determined that more information on those topics was needed. After further communication with USACE and the Diversion Authority, gaps were identified in the proposed mitigation. Therefore, in response, MNDNR developed Appendix O. Other concerns not directly related to takings, flowage easements or acquisitions are addressed in Appendix L—Responses to Public Comments Received on the Draft EIS.

The tables below summarize known or potential Project impacts with associated proposed mitigation; monitoring measures as detailed in previous environmental review documents or that were identified or updated during the development of this EIS; and recommendations for additional mitigation or monitoring as applicable. The table indicates if the mitigation or monitoring measure has been adopted as part of the Project or has been identified as a measure that could be implemented. Additional information related to mitigation for the Project is provided in the corresponding chapters of the EIS for each topic area.

ES Table 2 Summary of Hydrology and Hydraulics Proposed and Recommended Mitigation and Monitoring

Known or Potential Impact Type (approx. acreage when applicable)	**Proposed Mitigation and/or Monitoring Description** (sources: FFREIS (AMP), Supplemental EA, Ag Impacts Mitigation Plan, Operating Plan, FEMA/USACE Coordination Plan, Draft AMMP)	**EIS Recommended or Other Required Mitigation and Monitoring** (sources: EIS and Draft AMMP)
• Flood inundation beyond existing floodplain (an estimated 20,000 acres) resulting in impacts to various natural resource features and socioeconomics as covered within the EIS.	• Mitigation specific to Project hydrology was not proposed in the USACE environmental review documents. Hydrologic changes in the project area caused by the Project may impact a number of resources. Mitigation specific to identified or potential resource impacts are discussed under the appropriate resource categories.	• Red River hydrology and hydraulics should be monitored from USGS gages as part of the Geomorphology Monitoring Plan. Three new gages are proposed to be added at the three control structures; diversion channel inlet, Red River, and Wild Rice River. During critical flood events, field monitoring and measurements should be completed to validate gage information and used to compare existing hydraulic conditions to Project-predicted and Project-actual hydraulic conditions.

ES Table 3 Summary of FEMA Regulations and the CLOMR Process Proposed and Recommended Mitigation and Monitoring

Known or Potential Impact Type (approx. acreage when applicable)	**Proposed Mitigation and/or Monitoring Description** (sources: FFREIS (AMP), Supplemental EA, Ag Impacts Mitigation Plan, Operating Plan, FEMA/USACE Coordination Plan, Draft AMMP)	**EIS Recommended or Other Required Mitigation and Monitoring** (sources: EIS, Draft AMMP and Appendix O)
• 100-year flood inundation to residential and non-residential insurable structures.	• More than two feet flood inundation within FEMA revision reach (residential and non-residential): Acquisition or relocation of homes in manner consistent with federal law and policy and applicable state eminent domain law. • Up to two feet flood inundation within FEMA revision reach: Would be evaluated for non-structural measures, such as ring levees, relocation, or elevating structures. Acquisition may be considered in areas where risk and safety analysis indicates that leaving in place would be inappropriate.	• Out-costs for ring levees (i.e., operation, maintenance, recertification) should be included with mitigation. Accredited levees must have government (local, state, federal) ownership and/or responsibility for inspection and maintenance. All ring levees must meet FEMA accreditation requirements. • For portion of staging area in MN: Minnesota state law does not allow for the development of structures within the floodway. • Minnesota state law requires mitigation for structures located within the floodplain – this would include the newly defined floodplain or those that would experience an increase in flood damage potential on existing structures. • Mitigation would need to be completed prior to the LOMR being issued or flood insurance would be required. • Mitigation could include landscaping, structure relocation, flood-proofing, or elevating structures.
• Greater than 100-year flood inundation for residential and nonresidential structures.	• The FEMA/USACE Coordination Plan does not address mitigation above the 100-year flood event.	• Additional recommendations for structures not considered in the FEMA/USACE Coordination Plan can be found in ES Table 20.
• 100-year flood inundation to land including agricultural and organic farms.	• The areal extent of flood inundation required by the Project for operation in the staging area would be mapped as floodway. Flowage easements are proposed to be obtained. • Inundated land outside of the staging area and within the FEMA revision reach would be mapped as FEMA floodplain. USACE has proposed to perform an analysis to determine if a taking has occurred, and flowage easements are proposed to be obtained only where impacts rise to the level of a taking. (See Appendix O).	• Additional recommendations for properties not considered in the FEMA/USACE Coordination Plan can be found in Table 6.19.

Proposed and Recommended Mitigation and Monitoring (continued)

Known or Potential Impact Type (approx. acreage when applicable)	**Proposed Mitigation and/or Monitoring Description** (sources: FFREIS (AMP), Supplemental EA, Ag Impacts Mitigation Plan, Operating Plan, FEMA/USACE Coordination Plan, Draft AMMP)	**EIS Recommended or Other Required Mitigation and Monitoring** (sources: EIS, Draft AMMP and Appendix O)
• Greater than 100-year flood inundation to land including agricultural and organic farms.	• The FEMA/USACE Coordination Plan does not address mitigation above the 100-year flood event.	• Additional recommendations for land not considered in the FEMA/USACE Coordination Plan can be found in ES Table 20.

Proposed and Recommended Mitigation and Monitoring (continued)

ES Table 4 Summary of Stream Stability Proposed and Recommended Mitigation and Monitoring

Known or Potential Impact Type (approx. acreage when applicable)	**Proposed Mitigation and/or Monitoring Description** (sources: FFREIS (AMP), Supplemental EA, Ag Impacts Mitigation Plan, Operating Plan, FEMA/USACE Coordination Plan, Draft AMMP)	**EIS Recommended or Other Required Mitigation and Monitoring** (sources: EIS and Draft AMMP)
• Modification and control of water flow from Project construction and Project operation (alteration of flood flow frequency and velocity; modification of existing floodway and floodplain; channel abandonment and aqueducts channel/substrate alteration effects).	• Monitoring and adaptive management to track before and after Project changes and adjust management of the Project through Geomorphology Assessments. • **Geomorphology Assessment** – **Monitoring** - Includes: Pre- and post-construction geomorphic surveys once prior to Project construction and twice following construction. The pre-construction survey was completed in 2010 and 2011 (Geomorphology Report of Fargo, North Dakota and Moorhead Minnesota Flood risk Management Project, West 2012). Post-construction would potentially occur at five to ten years and 20 years following completion of Project construction. Additional surveys may occur if deemed necessary through the adaptive management process. • **Geomorphic Assessment Tasks**: Analysis of hydrology, bank stability, sediment transport, and morphological classification. • Final control structure designs should account for energy dissipation. Once design is finalized, shear stresses and velocities flowing out of the control structures should be verified to be lower than the threshold values for stiff clay. • Adaptive management approach: Following Project operation, if bank failures or increasing bank instability is observed under the typical receding limb rate, the drawdown should be decreased systematically until a solution is reached by the AMMPT. The AMMPT would consider potential impacts that would result from decreasing the drawdown (e.g., agricultural impacts) in their approach.	• Adaptive management approach: Following Project operation, if bank failures or increasing bank instability is observed under the typical receding limb rate, the drawdown should be decreased systematically until a solution is reached by the AMMPT. The AMMPT would consider potential impacts that would result from decreasing the drawdown (e.g., agricultural impacts) in their approach. • Monitoring (listed below) would be the basis for identifying the need for additional response/mitigation actions as described in detail in the Draft AMMP. • **Cross Sections:** No less than three pre-construction surveys should occur prior to construction completion. Post-construction surveys every two years for three sampling cycles (assumes Project operation has not occurred). Following three sampling events, the Geomorphology Monitoring Team (GMT) would assess findings and determine whether more sampling is necessary and at what frequency. If Project is operated, sampling would occur as soon as possible following Project operation. • **Cross Sections:** Additional and revised cross section survey locations (from those defined in the Geomorphology Report (West 2012) have been included in the Draft AMMP in an effort to provide a more complete assessment of potential Project impacts. • **Longitudinal Profile:** To collect bed topography data and other data that may otherwise be missed when performing cross-sections. Pre- and post-construction surveys to follow the same schedule as Cross Sections. (This was not completed during 2010-2011 geomorphology survey). • **Cross Section and Geomorphic Assessments**

Known or Potential Impact Type (approx. acreage when applicable)	**Proposed Mitigation and/or Monitoring Description** (sources: FFREIS (AMP), Supplemental EA, Ag Impacts Mitigation Plan, Operating Plan, FEMA/USACE Coordination Plan, Draft AMMP)	**EIS Recommended or Other Required Mitigation and Monitoring** (sources: EIS and Draft AMMP)
		Qualifications: For consistency and as supported by the MNDNR, the MNDNR highly recommends for quality assurance/quality control that these assessments should be completed by those trained in Rosgen III channel stability assessment certified by the MNDNR or other Rosgen course. Data management analysis should use one consistent data management tool; recommended data management tool is the RIVERMORPH data management software package associated with the Rosgen Stream assessments. If this data management tool is not utilized, then the software used should be in a format that is transferable to RIVERMORPH. • **Hydrology and Hydraulic Monitoring:** USGS gages used in study area. Addition of three new gages is proposed at the three control structures; channel inlet, Red River, and Wild Rice River. • **Bathymetry**: Every 10-20 years in absence of large geomorphic change events. • **Sediment Samples:** Of both instream and bed and bank samples to determine sediment load and particles. Pre- and post-construction surveys to follow the same schedule as Cross Sections. • **Bed Scour:** Monitoring at the water control structures should be completed once the design and operating plan is finalized for these structures. • **Communication with Local Agencies:** Annual or more frequent communication should be established with representatives from local agencies regarding channel morphology. • **Field Reconnaissance:** A reconnaissance of the detailed study reaches should be conducted immediately prior to the completion of the Project and of the diversion channel immediately following its completion (to establish baseline as a conditions) and every five years thereafter for the first

Proposed and Recommended Mitigation and Monitoring (continued)

Known or Potential Impact Type (approx. acreage when applicable)	**Proposed Mitigation and/or Monitoring Description** (sources: FFREIS (AMP), Supplemental EA, Ag Impacts Mitigation Plan, Operating Plan, FEMA/USACE Coordination Plan, Draft AMMP)	**EIS Recommended or Other Required Mitigation and Monitoring** (sources: EIS and Draft AMMP)
		ten years. If no significant changes are noted, reduce to every ten years. • **LiDAR**: Should be completed to complement cross section data on the reaches in areas that are not surveyed. To occur once every three years focused in the river corridor. • **Water Quality:** Sample for water quality way to assess river response to Project. Sampling frequency would be dependent on data being gathered (some continuous and some parameters would follow sediment sampling frequency). • **Aerial Photography:** To capture trends in the land surface – use and observations of impacts (Project and other causes). Every one to two years for five years or immediately following Project operation. If no significant changes have occurred after five years, the frequency can be reduced to every four to five years. If no significant changes have occurred after 15 years, the frequency can be reduced to every ten years.

ES Table 5 Summary of Wetlands Proposed and Recommended Mitigation and Monitoring – Forested Wetlands

Known or Potential Impact Type (approx. acreage when applicable)	**Proposed Mitigation and/or Monitoring Description** (sources: FFREIS (AMP), Supplemental EA, Ag Impacts Mitigation Plan, Operating Plan, FEMA/USACE Coordination Plan, Draft AMMP)	**EIS Recommended or Other Required Mitigation and Monitoring** (sources: EIS and Draft AMMP)
• 62 acres of direct impacts to floodplain forest.	**Mitigation** • A two to one mitigation ratio would be applied for floodplain forest impacts. • Floodplain lands would be acquired that are currently in agriculture or pasture, and re-establish woodland on those tracts. Restore native floodplain forest and herbaceous vegetation. These areas would also provide wildlife habitat. • USACE would develop a site restoration plan, including tree	**Mitigation** • Acquisition, monitoring, management, and easement acquisition should be the responsibility of the non-Federal sponsor. **Monitoring Plan:** • Monitoring through adaptive management (as detailed in the Draft AMMP) to evaluate whether the specific ratios proposed for wetland mitigation would replace lost function and temporal loss. The AMMPT would weigh in on

Proposed and Recommended Mitigation and Monitoring (continued)

Known or Potential Impact Type (approx. acreage when applicable)	Proposed Mitigation and/or Monitoring Description (sources: FFREIS (AMP), Supplemental EA, Ag Impacts Mitigation Plan, Operating Plan, FEMA/USACE Coordination Plan, Draft AMMP)	EIS Recommended or Other Required Mitigation and Monitoring (sources: EIS and Draft AMMP)
	planting areas, and clearing, treatment and management schedule of the site(s). A combination of direct seeding and seedling trees would be used as needed. Site(s) would be managed for effective growing. Site(s) would be protected and managed into perpetuity by an agreement for management as a wildlife management area by the MNDNR or North Dakota Game and Fish Department (NDGF). **Monitoring Plan:** • 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 and following major wind storms. • Adaptive management would be used to monitor the mitigation sites. Monitoring would include measurement of specific 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.	monitoring reports and decide whether additional response actions are needed. The monitoring plan should also include a post-event assessment. Particularly if the Project would go into operation prior to good root establishment. The rate and amount of sedimentation could impact these species. Mitigation sites should be monitored for sedimentation impacts and habitat function. Monitoring would evaluate impacts to wetland type and seed banks from various flood events. Wetland performance standards would include hydrology and vegetation observations over a period of several years. The Project consists of several monitored wetland types, each have different performance ranges for hydrology and vegetation.

ES Table 6 Summary of Wetlands Proposed and Recommended Mitigation and Monitoring -- Non-Forested Wetlands

Known or Potential Impact Type (approx. acreage when applicable)	**Proposed Mitigation and/or Monitoring Description** (sources: FFREIS (AMP), Supplemental EA, Ag Impacts Mitigation Plan, Operating Plan, FEMA/USACE Coordination Plan, Draft AMMP)	**EIS Recommended or Other Required Mitigation and Monitoring** (sources: EIS and Draft AMMP)
• 1,700 acres of non-forested wetland impact.	• Wetland replacement for diversion channel including side slopes and upland, at a 1.19 to 1 ratio and would be mitigated through revegetation/wetland creation at the bottom of the diversion channel and management of upland inside slopes. • Adaptive management would be used to monitor the mitigation sites. Monitoring would include measurement of specific 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.	• North Dakota wetland mitigation plan proposed wetland replacement based on function, not by specific wetland type. This would require monitoring and reporting of habitat function. A range of performance measure standards are discussed in the USACE AMP mitigation and monitoring plan for wetlands. • A project-specific wetland replacement plan for Minnesota is needed and should be developed under the direction of the WCA LGU(s) per WCA requirements. • Wetland performance standards should include hydrology and vegetation observations over a period of several years. The Project consists of several monitored wetland types, each have different performance ranges for hydrology and vegetation.

ES Table 7 Summary of Wetlands Proposed and Recommended Mitigation and Monitoring – Oxbow/Hickson/Bakke Ring Levee Wetlands

Known or Potential Impact Type (approx. acreage when applicable)	**Proposed Mitigation and/or Monitoring Description** (sources: FFREIS (AMP), Supplemental EA, Ag Impacts Mitigation Plan, Operating Plan, FEMA/USACE Coordination Plan, Draft AMMP)	**EIS Recommended or Other Required Mitigation and Monitoring** (sources: EIS and Draft AMMP)
• 53 acres of direct impact.	• Mitigation sites include Forest River site (already constructed) and the Oxbow Country Club site. The remaining sites would be developed through Ducks Unlimited In-Lieu Fee Program.	• No additional recommendations or requirements at this time.

ES Table 8 Summary of Wetlands Proposed and Recommended Mitigation and Monitoring -- Inundation Area Wetlands

Known or Potential Impact Type (approx. acreage when applicable)	**Proposed Mitigation and/or Monitoring Description** (sources: FFREIS (AMP), Supplemental EA, Ag Impacts Mitigation Plan, Operating Plan, FEMA/USACE Coordination Plan, Draft AMMP)	**EIS Recommended or Other Required Mitigation and Monitoring** (sources: EIS and Draft AMMP)
• Potential impacts to wetland in the unprotected Project inundation area from sedimentation and subsequent function loss are unknown.	• Wetland mitigation is not specifically proposed for the staging area and inundation areas for potential indirect impacts resulting from sedimentation.	• Monitoring of the inundation areas should occur to assess potential indirect impacts to wetlands due to Project operation. Considerations for the wetland mitigation and monitoring plan should include sedimentation monitoring and habitat function monitoring. In the event that negative impacts are observed, additional replacement requirements that meet federal and state replacement requirements would also be necessary.

ES Table 9 Summary of Cold Weather Impacts on Aqueducts Function and Biotics Proposed and Recommended Mitigation and Monitoring

Known or Potential Impact Type (approx. acreage when applicable)	**Proposed Mitigation and/or Monitoring Description** (sources: FFREIS (AMP), Supplemental EA, Ag Impacts Mitigation Plan, Operating Plan, FEMA/USACE Coordination Plan, Draft AMMP)	**EIS Recommended or Other Required Mitigation and Monitoring** (sources: EIS and Draft AMMP)
• Potential impacts to fish passage and biological connectivity as well as habitat.	• The mitigation and adaptive management proposed under Fish Passage and Biological Connectivity that includes monitoring fish, macroinvertebrates, and physical habitat would apply. • Current engineering plans include heating components to reduce the potential for freezing or ice buildup.	• Monitoring of surface ice in the heated and unheated portions of the aqueduct compared to ice formation on the Maple and Sheyenne Rivers. • Monitoring of backwater stage increase upstream of the proposed aqueducts compared to historic gage data.

ES Table 10 Summary of Cover Types Proposed and Recommended Mitigation and Monitoring

Known or Potential Impact Type (approx. acreage when applicable)	**Proposed Mitigation and/or Monitoring Description** (sources: FFREIS (AMP), Supplemental EA, Ag Impacts Mitigation Plan, Operating Plan, FEMA/USACE Coordination Plan, Draft AMMP)	**EIS Recommended or Other Required Mitigation and Monitoring** (sources: EIS and Draft AMMP)
• Land, primarily cropland, would be acquired for construction of the diversion channel and other Project	• Cropland impacts would be mitigated by compensation to landowners for direct cropland impacts, such as land acquisition for Project construction. Owners of croplands that are	• No additional recommendations or requirements at this time.

Known or Potential Impact Type (approx. acreage when applicable)	**Proposed Mitigation and/or Monitoring Description** (sources: FFREIS (AMP), Supplemental EA, Ag Impacts Mitigation Plan, Operating Plan, FEMA/USACE Coordination Plan, Draft AMMP)	**EIS Recommended or Other Required Mitigation and Monitoring** (sources: EIS and Draft AMMP)
features. • Impacts would occur primarily to croplands and wetlands.	purchased for the Project would be compensated at fair market value.	
• Direct and indirect impacts to forested and non-forested wetlands.	• Refer to Wetlands discussion.	• Refer to Wetlands discussion.

ES Table 11 Summary of Potential Environmental Hazards Proposed and Recommended Mitigation and Monitoring

Known or Potential Impact Type (approx. acreage when applicable)	**Proposed Mitigation and/or Monitoring Description** (sources: FFREIS (AMP), Supplemental EA, Ag Impacts Mitigation Plan, Operating Plan, FEMA/USACE Coordination Plan, Draft AMMP)	**EIS Recommended or Other Required Mitigation and Monitoring** (sources: EIS and Draft AMMP)
• Direct impacts to parcels from Project construction that may contain Recognized Environmental Conditions (RECs).	• Once Project designs are more refined and parcels have been identified for acquisition, the USACE would conduct additional Phase I Environmental Site Assessments (ESAs) and any necessary Phase II ESAs as recommended to determine if RECs are present and if remediation/mitigation is necessary. RECs could be mitigated through removal of REC, soil and groundwater remediation projects or other measures.	• Minnesota Rules, part 7035.0805 requires that a building survey be completed to identify potential asbestos containing materials, lead based paint, and any regulated/hazardous materials that require special handling or disposal prior to demolition of relocation of structures. Regulated materials would need to be mitigated/disposed of in accordance with local, state, and federal laws by a licensed hazardous waste contractor.
• Flood inundation to properties containing RECs.	• Mitigation for structures that would be impacted from inundation would be determined on a case-by-case basis as the level of impact (depth of flood impact) would be taken into consideration when determining a mitigation course of action. Refer to FEMA CLOMR and Socioeconomics discussions for more details.	• RECs should be considered during property evaluations and should be identified and properly mitigated for those properties that would be affected by inundation as a result of Project operation.

ES Table 12 Summary of Fish Passage and Biological Connectivity Proposed and Recommended Mitigation and Monitoring

Known or Potential Impact Type (approx. acreage when applicable)	**Proposed Mitigation and/or Monitoring Description** (sources: FFREIS (AMP), Supplemental EA, Ag Impacts Mitigation Plan, Operating Plan, FEMA/USACE Coordination Plan, Draft AMMP)	**EIS Recommended or Other Required Mitigation and Monitoring** (sources: EIS and Draft AMMP)
• Channel abandonment: ○ Lower Rush River: 2.7 miles ○ Rush River: 2.3 miles	• A low flow channel would be constructed in a sinuous nature from the Maple River downstream to the outlet of the diversion channel into the Red River to mimic a more natural stream channel.	• Monitoring would be the basis for identifying the need for additional response/mitigation actions. Ecological function of the proposed low-flow channel needs to be monitored post-construction and operation to determine its effectiveness. See Draft AMMP. • Construction Avoidance Periods: Proper timing of Project construction would need to be considered in order to minimize or avoid further potential impacts to the fish community.
• Red River connectivity - operation of control structure.	• Construct Drayton Dam Fish Passage, including installation of a new rock-ramp spillway and removal of portions of the existing dam.	• Consider additional ways to reduce frequency of operation by, for example, constructing more in-town levees (or other flood reduction project(s)) that would allow for flows through town to be greater than 17,000 cubic feet per section (cfs).
• Wild Rice River connectivity – operation of control structure.	• Remove the Wild Rice River Dam.	• No additional recommendations or requirements at this time.
• Impacts to connectivity in the project area.	• Monitoring would occur following Project operation at predefined locations. Techniques for monitoring would be determined following Project construction but would generally include evaluation of hydraulic conditions and biological sampling. See Draft AMMP for more details.	• Monitoring for fisheries impacts should be evaluated on a broader scale, as a fish connectivity barrier on the main stem can have impacts on upstream and downstream reproduction. Monitoring plan sampling techniques need to take into account large river species. See Draft AMMP – Considerations for benthic fishes on the Red River. • Final diversion channel and control structure designs should be reviewed by the AMMPT and the ABMT to ensure that they are designed to minimize the potential for impacts to fish passage.
• Impacts to aquatic biota and potential habitat in the project area.	• Fisheries, physical habitat, and macroinvertebrate assessments would be completed pre- and post-Project operation to establish baseline and Project conditions. At least two fish monitoring events would be conducted prior to construction of the Project and that the survey locations would include areas	• Fish community monitoring at sites identified within the Aquatic Biological Monitoring Plan (ABMP) in the Draft AMMP (currently 21 sites listed in the Draft AMMP but number may be adjusted by the ABM Team) should be conducted at least two times prior to Project construction

Known or Potential Impact Type (approx. acreage when applicable)	**Proposed Mitigation and/or Monitoring Description** (sources: FFREIS (AMP), Supplemental EA, Ag Impacts Mitigation Plan, Operating Plan, FEMA/USACE Coordination Plan, Draft AMMP)	**EIS Recommended or Other Required Mitigation and Monitoring** (sources: EIS and Draft AMMP)
	near the footprint of the Project structures (i.e., control structures, aqueducts, rock-ramps, etc.), as well as sites above or below the features. As of 2015, one pre-construction fish survey has already been completed. • Adaptive management would be used by the AMMPT to determine if additional mitigation is necessary based on assessment results.	and two additional times prior to Project operation. It is recommended that monitoring be conducted on a two or three-year return frequency for the pre-construction/operation surveys. After the Project construction is complete, additional monitoring events and assessments would be required to monitor future changes and assess impacts. The number of sites that are surveyed could vary depending on final Project design and due to the adaptive nature of this approach. Changes to survey sites would be recommended by the ABMT. See Draft AMMP. • Follow up surveys and assessments should follow the protocols and methodologies used in the initial assessment (URS, 2013), and if possible, should occur during the same time of the year. • Metrics where sites have scored well, such as taxa richness of fish-eating species or relative abundance, would be good to track across monitoring events, including pre-construction, post-construction and Project operation.
• Direct impacts to aquatic habitat from Project construction; ○ Maple River: 11 acres ○ Sheyenne River: 8 to 9 acres ○ Wild Rice River: 12 acres ○ Red River: 14 acres	• Stream restoration would be completed that includes stream remeandering, bank grading, riffles/grade control, riparian buffer strips and other actions. • The aquatic habitat within constructed channels would be measured (quantity and quality) and compared against pre-construction conditions to assess if additional aquatic habitat mitigation is necessary.	• Possible stream restorations on a different river that is not impacted by the Project or that may be located outside of the project area. The stream reconstruction projects should be restricted to other streams within the Red River basin to ensure the impacts from the Project are offset within the overall watershed. Consider large restoration efforts basin-wide if monitoring shows significant impacts occurring. Large restoration efforts would require financial assurance. • Construction Avoidance Periods: Proper timing of Project construction would need to be considered in order to minimize or avoid further potential impacts to the fish community.
• Potential fish stranding after Project operation.	• Visual Assessment to evaluate fish stranding after Project operation would be completed by non-Federal sponsors	• Operation should ensure that fish would have the ability to follow the receding hydrograph, i.e., prevent stranding.

Known or Potential Impact Type (approx. acreage when applicable)	**Proposed Mitigation and/or Monitoring Description** (sources: FFREIS (AMP), Supplemental EA, Ag Impacts Mitigation Plan, Operating Plan, FEMA/USACE Coordination Plan, Draft AMMP)	**EIS Recommended or Other Required Mitigation and Monitoring** (sources: EIS and Draft AMMP)
	• Design change to include diversion inlet structure gates to allow for more control over receding waters within diversion channel.	

ES Table 13 Summary of Wildlife and Wildlife Habitat Proposed and Recommended Mitigation and Monitoring

Known or Potential Impact Type (approx. acreage when applicable)	**Proposed Mitigation and/or Monitoring Description** (sources: FFREIS (AMP), Supplemental EA, Ag Impacts Mitigation Plan, Operating Plan, FEMA/USACE Coordination Plan, Draft AMMP)	**EIS Recommended or Other Required Mitigation and Monitoring** (sources: EIS and Draft AMMP)
• 62 acres of direct impacts to floodplain forest.	• See descriptions under Wetlands as wildlife habitat replacement would be incidental to wetland replacement.	• See descriptions under Wetlands as wildlife habitat replacement would be incidental to wetland replacement.
• Direct impacts to aquatic habitat from Project construction; ○ Maple River: 11 acres ○ Sheyenne River: 8 to 9 acres ○ Wild Rice River: 12 acres ○ Red River: 14 acres	• See descriptions for Fish Passage and Biological Connectivity.	• See descriptions for Fish Passage and Biological Connectivity.

ES Table 14 Summary of State-Listed Species and Special Status Species Proposed and Recommended Mitigation and Monitoring

Known or Potential Impact Type (approx. acreage when applicable)	**Proposed Mitigation and/or Monitoring Description** (sources: FFREIS (AMP), Supplemental EA, Ag Impacts Mitigation Plan, Operating Plan, FEMA/USACE Coordination Plan, Draft AMMP)	**EIS Recommended or Other Required Mitigation and Monitoring** (sources: EIS and Draft AMMP)
• Interruption of bald eagle nesting.	• Bald eagles nests would be monitored during spring construction season. The project area would continue to be monitored during the upcoming years to ensure that no new nests would be impacted by Project construction. There would be raptor nest surveys completed in the spring of the year preceding construction within or near any affected wooded areas.	• No additional or requirements recommendations at this time.

Proposed and Recommended Mitigation and Monitoring (continued)

Known or Potential Impact Type (approx. acreage when applicable)	Proposed Mitigation and/or Monitoring Description (sources: FFREIS (AMP), Supplemental EA, Ag Impacts Mitigation Plan, Operating Plan, FEMA/USACE Coordination Plan, Draft AMMP)	EIS Recommended or Other Required Mitigation and Monitoring (sources: EIS and Draft AMMP)
• Mortality of mussels from Project construction.	• Additional mussel surveys are being considered for Project footprint areas to verify whether impacts to mussel resources would be substantial. This would include determining presence of the black sandshell, mapleleaf and Wabash pigtoe mussels.	• Recommend that additional mussel surveys be completed for Project footprint areas.
• Interruption of cardinal and whip-poor-will nesting.	• To the extent practicable, vegetation clearing activities would be done so as to avoid affecting nesting individuals.	• No additional recommendations or requirements at this time.
• Interruption of bird nesting and rearing periods.	• Tree clearing on forested land would occur during the winter months in order to not impact listed bird species during their nesting and rearing periods.	• No additional recommendations or requirements at this time.
• Interruption to migration and spawning for lake sturgeon during Project operation.	• Monitoring would occur following Project operation as predefined locations. Techniques for monitoring would be determined following Project construction but would generally include evaluation of hydraulic conditions and biological sampling. See Fish Passage and Biological Connectivity for more details.	• See descriptions for Fish Passage and Biological Connectivity.

ES Table 15 Summary of Invasive Species Proposed and Recommended Mitigation and Monitoring

Known or Potential Impact Type (approx. acreage when applicable)	Proposed Mitigation and/or Monitoring Description (sources: FFREIS (AMP), Supplemental EA, Ag Impacts Mitigation Plan, Operating Plan, FEMA/USACE Coordination Plan, Draft AMMP)	EIS Recommended or Other Required Mitigation and Monitoring (sources: EIS and Draft AMMP)
• Invasive species establishment at disturbance sites (i.e., mitigation and construction sites).	• An invasive species management plan, including pre-construction monitoring data previously collected by the USACE and post-construction monitoring of biota and physical habitat for both construction sites and mitigation sites, would be prepared. The plan would outline the inspection procedures and occurrences to ensure compliance. BMPs would be followed to prevent the introduction and spread of aquatic or terrestrial invasive species during Project construction and monitoring. • Wetland mitigation sites would be managed for invasive species. Invasive and/or non-native plant species would be	• Control of invasive species may be needed at specific mitigation sites for functional lift/enhancement if monitoring shows that functions being replaced are not adequate. Minnesota wetland replacement requirements usually have specific performance criteria that must be met (e.g., max. percent cover of invasive species). • The construction of this project would involve work in zebra-mussel infested waters. The Corps should develop a plan for reducing the risk of spreading zebra mussels during construction, including: decontamination of construction equipment before it’s used at another site,

Known or Potential Impact Type (approx. acreage when applicable)	Proposed Mitigation and/or Monitoring Description (sources: FFREIS (AMP), Supplemental EA, Ag Impacts Mitigation Plan, Operating Plan, FEMA/USACE Coordination Plan, Draft AMMP)	EIS Recommended or Other Required Mitigation and Monitoring (sources: EIS and Draft AMMP)
	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. • 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 seeded areas would be monitored per the Project plans and specifications. • The non-Federal sponsors would be responsible for noxious weed control on the whole Project perpetually as part of the Operations, Maintenance, Repair, Rehabilitation, and Replacement (OMRR&R).	taking precautions with any water that is moved/transported/diverted from the site during the project, and proper disposal of any solid fill to reduce risk of spreading zebra mussels.
• Invasive species spread and establishment in inundation areas.	• A monitoring plan would be prepared that would include procedures on survey for identifying invasive species, treatment plans, and follow-up surveys to confirm that treatments are effective. • Monitoring would be completed on an annual basis in accordance with the OMRR&R and adaptive management plan.	• No additional recommendations or requirements at this time.

ES Table 16 Summary of Cultural Resources Proposed and Recommended Mitigation and Monitoring

Known or Potential Impact Type (approx. acreage when applicable)	Proposed Mitigation and/or Monitoring Description (sources: FFREIS (AMP), Supplemental EA, Ag Impacts Mitigation Plan, Operating Plan, FEMA/USACE Coordination Plan, Draft AMMP)	EIS Recommended or Other Required Mitigation and Monitoring (sources: EIS, Draft AMMP, and Appendix O)
• Flood impacts to eligible or listed NRHP properties and cemeteries.	• USACE and Diversion Authority would comply with Section 106 through consultations and Programmatic Agreement with North Dakota and Minnesota State Historic Preservations	• Adopt State Historic Preservation Office (SHPO) recommendations (per SHPO correspondence). • See Appendix O for potential mitigation measures.

Known or Potential Impact Type (approx. acreage when applicable)	**Proposed Mitigation and/or Monitoring Description** (sources: FFREIS (AMP), Supplemental EA, Ag Impacts Mitigation Plan, Operating Plan, FEMA/USACE Coordination Plan, Draft AMMP)	**EIS Recommended or Other Required Mitigation and Monitoring** (sources: EIS, Draft AMMP, and Appendix O)
	Officers. Programmatic Agreement for the Fargo-Moorhead Metropolitan Area Flood Risk Management Project was signed in June and July 2011, and Amendment 1, signed in 2013. • Programmatic Agreement defines the Project’s Area of Potential Effects and contains stipulations for cultural resources avoidance, minimization, and mitigation measures. • The USACE completed a 2015 Draft Cemetery Mitigation Plan that includes potential mitigation measures but none of these measures have been proposed at this time.	
• Flood impacts to cemeteries not eligible for NRHP.	• Federal mitigation plan consists of requiring the non-Federal sponsor to acquire flowage easements within the staging area.	• Adopt recommendations from the Draft Cemetery Mitigation Plan that go beyond flowage easements that fully consider potential impacts from Project operation specific to each cemetery. • See Appendix O for potential mitigation measures.
• Flood impacts to cemeteries outside the staging area.	• The Draft Cemetery Mitigation Plan does not identify any proposed mitigation for these cemeteries.	• See Appendix O for potential mitigation measures.

ES Table 17 Summary of Infrastructure and Public Services Proposed and Recommended Mitigation and Monitoring

Known or Potential Impact Type (approx. acreage when applicable)	**Proposed Mitigation and/or Monitoring Description** (sources: FFREIS (AMP), Supplemental EA, Ag Impacts Mitigation Plan, Operating Plan, FEMA/USACE Coordination Plan, Draft AMMP)	**EIS Recommended or Other Required Mitigation and Monitoring** (sources: EIS and Draft AMMP)
• Diversion channel construction impacts on existing roads and bridges.	• Construction of road and rail bridges over the diversion channel would be completed to mitigate transportation connectivity impacts	• Construction of roads and bridges as well as changes to other infrastructure may cause impacts to resources, which should be evaluated accordingly during permitting. • Coordination with entities such as the US Postal Service is recommended so that road closures can be anticipated in advance and planned for.
• Flood inundation of existing roads, culverts and ditches.	• I-29 and Highway 75 would be raised in the staging area to prevent inundation during Project operation. Small portions of Highways 81, 18, and 2 would be raised to maintain access to OHB and Comstock. All other roads in the staging area would be	• The Diversion Authority should develop a process for Project-related clean-up and repair, including identifying responsibility, priorities, and local government coordination.

Proposed and Recommended Mitigation and Monitoring (continued)

Known or Potential Impact Type (approx. acreage when applicable)	**Proposed Mitigation and/or Monitoring Description** (sources: FFREIS (AMP), Supplemental EA, Ag Impacts Mitigation Plan, Operating Plan, FEMA/USACE Coordination Plan, Draft AMMP)	**EIS Recommended or Other Required Mitigation and Monitoring** (sources: EIS and Draft AMMP)
	allowed to flood under Project operation. • Debris would be removed from public land and would be captured in the forthcoming Operation and Maintenance Plan.	
• Change in traffic patterns to roads that were not designed for increased traffic.	• Road improvements to maintain mobility.	• No additional recommendations or requirements at this time.
• Flood inundation of existing railroads.	• Railroads would be raised as needed through the inundation area.	• Additional studies are needed to evaluate potential impacts of railroad improvements or raises.
• Project construction or flood inundation of existing utilities.	• Utilities that cannot withstand occasional flooding in the inundation area would be abandoned, modified, or relocated, depending on the situation in accordance with applicable regulations.	• Additional studies are needed to evaluate potential impacts of modifying or relocating utilities. For example, high voltage transmission lines would require coordination and possible approval from the MN Public Utilities Commission.

ES Table 18 Summary of Land Use Plans and Regulations Proposed and Recommended Mitigation and Monitoring

Known or Potential Impact Type (approx. acreage when applicable)	**Proposed Mitigation and/or Monitoring Description** (sources: FFREIS (AMP), Supplemental EA, Ag Impacts Mitigation Plan, Operating Plan, FEMA/USACE Coordination Plan, Draft AMMP)	**EIS Recommended or Other Required Mitigation and Monitoring** (sources: EIS and Draft AMMP)
• Increased flooding of the inundation area, restricting development and/or use of areas ○ Depending on inundation depth and location (within or outside of the staging area).	• The USACE has indicated regulations would be followed as required by federal law, and would continue to work with state and local entities for Project implementation. • FEMA would require that the areal extent of flood inundation required by the Project for operation in the staging area be designated as floodway. Inundation outside of the staging area but within the FEMA revision reach would be designated as floodplain. Development restrictions would apply per FEMA regulations. See FEMA CLOMR for more details.	• Project construction may require permits and LGU approval. Conditional use permits (CUP) may be required. MNDNR may be involved with some of the local permit reviews, such as variances and CUPs that may include specific mitigation. • Zoning amendments could be needed at the county, township, and municipal level once the Project is in operation and impacts can be monitored and quantified. • Current floodplain ordinance and map revisal: the impact of the Project on the existing floodplain may require LGU review of current floodplain ordinances and maps. • Enhanced land use controls (e.g., “no build zones”) downstream of the dam in the benefited area (e.g., the hydrologic shadow of the dam, or areas impacted by flood

Known or Potential Impact Type (approx. acreage when applicable)	Proposed Mitigation and/or Monitoring Description (sources: FFREIS (AMP), Supplemental EA, Ag Impacts Mitigation Plan, Operating Plan, FEMA/USACE Coordination Plan, Draft AMMP)	EIS Recommended or Other Required Mitigation and Monitoring (sources: EIS and Draft AMMP)
		events greater than the 100-year). • Minnesota state law would not allow development to occur within the designated floodway (i.e., the inundated portions of the staging area on the MN side). Existing structures that would be within the newly designated floodplain would require flood insurance or would need to be mitigated. Restrictions for future development on parcels within the floodplain would apply per MN law.

ES Table 19 Summary of Minnesota Dam Safety and Work in Public Waters Regulations and Permitting Proposed and Recommended Mitigation and Monitoring

Known or Potential Impact Type (approx. acreage when applicable)	Proposed Mitigation and/or Monitoring Description (sources: FFREIS (AMP), Supplemental EA, Ag Impacts Mitigation Plan, Operating Plan, FEMA/USACE Coordination Plan, Draft AMMP)	EIS Recommended or Other Required Mitigation and Monitoring (sources: EIS and Draft AMMP)
• Dam construction on the Red River and Wild Rice River.	• No specific mitigation was described in the USACE environmental review documents. The Project would require a MNDNR Dam Permit, which has specific requirements for approval and possible mitigation.	• MNDNR dam safety and work in public waters permit would include necessary design, mitigation, and operation conditions for the Project. Application requires that specific studies be completed (by licensed engineers) and approved prior to permit approval. See Dam Safety Section 3.15 for further details on application process and permit approval criteria.

ES Table 20 Summary of Socioeconomics Proposed and Recommended Mitigation and Monitoring

Known or Potential Impact Type (approx. acreage when applicable)	Proposed Mitigation and/or Monitoring Description (sources: FFREIS (AMP), Supplemental EA, Ag Impacts Mitigation Plan, Operating Plan, FEMA/USACE Coordination Plan, Draft AMMP)	EIS Recommended or Other Required Mitigation and Monitoring (sources: EIS, Draft AMMP, and Appendix O)
• Flood inundation to residential and nonresidential structures in the staging area.	• See ES Table 3 (FEMA) above. • Flood insurance would be purchased for structures that are allowed to remain.	• See ES Table 3 (FEMA) above. • Financial assurance for unforeseen impacts.

Proposed and Recommended Mitigation and Monitoring (continued)

Known or Potential Impact Type (approx. acreage when applicable)	**Proposed Mitigation and/or Monitoring Description** (sources: FFREIS (AMP), Supplemental EA, Ag Impacts Mitigation Plan, Operating Plan, FEMA/USACE Coordination Plan, Draft AMMP)	**EIS Recommended or Other Required Mitigation and Monitoring** (sources: EIS, Draft AMMP, and Appendix O)
• Project operation flooding to land including agricultural.	• See ES Table 3 (FEMA) above.	• See ES Table 3 (FEMA) above. • Provide supplemental crop insurance. • Clean-up of debris following each Project operation. • Appraisal for the flowage easement should consider future impacts of Project operation. • Assess and compensate drainage ditch authorities for Project-related damage following each operation. • Financial assurance for unforeseen impacts. • Non-Federal sponsors purchase the impacted land.
• Organic Farms	• Mitigation for organic farms is proposed to be the same as for agricultural land.	• Provide supplemental crop insurance. • Approach organic farmers to discuss early buy-out options. • Clean-up of debris following each Project operation. • Potential impacts to certification should be determined prior to flowage easement issuance. • Appraisal for the flowage easement should consider future impacts of Project operation. • Flowage easements must consider “Going Concerns” for Minnesota businesses per Minnesota Constitution. • Financial assurance for unforeseen impacts.
• Century Farms	• Depending on structure eligibility, see ES Table 16 (Cultural) or ES Table 3 (FEMA) above.	• Depending on structure eligibility, see ES Table 16 (Cultural) or ES Table 3 (FEMA) above. • See above rows for organic farms and agricultural land recommendations, as applicable.
• Businesses in Unbenefited area	• Options include (impact-dependent): buy-outs, relocations, flowage easements, non-structural measures. • Proposed mitigation would go to the landowner; no mitigation is currently proposed for the lessee.	• Flowage easements must consider “Going Concerns” for Minnesota businesses per Minnesota Constitution. • Financial assurance for unforeseen impacts.
• Infrastructure and Public Services and Utilities	• See ES Table 17 (Infrastructure) above. • Development of a Utility Relocation Plan. • Completed transportation plan.	• See ES Table 17 (Infrastructure) above. • Financial assurance for unforeseen impacts.
• Unbenefited Area Access to Health Care and Emergency Services	• OHB and Comstock ring levee residents would have at least one access road maintained during Project operation. • Detour routes.	• Local Emergency Flood Plans (evacuation plans and routes) may need to be updated, particularly in areas with new inundation.

Proposed and Recommended Mitigation and Monitoring (continued)

Known or Potential Impact Type (approx. acreage when applicable)	Proposed Mitigation and/or Monitoring Description (sources: FFREIS (AMP), Supplemental EA, Ag Impacts Mitigation Plan, Operating Plan, FEMA/USACE Coordination Plan, Draft AMMP)	EIS Recommended or Other Required Mitigation and Monitoring (sources: EIS, Draft AMMP, and Appendix O)
• Social (e.g., effects of relocations, stress, community tie impacts)	• There is no proposed mitigation for these impacts.	• No additional recommendations or requirements at this time.
• Well, septic and groundwater impacts	• Removal or abandonment within footprint or those that are associated with structures proposed to receive relocated/buy-outs. • Well monitoring near Project inundation area. Modifications may be made to prevent contamination to drinking water.	• Regulations in accordance with Minnesota Rules, part 4725 must be followed. • Follow guidelines for the Minnesota Department of Health flood precautions for private water wells. • Include cost (as part of proposed mitigation) for floodproofing, abandonment or relocation of septic systems due to new inundation.
• Tenants (e.g., farmers, businesses, residents)	• Proposed mitigation would go to the property owner; no mitigation is currently proposed for tenants.	• Relocation assistance. • Advance notification of Project operation. • Provide supplemental crop insurance.
• Agricultural impacts (e.g., mobilization impacts, bisected properties, changes to soil chemistry, sedimentation/erosion, transportation of plant pathogens, invasive species and noxious weed spread, planting delays)	• There is no proposed mitigation for these impacts.	• Follow recommendations outlined in the NDSU Initial Ag Impact Study. • Mitigation for these types of impacts should consider the type of agriculture (traditional vs. organic) property. • Financial assurance for unforeseen impacts. • Provide supplemental crop insurance.
• Uninsurable farm structures, grain/livestock food spoilage	• Uninsurable farm structures would be mitigated, but specific measures have not yet been determined. • Livestock operations would not be allowed in the staging area. • Relocations or other mitigation for grain food storage has not yet been determined.	• Financial assurance for unforeseen impacts. • Flowage easements should account for damages to uninsurable structures.
• Cemeteries	• See ES Table 16 (Cultural) above.	• See ES Table 16 (Cultural) above. • Financial assurance for unforeseen impacts.
• Impacted land, primarily cropland, within the construction footprint	• See ES Table 10 (Cover Types) above.	• See ES Table 10 (Cover Types) above.
• Comstock and OHB ring levees.	• Comstock ring levee would be designed in collaboration with local officials and would allow for future development. All residents within Comstock would be protected by the ring levee. • OHB ring levee would require the relocation of 42 homes to	• No additional recommendations or requirements at this time.

Known or Potential Impact Type (approx. acreage when applicable)	**Proposed Mitigation and/or Monitoring Description** (sources: FFREIS (AMP), Supplemental EA, Ag Impacts Mitigation Plan, Operating Plan, FEMA/USACE Coordination Plan, Draft AMMP)	**EIS Recommended or Other Required Mitigation and Monitoring** (sources: EIS, Draft AMMP, and Appendix O)
	different sites within the OHB levee. An additional 60 residential lots would be added within the ring levee for other displaced residents within the unprotected area. • The Diversion Authority proposes to compensate the City of Oxbow and the Kindred School District for loss of tax base for a period of up to four years caused by the temporary loss of the 42 homes.	

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Areas of Controversy and Issues Yet to be Resolved

Areas of Controversy

Minnesota Rules part 4410.2300 identifies the minimum EIS content requirements. One of these content requirements is a summary that includes, among other items, areas of controversy and issues yet to be resolved. MNDNR has identified the following areas of controversy and issues based on public comments received in EIS Scoping and on the Draft EIS.

Flood Risk Transfer

The Project reduces flood risk within the Fargo-Moorhead urban area, but would increase flood risk upstream of the proposed dam. The justification for this flood risk transfer is that the Fargo-Moorhead urban area is a regional center with more structures and people. It is more feasible to remove or mitigate for flood risk in a confined area, less-developed area to the south. The extent of increased flood risk from the Project is such that some areas would have flood risk that previously had none. This brings up the criticism that those people who live in an area with flood risk are now transferring that risk to people who live in an area that did not have flood risk. Several commenters expressed concerns that this transfer of flood risk is unfair and unethical. The hydrology section (3.1) and the socioeconomic section (3.16) of the Final EIS describe how and to what extent this flood risk transfer would occur. For the 100-year flood, the Project benefits approximately 72,923.50 acres from flooding in the project area. This same flood event would flood approximate 20,461.30 acres of land upstream of the proposed dam that would not have been flooded without the Project.

Another aspect of flood risk transfer that has been a subject of controversy is associated with lands in Minnesota that would be flooded by the Project in comparison to how much benefit the project provides in Minnesota. Of the total benefits from the project approximately 10,229 acres, or about 14%, are within Minnesota. The total newly inundated acres in Minnesota are 12,317; an addition of 2,088 acres of inundation over existing conditions. This is largely due to higher ground in Minnesota and efforts of the City of Moorhead to manage flood risk. Minnesota ends up with more acres impacted than benefited. On the other hand, North Dakota would see 62,694 acres benefited, or about 86% of the Project benefits. The total newly inundated acres in North Dakota is 8,145; a reduction of 54,549.

Alternatives Analysis

The alternative analysis for the Project has been a source of concern and criticism since the early planning stages of the USACE's Feasibility Study. Federal alternative analysis conducted by the USACE relied heavily on cost-benefit ratios to determine suitability of various alternatives. USACE policy limits Federal participation in projects to only those projects that have a cost-benefit ratio greater than 1.0. Although the USACE found several different project alternatives that would have the required cost-benefit ratio, the proposed project was selected by the USACE because it was favored by the local sponsors (Diversion Authority). Another important aspect that led to selection of the Project was the ability to mitigate for increased inundation upstream of the Project.

Alternative screening conducted by USACE was not in compliance with alternative screening requirements in Minnesota Rules. To address this issue the MNDNR conducted alternative screening as part of EIS Scoping, the Draft EIS development and during development of the Final EIS. An alternative screening report and an EIS Appendix were provided for transparency and clarity around the alternative screening process so that the public could understand what was done and if needed, raise any issues during the Draft EIS review period. The biggest criticism of the alternative screening that was received from public comments was that the purpose and need for the Project was so narrow that it prevented a reasonable consideration of alternatives. To address this comment, the MNDNR rescreened all scoping alternatives using a broader Project purpose (see Appendix M).This alternatives rescreen exercise did not change the results of previous alternative screening process. Commenters also provided many additional alternatives or variants of alternatives in an effort to identify a better solution. These were evaluated as part of the rescreening exercise; however screening of these alternatives and variants did not result in the identification any additional reasonable alternatives to the Project.

The level of interest in alternatives is a strong indicator of dissatisfaction with the impacts of the Project. Some factors that could be contributing to dissatisfaction and inability to identify reasonable alternatives are the physical attributes of the project area and the long standing flood risk within the Red River Basin. The land around Fargo is particularly flat and flood protection measures are complicated by flood risk from North Dakota tributaries. Catastrophic flood events that have occurred in the Basin create additional challenges to reducing flood risk. Finding that one project that can protect a community requires incorporating large or expensive components to deal with the large amounts of water that are associated with catastrophic events. Incremental measures will not address extreme conditions, although these incremental measures can help reduce the severity of extreme conditions. To that end, basin-wide flood risk reduction measures are very valuable and should be pursued wherever possible. However, these measures will not substitute for community-specific projects to address catastrophic flood events.

Floodplain Development

Commenters have identified floodplain development as an area of controversy by asserting the Project is not compliant with Executive Order 11988 (E.O. 11988) and that the real purpose of the Project is so that Fargo can develop the floodplain south of the city. The Final EIS provides some information (subsection 1.5.1.3) related to the E.O. 11988 and the considerations that federal agencies must make if their activities may have impacts on floodplains. The USACE has asserted that the executive order is directed at federal agencies and, as such, only federal agencies can officially determine how they comply with that order. The USACE had also asserted that they have complied with the executive order. It is understandable that commenters would question compliance with E.O. 11988 for a project such as this that removes significant acreage from the floodplain.

This concern is amplified by existing City of Fargo growth plans that envision future development in the area that is now undeveloped floodplain that is proposed to be protected by the Project. Some commenters have asserted that development of this area is the true purpose of the Project, and that purpose is not justified. The Final EIS addresses future development by the City of Fargo in Land Use Section 3.14.2. The EIS did identify under the No Action Alternatives that additional floodplain development would continue with the same flood risk current experienced. Local land use plans and regulations would be revised over time to reflect growth trends and future needs of each community, including regulation of floodplain development where required and appropriate. The EIS also attempts to address this by evaluating a different alignment of the dam under the NAA. The NAA reduces the amount of existing floodplain that is protected by the Project; however, shifting the alignment north would impact more structures than the Project.

Mitigation

The USACE and the Diversion Authority have proposed a series of mitigation measures to address various potential Project impacts, such as physical impacts to water resources, loss of connectivity, construction impacts and increased inundation. The controversy associated with mitigation is whether or not the proposed mitigation is sufficient to address the potential impacts of the Project. In some cases there is a disagreement about whether an impact would actually occur or the degree that the Project contributes to the impact. For example the MNDNR believes that the Project would change the hydrology in the project area such that stream impacts could occur. The USACE believes this potential is small and should not require mitigation.

In other cases there is disagreement about the sufficiency of the mitigation. An agricultural impact due to increased inundation is just one of many potential examples where commenters felt the mitigation was insufficient. The USACE believes that it is not likely that Project operation would have an impact on agricultural production because Project operation would likely occur during early spring, prior to when planting occurs. In addition, it is believed that if Project operation would overlap with the planting schedule that the storing of additional water on agricultural land would not result in major impacts to planting delays, crop yields, and etc. Another area of potential disagreement is associated with storing additional water on land would have been flooded under existing conditions. For example, a specific parcel may currently be flooded with 18 inches of water during a 100-year flood event, but under Project operation that same parcel could be flooded with up to 3 feet of water during the a 100-year flood event. This raises questions about if the additional 18 inches of water makes any difference to that parcel, and if so, what mitigation is warranted.

There is disagreement between the MNDNR and the USACE and Diversion Authority about what level of mitigation is needed to compensate for Project impacts. Chapter 6.0 of the Final EIS identifies those impacts where MNDNR believes additional mitigation is needed. This same chapter also identifies potential additional mitigation measures that could be implemented to address these deficiencies. Examples of unmitigated impacts include:

- Sufficiency of takings process
- Increased inundation less than 6 inches.
- Increased inundation for flood between the 100-year and 500-year events
- Impacts to agricultural land including organic farms
- Impacts to cemeteries
- Geomorphology impacts
- Wetland impacts in the inundation area

Section 3.15 of the Final EIS identifies the permit requirements that MNDNR must consider when evaluating the application for a dam safety and work in public waters permit for the Project. One of these criteria is the sufficiency of mitigation. If during consideration of the application for the Project MNDNR determines that proposed mitigation is insufficient, the application must be denied. Alternatively, the USACE and Diversion Authority could develop additional mitigation measures that would become conditions of the permit to address this potential deficiency.

Areas of Controversy and Issues Yet to be Resolved (continued)

Issues Yet to be Resolved

In order to begin construction in Minnesota (including the Red River), the Project needs approval from the MNDNR for work in public waters and dam safety. Minnesota Statute and Rule contain requirements that must be met in order for MNDNR to issue a permit. The EIS does provide information relating to these topics; however there still are unresolved issues that would need to be addressed as part of a permit decision. Some examples of these potential unresolved issues include:

- Alternatives. As part of permit application review, there will need to be an evaluation of whether the Proposed Project represents a minimum impact solution to a specific need with respect to all other reasonable alternatives. For example, a different alternative could be deemed more reasonable or the Project could be deemed un-permitable.
- Plan compatibility. The MNDNR must make a finding that the Project is compatible with local land use and water management plans. The land use section of the Final EIS identifies the outstanding questions associated with plan compatibility.
- Mitigation. The MNDNR must determine if the proposed mitigation is sufficient. For additional information on proposed, recommended, and potential gaps in mitigation and monitoring, see Chapter 6 and Appendix O.

Permits, Approvals, and Federal Regulatory Programs and Laws

What permits, approvals or Federal Regulatory Programs and Laws would be required or would need to be complied with prior to construction and operation of the Project?

ES Table 21 provides a list of the possible permits, approvals, Federal Regulatory Programs and Laws that have been identified for the Proposed Project. Additional details are included in Chapter 1 of the EIS.

ES Table 21 Permit, Approvals, and Federal Regulatory Programs and Laws Related to the Project

Permit/Approval	Governing Agency	Responsibility
Federal Agencies		
Clean Water Act – Section 404	United States Army Corps of Engineers (USACE)	Non-Federal Sponsor if constructed by Non-Federal Sponsor[1]
Section 7 of the Endangered Species Act Coordination	United States Fish and Wildlife Service (USFWS)	USACE
Executive Order 11988: Floodplain Management	USACE	USACE
Rivers and Harbors Act of 1899 – Sections 9 and 10	USACE	Non-Federal Sponsor if constructed by Non-Federal Sponsors
Conditional Letter of Map Revision (CLOMR)	Federal Emergency Management Agency (FEMA)	Non-Federal Sponsors
Letter of Map Revision (LOMR)	FEMA	Non-Federal Sponsors
Prime and Unique Farmlands	Natural Resources Conservation Service	USACE
State Agencies: North Dakota		
Clean Water Act – Section 401 Certification, Water Quality - ND	North Dakota Department of Health (NDDH)	USACE
Dewatering Permit	NDDH	Contractor
NPDES Stormwater Permit	NDDH	Contractor/Owner
Aquatic Nuisance Species Rule	North Dakota Game and Fish Dept.	Contractor
Memorandum of Understanding	North Dakota Department of Transportation (NDDOT)	Non-Federal Sponsors
Section 106 Consultation	Archaeology and Historic Preservation Division, State Historical Society of North Dakota	USACE
Waters Drain Permit	North Dakota State Water Commission (ND State Water Commission)	Non-Federal Sponsors
Construction Permit	ND State Water Commission	Non-Federal Sponsors
Sovereign Lands Permit	Office of the State Engineer	Non-Federal Sponsors
State Agencies: Minnesota		

Permits, Approvals, and Federal Regulatory Programs and Laws (continued)

Permit/Approval	Governing Agency	Responsibility
Dam Safety Permit	Minnesota Department of Natural Resources (MNDNR)	Non-Federal Sponsors
Water Appropriations Permit	MNDNR	Non-Federal Sponsors
Public Waters Work Permit	MNDNR	Non-Federal Sponsors
Burning Permit	MNDNR	Non-Federal Sponsors
Infested Waters Permit	MNDNR	Non-Federal Sponsors
Prohibited Invasive Species Permit	MNDNR	Non-Federal Sponsors
Cooperative Construction Agreement	Minnesota Department of Transportation (MNDOT)	Non-Federal Sponsors
Clean Water Act (CWA) – Section 401 Certification, Water Quality – MN	Minnesota Pollution Control Agency (MPCA)	USACE
NPDES Stormwater Construction Permit	MPCA	Contractor/Owner
Section 106 Consultation	Minnesota State Historic Preservation Office (MN SHPO)	USACE
Counties: Minnesota		
Floodplain	Clay County, Minnesota	Non-Federal Sponsors
MN Wetland Conservation Act	Clay Soil and Water Conservation District	Non-Federal Sponsors
MN Wetland Conservation Act	Wilkin County, Minnesota	Non-Federal Sponsors
Townships: North Dakota		
Building Permit	Harwood Township, North Dakota	Non-Federal Sponsors
Floodplain Permit	Harwood Township, North Dakota	Non-Federal Sponsors
Conditional Use Permit -Site Approval for General Ground Excavation	Mapleton Township, North Dakota	Non-Federal Sponsors
Conditional Use Permit -Site Approval for General Ground Excavation	Pleasant Township, North Dakota	Non-Federal Sponsors
Conditional Use Permit -Site Approval for General Ground Excavation	Warren Township, North Dakota	Non-Federal Sponsors
Townships: Minnesota		
Interim Zoning Ordinance	Holy Cross, Minnesota	Non-Federal Sponsors
Municipalities: North Dakota		
Floodplain Permit	City of Fargo, North Dakota	Non-Federal Sponsors
Stormwater Permit	City of Fargo, North Dakota	Non-Federal Sponsors
Conditional Use Permit -Site Approval for General Ground Excavation	City of Horace, North Dakota	Non-Federal Sponsors
Conditional Use Permit	City of West Fargo, North Dakota	Non-Federal Sponsors
Conditional Use Permit -Site Approval for General Ground Excavation	City of Argusville, North Dakota	Non-Federal Sponsors

Permits, Approvals, and Federal Regulatory Programs and Laws (continued)

Permit/Approval	Governing Agency	Responsibility
Municipalities: Minnesota		
Floodplain Permit	City of Moorhead, Minnesota	Non-Federal Sponsors
Stormwater Permit	City of Moorhead, Minnesota	Non-Federal Sponsors
Other Jurisdictions		
Application to Drain	Cass County Joint Water Resource District, North Dakota (Cass County Joint WRD)	Non-Federal Sponsors
Construction/Floodplain Approval	Buffalo-Red River Watershed District, Minnesota (BRRWD)	Non-Federal Sponsors
Two Rivers Watershed District (WD) Application	Two Rivers WD, Minnesota	Non-Federal Sponsors

[1]A section 404 permit would be required for construction of the Project if construction is completed by an entity 879 other than the USACE as they are the governing agency. However, the USACE is required to adhere to Section 404 880 requirements for construction.

Organization and Content of the Environmental Impact Statement

This EIS analyzes potential impacts from the Project for various topics as identified in the FSDD. Organization of the EIS generally follows the standard format as set forth in Minnesota Rules, part 4410.2300. The EIS is organized by the following components:

- **Chapter 1** – **Introduction** provides a Project overview, describes the purpose and need for the Project, and the government approvals that would be needed for construction and operation of the Project, including the various permits and agencies that would review the Project prior to construction and operation.
- **Chapter 2** – **Proposed Project and Project Alternatives** provides detailed information on the Project and the alternatives evaluated in the EIS, including the Base No Action Alternative, No Action (with Emergency Measures), and the NAA. This chapter also provides an alternative evaluation with information on alternatives considered, but not carried forward for further evaluation in this EIS.
- **Chapter 3** – **Affected Environment and Environmental Consequences** describes the potentially affected environment in which the Base No Action Alternative, Proposed Project, No Action (with Emergency Measures), and the NAA would occur. Environmental consequences of the Project and alternatives are analyzed, and a discussion of potential impacts is presented for each topic area, which considers short-term, long-term, beneficial, and adverse effects, and the significance of each of those potential effects.
- **Chapter 4 – Cumulative Effects** presents the results of the analysis that identified the potential for cumulative effects within a local and regional context.
- **Chapter 5** – **Comparison of Alternatives** provides a summary of each of the alternatives relevant to the Project purpose and potential impacts.
- **Chapter 6** –**Mitigation and Monitoring Measures** describes mitigation measures that could reasonably eliminate or minimize adverse environmental, economic, or sociological effects of the Project. Identifying these measures is required per Minnesota Rules, part 4410.2300. To meet this requirement, the EIS evaluates and discusses mitigation measures to address adverse effects identified as a result of analyses proposed in Chapter 3 of the EIS.
- **Chapter 7** – **Consultation and Coordination** describes how the MNDNR and Project Proposer developed the FEIS in coordination with other state and federal agencies, tribal entities, and the public. This chapter also includes a description of the public involvement completed and planned.
- **Chapter 8** – **List of Preparers** provides a list of preparers and document reviewers, their qualifications, and areas of responsibility.
- **Chapter 9 – References** provides a list of references that were used during the evaluation and analysis for the EIS and are cited in the EIS text.
- **Figures and Appendices** are also included in the EIS, and the reader is directed to these sources of information as needed throughout the EIS.

1.0 Introduction

1.1 EIS ORGANIZATION

This Environmental Impact Statement (EIS) analyzes potential impacts from the Project for various topics as identified in the State Final Scoping Decision Document (FSDD). Organization of this section generally follows the standard format as set forth in Minnesota Rules, part 4410.2300. The EIS is organized by the following components:

- **Chapter 1** – **Introduction** provides a Project overview, describes the purpose and need for the Project, and the government approvals that are or may be needed for construction and operation of the Project, including the various permits and agencies that would review the Project prior to construction and operation.
- **Chapter 2** – **Proposed Project and Project Alternatives** provides detailed information on the Project and the alternatives evaluated in the EIS, including the Base No Action Alternative, No Action Alternative (with Emergency Measures), and the Northern Alignment Alternative (NAA). This chapter also provides an alternative evaluation with information on alternatives that were considered, but not carried forward for further evaluation in this EIS.
- **Chapter 3** – **Affected Environment and Environmental Consequences** describes the potentially affected environment in which the Base No Action Alternative, Proposed Project, No Action Alternative (with Emergency Measures), and the NAA would occur. Environmental consequences of the Project and alternatives are analyzed and a discussion of potential impacts is presented for each topic area, considering short-term, long-term, beneficial, and adverse effects, and the significance of each of those potential effects.
- **Chapter 4 – Cumulative Potential Effects** presents the results of the analysis that identified the potential for cumulative effects within a local and regional context.
- **Chapter 5** – **Comparison of Alternatives** provides a summary of reasonable alternatives relevant to the Project purpose and potential impacts.
- **Chapter 6** –**Proposed and Recommended Mitigation and Monitoring** describes mitigation measures that could reasonably eliminate or minimize adverse environmental, economic, or socioeconomic effects of the Project. Identifying these measures is required per Minnesota Rules, part 4410.2300. To meet this requirement, the EIS evaluates and discusses mitigation measures to address adverse effects identified as a result of analyses proposed in Chapter 3 of the EIS.
- **Chapter 7** – **Consultation and Coordination** describes how the Minnesota Department of Natural Resources (MNDNR) developed the Draft EIS in coordination with other state and federal agencies, tribal entities, and the public.
- **Chapter 8** – **List of Preparers** provides a list of document contributors, their qualifications, and areas of responsibility.
- **Chapter 9 – References** provides a list of references that were used during the evaluation and analysis for the EIS and are cited in the EIS text.
- **Figures and Appendices** are also included in the EIS, and the reader is directed to these sources of information as needed throughout the EIS.

1.2 ABOUT THE PROJECT PROPOSER

The Project Proposer is the Flood Diversion Board of Authority (Diversion Authority). The Diversion Authority was created by a joint powers agreement between the Cities of Fargo, North Dakota (ND) and Moorhead, Minnesota (MN), along with Cass County, North Dakota, Clay County, Minnesota, the Cass County Joint Water Resources District, and the Buffalo-Red River Watershed District effective July 11, 2011. The Diversion Authority is led by nine board members from the stakeholder entities. The purpose of the Diversion Authority is to build and operate a flood diversion channel along the Red River of the North (Red River) to reduce the flood risk of the stakeholder communities and counties. Additional information on the Diversion Authority is available on their website, www.fmdiversion.com.

1.2.1 Other Parties Involved

The United States Army Corps of Engineers (USACE) has partnered with the Diversion Authority to plan, secure funding for, and construct the Project (as defined below). The Project would be owned and operated by the non-Federal sponsors. Project operation, maintenance, and monitoring would be the responsibility of the non-Federal sponsors.

Prior to formation of the Diversion Authority, the USACE was brought in by the Cities of Fargo and Moorhead to help them determine what could be done to reduce flood risk in the metropolitan area. Together, they worked to create the Fargo-Moorhead Metro Flood Risk Management Feasibility Study (Feasibility Study) and evaluated many alternatives based on many factors and ultimately recommended the Locally Preferred Plan (LPP). The Cities officially partnered with USACE as a non-Federal sponsor and proceeded with federal environmental review.

The Diversion Authority should not be confused with "local sponsor," which is synonymous with "non-Federal sponsor" or "non-Federal interest," the preferred term being "non-Federal sponsor" by the USACE. The USACE defines the non-Federal sponsor as a 1) a legally constituted public body (including a federally recognized Indian tribe); or 2) a nonprofit entity with the consent of the affected local government; that has full authority and capability to perform the terms of its agreement and to pay damages, if necessary, in the event of failure to perform. Fargo and Moorhead were the two non-Federal sponsors during the Project feasibility study and for the original Design Agreement (executed September 12, 2011). A Design Agreement Amendment 1 was executed on December 19, 2013 which added the Diversion Authority as a non-Federal sponsor. Thus, as of the production of the EIS, the non-Federal sponsors are considered the City of Moorhead, City of Fargo, and the Diversion Authority. Note that even though Fargo and Moorhead are stakeholder entities of the Diversion Authority, legally and for the purposes of the Design Agreement they are three different entities and thus are currently all considered non-Federal sponsors.

1.3 NEED FOR A STATE OF MINNESOTA ENVIRONMENTAL IMPACT STATEMENT

The proposed project (Project) includes a water control structure on the Red River that would meet the definition of a Class I Dam under Minnesota's Dam Safety program rules (Minnesota Rules, part 6115.0340). Any embankment upstream of the control structure that is at or below the elevation of the top of the dam and impounds water due to the presence of the control structure would be considered to be part of the dam. Minnesota Rules, part 4410.4400, subpart 18 requires a mandatory EIS for projects that involve construction of a Class I dam. The MNDNR, as the Responsible Governmental Unit (RGU), prepared this EIS, which evaluated the Project in accordance with the Minnesota Environmental Policy Act (MEPA) (Minnesota Statutes 2008, section 116D). This EIS was developed to meet applicable requirements of Minnesota Rules, part 4410 (Environmental Quality Board; Environmental Review Program) that govern environmental review in Minnesota.

1.3.1 Federal Environmental Review

In accordance with the National Environmental Policy Act (NEPA) process, per Council on Environmental Quality (CEQ) regulations 40 Code of Federal Regulations (CFR) 1500-1508, and guidance for implementation of NEPA for the Civil Works Program of the USACE provided in 33 CFR 230, and Engineer Regulation 220-2-2; the USACE with cooperation from the City of Moorhead and the City of Fargo, issued a Final Feasibility Report and Environmental Impact Statement (FFREIS) for the Project in July 2011. The USACE's Record of Decision (ROD) was issued in April 2012 in accordance with 40 CFR 1505.2. The USACE designated the LPP as its Selected Plan in the FFREIS, also referred to as the Federally Recommended Plan (FRP) in the Supplemental Environmental Assessment (EA) (USACE).

Following the issuance of the ROD, on October 11, 2012 the Diversion Authority endorsed two design changes proposed by the USACE to reduce potential impacts of the LPP. These changes added adjustable gates on the diversion inlet control structure and increased the Red River flows through the Fargo-Moorhead downtowns to a Fargo stage of 35 feet by constructing new levees and floodwalls and improving existing levees. This change reduces the need for operation of the LPP by limiting its operation to flood flows in the Red River in excess of 17,000 cubic feet per second (cfs). A third USACE-proposed change was endorsed by the Diversion Authority on November 8, 2012. This change revised the diversion channel and associated features, including the addition of the City of Oxbow, Village of Hickson, Bakke Subdivision (OHB) ring levee, to achieve cost savings and reduce the number of impacted residential structures. Due to substantial Project design changes, the USACE prepared a Supplemental EA for the Project in September 2013. The MNDNR submitted comments on the federal Draft EIS, federal Supplemental Draft EIS, FFREIS, and Supplemental EA.

The MNDNR, as the RGU, developed and prepared this EIS, which evaluated the Project in accordance with the MEPA (Minnesota Statutes 2008, section 116D), and the rules governing the environmental review process, included in Minnesota Administrative Rules, part 4410. Utilization of the existing federally prepared environmental review documents was done as required by Minnesota Rules, part 4410.3900, subpart 3, which allows for the substitution of federal documents for state environmental review documents, insofar as the applicable documents satisfy the state level environmental review information needs as established through Minnesota Rules, part 4410 and the EIS scoping process. The EAW scoping process for the Minnesota EIS was conducted April 15, 2013 to May 15, 2013 and, as a result, many topics were identified as satisfactory for the Minnesota EIS and could utilize existing information present in the federal FFREIS and Supplemental EA. However, there were additional topics identified through the scoping process, including hydrology, socioeconomics, and stream stability, which required additional gathering of information. This scoping process is more thoroughly discussed in Chapter 7—Consultation and Coordination.

1.4 PROJECT PURPOSE AND NEED

The Project is located on the Red River, which forms the state border of Minnesota and North Dakota, flowing through the Fargo-Moorhead area (F-M area). The project area is located within the area from approximately 12 miles west to six miles east of the Red River and from 20 miles north to 20 miles south of Interstate Highway 94 (I-94) (Figure 1) and consists of a central urban area (i.e., F-M urban area), surrounded by smaller outlying communities, interspersed with rural residences and agricultural operations.

The Red River basin in eastern North Dakota and along the western Minnesota border has a long history of flooding due to the unique hydrology of the area. This unique hydrology includes an expansive floodplain that serves as an important natural resource for water conveyance and water storage. Three large rivers; the Red River, the Wild Rice River, and the Sheyenne River; converge in the F-M area and contribute to extensive flooding. This prompted studies, analysis, and engineering design to develop a plan to manage the flood risk in the F-M area, known as the Fargo-Moorhead Flood Risk Management Project (Project).

The Red River, Wild Rice River, Sheyenne River, Maple River, Lower Rush River, and the Rush River all contribute to the flood risk. Average annual national economic flood damages in the F-M area are estimated to be more than $51 million (see Section 3.16 - Socioeconomics), and a failure of emergency flood measures could result in loss of life. Flooding in the F-M area typically occurs in late March and early April as a result of spring snowmelt. Flooding poses a significant risk of damage to urban and rural infrastructure and disrupts transportation throughout the F-M area. The F-M urban area is a regional center for healthcare, education, government, and commerce. Infrastructure at risk in the F-M urban area includes several regional medical centers, three college campuses, and city and county government headquarters offices.

The Red River has exceeded the National Weather Service flood stage of 18 feet at the United States Geological Survey (USGS) gage in Fargo (the Fargo gage) in 52 of the past 114 years (1902 through 2015) and recently every year except 2012 from 1993 through 2013. Flood stage is defined as “an established gage height for a given location above which a rise in water surface level begins to create a hazard to lives, property, or commerce” (www.noaa.gov). The record-setting Red River flood stage in 2009 at Fargo was 40.82 feet on the Fargo gage. The hydrologic record of the Red River shows a trend of increasing magnitude and frequency of flooding in recent decades.

Official estimates vary for the 1-percent chance flood (100-year flood) flow and stage. Up until recently, the base flood stage (100-year flood) established by the Federal Emergency Management Agency (FEMA) corresponded to a flood stage of 38.3 feet on the Fargo gage. FEMA has recently revised the 100-year flood stage of 39.3 feet. However, FEMA's effective 100-year flood flow of 29,300 cfs is based on hydrology that dates to the 1970s. An updated standard hydrologic analysis would increase the 100-year flood flow from 29,300 cfs to 33,000 cfs, which would increase the 100-year flood stage to something between 40.7 feet and about 41.5 feet, the exact value depending on levee effectiveness and a more detailed analysis than has been completed to date for a flow of 33,000 cfs.

The USACE went beyond a standard hydrologic analysis by engaging a panel of experts (Expert Opinion Elicitation Panel (EOEP) in hydrology and climate change to discuss flooding trends in the Red River basin. The panel concluded that the hydrologic record showed a “dry” period in the early decades of the 20th century and a “wet” period in later years continuing to the present and recommended developing revised flow frequency curves separately for the dry and wet periods. The EOEP use of the terms “wet cycle” and “dry cycle” were not intended to imply wet or dry climatic conditions. Rather, the EOEP used those terms to identify periods of generally lower and higher river flows. The EOEP did not reach any conclusion about why flows on the Red River at Fargo have been higher since the 1940s. Flood discharge frequency data (e.g., the 100-year flood discharge) are based on statistical analyses of historical gage station records when those data are available – not precipitation data.

Appendix N reviews and discusses the possible hydrology methodologies to determine which methodology would be appropriate to use (i.e., FEMA, updated period of record, EOEP) for the Project. The USACE continues to use the same EOEP hydrology (flood flows) that were used in the FFREIS. The MNDNR has utilized the recommendations of the EOEP in this EIS. Unless mentioned otherwise, all discussions in this EIS use EOEP hydrology. Similarly, all elevations are relative to North American Vertical Datum of 1988 (NAVD 88), unless noted.

When assessing the viability of various alternatives, the MNDNR considered the fundamental need for the Project in addition to the environmental and socioeconomic merits of each alternative. Appendix M further evaluates the purpose and need for the Project. The following purpose and need statements were developed by the Diversion Authority to meet the needs of the state environmental review process and are not the same as those used in the FFREIS.

The purpose of the Project is to reduce flood risk, flood damages, and flood protection costs related to flooding in the F-M metropolitan area. To the extent technically and fiscally feasible, the Project will:

- Reduce flood risk potential associated with a long history of frequent flooding on local streams including the Red River, Sheyenne, Wild Rice, Maple, Rush and Lower Rush Rivers passing through or into the F-M metropolitan area,
- Qualify substantial portions of the F-M metropolitan area for 100-year flood accreditation (i.e., meets the standard to be shown on a Flood Insurance Rate Maps as providing protection) by the FEMA under the National Flood Insurance Program; and
- Reduce flood risk for floods exceeding the 100-year flood or greater, given the importance of the F-M metropolitan area to the region and recent frequencies of potentially catastrophic flood events.

1.5 GOVERNMENT APPROVALS AND FEDERAL REGULATORY PROGRAM AND LAW REQUIREMENTS

The EIS provides information and evaluation on potential environmental impacts resulting from the Project, as well as identifies the possible need for additional mitigation measures. The EIS is not a decision-making document, but is to be used by governmental units as information and a guide for the permitting process (Minnesota Rules, part 4410.0300: Authority, Scope, Purpose, and Objectives). All Minnesota local and state government bodies identified in an environmental impact statement with permitting authority shall consider the report in making any decision to authorize the project according to Minnesota Rules, part 4410.7055. Also, if an EIS is required for a governmental action (i.e., activities including project wholly or partially conducted, permitted, assisted, financed, regulated, or approved by governmental units, including the federal government [Minnesota Rules, part 4410.0200, subpart 33]); no permits, approvals, nor can a project begin until environmental review is completed, including an EIS Determination of Adequacy by the MNDNR, according to Minnesota Rules, part 4410.3100.

The substantive requirement under MEPA is identified in Minnesota Statutes 2008, section 116D.04, subdivision 6 and further states that:

> *"No state action significantly affecting the quality of the environment shall be allowed, nor shall any permit for natural resources management and development be granted, where such action or permit has caused or is likely to cause pollution, impairment, or destruction of the air, water, land or other natural resources located within the state, so long as there is a feasible and prudent alternative consistent with the reasonable requirements of the public health, safety, and welfare*

and the state's paramount concern for the protection of its air, water, land and other natural resources from pollution, impairment, or destruction. Economic considerations alone shall not justify such conduct."

Although the EIS provides information for use in permit issuance or denial, it is not required to gather or present all necessary permit-related information. Additional information may be required as part of the various permitting processes depending on the permit and the permitting authority. A Determination of Adequacy does not mean a permit will be granted.

The permits and approvals required or potentially required for the Project are listed in Table 1.1 and explained further in the sections that follow. Federal regulatory program requirements and federal laws applicable to the Project are also addressed below. Prior to Project implementation, the non-Federal sponsors are required to comply with all applicable federal and state laws and regulations (USACE, 2011b). The USACE has indicated regulations would be followed as required by federal law, and that they would continue to work with state and local entities for Project implementation.

Table 1.1 Summary of Permits, Approvals, and Federal Regulatory Programs and Laws Related to the Project

Permit/Approval/Compliance	Governing Agency	Responsibility
Federal Agencies		
Clean Water Act – Section 404	USACE	Non-Federal Sponsor *if* constructed by Non-Federal Sponsor[1]
Section 7 of the Endangered Species Act Coordination	United States Fish and Wildlife Service (USFWS)	USACE
Executive Order 11988: Floodplain Management	USACE	USACE
Rivers and Harbors Act of 1899 – Sections 9 and 10	USACE	Non-Federal Sponsor *if* constructed by Non-Federal Sponsors
Conditional Letter of Map Revision (CLOMR)	FEMA	Non-Federal Sponsors
Letter of Map Revision (LOMR)	FEMA	Non-Federal Sponsors
Prime and Unique Farmlands	Natural Resources Conservation Service	USACE
State Agencies: North Dakota		
Clean Water Act – Section 401 Certification, Water Quality - ND	North Dakota Department of Health (NDDH)	USACE
Dewatering Permit	NDDH	Contractor
NPDES Stormwater Permit	NDDH	Contractor/Owner
Aquatic Nuisance Species Rule	North Dakota Game and Fish Dept.	Contractor
Memorandum of Understanding	North Dakota Department of Transportation (NDDOT)	Non-Federal Sponsors
Permit(s) for work in right-of-way	NDDOT	Non-Federal Sponsors

Permit/Approval/Compliance	Governing Agency	Responsibility
Section 106 Consultation	Archaeology and Historic Preservation Division, State Historical Society of North Dakota	USACE
Waters Drain Permit	North Dakota State Water Commission (ND State Water Commission)	Non-Federal Sponsors
Construction Permit	North Dakota Office of State Engineer	Non-Federal Sponsors
Sovereign Lands Permit	North Dakota Office of State Engineer	Non-Federal Sponsors
Surface Drain Permit	North Dakota Office of the State Engineer	Non-Federal Sponsors
State Agencies: Minnesota		
Dam Safety Permit	Minnesota Department of Natural Resources (MNDNR)	Non-Federal Sponsors
Water Appropriations Permit	MNDNR	Non-Federal Sponsors
Work in Public Waters Permit	MNDNR	Non-Federal Sponsors
Burning Permit	MNDNR	Non-Federal Sponsors
Infested Waters Permit	MNDNR	Non-Federal Sponsors
Prohibited Invasive Species Permit	MNDNR	Non-Federal Sponsors
Cooperative Construction Agreement	Minnesota Department of Transportation (MNDOT)	Non-Federal Sponsors
Clean Water Act (CWA) – Section 401 Certification, Water Quality – MN	Minnesota Pollution Control Agency (MPCA)	USACE
NPDES Stormwater Construction Permit	MPCA	Contractor/Owner
Section 106 Consultation	Minnesota State Preservation Historic Office	USACE
Counties: Minnesota		
Floodplain	Clay County, Minnesota	Non-Federal Sponsors
MN Wetland Conservation Act	Clay Soil and Water Conservation District	Non-Federal Sponsors
MN Wetland Conservation Act	Wilkin County, Minnesota	Non-Federal Sponsors
Townships: North Dakota		
Building Permit	Harwood Township, North Dakota	Non-Federal Sponsors
Floodplain Permit	Harwood Township, North Dakota	Non-Federal Sponsors
Conditional Use Permit -Site Approval for General Ground Excavation	Mapleton Township, North Dakota	Non-Federal Sponsors
Conditional Use Permit -Site Approval for General Ground Excavation	Pleasant Township, North Dakota	Non-Federal Sponsors

Permit/Approval/Compliance	Governing Agency	Responsibility
Conditional Use Permit -Site Approval for General Ground Excavation	Warren Township, North Dakota	Non-Federal Sponsors
Townships: Minnesota		
Interim Zoning Ordinance	Holy Cross, Minnesota	Non-Federal Sponsors
Municipalities: North Dakota		
Floodplain Permit	City of Fargo, North Dakota	Non-Federal Sponsors
Stormwater Permit	City of Fargo, North Dakota	Non-Federal Sponsors
Conditional Use Permit -Site Approval for General Ground Excavation	City of Horace, North Dakota	Non-Federal Sponsors
Conditional Use Permit	City of West Fargo, North Dakota	Non-Federal Sponsors
Conditional Use Permit -Site Approval for General Ground Excavation	City of Argusville, North Dakota	Non-Federal Sponsors
Municipalities: Minnesota		
Floodplain Permit	City of Moorhead, Minnesota	Non-Federal Sponsors
Stormwater Permit	City of Moorhead, Minnesota	Non-Federal Sponsors
Other Jurisdictions		
Application to Drain	Cass County Joint Water Resource District, North Dakota (Cass County Joint WRD)	Non-Federal Sponsors
Construction/Floodplain Approval	Buffalo-Red River Watershed District, Minnesota (BRRWD)	Non-Federal Sponsors
Two Rivers Watershed District (WD) Application	Two Rivers WD, Minnesota	Non-Federal Sponsors

[1]A section 404 permit would be required for construction of the Project if construction is completed by an entity other than the USACE as they are the governing agency. However, the USACE is required to adhere to Section 404 requirements for construction.

1.5.1 United States Army Corps of Engineers

The USACE regulatory program implements Section 404 of the CWA (33 United States Code (U.S.C.) § 1344) and Sections 9 and 10 of the Rivers and Harbors Act of 1899. The USACE also is required to implement Executive Order 11988: Floodplain Management. Federal laws that the USACE must comply that pertain to this Project include Section 7 of the Endangered Species Act and Section 106 of the National Historic Preservation Act. The USACE St. Paul District's regulatory jurisdiction covers the state of Minnesota and the USACE Omaha District covers the state of North Dakota.

1.5.1.1 Section 404 Clean Water Act

Under Section 404, the USACE has regulatory authority over waters of the United States (U.S.), which includes jurisdictional lakes, rivers, streams, and wetlands. A Section 404 permit would be required for discharges of dredged or fill material in jurisdictional waters for any construction performed by the non-Federal sponsor. A Section 404 permit would not be required for construction completed by the USACE; however, the USACE would be required to make a determination that the Project complies with the Section 404(b)(1) guidelines.

The USACE generally requires compensatory mitigation for adverse effects to aquatic resources. Standards and criteria for any compensatory mitigation would be included in the Section 404 permit. Specifically 33 CFR 332.3(n)(1) addresses financial assurance stating, "The district engineer shall require sufficient financial assurances to ensure a high level of confidence that the compensatory mitigation project will be successfully completed, in accordance with applicable performance standards. In cases where an alternate mechanism is available to ensure a high level of confidence that the compensatory mitigation will be provided and maintained (e.g., a formal, documented commitment from a government agency or public authority) the district engineer may determine that financial assurances are not necessary for that compensatory mitigation project." Financial assurance requirements for aquatic resource impacts would be based on the size and complexity of the mitigation project, the likelihood of success, past performance of the Diversion Authority, all costs related to mitigation of project development, and the form of financial assurance (e.g., performance bond, letters of credit, or escrow accounts).

1.5.1.2 Rivers and Harbors Act of 1899 – Sections 9 and 10

Under Section 9 the USACE has regulatory authority over navigable waters for the construction of dikes and dams in navigable waters of the United States. Under Section 10 the USACE has regulatory jurisdiction over structures or work in or affecting navigable waters. A Section 9 and/or 10 permit would be required for any construction performed by the non-Federal sponsor in navigable waters. A Section 9 or 10 permit is not required for construction by the USACE.

1.5.1.3 Executive Order 11988: Floodplain Management

Executive Order 11988 (E.O. 11988) requires federal agencies to consider the impacts their activities may have on floodplains. It applies to federally assisted or regulated activities as well as to those actually conducted by federal agencies.

The objectives of the E.O. 11988 are "to avoid to the extent possible the long- and short term adverse impacts associated with the occupancy and modification of floodplains and to avoid direct and indirect support of floodplain development wherever there is a practicable alternative..." (FEMA http://www.fema.gov/executive-order-11988-floodplain-management). To accomplish this, each federal agency is required "to take action to reduce the risk of flood loss, to minimize the impact of floods on human safety, health, and welfare, and to restore and preserve the natural and beneficial values served by floodplains…" (FEMA http://www.fema.gov/executive-order-11988-floodplain-management).

Each federal agency is responsible for developing their own regulations for implementation of E.O. 11988.Through their developed regulations and procedures, the federal agencies are required to take a leadership role in the following: avoiding the base floodplain (100-year flood) if at all possible; minimizing impacts to the floodplain; and keeping the public informed of proposed actions in the base floodplain and facilitating public comments.

Eight-step process

Agencies generally use an 8-step process in evaluating floodplain impacts. The USACE's 8-step general procedures to be followed for implementing E.O. 11988 are described in Regulation No. 1165-2-26 (http://planning.usace.army.mil/toolbox/library/ERs/ER1165-2-26_30Mar1984.pdf) and are listed below.

1. Determine if a proposed action is in the base floodplain (that area which has a 100-year or greater chance of flooding in any given year).
2. If the action is in the base floodplain, identify and evaluate practicable alternatives.
3. If the action must be in the floodplain, advise the public and obtain their views and comments.
4. Identify beneficial and adverse impacts due to the action and any expected losses of floodplain values. Where actions proposed to be located outside the base floodplain will affect the base floodplain, impacts resulting from these actions should also be identified.
5. If the action is likely to induce development in the base floodplain, determine if a practicable non-floodplain alternative for the development exists.
6. Determine viable methods to minimize any adverse impacts, including any likely induced development.
7. If a determination is made that no practicable alternatives exists to locating the action in the floodplain, advise the general public.
8. Recommend the plan most responsive to the planning objectives and consistent with the requirements of the E.O. 11988.

E.O. 11988 requirements, environmental review, and permitting

E.O. 11988 requires that agencies consider floodplain impacts in making decisions but does not dictate a particular outcome. The USACE Regulatory Program regulations (33 CFR 320.4) require USACE to consider the requirements of E.O. 11988 when determining whether or not to issue a Department of Army permit under these authorities. Specifically, the USACE "must consider the requirements of E.O. 11988 as part of its public interest review when an application is received requesting authorization to impact waters of the U.S. that also has the potential to alter a floodplain." (USACE http://www.usace.army.mil/Media/FactSheets/FactSheetArticleView/tabid/219/Article/613901/applicability-of-floodplain-management-and-ffrms-executive-orders-to-usace-perm.aspx). The USACE has determined that the Project is in compliance with E.O. 11988 and that all decision-making process evaluation steps have been met (Chapter 3.0 – FFREIS, 2011).

As E.O. 11988 addresses federal decision-making considerations, neither the Minnesota environmental review process nor state or local permitting is required to consider this Order. However, if the decision-making steps defined above were applied to the state environmental review process, this EIS could be considered as meeting decision-making steps 1-7. Steps 2 and 6 are critical steps in this process. Step 2 is where potential feasible alternatives are identified that aim to minimize impacts to the floodplain. Step 6 is where measures are developed (or recommended) to minimize the impacts and determine appropriate mitigation actions. What is determined in these steps would serve as a basis for future permit decisions and if approved, permit-required conditions that go beyond environmental review.

1.5.1.4 Section 7 Endangered Species Act Consultation with U.S. Fish and Wildlife Service

Section 7 of the Endangered Species Act [16 U.S.C. 1531 *et seq.*] requires federal agencies to consult with the USFWS to ensure that actions they authorize, permit or carry out would not jeopardize the continued existence of any listed species or adversely modify designated critical habitats. Section 7(a)(2) defines the consultation process, which is further developed in regulations promulgated at 50 CFR § 402. The USACE coordinated with the USFWS to fulfill the requirements of Section 7 as part of the NEPA process.

1.5.1.5 Section 106 National Historic Preservation Act Determination for Historic Properties

Section 106 of the National Historic Preservation Act as implemented by the Advisory Council on Historic Preservation's regulations found at 36 CFR Part 800 is applicable to the proposed project. The USACE executed a Programmatic Agreement pursuant to 36 CFR § 800.14(b) during the feasibility study that was amended in September 2013 (see Appendix H). As project design and implementation proceeds, the USACE would complete their Section 106 consultation in accordance with the Programmatic Agreement and in coordination with the state historic preservation offices: Archaeology and Historic Preservation Division, State Historical Society of North Dakota and Minnesota State Historic Preservation Office.

1.5.2 Federal Emergency Management Agency

FEMA requires submittal of data for projects that change a Flood Insurance Rate Map (FIRM), including changes to the Base Flood Elevations (BFE), Special Flood Hazard Areas (SFHA) or the regulatory floodway. Data is submitted through the LOMR process. Proposed projects use the CLOMR process. Completed projects use the LOMR process. Both processes review technical engineering data to determine that approved engineering methods, required by 44 CFR Section 65.10, were applied and that the project is in compliance with the local government ordinance and FEMA's standards. This includes FEMA levee system accreditation, which allows the levee system to be shown on a FIRM as providing a 100-year flood event or greater level of flood protection. The CLOMR process and LOMR process for the Project is further discussed in Section 3.2 – FEMA Regulations and the CLOMR Process.

1.5.2.1 Conditional Letter of Map Revision

The CLOMR is required if the proposed project causes an increase in excess of 0.00 feet in a regulatory floodway or a SFHA with existing structures. In floodplain areas without regulatory floodways, if no existing structures are affected, a floodway analysis is required to determine that the proposed project does not cause an increase above the allowable surcharge in the local government ordinance. CLOMRs are not required if the project is compliant with the local ordinance. Certification that no insurable structures are impacted is required.

CLOMRs require certification from a Professional Engineer that the elevation, hydrologic and hydraulic data is accurate and in compliance with 44 CFR 65.2. It also requires acknowledgement by the local community official that the proposed project is in compliance with the community floodplain management requirements and the Endangered Species Act (7 U.S.C. § 136, 16 U.S.C. § 1531 et seq). Another requirement is that individuals and organizations affected by the project are aware of the changes and have had a chance to comment. This usually requires documented individual notices to the impacted property owners.

FEMA's review is usually completed within ninety days from submittal of all necessary data, but it is rare that the first submittal has all necessary data. CLOMRs do not change the FIRM. Their purpose is to review project floodplain impacts before construction.

1.5.2.2 Letter of Map Revision

LOMRs revise the maps based on better data or analysis or completed projects. The CLOMR requirements for the Professional Engineers and local community officials are also required for LOMRs. As-built drawings of the project are needed for the review. The same technical review process is followed. If the project is built as presented for the CLOMR and the engineering analyses have not changed, a LOMR can reference an approved CLOMR instead of resubmitting all of the data.

FEMA's review timelines are the same as for the CLOMR, but there are changes after the LOMR is issued. There is a 90-day appeal period from the LOMR approval date. If no valid appeals are made, the local government must adopt the LOMR mapping as the official community floodplain map.

1.5.3 Natural Resources Conservation Service

The Natural Resources Conservation Service (NRCS) is a branch of the United States Department of Agriculture (USDA). The NRCS assists with the conservation of soil, water, air, and other natural resources. The NRCS regulatory programs include the Farmland Protection Policy Act (FPPA) of 1981.

1.5.3.1 Prime and Unique Farmlands

The FPPA requires potential impacts to prime farmlands to be identified and avoided as possible for federally funded projects. Farmlands identified are recorded and given a farmland conversion impact rating through completion of Form NRCS-CPA-106**.** The impact rating is determined by the NRCS and is used to work with a project proposer to determine avoidance actions as needed to minimize the conversion of farmland into nonagricultural lands. The NRCS evaluated the Project footprint during the FFREIS process and made prime farmland determinations. Because over 90-percent of all farmland in the project area is considered prime and unique, the Project impact is considered to be less than significant. The USACE would continue to coordinate with the NRCS as the Project develops.

1.5.4 North Dakota Game and Fish Department

The North Dakota Game and Fish Department (NDGF) regulates activities that affect the state's fish and game. These regulatory programs may require certain permits depending on the proposed activity and its magnitude. Specifically, NDGF regulates the spread of aquatic invasive species.

1.5.4.1 Aquatic Nuisance Species Rule

Pursuant to North Dakota Century Code Chapter 20.1-17, the NDGF has authority to prohibit the spread of aquatic invasive species. This would be enforced to assure that nuisance species are not spread via any equipment used for the construction of the Project.

1.5.5 North Dakota Department of Health

The North Dakota Department of Health (NDDH) focuses on protection of health and enhancement of the safety and environment for North Dakota and has responsible, delegated authority for Section 401 water quality certification, required for Section 404 permits issued by the USACE and for projects implemented by USACE. The NDDH also is the permitting authority for the National Pollutant Discharge Elimination System (NPDES) Permit and general stormwater discharge permits required for Project construction activities in North Dakota.

1.5.5.1 Section 401 Water Quality Certification

Section 401 of the CWA (33 United States Code (U.S.C.) § 1341) requires activities that may result in discharges to navigable waters and require a federal license or permit to construct, modify, or operate (i.e., Section 404 permits), to be conducted in compliance with Sections 301, 302, 303, 306, and 307 of the CWA. These portions of the CWA are the basis of state water quality standards. In order to ensure these activities comply with the CWA and the state water quality standards, a determination is made by the state agency with primary water quality regulatory responsibilities under the CWA. Such a determination is known as a 401 Water Quality Certification.

In North Dakota, the NDDH is the delegated agency responsible for making certification determinations on federal permits and federal projects that affect waters of the United States. The NDDH would evaluate whether to issue Section 401 certification for this Project.

1.5.5.2 National Pollutant Discharge Elimination System (NPDES) Permits

The NPDES permitting authority, delegated to the NDDH by the U.S. Environmental Protection Agency (USEPA), regulates wastewater and stormwater discharges to lakes, streams, wetlands, and other surface waters in North Dakota. The NPDES permit establishes specific limits and requirements to protect North Dakota's surface and groundwater quality.

1.5.5.3 NPDES/SDS General Stormwater Discharge Permit for Construction Activity

Construction projects in North Dakota that disturb one acre or more of land must obtain coverage under North Dakota's NPDES general stormwater discharge permit for construction activity. The permit application certifies that temporary and/or permanent erosion and sediment control plans have been prepared and implemented to prevent soil particles from being transported off-site both during and after construction. The permit requires the applicant to prepare a Stormwater Pollution Prevention Plan (SWPPP) that applies best management practices for controlling and managing stormwater runoff during and after construction.

1.5.6 North Dakota Department of Transportation

The North Dakota Department of Transportation requires a permit for work within the right-of-way of state roadways. The type of permit is dependent on the construction activity, but could include a utility permit or drainage permit, for example. The permit would also require appropriate risk management documents for project activities.

1.5.7 North Dakota State Water Commission/North Dakota Office of the State Engineer

The North Dakota Office of the State Engineer regulates activities that affect the state's water resources. Regulatory programs may require certain permits depending on the proposed activity and its magnitude. The North Dakota Office of the State Engineer's Sovereign Lands Permit is applicable for any feature of the Project that occurs partly or wholly on sovereign lands. As outlined in North Dakota Century Code (NDCC), chapter 61-03, the state engineer is responsible for review of permit applications for construction permits, surface drain permits, and sovereign lands permits.

1.5.7.1 North Dakota Office of State Engineer Construction Permit

Pursuant to NDCC, chapter 61-16.1-38 and North Dakota Administrative Code (NDAC), article 89-08, permit(s) to construct or modify a dam, dike, or other device would be required for this Project. As part of the construction permit application process, the Dam Safety Engineer, through the North Dakota Dam Safety Program, would specify the design requirements associated with the appropriate hazard classification of the proposed structure. A completed construction permit application must include: plans and specifications; evidence establishing a property right for the property (incudes land and structures) that would be affected by the construction of the dam, dike, or other device; and any additional information required by the State Engineer.

As part of that process the State Engineer would forward the application to the water resource board of the appropriate water resource district. The board then has 45 days to review the application and suggest any changes, conditions, or modifications, and then return the application to the State Engineer for the final review and decision. The state engineer also notifies the North Dakota Department of Health and the USACE—North Dakota regulatory office that a construction permit application was submitted. A draft construction permit for the Project was received by the North Dakota Office of State Engineer on February 22, 2016.

1.5.7.2 North Dakota Waters Drain Permit

Pursuant to NDCC, chapter 61-32 and NDAC, article 89-02-01, permit(s) to drain surface waters would be required if drainage of any pond, slough, lake, sheet water, or series thereof, with a watershed of 80 acres or more would occur. Applications would need to be submitted to the state engineer who would then make a determination if the proposed project involves drainage of statewide or interdistrict significance.

As part of the permitting process for a dam, the Dam Safety Engineer, through the North Dakota Dam Safety Program, would specify the design requirements associated with the appropriate hazard classification of the proposed structure. A completed construction permit application must include: plans and specifications; evidence establishing a property right for the property (incudes land and structures) that would be affected by the construction of the dam, dike, or other device; and any additional information required by the State Engineer. The State Engineer, for all applications, would forward the application on to the appropriate water resource district for review and approval. The State Engineer also notifies the NRCS local and state offices and the USACE—North Dakota regulatory office that a surface drain permit application was submitted. For applications of statewide or interdistrict significance, the board must return the application to the State Engineer for final approval.

If subsurface drainage is to be used as part of the project, NDCC, chapter 61-32-03.1 states that construction of a subsurface drainage system greater than 80 acres would require a subsurface drain permit. Applications would need to be submitted to the appropriate water resource board for review and approval.

1.5.7.3 North Dakota Office of State Engineer Sovereign Lands Permit

Pursuant to NDCC, chapter 61-33 and NDAC, article 89-10-01, a sovereign lands permit(s) would be required for this Project. Sovereign lands are defined as those areas within the ordinary high water mark of the state’s navigable lakes and streams. Applications would need to be submitted to the state engineer. The state engineer would solicit comments during a 30-day comment and review period from the NDGF, North Dakota Parks and Recreation Department, NDDH, State Historical Society of North Dakota, North Dakota Department of Trust Lands, Water Resource Board of the appropriate Water Resource District, USACE, and United States Fish and Wildlife Service.

1.5.8 Minnesota Department of Natural Resources

The MNDNR regulates activities that affect the state's natural resources, including those related to wetlands, water, and threatened and endangered species. These regulatory programs may require certain permits depending on the proposed activity and its magnitude. Additionally, the MNDNR is responsible for determining EIS adequacy pursuant to MEPA, which is required for the permitting process to move forward.

1.5.8.1 Infested Water Permit

Pursuant to Minnesota Statutes 2008, section 84D and Minnesota Rules, part 6216, the MNDNR has authority to prohibit the spread of aquatic invasive species within the State of Minnesota. This would be enforced to assure the spread of nuisance species from the construction and operation of the Project is avoided and minimized as feasible. An infested water permit would be required to appropriate, divert, or transport water from listed infested waters.

1.5.8.2 Invasive Species

State laws and rules prohibit the possession, importation, purchase, sale, propagation, transportation, and introduction of prohibited invasive species without a permit. For these activities, even transporting equipment for decontamination, a prohibited invasive species permit would be required from MNDNR.

1.5.8.3 Dam Safety Permit

Minnesota Rules, parts 6115.0300 through 6115.0520 for Public Water Resources describe the requirements pertaining to dam safety permits for new construction, repair, alteration, removal, and transfer of property containing a dam. A dam safety permit would be needed from the MNDNR for construction, operation, and maintenance of dam, which falls within the definition of a Class I dam under Minnesota Rules, part 6115.0340.

1.5.8.4 Work in Public Waters Permit

Pursuant to Minnesota Statutes 2008, section 103G and Minnesota Rules, part 6115, a work in public Waters permit is required for proposed projects constructed below the ordinary high water level (OHWL) which alter the course, current, or cross section of public waters or public waters wetlands. The MNDNR would be responsible for defining special provisions of the permit and implementing the permit approval.

A work in public waters permit would be required from the MNDNR for Project construction. The work in public waters permit and dam safety permit would likely be authorized under one permit. However, depending on how Project construction is phased, a separate public waters work permit not associated with dam construction related activities may be a possible permitting approach.

1.5.8.5 Burning Permit

Per Minnesota Statute 2008, section 88.17, an open burning permit may be required from the MNDNR if trees, brush, and other vegetative materials are burned on-site as part of any land clearing activities conducted for the Project.

1.5.8.6 Water Appropriations Permit

Per Minnesota Rules, part 6115, a water appropriations permit is required for any project withdrawing more than 10,000 gallons of water per day or one million gallons of water per year.

Diversion of river flow associated with dam construction would be included within the provisions of the dam safety permit as discussed above. A separate water appropriations permit would be required for all other dewatering activities. Construction dewatering may be eligible to be authorized under a state general permit.

1.5.9 Minnesota Pollution Control Agency

The Minnesota Pollution Control Agency (MPCA) monitors environmental quality and administers a number of regulatory programs focused on protecting water resources, including the Section 401 of the Clean Water Act. Many of the MPCA regulatory programs require a permit from the agency.

1.5.9.1 Section 401 Water Quality Certification

The MPCA is responsible for Section 401 water quality certification required for Section 404 permits issued by the USACE and for projects implemented by the USACE. Section 401 of the CWA (33 U.S.C. § 1341) requires that activities that may result in discharges to navigable waters and require a federal license or permit to construct, modify, or operate (i.e., Section 404 permits), must be conducted in compliance with Sections 301, 302, 303, 306, and 307 of the CWA. These portions of the CWA are directives for the development of state water quality standards. In order to ensure these activities comply with the CWA and the state water quality standards, a determination is made by the state agency with primary water quality regulatory responsibilities under the CWA. Such a determination is known as a 401 Water Quality Certification.

In Minnesota, the MPCA is the delegated agency responsible under Minnesota Statutes 2008, section 115.03 - Powers and Duties for making certification determinations on federal permits and federal projects that affect waters of the state. MPCA would evaluate whether to issue Section 401 certification for the Project.

1.5.9.2 NPDES/SDS General Stormwater Discharge Permit for Construction Activity

Construction projects in Minnesota that disturb one acre or more of land must obtain coverage under Minnesota's NPDES general stormwater discharge permit for construction activity. The permit application certifies that temporary and/or permanent erosion and sediment control plans have been prepared and implemented to prevent soil particles from being transported off-site both during and after construction. The permit requires the applicant to prepare a SWPPP that applies best management practices for controlling and managing stormwater runoff during and after construction. An NPDES permit would be required in Minnesota for construction of the tieback embankment and control structures.

1.5.10 Local Government Approvals

There are local governments in North Dakota and Minnesota that potentially have jurisdiction over portions of the Project. Table 1.1 (above) provides a summary of the local government units (LGUs) with potential permitting and approval authority in the project area. The planning, zoning, and permits required or potentially required for the Project are discussed in greater detail in Chapter 3, Section 3.14 - Land Use Plans and Regulations.

The following provides a general description of the primary local government approvals that could be required for construction and operation of the Project, which include a wetlands permit, shoreland permit, conditional use permit, floodplain permit, and stormwater permit. Issuance of approval or a permit is at the discretion of the LGU and may require an application, environmental commitments, site plans, public hearings or other conditions.

1.5.10.1 Zoning Variance, Conditional Use Permit

Variances may be granted when compliance with a local ordinance cannot be achieved. Conditional Use Permits (CUPs) may be issued for certain land uses or development that would not be appropriate or are restricted in a particular zoning district, but may be allowed with conditions. These applications require a public hearing process and review by the individual local government.

1.5.10.2 Zoning Amendment

A zoning amendment may be required in some of the local governments once the Project is in operation, and it can be observed for potential impacts. If impacts are observed, a zoning amendment may be needed. A zoning amendment may include rezoning of areas of a community to accurately reflect changes due to the Project, including amending the zoning map for zoning district changes. This could include, for example, water retention in the staging area or land use that is no longer agricultural. Each local government would have specific steps for their approval process. The individual local governments would be consulted as to the appropriate approval or permit needed and the application process for that approval.

1.5.10.3 Wetland Conservation Act

The Minnesota Wetland Conservation Act (WCA) would apply to wetland impacts from the Project. Wetland impacts resulting from construction in Clay County or Wilkin County would require WCA approval for unavoidable wetland impacts associated with the Project. As currently proposed, no direct impacts to wetlands from the Project would occur in Wilkin County. For additional information regarding wetland impacts from the Project, see Section 3.4 – Wetlands.

The USACE, MNDNR, MPCA, and local governments in Minnesota have jurisdiction over wetland impacts for the Project and would review and approve the proposed wetland mitigation plan to satisfy replacement requirements for unavoidable wetland impacts. In Minnesota, wetland impact would be replaced under WCA and CWA standards. In Minnesota, local governments, typically counties, administer WCA. Wetland impacts occurring in Minnesota would require mitigation to occur in Minnesota. The USACE Omaha District is the primary agency that determines the adequacy of wetland replacement for the CWA wetland impacts in North Dakota. Mitigation for wetland impacts in North Dakota would not qualify as wetland mitigation credit for wetland impacts in Minnesota.

Minnesota Rules, part 8420.0522 outlines the replacement standards for wetlands as regulated under WCA. Minnesota Rules, part 8420.0522, subpart 9(A) and (B) discuss financial assurance requirements for compensatory wetland mitigation stating, "(A) For wetland replacement that is not in advance, a financial assurance acceptable to the local government unit must be submitted to, and approved by, the local government unit to ensure successful replacement. The local government unit may waive this requirement if it determines the financial assurance is not necessary to ensure successful replacement. The local government unit may incorporate this requirement into any financial assurance required by the local government unit for other aspects of the project. (B) The financial assurance may be used to cover costs of actions necessary to bring the project into compliance with the approved replacement plan specifications and monitoring requirements." The financial assurance requirements would be part of the WCA permitting process for the Project.

1.5.10.4 Floodplain Permit

Minnesota Statutes 2008, sections 103F and 394.21 delegate responsibility to LGUs to adopt regulations designed to minimize flood losses. The FIRM, developed by the FEMA, is typically used by LGUs as their official floodplain zoning district map in order to establish floodway, flood fringe, and general floodplain (unnumbered A zones on the FIRM) zoning districts. The Regulatory Flood Protection Elevation is also used and defined as an elevation no lower than one foot above the elevation of the regional flood plus any increases in flood elevation caused by encroachments on the floodplain that result from designation of a floodway.

A floodplain permit is required for construction within one of the three flood-related zoning districts. The permit requires structures to be constructed to meet certain criteria for elevation and flood proofing, for example. A LGU permit application process would be used and may be tied to a local condition use permit (CUP) depending on the LGU. The MNDNR would be available for assistance and review for issuance and administration of permits.

1.5.10.5 Shoreland Permit

Minnesota Rules, part 6120 provides standards for shoreland management. A shoreland permit is typically required from a township or municipality for any grading/filling or excavation within the Shoreland Overlay District established under the LGU zoning ordinance. The Shoreland Overlay District is defined as the area surrounding a designated water body, extending out 1,000 feet from the OHWL of lakes/wetlands and 300 feet from streams. Conditions of this permit may be covered under the floodplain permit or CUP depending on the LGU. The MNDNR would be available for assistance and review for issuance and administration of permits.

1.5.11 Other Jurisdictions

There are two watershed districts, the Buffalo-Red River Watershed District and the Two Rivers Watershed District that may require permits for the Project. The BRRWD Rules Section 8 require a permit for alteration of natural drainage-ways, lakes, and wetlands. Project construction would occur on the Red River, and therefore, the BRRWD should be consulted for permit requirements. The Two Rivers Watershed District may require a permit for modification of the Drayton Dam as part of proposed mitigation for the Project. The Cass County Joint Water Resource District also requires an application to drain permit, and should be consulted for potential permits needed for the Project.

2.0 Proposed Project and Alternatives

The Project would primarily serve the Fargo-Moorhead (F-M) area as previously described in Chapter 1. This section provides descriptions and discussion on the Project and alternatives. Environmental Impact Statements (EIS) Alternatives include: the Base No Action Alternative, No Action Alternative (with Emergency Measures), and the Northern Alignment Alternative (NAA). Two alternatives were considered (Distributed Storage Alternative and More Flows Through Town Alternative) but were not carried forward for further analysis (discussed further below). Section 2.2.1 provides an Alternatives Evaluation Summary to describe the alternatives and the criteria used to determine if EIS analysis was warranted.

2.1 PROPOSED PROJECT OVERVIEW

The Project would be located in the F-M area, within an area approximately 12 miles west to six miles east of the Red River and from 20 miles north to 20 miles south of Interstate 94 (I-94) (Figure 1). The Project primarily consists of a dam and diversion channel system including the following major components: a tieback embankment and overflow embankment; excavated channels; diversion inlet control structure; aqueducts on the Maple and Sheyenne Rivers; control structures on the Red and Wild Rice Rivers; an upstream flood water staging area (staging area); inlet control structures on tributaries; a rock ramp diversion outlet structure; the City of Oxbow, Village of Hickson, Bakke Subdivision (OHB) ring levee; Comstock ring levee; levees and floodwalls in the F-M urban area; non-structural features (such as buyout, relocation, or raising individual structures); and recreation features (such as multipurpose trails) (Figure 2 – note that recreational features are not depicted on this figure due to scale). The Project also consists of environmental mitigation projects, which would be located inside and outside the project area.

The Project would be federally-sponsored and would be designed and constructed to state and federal standards. The Project would be owned and operated by the non-Federal sponsors. Once constructed, Project operation, maintenance, and monitoring would be the responsibility of the non-Federal sponsors. With continual, sufficient funding, construction is expected to take a minimum of eight and one half years.

Direct disturbance of approximately 8,000 acres would occur with construction of the Project components listed above. Project operation would increase the depth and duration of existing flooded areas in portions of the project area. It is estimated that approximately 20,000 acres of land that does not currently receive flood waters would be newly inundated within and beyond the boundaries of the staging area. Any land that becomes flooded (including areas that are flooded without the Project), regardless of depth, and as a result of Project operation is referred to as inundation area(s) for this EIS (Figure 3). A 1-percent chance flood (100-year flood), with construction and operation of the Project, has the potential to create an inundation area of approximately 80,000 acres which would be inundated with or without the Project and 20,000 acres of new inundation, for an inundated area totaling approximately 100,000 acres.

The tieback embankment would extend from high ground in Minnesota to connect the Red River, Wild Rice River, and diversion inlet control structures. The overflow embankment would be constructed from the diversion inlet control structure sound along Cass County Highway 17 to high ground in North Dakota. The overflow embankment, tieback embankment, and control structures would impound water in the inundation areas and would be designed to meet USACE dam safety standards. Also, the embankments and control structures collectively fall within the definition of a Class I dam under Minnesota Rules, part 6115.0340.

As proposed, the Project would create a 30-mile long diversion channel on the North Dakota side of the F-M area. There would be a six-mile long connecting channel between the Red River and the diversion inlet control structure. When operated, the Project would divert a portion of the Red, Wild Rice, Sheyenne and Maple rivers' flow upstream of the F-M urban area, intercept flow at the Lower Rush and Rush Rivers, and return it to the Red River downstream of the F-M urban area.. Operation of the Project would occur when it becomes known that a stage of 35.0 feet would be exceeded at the United States (U.S.) Geological Survey (USGS) gage in Fargo (Fargo gage). At this stage, the flow through Fargo would be approximately 17,000 cubic feet per second (cfs). A flow of 17,000 cfs at the Fargo gage is approximately a ten-percent chance flood (i.e., ten-year flood). Operation begins by partially closing the gates at the Red River and Wild Rice River control structures. Once the gates are partially closed, water would begin to accumulate in the inundation areas.

The Project would remove large portions of existing floodplain from the special flood hazard area downstream of County Road 16 and within the F-M area downstream of the tieback embankment. This would reduce flood damages and flood risk in the F-M urban area, but it would not completely eliminate flood risk. The Project would reduce flood stages on the Red River in the cities of Fargo and Moorhead and would also reduce stages on the Wild Rice, Sheyenne, Maple, Rush and Lower Rush Rivers between the Red River and the diversion channel. With the Project operational, the stage from a 100-year flood on the Red River would be reduced from approximately 42.1 feet (assuming emergency levees confine the flow) to 35.0 feet at the Fargo gage.

2.1.1 Detailed Project Description

The following provides details on the Project components. These include the dam, control structures, connecting channel, diversion inlet control structure, staging area, diversion channel, Maple River and Sheyenne River aqueducts, Lower Rush River and Rush River rock ramps, inlet structures, OHB and Comstock ring levees, floodwalls and in-town levees, and non-structural project features. The Project also includes floodwalls and in-town levees, non-structural features, and recreation features. Details about Project operation and Project components are provided below and identified in Figure 2.

2.1.1.1 Dam

A "dam" is an artificial barrier that may impound water, so the "dam" includes the control structures and embankments, and collectively fall within the definition of a Class I dam under Minnesota Rules, part 6115.0340. Regulated dams subject to existing dam safety rules are defined in Minnesota Rules, part 6115.0320, subpart 5, and typically include dams with a height of greater than six feet and an impoundment volume greater than 15 acre-feet. The control structures are gated structures that span the river and control the flow of water downstream and include the Red River control structure, the Wild Rice River control structure, and the diversion inlet control structure. The embankments are raised structures constructed of soil and include the tieback embankment and the overflow embankment.

The length of dam between high ground in Minnesota to the diversion inlet control structure would be approximately 12 miles (six miles in Minnesota and six miles in North Dakota) and would be generally in an east/west direction. The expected elevation of this portion of the dam is between 927.5 feet and 930.1 feet. A four-mile long overflow embankment would be built south of the diversion inlet control structure along Cass County Highway 17 at an elevation lower than the east/west portion of the dam. This portion of the dam would act as an emergency spillway for extreme events that exceed the 0.2-percent chance (500-year flood) 0.2-percent chance (500-year flood).

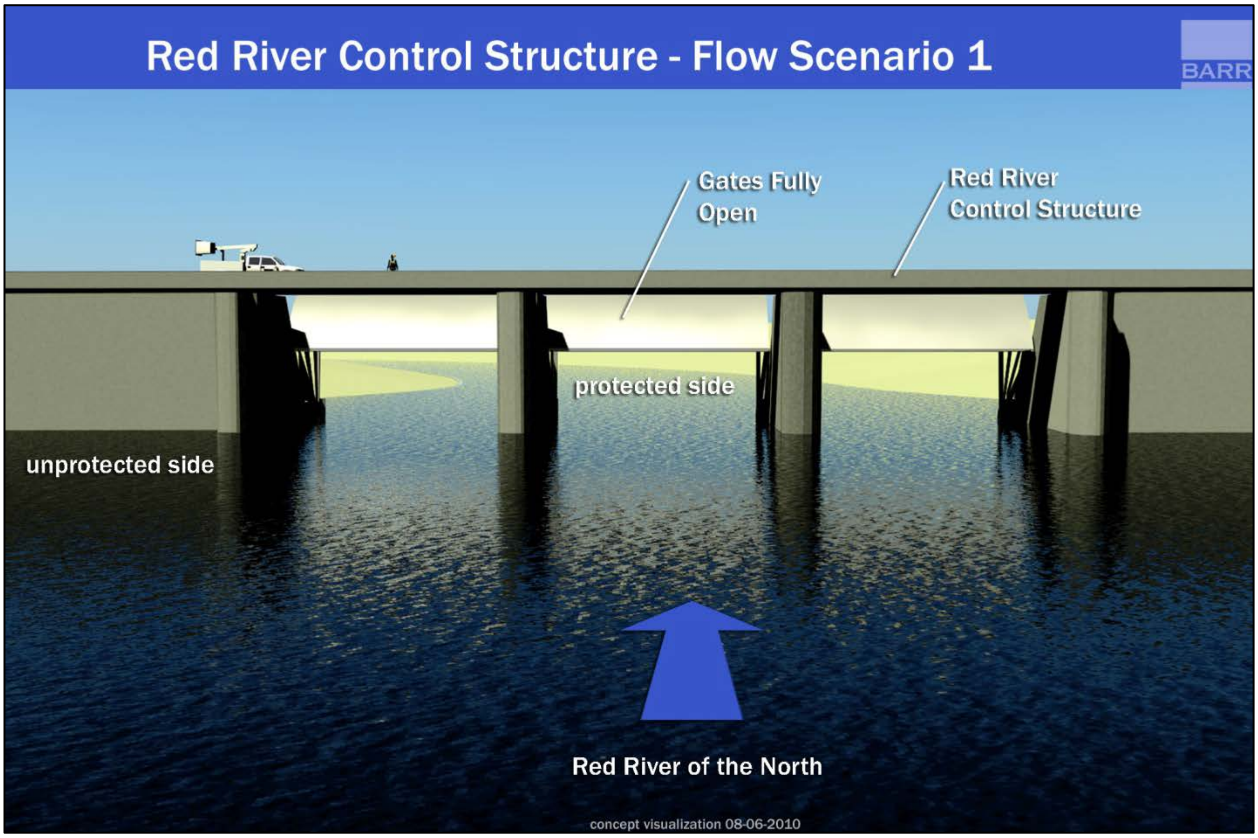
2.1.1.2 Red River and Wild Rice River Control Structures

A gated control structure would be constructed adjacent to the Red River in Holy Cross Township, Clay County, Minnesota. A similar control structure would be constructed adjacent to the Wild Rice River in Pleasant Township, Cass County, North Dakota. The structures would be constructed adjacent to the existing channels in order to keep the sites dry during construction.

The Red River control structure is expected to consist of three 50-feet wide gates, as shown in Illustration 2.1, and the Wild Rice River control structure is expected to consist of two 30-feet wide gates. The sills of both structures would be at the existing river bed elevations.

Once the control structures are built, the Red River and Wild Rice River would be rerouted through the control structures. When operated during flood events, these control structures and their gates would limit flows downstream in the natural channels and cause the water to accumulate in the inundation areas.

Illustration 2.1 Control Structure



Source: Diversion Authority, 2015

2.1.1.3 Connecting Channel

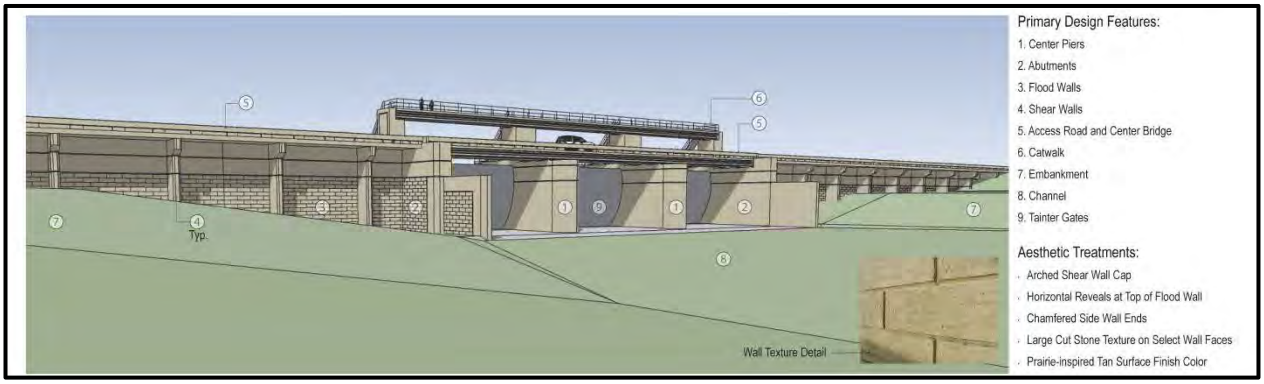
The Project would include a six mile long connecting channel between the Red River and the diversion channel inlet control structure. The connecting channel is smaller than and separate from the diversion channel. The proposed design of the connecting channel is lower than ground level, so it would be the first area inundated when the Project operates. The connecting channel bottom width is approximately 100 feet and would slope toward the Wild Rice and Red Rivers to drain the inundation areas when flood flows have receded.

At the Wild Rice River crossing, there would be two weirs (a low wall or dam built across a stream or river to raise the level of the water or to change the direction of its flow) across the connecting channel to maintain flow in the Wild Rice River during non-flood conditions.

2.1.1.4 Diversion Inlet Control Structure

The diversion inlet control structure would be located where the diversion channel crosses Cass County Highway 17 in the southwest quarter of Section 31, Stanley Township, Cass County, North Dakota. The diversion inlet control structure would consist of a 135-foot wide spillway with operable gates to control flows going into the diversion channel, as shown in Illustration 2.2. Conditions on the Red, Wild Rice, Sheyenne, and Maple Rivers would be monitored to determine gate operation need and minimize downstream impacts.

Illustration 2.2 Diversion Inlet Control Structure



Source: Diversion Authority, 2015

2.1.1.5 Staging Area

The staging area boundary contains 75,000 acre-feet of existing floodplain storage for the 100-year flood. In order to minimize downstream impacts, an additional 150,000 acre-feet of storage is needed. 225,000 acre-feet is the total amount of storage in the staging area for both the 100-year and the 500-year floods. Roughly 32,000 acres is required for the storage needed for Project operation. This required area is generally referred to as the staging area. Water would begin to pool and inundate behind the dam when the Red and Wild Rice River control structure gates are partially closed to limit flows through the F-M urban area. Red River and Wild Rice River control structures would be operated to raise water surface elevations to approximately 922.2 feet at the diversion inlet control structure for all events up to a 500-year flood. The staging area would be regulated so that the required volume is maintained.

The perimeter of the inundated area within the staging area would experience additional flood depths of zero to one foot, while the majority of the land within the staging area would see additional depths greater than one foot. There are some areas within the staging area that would not become inundated during Project operation. In contrast, there are areas outside of the staging area that would become newly inundated or would experience additional depths of flooding as a result of Project operation. The majority of these inundated areas outside the staging area boundary would experience less than one foot of additional flood depth and are not considered as part of the required volume for Project operation. For the purposes of the EIS, the term “staging area” is used when referring to a Project component as in discussing where mitigation applies. The term “inundation area(s)” is used to describe any land that becomes flooded, regardless of depth. “Inundation area” is not tied to use with any specific flood event or to the Project or Project alternatives.

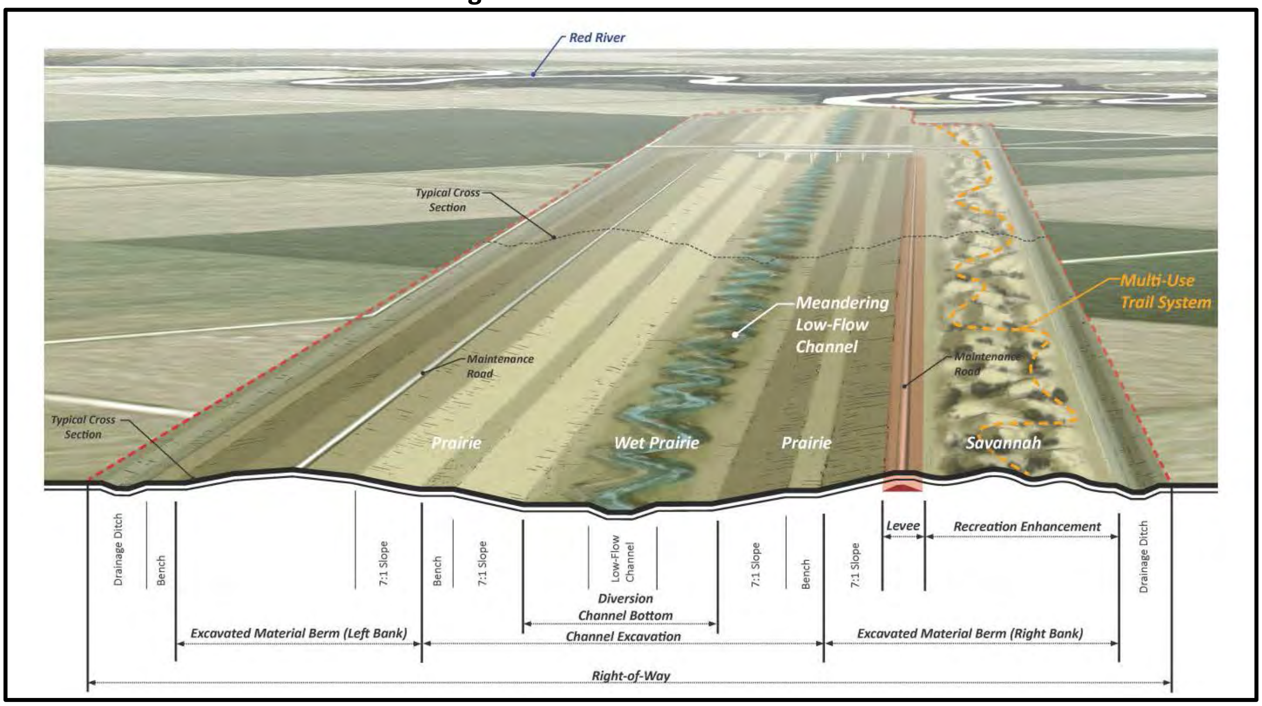
The staging area is defined as:

> *“…a defined area immediately upstream of the dam. When the project is operated, water will be temporarily detained in the staging area to minimize impacts downstream of the diversion outlet. The staging area encompasses the area where the Project increases the 100-year flood water surface elevation by 1 foot or more over existing conditions and encroachment must be prevented to preserve operability of the project. The staging area is a Project component that is being used as a management tool for land use/development and application of mitigation by the USACE, such as property acquisition, easements, and programmatic agreements, and it does not constitute the total area affected by Project operation.”*

2.1.1.6 Diversion Channel

The diversion channel would start from the diversion inlet control structure near Cass County Road 17, just southeast of Horace, North Dakota. From the diversion inlet control structure, the diversion channel would extend approximately 30 miles downstream to its outlet north of the confluence of the Red and Sheyenne Rivers near Georgetown, Minnesota. Illustration 2.3 provides an artist rendering of the diversion channel design. The diversion channel would route west of Horace, West Fargo, and Harwood and cross the Sheyenne, Maple, Lower Rush and Rush rivers. The diversion channel would continue west of and separate from the existing "Horace to West Fargo" and "West Fargo" diversion channels.

Illustration 2.3 Diversion Channel Design

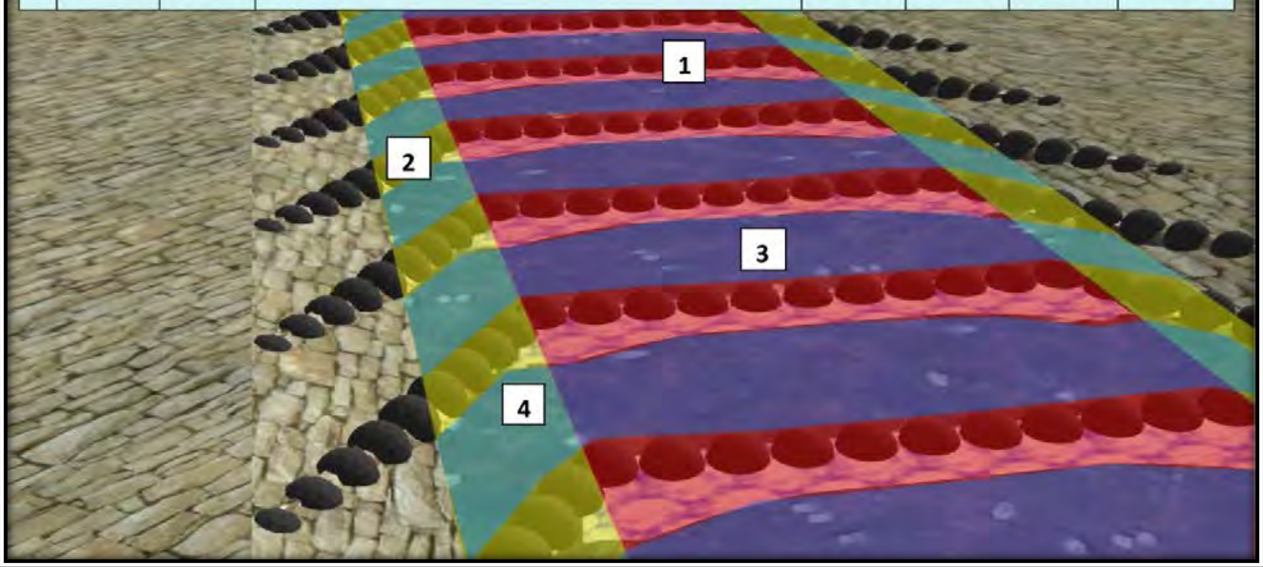


Source: Diversion Authority, 2015

The diversion channel outlet, located where the diversion channel returns to the Red River in Wiser Township, Cass County, North Dakota, would consist of a rock ramp with a crest width of 300 feet designed to allow fish passage, as shown in Illustration 2.4.

Illustration 2.4 Diversion Channel Outlet

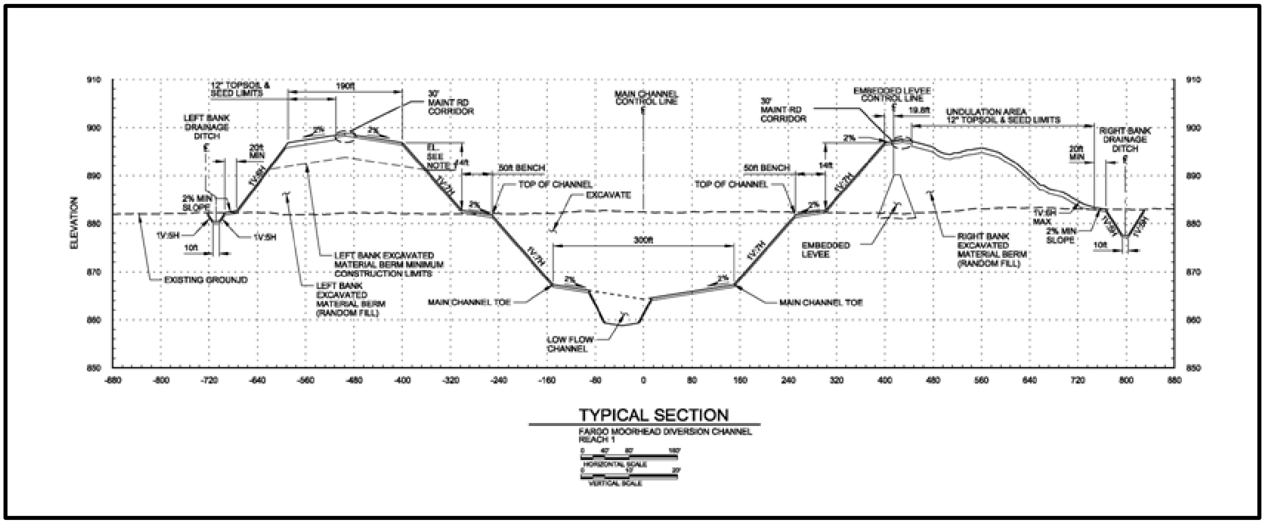
	Location	Feature	Description	Peak Velocities			
				100 cfs	1000 cfs	7000 cfs	20000 cfs
1	Center	Weir	High velocity area at the center of the channel through the boulder weirs which can accommodate passage for fish with stronger ***maximum burst speeds***	5.5 ft/s	8.5 ft/s	10.8 ft/s	3.6 ft/s
2	Fringe	Weir	Fringe area through boulder weirs with moderate velocity to accommodate fish passage for ***a full range of burst speeds***	4 ft/s	5 ft/s	6.4 ft/s	2.4 ft/s
3	Center	Pool	Pool area at the center of the channel with velocities in the range of ***sustained swim speeds*** for most flows	0.4 ft/s	2.2 ft/s	6.3 ft/s	3.3 ft/s
4	Fringe	Pool	Fringe areas of the pools with low velocities for ***resting***	0.3 ft/s	1 ft/s	2.7 ft/s	2.3 ft/s



Source: Diversion Authority, 2015

The diversion channel is designed to receive 20,000 cfs for the 100-year flood at the diversion inlet control structure and additional water from drainages intersected downstream of the inlet control structure. The diversion is designed to keep the 100-year flood flows below existing ground elevations as much as practicable to limit impacts to drainage outside the channel. The diversion channel would have a bottom width of 300 feet and a variable-width, low-flow channel that has been sized based on sediment transport considerations (Illustration 2.5). The low-flow channel would meander within a 200-foot belt width within the 300-foot bottom width from just upstream of the diversion channel outlet to just downstream of the Maple River aqueduct.

Illustration 2.5 Diversion Channel Cross Section



Source: Diversion Authority, 2015

The depth of the diversion channel would range from 15 to 25 feet deep excluding the low-flow channel and 20 to 30 feet deep including the low-flow channel. The general longitudinal slope of the diversion would be 0.9 ft/mile, with the low-flow channel having slightly less slope due to the meandering pattern. The side slopes outward from the 300-foot bottom width would be one vertical step to seven horizontal steps, and include geotechnical “benches” of 0 to 30 feet wide, as needed, to provide additional stability to meet the required factors of safety. Surfaces such as the bottom width and the geotechnical stability benches would be sloped at two percent toward the center of the channel to provide adequate drainage. The low-flow channel increases in size and capacity as the diversion channel moves downstream to accommodate drainage inflows; its bottom width increases from 10 feet to 52 feet, and its depth below the main channel increases from 2.5 feet to 6.5 feet in four increments along the 30-mile channel alignment. Additional details are described in Appendix D of the Supplemental EA, September 2013.

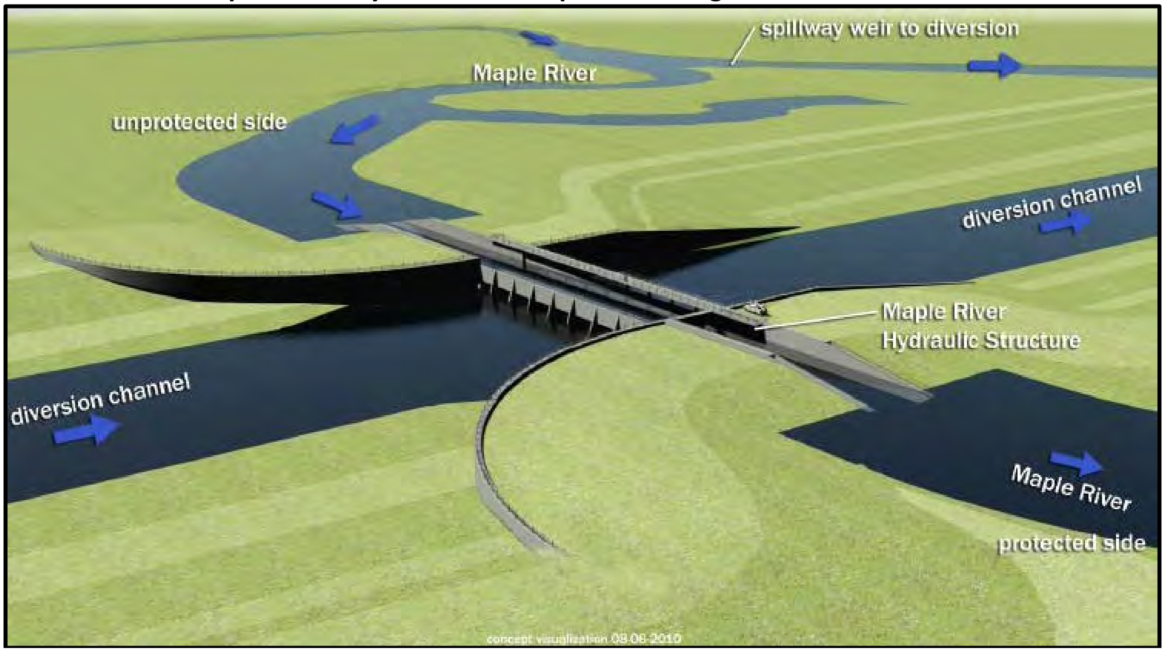
Soil excavated from the diversion channel would be placed into excavated material berms adjacent to the channel to a typical height of 16 feet. The excavated material berms would be as wide as necessary to contain the excavated material. Portions of the berms on the east side of the channel would be constructed to serve as levees when the water surface in the channel is higher than the natural grade. The maximum width of the footprint along the diversion channel would be approximately one half mile including the diversion channel and excavated material berms.

Drainage ditches adjacent to the berms would be necessary to intercept local drainage and direct it to the nearest downstream diversion inlet control structure. The drainage ditches would run along the exterior excavated material berm toe on both sides of the diversion channel. The left-bank (looking downstream) ditch would direct flow to the diversion inlet structures (e.g., Drain 30 and Rush River). The right-bank ditch would direct flow into existing drainage features that would direct flow away from the diversion channel.

2.1.1.7 Maple River and Sheyenne River Aqueducts

Aqueducts (bridge-like structures that convey water over the diversion channel) would be constructed for the Maple and Sheyenne Rivers. At both crossings, there would be open aqueducts that cross over the top of the diversion channel to allow continuous connectivity of these two rivers and inlet structures (Illustration 2.6).

Illustration 2.6 Maple and Sheyenne Rivers Aqueduct Design



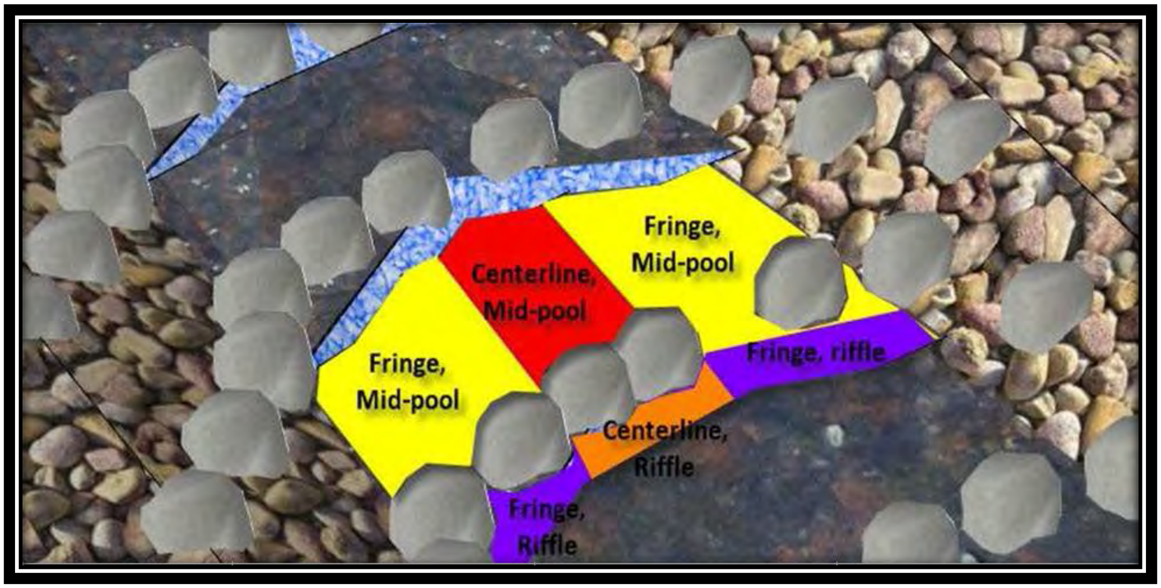
Source: Diversion Authority, 2015

During flood events, fixed-crest weir spillways would direct flood flows into the diversion channel and allow for flows in the diversion channel to pass underneath the aqueducts while allowing the existing river bank-full flows to continue downstream. Once bank-full flows are exceeded in the river channels, excess water would be diverted into the diversion channel. The purpose of maintaining bank-full flows (the flow at which water fills the channel without overtopping the banks – the average recurrence for the Maple River is 1.16 years and 1.67 years for the Sheyenne River (West, 2012)) in the rivers is to maintain existing geomorphologic processes and existing habitat conditions in the natural channels. The intent of the Sheyenne and Maple River aqueducts, as planned and operated, would be to maintain biological connectivity and fish passage in the rivers. The two aqueducts are similar in concept; each includes a grade control structure to prevent headcutting on the tributary, an inlet structure spillway weir to control diversion of tributary flows, heating components for cold weather operation, and an aqueduct to pass a limited flow over the diversion channel to maintain the desired downstream flow. The aqueducts would be constructed off-channel with the river diverted across the aqueduct upon completion.

2.1.1.8 Lower Rush River and Rush River Rock Ramps

At the Lower Rush River and Rush River, rock ramps would be used to continuously divert the entire flow into the diversion channel. The Lower Rush River and Rush River would be diverted into the diversion channel and no longer would flow into the Sheyenne River downstream. The Rush River rock ramp design is shown in Illustration 2.7.

Illustration 2.7 Rush River Rock Ramp Design



Source: Diversion Authority, 2015

2.1.1.9 Inlets, Ditches, and Smaller Control Structures

Ditches and smaller control structures would be required to accept existing drainages intersected by the diversion channel. Ditches running outside and parallel to the diversion channel would direct local drainage to a reasonable number of inlet structure locations. Existing ditches, field swales, and drain tile would be directed into these parallel ditches. The larger inlet structures, such as Drain 14 (a drainage ditch which runs generally south to north from Davenport to the Maple River near its mouth), would be open inlet structures like the Lower Rush River and Rush River. These larger inlet structures would be either concrete drop structures or rock ramps. The smaller inlet structures would be culvert structures with flap gates and energy dissipation chambers at the outlet. The culvert flap gates would prevent backflow from the diversion channel after peak flows.

Uncontrolled inlet structures (inlet structures without backflow prevention) would be placed at drainages that have either natural or manmade levees which would prevent widespread flooding from diversion channel backflow for events up through the 100-year flood. The project design is to maintain the existing 100-year flood floodplain in adjacent upstream drainages.

2.1.1.10 Oxbow/Hickson/Bakke Ring Levee

Under Project operation, the city of Oxbow, village of Hickson, and Bakke Subdivision (OHB) in North Dakota would be inundated up to eight feet during a 100-year flood. A community ring levee was proposed by the USACE in the Supplemental Environmental Assessment (EA) as a modification to the Project to address these impacts.

The OHB ring levee would surround the city of Oxbow, village of Hickson, and the Bakke subdivision (Figure 5). Oxbow is located along the banks of the Red River and generally consists of residential lots surrounding the Oxbow Country Club. A number of residential lots as well as the country club would be impacted by the levee alignment. Approximately 40 residential structures would be removed. The alignment would generally parallel the Red River through residential areas in both the north and south portions of Oxbow and would cross directly through the Oxbow Country Club. The alignment would parallel the north edge of Bakke and continue south along the west edge of Bakke and Hickson. From the southeast edge of Oxbow and the southwest edge of Hickson, the levee would encompass agricultural areas, new residential lots, and portions of the golf course.

The ring levee would be constructed to project operation elevation for a 100-year flood event plus four feet of freeboard. The 100-year flood elevation at the city of Oxbow, village of Hickson and Bakke Subdivision based on modeling information, is an elevation of approximately 922.3 feet, and the 500-year flood elevation is approximately 922.5 feet. The 100-year and 500-year flood elevations are similar since all three communities are located in the inundation area. The top of OHB ring levee elevation is designed to 927.50 feet. The five foot elevation difference accounts for: four feet of freeboard, 0.5 feet of overbuild to account for settlement, and 0.5 feet of aggregate roadway. The OHB ring levee includes a 2,300 foot overflow section on the west side of the levee that is one foot lower than the levee designed elevation. During a flood event greater than the 500-year flood, which could potentially overtop the OHB ring levee, this overflow section would allow flood water to enter (overtop) the levee, but in a controlled location. This design could potentially prevent an uncontrolled breach of the levee elsewhere along the alignment.

The levee embankment would be located a sufficient distance, approximately 150 feet, from residential lots to allow for levee maintenance access, drainage features, and a vegetative buffer. The levee would be located a sufficient distance from the Red River to ensure geotechnical stability.

OHB ring levee construction requires the raising of Cass County Highways 81 and 18 to allow access during Project operation. Cass County Highway 25, and 51st Street Southeast would be raised over the levee to allow access to agriculture fields when the Project is not operating. An additional area of Oxbow would be created within the Benefited Area that would include new roads, residential lots, golf course holes, and a new clubhouse to replace structures and features lost due to construction. The existing sanitary sewer system, water main, and storm sewer system would be modified to accommodate the ring levee and new residential areas. Internal drainage features would be included, such as: open channels, storm sewers, stormwater ponds, and a storm sewer pump station.

2.1.1.11 Comstock Ring Levee

A ring levee would be also constructed around the city of Comstock, Minnesota, which is currently located outside of the 100-year floodplain. Without a ring levee, operation of the Project would cause new inundation of up to one foot, which would impact 26 structures in this community during the 100-year flood. The design of the Comstock ring levee is conceptual at this time (Figure 6). The details that follow are subject to revision pending further design and coordination between the Diversion Authority and the City of Comstock.

The 100-year flood elevation at Comstock, based on unsteady modeling information, is an elevation of 922.3 feet, and the 500-year flood elevation is approximately 922.5 feet. The 100-year and 500-year elevations are similar since the city of Comstock is located in the staging area. The proposed levee elevations for Comstock would be set at approximately 926.5 feet on the north end of the city to provide four feet of freeboard. The elevation of the proposed levee on the south side of the city is 927.0 feet. The additional one foot of freeboard over the required amount was factored in based on the assumed level of settlement amount of six inches and six inches of topsoil.

Clay County Highway 2 would be raised at both places where it crosses the ring levee. The railroad on the north and south side would require protection measures above a 100-year flood.

The alignment on the north and east side of Comstock would have an internal ditch constructed along the levee. South of Clay County, Highway 2 and east of the Burlington Northern Santa Fe (BNSF) railroad, a conceptual area for future development would be included within the leveed area. West of the railroad tracks on the south side, the alignment of the levee was conceptually designed to include future commercial expansion. Existing flow from the southeast would be diverted by an external ditch installed around the outside of the levee. This ditch would carry the storm/flood water around town.

Interior drainage east of the railroad would continue to drain to the north; however, instead of exiting town through an existing ditch on the east side of the railroad, the water would enter an internal ditch, which would carry the water to a new interior stormwater pond. A pump station would be installed to drain the pond. Another pond located in the southwest corner would be used for interior stormwater storage. The two ponds would be connected through a surface ditch.

2.1.1.12 Floodwalls and In-Town Levees

The Project would include floodwalls and levees in Fargo and Moorhead, which would allow flows up to 17,000 cfs to pass through town. Flows less than 17,000 cfs would not result in Project operation. The in-town levees would be such that Federal Emergency Management Agency (FEMA) would be able to accredit the levees for the 100-year flood once the Project is complete.

The in-town levees would include the following features:

- Maintain certification of existing 4th Street Levee
- Certification of the existing Ridgewood/VA levee (Fargo)
- Certification of the existing project area F1 levee (Moorhead)
- Construction and Certification of the Mickelson Field levee (Fargo)
  - o Certification of recently completed levee paralleling Oak Street from 11th Avenue North to the south line of Mickelson Field.
  - o Construction and certification of the final segment of the Mickelson Field levee consisting of an approximate 550-foot long levee connecting the existing levee to high ground at North Terrace and North River Road. Five (5) residential structures would require removal for this feature as they are impacted by the levee footprint.
- Acquisition of the isolated urban property near Wood Lawn Park (Moorhead)
- Certification of the existing Woodlawn Area levee (Moorhead)
- Acquisition of two residential structures in the Belmont Area
- Certification of the existing Horn Park Area levee (Moorhead)

2.1.1.13 Transportation and Utility Features

Interstate Highway 29 (I-29), U.S. Highway 75, and the BNSF railroad (BNSF Moorhead Subdivision rail line) near U.S. Highway 75 would be raised slightly above the 500-year flood elevation to maintain access during flood inundation. Other roads within the inundation areas, except OHB and Comstock ring levee access roads, would be allowed to flood when the Project is operating. Utilities located in the inundation area would be evaluated during final Project design. Known utilities include, but are not limited to, electric power lines, rural water supply, and sewer facilities. Utilities that cannot withstand occasional flooding would be abandoned, modified or relocated, depending on the situation in accordance with applicable regulations.

Along the length of the diversion channel, 19 road crossings, including four railroad bridges, and highway relocations would occur at approximately three mile intervals, primarily for county roads. Other roads may be terminated at the diversion channel or rerouted to the local road network, which would be determined during final Project design. The four new railroad bridges would be needed where existing railroads intersect the diversion channel.

2.1.1.14 Project Operation

The gates at the Red River and Wild Rice River control structures would be fully open and the gates at the diversion inlet control structure would be fully closed when the Project is not operating. The decision as to whether the Project would begin to operate or not would be based on measurements, not forecasts. Project operation (see Appendix A) would occur when it becomes known that a stage of 35.0 feet would be exceeded at the USGS gage in Fargo (the Fargo gage). At a stage of 35.0 feet, the corresponding flow through Fargo would be approximately 17,000 cfs. A flow of 17,000 cfs at the Fargo gage is approximately a 10-percent annual exceedance probability (AEP) flood event (10-percent chance flood, i.e., 10-year flood). The USGS Red River gage at Enloe, North Dakota (Enloe gage) and the USGS Wild Rice River gage near Abercrombie, North Dakota (Abercrombie gage) would be observed to determine whether 17,000 cfs would occur at the Fargo gage. An analysis of historical floods indicates close to a one to one relationship between the sum of the Enloe gage flow and the Abercrombie gage flow and the total flow at the Fargo gage. Therefore, once the sum of the flows at Enloe/Abercrombie reaches 17,000 cfs, Project operation would begin unless the hydrographs indicate they may be close to peaking, at which point the flows at the control structures would be monitored to be sure 17,000 cfs would occur at the Fargo gage before Project operation begins.

Operation would begin with partially closing the gates at the Red River and Wild Rice River control structures. Once the gates are partially closed (i.e., partially lowered), water would begin to accumulate upstream of the control structures. Water would not be released through the diversion inlet control structure gates until the Red River and Wild Rice River control structures are partially closed.

Project operation on the rising limb of the flood hydrograph is based on minimizing downstream impacts. The diversion inlet control structure gates would be opened only after the initial diversion tributary (Sheyenne River, Maple River, Lower Rush River, and Rush River) flow peaks have made it to the diversion.

Project operation on the falling limb of the flood hydrograph is based on the rate of stage decrease experienced during historic floods and minimizing the duration of upstream impacts.

Flood stages through the F-M urban area and upstream of the control structures would depend on the shape and size of the Red River and Wild Rice River flood hydrographs coming towards Fargo-Moorhead. While the decision to operate would not be based on a forecast, the target stage at the Fargo gage would be based on a forecast if it appears that the flood would exceed the 1-percent AEP (100-year flood) peak flow of 34,700 cfs. As long as it is clear that 34,700 cfs would not be exceeded, the stage at the Fargo gage would be limited to 35.0 feet and the maximum flow allowed through the diversion inlet control structure would be 20,000 cfs. The Project 100-year flood would produce an elevation of 922.2 feet just upstream of the control structures in the staging area.

After the Project is operating, if the forecasted peak flow at Fargo is greater than 34,700 cfs, the target stage at the Fargo gage would be increased from 35.0 feet up to 40.0 feet, depending on the flood forecast. Emergency flood fighting measures are required once the target stage is increased above 35.0 feet. The maximum target stage of 40.0 feet is comparable to the stage experienced during the 2009 flood. Since this operating procedure allows more flow to be passed through town (resulting in the higher stages), it allows the staging area to crest at 922.2 feet for 100-year through 500-year floods. The maximum flow allowed through the diversion inlet control structure would be 20,000 cfs up through the 500 year flood.

For events greater than a 500-year flood, a stage of 40.0 feet would be maintained at the Fargo gage and the staging area elevation would be allowed to rise above 922.2 feet, up to the point of minimum acceptable freeboard (four to five feet at the dam). The rise of the staging area would be minimized as much as possible by further opening the diversion inlet control structure gates to allow more flow into the diversion. At the point of minimum acceptable freeboard, flow out of the staging area would be maximized at the diversion inlet structure and over the overflow embankment along the west side of the staging area. Flow exiting the staging area via the overflow embankment would flow overland into the Sheyenne River basin.

An evacuation order would be issued for the F-M urban area as the staging area elevation approaches the minimum acceptable freeboard level. Once the upstream staging elevation reaches the point of minimum acceptable freeboard, the Red River and Wild Rice River control structure gates would be opened further to maintain the minimum freeboard and stages would rise above 40.0 feet at the Fargo gage.

The non-Federal local sponsors would be responsible for all operations, maintenance, repair, rehabilitation and replacement (OMRR&R) of the Project. The cost share agreement between the USACE and the non-Federal local sponsors requires the sponsors to operate the Project in accordance with the OMRR&R manual provided by the USACE.

Project Operation Summary:

1. If Enloe Gage (Red River) + Abercrombie Gage (Wild Rice River) = 17,000 cfs and clearly peaking well above 17,000 cfs, Project begins operating.
2. If Enloe Gage (Red River) + Abercrombie Gage (Wild Rice River) = 17,000 cfs and would be peaking near 17,000 cfs, the decision to operate the Project would be based on flows measured at the control structures.
3. With the Project operating and a peak flow forecast at or below the 100-year flood peak flow of 34,700 cfs, the target stage at the Fargo gage would be 35.0 feet.
    - Maximum flow through diversion inlet control structure would be 20,000 cfs
        - May be less than 20,000 cfs for events smaller than the 100-year flood (details to be provided with detailed operating plan)
    - Maximum pool elevation at control structures would be 922.2 feet

        - Would be less than 922.2 feet for events smaller than the 100-year flood (details to be provided with detailed operating plan)
4. With the Project operating and a peak flow forecast between the 100-year flood peak flow of 34,700 cfs and the 500-year flood peak flow of 61,700 cfs, the target stage at the Fargo gage would be greater than 35.0 feet, but not greater than 40.0 feet.
    - Maximum flow through diversion inlet control structure would be 20,000 cfs
    - Maximum pool elevation at control structures would be 922.2 feet
5. With the Project operating and a peak flow forecast above the 500-year flood peak flow of 61,700 cfs, the target stage at the Fargo gage would be 40.0 feet up until the pool elevation reaches the point of minimal acceptable freeboard at the dam.
    - Flow through diversion inlet control structure would be increased as needed up to the maximum capacity of the diversion inlet control structure.
    - Flow exiting the staging area via the overflow embankment would flow overland into the Sheyenne River basin.
6. Pool elevation reaches the point of minimal acceptable freeboard at the dam.
    - Evacuation order would be issued for the F-M urban area in advance of reaching the point of minimal acceptable freeboard at the dam.
    - Red River and Wild Rice River control structures are opened such that minimal acceptable freeboard at the dam is maintained.
    - The stage at the Fargo gage rises above 40.0 feet.

2.1.1.15 Non-structural Project Features

There are several non-structural mitigation measures included in the Project to address impacts of increased flooding within the inundation area. These consist of fee acquisitions or relocations, construction of ring levees and the acquisition of flowage easements.

The April 2015 FEMA/USACE Coordination Plan (Appendix F) states that all impacts to insurable structures within the FEMA revision reach (i.e., where the Project would alter the Red River profile flood elevation by more than 0.5 feet) would be mitigated through agreed methods consistent with those specified by the National Flood Insurance Program (NFIP) based on the depth of flooding at each structure. In accordance with the FEMA/USACE Coordination Plan (April 2015) impacted homes, structures, and businesses that have greater than two feet of flooding for the 100-year flood with the Project would be purchased or relocated and, those with up to two feet of flooding would be evaluated for non-structural measures such as ring levees, relocation, or elevating structures. The FEMA revision reach includes the entire staging area as well as some areas upstream of the staging area.

The Coordination Plan requires that the areal extent of flood inundation required for operation of the Project within the staging area be mapped as floodway in order to ensure that the required volume is available for the Project during the 100-year flood. Flowage easements would be obtained for all floodway designated areas. Any additional flood inundation within the FEMA revision reach that is outside of the staging area would be mapped as floodplain in order to portray the elevated flood risk outside of the required staging area.

Areas outside the FEMA revision reach (and thereby outside of the staging area) such as those along the Red River, Wild Rice River and connected drainages may also be affected by Project operation. Inundation outside of the designated staging area is estimated to be less than one foot of additional flood depth for a 100-year flood and would be impacted by the Project primarily in the spring. It is anticipated that for agricultural lands in most areas, farming could continue without significant impacts. The USACE has proposed that a takings analysis on a case-by-case-basis would be performed to determine mitigation needs within this area. Flowage easements would be obtained for land and structures would be mitigated only where the taking analysis (see Section 3.2 – FEMA Regulations and the (Conditional Letter of Map Revision) CLOMR Process for more details on the takings analysis) determines impacts rise to the level of a taking under the Fifth Amendment of the U.S. Constitution[1]. This analysis would include evaluation of property impacts such as land value, water supply, and septic systems. Landowners would be compensated appropriately for any takings. Minnesota Rules, part 6120.5700, subpart A requires mitigation for existing insurable structures in Minnesota with any impact. Additional permit requirements may be needed from the North Dakota Office of the State Engineer for impacted properties in North Dakota.

2.1.1.16 Recreation Features

The conceptual recreation plan for the Project includes one concrete multi-purpose trail and one aggregate equestrian trail loop with a combined length of approximately 47 miles. These trails are in addition to the aggregate maintenance road that is included in the Project. The multi-purpose trails would be 10-foot wide concrete, while the equestrian trail would be 12-foot wide compacted gravel. Both trails would be situated within an undulating landscape on top of the right bank excavated material berm (EMB) of the diversion channel, and designed to be a trail system that would provide varying distances and aesthetic experiences to the users. The trails would start at the diversion channel outlet to the Red River and extend upstream. At this time, the aqueducts have planned service maintenance bridges that could allow for pedestrian traffic to cross, and the proposed County and local road bridge designs allow for shared-use. At each proposed bridge location, including railroad and interstate bridges, the trails would merge and be constructed down the side slopes of the main diversion channel so that the trail can pass underneath the bridge structures. Along the trails, benches, trash receptacles, and interpretive signage would be located approximately every mile to provide the trail users information about the wildlife, history, culture, and ecology of the area as well as respite.

Recreation use along the left bank EMB would be limited to a winter snowmobile trail, which could be located along the base of the outside slope. The maintenance road on both the left and right bank EMB could serve as a bird watching trail or for other passive recreation opportunities. This access road would be closed to motorized vehicles, but public non-motorized use may be allowed.

In addition to the proposed trail system, other activities have been identified and planned for in key locations. These locations are known as Activity Hubs. There are four hubs identified for the Project; Red River Hub, Maple River Hub, Sheyenne River Hub, and Diversion Structure Hub. These Activity Hubs would function as primary trail access locations as well as recreation destinations. While the individual hubs would vary in character, recreation features would

[1] The 5th Amendment of the US Constitution requires just compensation when private property is taken for public use. CFR 49 Part 24 - Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970, PL 91-646, as amended, details benefits to the property owner and/or displaced residential renters for Federal and Federally Assisted Programs.

include parking, restrooms, trail way-finding signage, picnic facilities, drinking water, interpretative signage, fishing, and boat access to the river channels.

Also included in the conceptual recreation plan are Activity Nodes. Nodes are similar to hubs but provide less intensive site-specific activities and could serve as secondary access points to the trails. Proposed activity nodes include the following:

- Two Off-Highway Vehicle (OHV) nodes are proposed for adjacent parcels along the diversion and would be designed to accommodate four-wheel vehicles, all-terrain vehicles (ATVs), off-road motorcycles and mountain biking. The OHV node would also include a trailhead facility with restrooms and concessions.
- Rush River Node would accommodate fishing access and a small trailhead.
- I-94 Node would provide a small trailhead off of I-94 and provide access to the Diversion trail system.
- Rendezvous Node would enlarge the existing Rendezvous Park and provide a dog park as well as parking and portable restroom facilities.
- Wild Rice River Node would provide fishing access to the Wild Rice River and a small trailhead to access the Diversion trails.

Landscaping of trees and shrubs at the trailheads, Activity Hubs and Nodes are proposed along with trees, native prairie grasses and forbs along the trail. All proposed recreation facilities would meet the guidelines for Americans with Disabilities Act (ADA) and the Architectural Barriers Act (ABA) as well as the final draft of the ADA-ABA Accessibility Guidelines for Outdoor Developed Areas.

2.2 ALTERNATIVES

The alternatives section describes the process that was used to develop, evaluate, and eliminate potential alternatives based on the Project Purpose and Need described in Chapter 1. The discussion includes how alternatives were selected for detailed study, the reasons why some alternatives were eliminated from consideration and describes how the alternatives meet the purpose for the Project.

2.2.1 Alternatives Evaluation Summary

Projects that require the preparation of an EIS focus on key environmental, social and economic issues that are likely to result from the Project, and the detailed analysis of those issues. EISs are required to include alternative Project designs or locations that are reasonable, would result in fewer environmental impacts, and achieve the Project Purpose and Need. The goal is to identify if other alternatives could improve socioeconomic benefits while reducing environmental impacts. Alternatives offer decision makers and the public options to the Project. A no action alternative is always included in this evaluation and considers existing conditions that would continue without the Project being constructed.

2.2.1.1 Process Overview

The Minnesota Environmental Policy Act of 1973 (MEPA) established a formal process for investigating the environmental impacts of major development projects. This formal process operates according to rules adopted by the Environmental Quality Board (EQB). Under MEPA, the EQB statutes and rules (Minnesota Statutes 2008, section 116D, subdivisions 04 and 045; and Minnesota Rules, parts 4410.0200 to 4410.6500) require that an EIS consider at least one alternative from each of the following categories or provide a concise explanation of why no alternative of a particular type is included in the EIS:

- Alternative sites;
- Alternative technologies;
- Modified designs or layouts;
- Modified scale or magnitude; and
- Alternatives incorporating reasonable mitigation measures identified through comments received during the public comment period during EIS scoping.

2.2.1.2 Screening Analysis

The MNDNR conducted an independent assessment of potential projects within the above categories, considering the alternatives discussed in the Final Feasibility Report and Environmental Impact Statement (FFREIS) and combining other measures with those alternatives. As part of the scoping, the MNDNR prepared the Alternatives Screening Report: Fargo-Moorhead Metropolitan Area Flood Risk Management Project (December 2012) (Alternatives Screening Report).

Reasonable alternatives were considered for their relevance to meet the proposer's defined Project purpose and need, as well as their feasibility to improve environmental and/or socioeconomic benefits, while reducing potential environmental impacts that may result. Alternative sites and alternative technologies were evaluated in the EIS. Other alternatives considered, but dismissed from further evaluation in the EIS, include modified designs and layouts, and modified scale and magnitude. Alternatives incorporating reasonable mitigation measures were also evaluated in the EIS for each topic area as it related to the mitigation.

According to Minnesota Rules, part 4410.2300, item G, an alternative may be excluded from analysis if it would not meet the underlying need for or purpose of the Project, it would not likely have a significant environmental benefit compared to the Project as proposed, or another alternative, of any type, that will be analyzed in the EIS would likely have similar environmental benefits but substantially less adverse economic, employment, or socioeconomic impacts.

2.2.1.2.1 Alternative Sites

As part of the Alternatives Screening Report (Wenck, 2012), MNDNR determined that the reasonably available alternate diversion sites in Minnesota and/or North Dakota do not produce benefits for environmental resources or socioeconomic factors, and therefore the EIS will not evaluate alternative sites.

2.2.1.2.2 Alternative Technologies

Six potential technology alternatives were studied in the Alternatives Screening Report. Two of these alternatives, tunneling and I-29 Viaduct, had a similar effectiveness to the Project but did not present a significant environmental benefit. In addition, they are expected to transfer potential impacts of the Project downstream, and they have excessive capital costs, and therefore will not be evaluated in the EIS.

The remaining alternative technologies (non-structural measures; flood barriers; flood storage; and flood storage combined with a control structure) did not effectively meet the Project purpose by themselves. However, it was initially thought that a combination of these alternatives could potentially meet the Project purpose and present increased environmental benefit. Therefore, the Distributed Storage Alternative (DSA), which is principally a modified design alternative that incorporates these alternative technology aspects, was further evaluated as part of the alternatives evaluation. Additional discussion on the DSA is provided in subsection 2.2.1.3.1.

2.2.1.2.3 Modified Design or Layouts

The NAA is a modified version of the Project design and layout. The NAA was conceptualized during the public comment and alternatives screening process. The Alternatives Screening Report has details on the alternatives considered and the screening criteria used to select alternatives that could meet Project purpose while providing other potential benefits. The NAA was one of two additional alternatives recommended for further study through the EIS process. The NAA was selected for further evaluation in this EIS.

The NAA would move the tieback embankment of the Project north approximately 1.5 miles (Figure 7). The remaining design features of the NAA would remain the same as the Project. The NAA consists of a dam and diversion channel system including, but not limited to: a tieback embankment and overflow embankment, excavated channels; diversion inlet control structure; control structures on the Red and Wild Rice Rivers; a flood water staging area (staging area); inlet structures on tributaries; in-town levees and floodwalls in the F-M urban area; the OHB ring levee; and non-structural features (such as buyout, relocation, or raising individual structures); and recreation features (such as multipurpose trails and pedestrian bridges). The NAA also includes environmental mitigation projects located inside and outside the project area.

Because the Project impact footprint is different than the NAA, some studies or investigations providing environmental effects may not have been completed, or may not have been completed to the same extent as for the Project. According to Minnesota Rules, part 4410.2500, if information about potentially significant environmental effects of an alternative is not available or is incomplete, the EIS shall include a statement of the information that is incomplete or unavailable, a brief explanation of why it is not available, and an explanation of the information's importance. Incomplete NAA impact information will be addressed within each EIS topic section. If the NAA is pursued beyond the EIS, additional site specific studies would need to be conducted and considered in the final design and construction plans.

Additionally, the design details or construction plans for the structures might need to be modified for reasons such as different topography, soil types, or land use. These potential differences or modifications are not anticipated to be significant; therefore, for the purposes of the EIS, the NAA design features are described as being similar to or the same as the Project as applicable. To the extent that studies or investigations have been completed within the NAA project area, these have been included in the EIS and discussed in the appropriate sections. A more detailed description of the NAA is provided in subsection 2.2.2.2.

2.2.1.2.4 Modified Scale or Magnitude

The MNDNR considered one scale or magnitude alternative in the EIS: More Flows Through Town. The More Flows Through Town Alternative was first conceptualized in 2011 by the USACE as part of the FFREIS as a potential fish mitigation measure. Since then, the concept of sending more flows through town has been discussed many times between the USACE and MNDNR, including during development of this EIS. MNDNR technical staff suggested that the concept of sending more flows through town during Project operation might provide greater environmental and social benefits than the proposed Project. Additional discussion on the More Flows Through Town Alternative screening evaluation is discussed in subsection 2.2.1.3.2.

2.2.1.2.5 Alternatives Incorporating Reasonable Mitigation Measures

The MNDNR has considered alternatives and mitigation measures identified during the comment period on the draft scoping documents. These suggested mitigation measures were considered against the exclusionary criteria identified in Minnesota Rules*,* part 4410.2300, subpart G. Mitigation measures identified through public comments include:

- monitoring diversion channel and flood water drawdown to reduce fish stranding in the diversion channel and inundation areas;
- incorporate invasive species monitoring and mitigation strategies into the Project operation plan;
- review existing Indexes of Biological Integrity (IBIs) for their potential to inform future monitoring of the aqueducts on the Maple River and Sheyenne River for freezing during low-flow and no-flow conditions; and
- assess the need for groundwater monitoring as part of the Draft Adaptive Management and Monitoring Plan (AMMP) (Appendix B).

These mitigation and monitoring measures, along with proposed and additional recommended mitigation and monitoring measures, were considered and evaluated in the EIS. Measures specific to a certain topic area, such as fish passage and mortality, are discussed in the relevant sections of this EIS. Chapter 6 further evaluates the proposed mitigation and monitoring measures and provides additional recommended measures where needed. Additionally, the Adaptive Management Plan concept presented in the FFREIS was further refined during this EIS process which resulted in a comprehensive Draft AMMP that provides background information, proposed and recommended mitigation and monitoring measures, and outlines draft monitoring protocols. The Draft AMMP is provided as Appendix B.

2.2.1.3 Alternatives Considered But Dismissed From Further Evaluation

2.2.1.3.1 Distributed Storage Alternative

The DSA was conceptualized during the public comment and alternative screening process as part of scoping for the State of Minnesota environmental review for the Project. During the EIS scoping process, many public comments received suggested that distributed storage, or a similar approach, or in combination with other measures, might provide greater environmental benefits than the proposed Project. As a result, the MNDNR included the DSA alternative in the Final Scoping Decision Document (FSDD) for further evaluation in the EIS. An alternative may subsequently be excluded from analysis in the EIS if it is determined that the alternative would not meet the underlying purpose of the project, would not have significant environmental benefit, or would have similar environmental benefits but more adverse economic, employment or social impacts. If a scoped alternative is excluded from the EIS analysis, it must be discussed briefly and the reasons for its elimination shall be stated (Minnesota Rules, part 4410.2300).

<u>Distributed Storage Alternative Description</u>

The DSA is a combination of distributed Red River basin storage sites upstream of Halstad, Minnesota, and an in-town levee for flood protection of the F-M urban area. The distributed storage component of the DSA relies on the recent Halstad Upstream Retention Study (HUR) completed by the Red River Basin Commission in December 2013. The HUR identified 96 specific retention sites throughout the basin to achieve a 20-percent flow reduction on the Red River. The in-town levee component of the DSA relies on a maximum levee protection plan that was developed by the USACE. The levee plan includes over 50 miles of levee construction and ties into high ground. As part of analyzing the DSA, the MNDNR considered other measures, including the Sheyenne diversion and wetland/grassland restoration that could be combined with the DSA to improve flood risk reduction in the F-M urban area.

Distributed Storage Alternative Evaluation
MNDNR first evaluated the conceptualized DSA by seeing if it would meet the project purpose as defined by the Diversion Authority. Second, MNDNR evaluated the following two variations to the DSA to see whether they could provide additional benefits to meet the project purpose: 1) the DSA in combination with a new Sheyenne River Diversion, and 2) the DSA in combination with other non-structural measures (e.g., wetland and grassland restoration).

The project purpose is defined as:
1. Qualify substantial portions of the F-M metropolitan area for 100-year flood accreditation by the FEMA under the National Flood Insurance Program;
2. Reduce flood risk potential associated with a long history of frequent flooding on local streams including the Red River, Sheyenne, Wild Rice (in North Dakota) Maple, Rush and Lower Rush Rivers, passing through or into the F-M metropolitan area; and
3. Reduce flood risk for floods exceeding the 100-year flood, given the importance of the F-M metropolitan area to the region and recent frequencies of potentially catastrophic flood events.

Evaluation in the screening analysis is based on the following information:
- Water flow models included in the Final DSA Report (Appendix D).
- Relevant literature examining the potential for using upstream storage areas (e.g., wetlands and reservoirs) in major subwatersheds to reduce downstream flows through the F-M urban area. These storage areas referenced were often built with other structural and non-structural measures for flood risk reduction.

Reasons for Elimination
As described in the Final DSA Report (Appendix D), it appears that the DSA by itself would not meet the Project purpose as defined by the Diversion Authority.

One of the project purpose components is to qualify substantial portions of the F-M metropolitan area for 100-year flood FEMA accreditation. While the DSA does provide some protection, it faces challenges to meeting freeboard requirement for 100-year flood FEMA accreditation. Additionally, FEMA accreditation would require that all 96 sites identified in the HUR study be constructed. Compounding these challenges are the factors of time, funding, land acquisition, and regulatory issues. While it is possible that this component could be met, the feasibility of getting FEMA accreditation is questionable.

The second component of the project purpose is to reduce flood risk from the North Dakota tributaries. The DSA does provide some flood risk reduction, but it does not protect from break out flows on the Sheyenne River. Large portions of the F-M area would continue to have flood risk from the Sheyenne, particularly the north and west. Therefore, the DSA does not meet this component of the Project purpose.

Protection from floods greater than the 100-year flood is the third component of the Project purpose. The HUR study limited the evaluation to a 100-year flood; while there is potential for storage to protect above this event, it is likely limited. The levee system would contain flows greater than the 100-year flood, but it would do so without the additional freeboard that would typically be required for a larger event. Flood events greater than the 100-year flood increase the probability of overtopping the levee, which would result in catastrophic flood damages. Thus, the DSA does not present a reasonable or prudent alternative from flood events greater than the 100-year flood.

Consideration was given as to whether the cumulative benefit of additional flood reduction measures could help the DSA meet the project purpose. The MNDNR revisited an alternative (i.e., DSA with Sheyenne Diversion, or Northwestern Diversion) that was suggested in the Alternatives Screening Report to see if there was a modification that would increase the alternative's ability to meet the project purpose. While this addition does provide additional protection from the North Dakota tributaries and removes the need for a dam on the Red River, there are still problems with getting 100-year flood FEMA accreditation and with flood flows greater than the 100-year flood event. Similarly, adding wetland restoration to storage already considered in the DSA would have minimal impact on reducing flow rate and volume for the F-M urban area. It was, therefore, determined that these additions do not present a feasible and prudent alternative, and still is not likely to meet the project purpose.

The screening analysis of this alternative indicates that the DSA:

1) is limited in meeting the project purpose;
    a. The DSA provides the communities on the Red River mainstem with limited protection from catastrophic events or from peak tributary flows.
2) is not a feasible or practical alternative to the proposed project; and
    a. Roughly 96 impoundment sites would be required to achieve the desired 20 percent flow reduction basin-wide. Since 1997, only three impoundment projects have been completed upstream of Halstad.
    b. It would be very challenging for the Diversion Authority or the USACE to work with all interested parties across the basin to implement this number of storage sites within a reasonable time period.
3) in combination with other measures, does not substantially improve the performance of the alternative toward meeting the project purpose.
    a. Sheyenne Diversion: The addition of the Sheyenne Diversion has the potential to increase flood flows downstream of the F-M urban Area; and the cost of adding the Sheyenne Diversion, while not a prime consideration, would decrease the feasibility of DSA.
    b. Wetland/Grassland Restoration: it is unlikely that adding wetland/grassland restoration to the DSA measures would have a sufficient impact to allow the DSA to meet the Project purpose as it relates to catastrophic flood events.

Distributed Storage is a positive basin-wide approach and should be pursued wherever feasible. Distributed Storage would provide both local and mainstem benefits to the region, and if considered in conjunction with the proposed project along with flood fighting efforts, the Proposed Project would have a greater chance of achieving 500-year flood protection. Additional upstream storage would greatly benefit many downstream communities in the Red

River Basin, including Fargo and Moorhead, but individual communities would still need additional flood protection for large or catastrophic flood events.

The analysis of this alternative determines that the DSA: 1) does not fully meet the project purpose; and 2) therefore, is not a feasible or practical alternative to the Project. Minnesota Rules, part 4410.2300, subpart G allows for alternatives that were included in the scope of the EIS to be eliminated from further consideration based on information developed as part of the EIS. The full DSA screening analysis (Appendix C) is included in this EIS to briefly describe why this alternative is not being carried forward for full analysis in the EIS.

2.2.1.3.2 More Flows Through Town Alternative

The More Flows Through Town Alternative was first conceptualized in 2011 by the USACE as part of the FFREIS as a potential fish mitigation measure. Since then, the concept of sending more flows through town has been discussed many times between the USACE and MNDNR—three 2012 interagency meetings (May 30, July 18, and November 8, 2012) and again during development of the State of Minnesota's Draft EIS. MNDNR technical staff suggested that the concept of sending more flows through town during Project operation might provide greater environmental and social benefits than the proposed Project. The non-Federal sponsor evaluated more flow through town in 2012, resulting in a project change that increased the river stage through the protected area from River Stage (RS) 31 to RS 35. Subsequently, the MNDNR screened the concept to see if additional flows through town should be included as an alternative suitable for further evaluation in the EIS. An alternative, whether scoped in the FSDD or not, may subsequently be excluded from analysis in the EIS if it is determined that the alternative would not meet the underlying purpose, would not have significant environmental benefit, or would have similar environmental benefits but substantially less adverse economic, employment or social impacts. If a scoped alternative is excluded from the EIS analysis, it must be discussed briefly and the reasons for its elimination shall be stated (Minnesota Rules, part 4410.2300).

<u>More Flows Through Town Alternative Description</u>

As currently proposed, the Project would not operate until Red River flows exceed 17,000 cfs. This flow is equivalent to RS 35 feet, or about the 10-year flood. MNDNR suggested that allowing river stages through town in excess of RS 35 could potentially reduce environmental and social impacts of the Project. The potential benefits of sending more flows through town would be decreasing the duration that flood water is stored in the staging area and decreasing the frequency of Project operation. Sending more flows through town would still require upstream staging to offset downstream stage impacts and would have the same staging area footprint.

<u>More Flows Through Town Evaluation</u>

MNDNR first evaluated the More Flows Through Town concept to see if it would meet the Project purpose as defined by the Diversion Authority. Second, the alternative was evaluated for significant environmental benefit and substantially less adverse economic, employment or social impacts compared to the Project.

In order for this alternative to meet the Project purpose, the existing and proposed levees would need to be as high as possible (i.e., maximum levee height). As explained in Appendix O (Plan

Formulation) of the FFREIS, the top elevation of flood barrier alternatives is limited to the highest natural ground available to begin and end the levee.

The Project purpose has been defined as:

1. Qualify substantial portions of the F-M metropolitan area for 100-year flood accreditation by the FEMA under the NFIP;
2. Reduce flood risk potential associated with a long history of frequent flooding on local streams including the Red River, Sheyenne, Wild Rice, Maple, Rush and Lower Rush Rivers, passing through or into the F-M metropolitan area; and
3. Reduce flood risk for floods exceeding the 1-percent chance event (100-year flood or greater), given the importance of the F-M metropolitan area to the region and recent frequencies of potentially catastrophic flood events.

The screening analysis evaluation was based on the following documents:

- Appendix A-1 (Hydrology) from USACE FFREIS
- Appendix B (In-Town Levees) from the USACE EA
- Final Technical Memo AWD-00002 – Flows Through Flood Damage Reduction Area (Table 11 updated August 25, 2014)
- Diversion Authority RS 35 Decision Document (January 13, 2015)

MNDNR worked with USACE during Draft EIS development to update the Phase 2 levee results to match the most recent models. The results of the updates are in Table 2.1.

Table 2.1 Residual Peak 100-year Flood Stage, Discharge, and Approximate Existing Frequency Conditions.

Residual 100-yr Flood Stage	Residual 100-yr Peak Discharge (cfs)	Approximate Existing Condition Frequency (yr)
RS30	10,700	4.1
RS31	11,900	4.8
RS32	13,300	5.9
RS33	14,600	7.0
RS34	15,900	8.3
RS35	17,500	10.5
RS36	19,200	13.3
RS37	21,000	17.2

Source: USACE and HMG 2015.

Reasons for Elimination

The Project has three components to the project purpose; in order for the alternative to be considered for full analysis in the EIS, it must meet all three components. Additionally, it must offer less environmental or social impacts.

One of the three project purpose components is to qualify substantial portions of the F-M metropolitan area for 100-year flood FEMA accreditation. On the whole, portions of the F-M urban area could qualify for FEMA accreditation, so this component of the Project purpose could potentially be met.

The second component of the Project purpose is to reduce flood risk from the North Dakota tributaries. The More Flows Through Town Alternative does provide some flood risk reduction, but it would provide less opportunity to mitigate downstream impacts from tributary flows on the Sheyenne, Maple, Rush, and Lower Rush Rivers. Nevertheless, this component of the Project purpose could be met.

Protection from floods greater than the 100-year flood is the third component of the Project purpose. As explained in the January 13, 2015 decision document, "it is expected that the in-town levee segments would meet USACE Risk and Uncertainty requirements for RS 37." These additional risks include:

- RS37 would require mitigation for an additional 10 homes inside the protected area;
- RS37 would inundate an additional 4,800 acres (approximately 7.5 square miles) of land within the protected area;
- RS37 would add an additional 9,400 basements below the water surface profile;
- RS37 would inundate an additional 22,600 feet of roadway (approximately 4.3 miles);
- RS37 would have an additional 29,900 feet of levee that would have floodwater against the base of the levee (approximately 5.7 miles); and,
- RS37 would require the modification or relocation of City of Moorhead Sanitary Lift Station #2.

Impacts would be greater than listed above for floods greater than the 100-year flood, which would inhibit, but do not prevent, this alternative from fully meeting this Project component.

Since the More Flows Through Town Alternative marginally meets the Project purpose, it could be included for full analysis in the EIS provided it has similar environmental benefits but substantially less adverse economic, employment or socioeconomic impacts (Minnesota Rules, part 4410.2300, subpart G.). Moderate environmental benefits would be realized for fish passage and wetlands (reduced sedimentation occurrences and accumulation). Further reduction in frequency of operation would provide only minor geomorphic benefits. While this alternative would provide incremental environmental benefits, the social benefits are not substantial enough—the staging area footprint is projected to be the same, and mitigation (i.e., buyouts) would still be required. Therefore, it was determined that this alternative offers similar environmental benefits (an incremental benefit) but fails to provide substantially less social impacts. Therefore, the More Flows Through Town Alternative does not present a feasible and prudent alternative.

The analysis of this alternative determines that More Flows Through Town: 1) marginally meets the project purpose; and 2) therefore, is not a feasible or practical alternative to the proposed project. Minnesota Rules, part 4410.2300, subpart G allows for alternatives considered during EIS development to be eliminated from further consideration. Despite the fact that the More Flows Through Town Alternative will not receive full evaluation in the EIS, increasing flows does offer incremental environmental benefits and will be included as a recommended mitigation measure (see Chapter 6).

2.2.1.3.3 Draft EIS Purpose & Need and Alternative Rescreen Report

MNDNR received numerous public comments on the Draft EIS that requested review of previously-screened (Scoping) alternatives, new alternatives or additional combinations of components of previously-screened alternatives. Some commenters offered only general descriptions of alternatives with insufficient detail to allow for evaluation. MNDNR staff attempted to develop reasonable alternatives from what was offered so that an evaluation could occur. In response to these public comments, MNDNR conducted an "Alternative Rescreen Exercise" to help us determine if any alternatives (Previously-Screened/New/Combination) should be reevaluated or newly-evaluated in the Final EIS. MNDNR used information provided by commenters to develop enough detail about a newly-proposed alternative so that they could be evaluated. MNDNR decided to rescreen the Scoping Alternatives alongside the New/Combination alternatives on their ability to achieve FEMA Accreditation to determine if a less impact alternative existed and was subsequently screened out by one of the remaining two Purpose & Need components. All alternatives were then further evaluated in accordance with Minnesota Rules, part 4410.2300, item G (4410.2300, item G) (i.e., significant environmental benefit or substantially less adverse socioeconomic impact over Project). If the Alternative Rescreen Exercise resulted in zero alternatives that were able to meet the most critical component of the P&N (FEMA Accreditation) and the other criteria of 4410.2300, item G, it would indicate that no Previously-Screened, new or combination alternatives should be fully evaluated in the EIS. None of the Scoping Alternatives or the 15 New/Combination Alternatives were able to pass all five steps of the rescreening criteria; therefore, MNDNR determines none of the Previously-Screened/New/Combination Alternatives require further analysis. The Purpose & Need and Alternatives Rescreen Report is included as Final EIS Appendix M.

2.2.2 Project Alternatives Analyzed in the EIS

As a result of the screening analysis, three alternatives have been included in this EIS. These include two No Action Alternatives: the Base No Action Alternative and the No Action Alternative (with Emergency Measures), and the Northern Alignment Alternative. The No Action Alternatives are required to be evaluated by State rules, and are therefore, carried forward to the EIS analysis. The NAA would meet the purpose and need for the Project. These three alternatives are discussed in greater detail below.

2.2.2.1 No Action Alternatives

The No Action Alternatives provide the context for the potential environmental and socioeconomic effects that would occur if the Project is not developed. There are two No Action alternatives considered for the Project: 1) Base No Action Alternative; and 2) No Action Alternative (with Emergency Measures). The Base No Action Alternative includes the potential flood risk reduction impact of already completed and currently funded projects, such as levee construction and property buyouts, and does not include the utilization of emergency measures. The No Action Alternative (with Emergency Measures) is similar to the Base No Action Alternative, but also acknowledges the emergency measures currently being pursued in the project area and assumes that those would continue to be implemented as necessary due to flooding. Emergency measures have lower reliability, higher risk for loss of life than permanent flood risk reduction features and cannot be certified or accredited by the USACE or FEMA, respectively; and so they are being discussed under a second No Action alternative option.

2.2.2.1.1 Existing Conditions

As explained in Section 1.4, FEMA's effective flows are different from what would be used if an updated standard hydrologic analysis were completed and are different from the Expert Opinion Elicitation Panel (EOEP) hydrology being used by the USACE for the Project. At a minimum, the existing-condition 100-year flood flow should be viewed as 33,000 cfs (the updated standard hydrologic analysis value). The USACE's EOEP hydrology indicates the existing-condition 100-year flood flow is 34,700 cfs. The following from the FFREIS provides a summary of the EOEP anticipated flood stages, implementation of emergency measures, and general overview of Flood Damage Reduction (FDR) projects.

As summarized in the FFREIS (USACE 2011a):

> *"Flood impacts in Fargo begin at a stage of about 18 feet, when Elm Street is closed to traffic. The City of Fargo's existing levees have top elevations that vary from a stage of 30 feet to 42 feet, but most reaches are at or below 37 feet. The 2nd Street area near Fargo City Hall begins to flood at a stage of approximately 30 feet. Many places along the line of protection rely on private sandbag levees which begin to be needed at a stage of about 33 feet. Newer developments in the southern part of the F-M urban area have been elevated above the base flood elevation, but city infrastructure (e.g., roads and sewers) is still at risk.*
>
> *Rural areas and developed subdivisions in Cass County, North Dakota are susceptible to flooding from the Sheyenne, Maple, Rush, Lower Rush, Wild Rice and Red Rivers. During the significant 2009 flood of record, many homes north and west of Fargo were surrounded by flood waters. Although most structures in this area were elevated above the flood level and escaped major damage, residents were not able to access their homes for up to six weeks except by boat. The rural road network was damaged by overland flows that washed out portions of roads. Private sandbag levees and emergency clay levees constructed by the USACE protected many areas, but the areas closest to the rivers had significant damage.*
>
> *The West Fargo and Horace to West Fargo diversions of the Sheyenne River Flood Control Project, completed in 1994, prevented breakout flows from the Sheyenne River from flooding Fargo and West Fargo in 1997, 2009 and 2010. While these existing diversions provide significant benefit from Sheyenne River flooding, Horace and West Fargo are vulnerable to flooding from the Red River during events larger than the 100-year flood event.*
>
> *The city of Moorhead sits on relatively higher ground compared to Fargo. At a stage of 31 feet, Moorhead's 1st Avenue North is closed. Homes begin to be threatened at stages of 32 to 35 feet. Most of Moorhead's developed areas are above the FEMA 100-year flood stage, but the 500-year flood floodplain south of I-94 extends east almost to 20th Street South. North of I-94, the 500-year flood floodplain generally extends to east of 14th Street. During flood events larger than a 100-year flood, it is anticipated that I-94 would be inundated, eliminating a major thoroughfare and possible evacuation route. Moorhead has no permanent federal flood risk management project. Most of the land along the river is residential development, and private sandbag levees or other private measures provide most of the line of protection."*

2.2.2.1.2 Flood Damage Reduction Projects

Permanent FDR projects are a key component to both the Base No Action Alternative and the No Action Alternative (with Emergency Measures). Since the 1997 flood, the Cities of Fargo and Moorhead have implemented flood risk reduction measures, including acquisition of floodplain houses, constructing levees and floodwalls, raising and stabilizing existing levees, installing permanent pump stations and improving storm sewer lift stations and the sanitary sewer system. Both Fargo and Moorhead have lists of potential properties along the Red River and in the floodplain that have been identified for purchase and removal from the floodplain. Fargo also has a flood risk management incentive program that provides for a City cost share of up to 75-percent for improvements made by the individual homeowners to reduce their level of flood risk.

Since the historic 2009 flood on the Red River, both the Cities of Fargo and Moorhead have implemented a number of additional flood damage reduction measures, including buyouts of flood-prone properties, construction of permanent levees and floodwalls, and improvements to stormwater facilities. These measures are on-going. When several adjacent properties have been acquired, levees and/or floodwalls are constructed on the properties with the balance of the property typically converted to open space or public park land. Clay County and Cass County have also identified properties for acquisition, removal and remediation that would result in similar land use as Fargo and Moorhead.

In general, floodwalls are being constructed to an elevation of RS 39.5 feet plus 5.5 feet of freeboard. Earthen levees are designed to have a top of protection elevation of RS 39.5 feet plus four feet of freeboard. The proposed levees and floodwalls tie into natural ground at approximately RS 39.5 feet. RS 39.5 feet equates to approximately the FEMA 100-year flood levels as defined in the Digital Flood Insurance Rate Maps (DFIRM) for eastern Cass County, North Dakota dated July 31, 2012, which became effective on January 16, 2015, and the effective DFIRM for Clay County, MN dated April 17, 2012.

FDR projects have been designed for protection at the current, effective FEMA 100-year flood event. Because of the difference between the FEMA hydrology and the EOEP hydrology, some of the FDR projects are at elevations above the EOEP 100-year flood elevation, but do not have sufficient free board and/or tie-in elevations for FEMA accreditation under the EOEP hydrology. This means there could be actual protection, but not accredited protection under the EOEP hydrology (see Appendix N for more discussion on the differences between flood elevations when applying different hydrology methodologies). For the purposes of EIS analysis, non-accredited structures are shown as flooded for the Base No Action Alternative.

FDR projects, such as permanent levees and floodwalls, are being constructed for a number of purposes, including:

- Protection of critical infrastructure.
- Reduction of emergency measures that need to be implemented during flood events.
- Protection that can be certified and accredited by FEMA to remove properties from the current, effective FEMA regulatory 100-year flood floodplain. Both FEMA Regions V and VIII have recently indicated they may require the levees and floodwalls to tie into natural ground at approximately RS 39.5 feet plus three feet of freeboard, which may not allow the existing levees and floodwalls to be accredited by FEMA for either hydrology.
- Interim flood protection.
- USACE certifiable flood protection for the 100-year flood (following construction of the Project).
- Make emergency measures for flood events greater than the 100-year flood following completion of the Project more feasible.

Fargo FDR Projects

Total projected cost for implementing FDR projects (completed, in-progress, and funded for future construction) in the city of Fargo is $187,274,000.

- Table 2.2 provides a summary of completed FDR projects in Fargo and shown on Figures 8 and 9.
- Table 2.3 provides a summary of Fargo FDR projects currently in progress and shown on Figure 9.
- Table 2.4 provides a summary of planned FDR projects as of July 2015 for implementation in Fargo and shown on Figure 9.

Table 2.2 Fargo - Completed Flood Damage Reduction Projects.

Project	Location	Levee River Gage (RG) Height (ft)	Permanent Levee Length (ft)
5229-04	Ridgewood Addition	45	2,825
5601	University Drive South	44	3,750
5747-24	Demolition-Oak Grove, South River Rd, and River Drive South	44	2,200
5747-25	Demolition-Southwood	42.5	1,100
5747-26	Demolition - Oak St, North Terrace, Lindenwood, Southwood	44	350
5747-27	Demolition-Sterling Rose Lane, Rose Creek Parkway, River Vili	-	-
5747-28	Demolition-Mickelson Field, Southwood, 64th Avenue	-	-
5747-29	Demolition - Harwood, 64th Ave	43.5	665
5902	Mickelson Field	43.5	1,000
5903	Drain 27 (South of 52nd Ave S)	43.5	13,648
5904	Drain 53 (South of 52nd Ave S)	43	11,364
5906	South Acres Addition	44	2,400
5909	4th Street Levee Raise	43	3,000
5944	Meadow Creek	44	5,400
5944-03	Meadow Creek Tree Planting	-	-
5946-02	North Oaks	43-44	2,000
5949	Timberline Phase I	44	2,500
5949-03	Timberline Phase II	44	1,850
5951-02	Rose Creek Storm Sewer Lift Station, Earth Levee & Incidentals	44	550
5958-02	Rose Creek Phase 1	43	1,550
6002-02	Fargo Country Club/Southwood	43.5	3,200
6024	Lindenwood Park	44	1,900

Project	Location	Levee River Gage (RG) Height (ft)	Permanent Levee Length (ft)
6030	Lemke Park	44	900
6031	Riverview Place, Oakcreek & Coulees Crossing	44	900
6031	Additional Site - Coulees Crossing Extension	44	500
6032	Various Locations - Drain 27	44	6,450
6042	Ulteig/Fleet Farm Area - Drain 27	44	2,900
6043-02	River Vili - Phase I	43.5	1,850
6058	El Zagal Storm Sewer (STS) Lift Station (LS)	-	-
6172-01	Oakcreek & Harwood Demos	-	-
6172-02	Oakcreek Demos/Temporary Levee	-	-
	Total Levee Length		**74,752**

Source: City of Fargo, as of June 2014. Some changes to projects and/or status have occurred since June 2014.

Table 2.3 Fargo – Construction-In-Progress Flood Damage Reduction Projects

Project	Location	Levee RG Height (ft)	Permanent Levee Length (ft)
5958-03	Rose Creek - Phase 2	45	2,050
5902-02	Mickelson Field	44	1,550
6172-03	Home Demos (Harwood, Hackberry, Woodcrest, Oak Grove, Belmont)	Structure Removal	-
6234	Drain 53 (South of 64th Ave) & 64th Ave Borrow Pit	44	4,200
FM-14-01	4th Street Levee (Misc. Encroachments, NSP Gatewells)	43	Existing
FM-14-02	4th Street Levee (Earth Levee Relocation, Floodwall construction)	44	510
FM-14-21	River Vili (Earth Levee, STS Lift Station Relocation)	44	500
HD-14-01	Woodcrest, South River Rd, Copperfield, Rosewood (Home Demos)	Structure Removal	-
HD-14-11	Hackberry & River Drive (Home Demos)	Structure Removal	-
HD-14-21	River Drive (Home Demos)	Structure Removal	-
	Total Levee Length		**8,810**

Source: City of Fargo, June 2014. Some changes to projects and/or status have occurred since June 2014.

Table 2.4 Fargo – Planned Flood Damage Reduction Projects

Project	Location	Levee RG Height (ft)	Permanent Levee Length (ft)
6260	4th Street Pump Station and 2nd Street S. Wall (Main Ave. to 4th St. S.) & STS #18 & #19 Reconstruction – Phase 1	45	430
FM-14-11	Coulees Crossing, Oakcreek, Copperfield (Earth Levee Construction)	44	2,000
FM-14-31	2nd Street N (NP Ave to 6th Ave N) - Floodwall, Street Relocation, and Pump Station	45	2,000
FM-14-41	Harwood, Hackberry, River Dr (Earth Levee, STS Lift Station Construction)	44	3,600
FM-14-51	El Zagal Bowl (Earth Levee, Floodwall, Utility Relocations, Property Buyouts)	44	3,200
FM-14-61	Drain 27 (40th Ave to I-29) - Earth Levee, Floodwall	44	1,000
FM-14-71	Drain 27 (I-29 to 42nd St) - Earth Levee, Floodwall	44	1,900
HD-14-31	Prairie Rose, Rosewood	Structure Removal	-
HD-14-41	Rosewood, Oakcreek, Hackberry, Southwood	Structure Removal	-
6260	2nd Street S (Main Ave to 4th St. S) & STS #18 & #19 Reconstruction – Phase 2	44	900
FM-14-03	4th Street Levee Phase 3	44	900
FM-14-12	Oakcreek & Copperfield – Phase 2	44	1,700
FM-14-32	2nd Street N (NP Ave to 6th Ave N)	45	2,000
FM-14-52	El Zagal Bowl – Phase 2	44	700
FM-14-62	Drain 27 (40th Ave to I-29) – Phase 2	44	3,700
FM-14-72	Drain 27 (I-29 to 42nd St) – Phase 2	44	650
	Total Levee Length		**21,780**

Source: City of Fargo, June 2014. Some changes to projects and/or status have occurred since June 2014.

Moorhead Flood Damage Reduction Projects

Total projected cost for implementing FDR projects (completed, in-progress, and funded for future construction) in the city of Moorhead is $137,281,000.

- Table 2.5 provides a summary of completed FDR projects in Moorhead, which are shown on Figure 10.

- Table 2.6 provides a summary of Moorhead FDR projects currently in progress and shown on Figure 10.
- Table 2.7 provides a summary of planned FDR projects that are funded for future implementation in Moorhead and shown on Figure 10.

Table 2.5 Moorhead – Completed Flood Damage Reduction Projects

Project	Project Name	Levee Height (ft)	Permanent Levee, Floodwall, and/or Road Raise Length (ft)
09-A13-02A Phase 1	27th Ave N Levee - Phase 1	44	450
09-A13-02A Phase 1	Voll Park Contingency Levee	44	415
09-A13-02A Phase 2	27th Ave N Levee - Phase 2	44	1,430
09-A13-02B Phase 1	River Haven Road: 46th - 50th Ave S (Contingency Levee)	44	2,475
09-A13-02B Phase 2	River Haven Road: 40th - 43rd Ave S Road Raise & Floodwall	44/45	1,970
09-A13-02C	Horn Park Levee	44	2,380
09-A13-02D	Woodlawn Park South Levee	44	375
09-A13-02D	Woodlawn Park Levee & Road Raise	44	1,350
09-A13-02E	Caddy/18th Ave N Area Levee: 900 Block of 18th Ave Circle N	44	390
09-A13-02E	Caddy/18th Ave N Area Levee: 18th Ave N & Cart Path (Contingency Levee)	44	1,990
09-A13-02G	Hjemkomst Area: Hjemkomst & Parkview Terrace Levees & 1st Ave N Road Closure Structure	44/45	1,305
09-A13-02I Phase 1	Horn Park Floodwall & Road Closure Structure	45	380
09-A13-02I Phase 2	Brookdale Levee: 4th St S & Rivershore Dr Levee & 22nd Ave S road raise	44	3,470
09-A5-01H&I	I-94 Right-of-Way (ROW) Floodwall & Levee	44/45	237
09-A5-02B Phase 1	Public Works Yard Levee: 700 15th Ave N	44	790
09-A5-02B Phase 4	The Saddle - Phase 1	44	280
09-A5-02B Phase 4	2900 Block of Rivershore Dr Levee	44	180
09-A5-02B Phase 4	Davy Park Levee: 1st Ave & 8th St N	44	600
09-A5-02B Phase 4	Public Housing High Rise - Middle Levee	44	380
09-A5-02B Phase 4	7th St Levee	44	360
09-A5-02B Phase 4	Bridgeview Levee - Phase 1	44	460
09-A5-02B Phase 4	15th Ave North/St Francis De Sales Levee	44	760
09-A6-02A	Woodlawn Lift Station	43.5	280
11-13-02	Bluestem Levee	44	3,700
11-13-03	Rivers Edge Levee	44	1,000
11-A13-02B	Rivershore Drive Floodwall & Road Closure Structure	44.5	204

Project	Project Name	Levee Height (ft)	Permanent Levee, Floodwall, and/or Road Raise Length (ft)
11-A13-02B	Public Housing High Rise - South Levee	44	200
11-A13-02B	Public Housing High Rise - North Levee	44	230
11-A13-02D	River Haven Road Levee: 43rd - 46th Ave S	44	1,600
11-A13-02E	River Oak Circle	44	450
11-A13-02I	43rd Ave N Road Raise	44	1,400
11-A13-03A	Project A Levee	44	4,830
11-A13-03B	Project B	44/45	1,800
11-A13-03C Phase 1	Project C	44	650
11-A13-03C Phase 1	Project C	44	1,200
11-A13-03C Phase 2	Project C - Phase 2	45	575
11-A13-03F1	Project F1	44	3,560

Source: City Moorhead, June 2014. Some changes to projects and/or status have occurred since June 2014.

Table 2.6 Moorhead – In-Progress Flood Damage Reduction Projects.

Project	Project Name	Levee Height (ft)	Permanent Levee, Floodwall, and/or Road Raise Length (ft)
11-A13-02H	50th Ave S Levee - South Levee	44	8,300
11-A13-02H	50th Ave S Levee - NW & NE Levee	44	4,100

Source: City Moorhead, June 2014. Some changes to projects and/or status have occurred since June 2014.

Table 2.7 Moorhead – Funded Future Flood Damage Reduction Projects

Project	Project Name	Levee Height (ft)	Permanent Levee, Floodwall, and/or Road Raise Length (ft)
TBD	Tessa Terrace	44	930
TBD	The Saddle - Phase 2	44	200
11-A13-03D&E	Project D & E	44	3,137
TBD	Elm Street: 600 block	44/45	270
TBD	4th St Levee: 3rd to 5th Ave S	44	481
TBD	2nd Ave S Road Closure	44/45	206
11-A13-05	7th St N Cul-de-sac Road Raise	44	218
11-A13-05	15th Ave Road Raise	44	50
N/A	Crystal Creek Levee	42.5	3,079
N/A	Oakport Protection - Phase 3A - Brentwood Levee north	44	1,200
N/A	Oakport Protection - Phase 3B - Brentwood Levee, west, east & south	44	7,000
N/A	Oakport Protection - Phase 3C - Wall St & Oakport St road raises	44	4,100
N/A	Oakport Protection - Phase 1A - South Levee (west of coulee)	44	5,000

Project	Project Name	Levee Height (ft)	Permanent Levee, Floodwall, and/or Road Raise Length (ft)
N/A	Oakport Protection - Phase 1B - East Levee (west side of coulee)	44	5,400
N/A	Oakport Projection - Phase 2 - 70th Ave N/CR 93 Road Raise	44	4,500
N/A	Oakport Protection Phase 4 - Broadway St NW road raise/levee*	44	8,900

Source: City of Moorhead, June 2014. Some changes to projects and/or status have occurred since June 2014.

2.2.2.1.3 Base No Action Alternative

The Base No Action Alternative includes the potential flood risk reduction impact of already completed and currently funded permanent projects such as levee construction (i.e., structural measures) and property buyouts (i.e., non-structural measures). The FDR projects presented in the tables above for Fargo and Moorhead are the specific projects included in this alternative. This alternative does not include emergency measures currently pursued in the project area as necessary due to flooding, and therefore, the Base No Action Alternative would have flooding where the water level exceeds the tie-in of levees to natural ground.

Figure 11 illustrates the current areas of flooding in the F-M area during the 100-year flood. Within this area the 100-year flood causes approximately 170,000 acres of inundation. The extent of flooding illustrated on the figure represents currently constructed FDR projects as well as currently funded permanent projects. As shown on Figure 11, flooding during the 100-year flood would flow around the levees where the water level exceeds the tie-in elevations to natural ground.

2.2.2.1.4 No Action Alternative (with Emergency Measures)

The No Action Alternative (with Emergency Measures) includes the potential flood risk reduction impact of already completed and currently funded FDR projects presented in the Tables 2.2 through 2.7 for Fargo and Moorhead. This alternative also assumes that emergency measures similar to those that have been historically implemented in the project area would continue to be implemented as necessary due to flooding.

Winter snowfall and precipitation can be monitored to predict potential levels of spring runoff that influence flooding and flood levels. Flood crest elevations are predicted in the F-M area by the National Weather Service in order to provide as much time as possible to implement emergency measures. The higher the flood crest elevation, the more time and effort it would take to construct emergency measures. Both Fargo and Moorhead, as well as Cass County have flood emergency plans in place outlining the implementation steps, emergency measures, and the locations for each of the measures. These emergency measures may include temporarily raising permanent levees, constructing temporary levees and other temporary flood barriers in various areas, and sandbagging.

Emergency measures are intended to temporarily protect specific areas from flooding that do not have permanent FDR projects in place or enhance existing FDR projects, where there are gaps in levee protection between each of the individual FDR projects, for example. Where gaps in FDR project protection exist, a temporary levee may be constructed to tie into existing levees to reduce flood risk from occurring behind the levee or overtopping an existing levee. Implementation of emergency measures could result in upstream stage increases larger than those under full levee protection for the Base No Action Alternative. Figure 12 shows the extent of flooding in the project area under the No Action Alternative (with Emergency Measures). This alternative would reduce flood risk in some areas not protected under the Base No Action Alternative, while increasing flooding in other areas upstream, as shown on Figure 12.

The locations of each type of emergency measure are mapped with instructions for implementation at various times and stages of flooding. Emergency measures in the F-M urban area require significant financial and human resources. During past large flood events, such as the 2009 flood, 80 miles of temporary emergency levees were constructed, requiring more than seven million sandbags and thousands of volunteers.

Several factors have made the probability of having consistently successful emergency efforts in the future low, especially for flooding events larger than the 100-year flood. These factors include variable and extreme temperatures and weather conditions during March and April when flooding typically occurs. These conditions also complicate flood crest predictions and time needed for emergency measures implementation. Construction of emergency measures typically occurs on frozen ground using frozen materials, which adds to greater difficulty and risk to implement. Additionally, due to successful emergency measures in the past, there is a perceived sense of security that may not reflect the true flood risk in the area. This has led to people staying to fight the flood rather than evacuate, which puts a greater number of people at risk if the emergency measures suddenly fail, especially during the 100-year flood.

2.2.2.2 Northern Alignment Alternative

The following provides details on the NAA that differ from the Project. Components of the NAA and the Project that are the same should be reviewed for details in the description for the Project. From upstream to downstream, the NAA includes a staging area, including the OHB ring levee, overflow embankment, tieback embankment, Red River and Wild Rice River control structures, connecting channel, diversion inlet control structure, diversion channel, Maple River and Sheyenne River aqueducts, floodwalls and in-town levees, Lower Rush River and Rush River rock ramps, diversion channel inlet structures, and diversion outlet control structure. The NAA tieback embankment and connecting channel would be located approximately 1.5 miles north of the Project tieback embankment and connecting channel proposed location. The southern boundary of the NAA staging area is between approximately 1.5 miles and three miles north of the Project staging area southern boundary (Figure 7). Therefore, direct impacts due to construction and indirect impacts due to construction and Project operation (i.e., inundation) would be shifted north. NAA operation would be similar; therefore the depth and duration of flooding of the current 100-year flood within the project area would increase upstream of the tieback embankment. It is estimated that 15,000 acres of land that does not currently receive flood waters would be newly inundated within and beyond the boundaries of the staging area.

2.2.2.2.1 Dam

The NAA dam would be similar to the features described for the Project as it would consist of the embankments and associated control structures.

2.2.2.2.2 Red River and Wild Rice River Control Structures

A gated control structure would be constructed adjacent to the Red River in Kurtz Township (Clay County), Minnesota. A similar control structure would be constructed adjacent to the Wild Rice River in Stanley Township, Cass County, North Dakota. The structures would be constructed adjacent to the existing channels in order to keep the sites dry during construction. The remaining features of the Red River and Wild Rice River hydraulic control structures would be the same as those described for the Project.

2.2.2.2.3 Connecting Channel

The connecting channel would be designed the same as described for the Project.

2.2.2.2.4 Diversion Inlet Control Structure

The diversion inlet control structure for the NAA would be designed the same as described for the Project.

2.2.2.2.5 Staging Area

The staging area would be shifted north approximately 1.5 miles from the Project's proposed tieback embankment and connecting channel locations. The southern boundary of the NAA staging area is between approximately 1.5 miles and three miles north of the Project staging area southern boundary (Figure 7). In order to nearly eliminate downstream impacts, approximately 225,000 acre-feet of storage (approximately an additional 150,000 acre-feet is required upstream of the dam and diversion channel inlet control structure. The Red River and Wild Rice River control structures would be operated to raise water surface elevations to approximately 919.3 feet at the diversion inlet for all events up to a 500-year flood. The remaining features of the staging area would be the same as those described for the Project.

2.2.2.2.6 Diversion Channel

The diversion channel features for the NAA are the same as those described for the Project.

2.2.2.2.7 Maple River and Sheyenne River Aqueducts

The Maple River and Sheyenne River aqueducts for the NAA are the same as those described for the Project.

2.2.2.2.8 Lower Rush River and Rush River Rock Ramps

The Lower Rush River and Rush River spillways for the NAA are the same as those described for the Project.

2.2.2.2.9 Inlets, Ditches, and Smaller Hydraulic Structures

The inlets, ditches and smaller hydraulic structures for the NAA are the same as those described for the Project.

2.2.2.2.10 Oxbow/Hickson/Bakke Ring Levee

The OHB ring levee for the NAA is the same as described for the Project.

2.2.2.2.11 Comstock Ring Levee

The community of Comstock, Minnesota is located near the NAA inundation area; however, the community would not be impacted directly so a ring levee is not included as part of the NAA. The lagoons for the community are located in the NAA inundation area and may require mitigation.

2.2.2.2.12 Northern Alignment Alternative Operation

Operation of the NAA would be similar to the Project with the exception of the upstream staging elevation. A maximum stage of 35.0 feet would be maintained at the Fargo gage until the upstream staging elevation reaches 919.3 feet, which is anticipated to occur with the 100-year flood event. The remaining NAA operational details would be the similar as those described for the Project.

2.2.2.2.13 Floodwalls and In-Town Levees

The floodwalls and in-town levees for the NAA would the same as those described for the Project.

2.2.2.2.14 Non-structural Features

The non-structural features associated with the NAA are the same as those described for the Project except that different properties would be affected due to the staging area shift to the north approximately 1.5 miles.

2.2.2.2.15 Recreation Features

The conceptual recreation plan for the NAA is the same as those described for the Project.

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3.0 Affected Environment and Environmental Consequences

The Affected Environment and Environmental Consequences Chapter evaluates the following topics: Section 3.1 Hydrology and Hydraulics, Section 3.2 FEMA Regulations and the Conditional Letter of Map Revision (CLOMR) Process, Section 3.3 Stream Stability, Section 3.4 Wetlands, Section 3.5 Cold Weather Impacts on Aqueduct Function and Biotics, Section 3.6 Cover Types, Section 3.7 Potential Environmental Hazards, Section 3.8 Fish Passage and Biological Connectivity, Section 3.9 Wildlife and Wildlife Habitat, Section 3.10 State Listed Species and Special Status Species, Section 3.11 Invasive Species, Section 3.12 Cultural Resources, Section 3.13 Infrastructure and Public Services, Section 3.14 Land Use Plans and Regulations, 3.15 Minnesota Dam Safety and Work in Public Waters Regulations and Permitting, and Section 3.16 Socioeconomics.

3.1 HYDROLOGY AND HYDRAULICS

Due to the nature of the Project, hydrologic and hydraulic (H and H) analysis is a key component for evaluation as it forms a basis for Project design. Hydrology refers to the rainfall and resulting runoff as it applies to flood events. It is used to estimate flood flow rates, typically through stream gage analysis, rainfall-runoff models, or a combination of the two. Hydraulics is the study of water flow. In floodplain management, hydraulics refers to determination of the flood depth and area flooded. Hydraulics also encompasses the flow characteristics around and through control structures such as bridges, culverts, and weirs (IDNR 2002).

This section discusses the H and H Phase 7 analyses completed for the Project. The USACE, along with the Diversion Authority and its consultants have completed comprehensive H and H modeling.

3.1.1 Affected Environment

The cities of Fargo and Moorhead are located along the Red River (Red River) that flows north, discharging into Lake Winnipeg in Manitoba, Canada. The Red River and its associated floodplain carry water from the entire Red River basin (i.e., Red River and its tributaries) to Hudson Bay. The floodplain is an important natural resource for water conveyance and water storage. Figure 1 shows the location and general layout of the Fargo-Moorhead (F-M) area. There are six primary rivers and tributaries that connect in the vicinity of the F-M urban area. This includes the Wild Rice River, which flows into the Red River upstream of the F-M urban area. Flowing into the Sheyenne River on the west side of the project area, the Maple, Lower Rush, and Rush Rivers connect with each other downstream of the F-M urban area, where the Sheyenne River eventually flows into the Red River (Figure 1). The Buffalo River is also in the project area, and is located within the Benefited Area downstream of the Project.

In general, when water flow within a river channel exceeds its capacity, or banks, flooding occurs to surrounding areas (i.e., floodplain). Flow capacity of a river is dependent on its channel shape and size, which is constantly changing over time. Increased water flow can occur from a number of factors, but in the Midwest, it primarily occurs due to precipitation. The location, quantity, and amount of time over which precipitation occurs influences the ability of a river channel to handle water flow before exceeding its capacity and flooding into adjacent areas. The F-M area has a long history of flooding due to the unique hydrology of the area. The geographic characteristics of the area and the large watershed draining through the Red River contribute to the higher flood risk for the F-M area. There are four main factors that contribute to flooding of the Red River: synchrony of discharge with spring thaw, ice jams, glacial lake plain, and decrease in gradient. As the Red River flows north, timing of the spring melt has an impact on flooding as the upstream watersheds start melting earlier in the spring and flow downstream into portions of the river that can remain frozen later into the season. This causes water to back up a long distance upstream due to the shallow slope of the Red River. Additionally, the spring thaw cycle also contributes to the potential for ice jams as the ice is not fully melted in the northern portions of the watershed, resulting in damming water flow. A major portion of the upper watershed of the Red River lies within the former bed of Glacial Lake Agassiz. As a result, the watershed and rivers have little slope with shallow meandering channels, which cannot handle much increased water flow capacity before flooding its banks. The flat topography also contributes to the gradient, or slope, of the river, which results in pooling of water during floods due to lack of slope. Additionally, three large rivers, the Red River, the Wild Rice River, and the Sheyenne River, converge in the F-M area and contribute to extensive flooding. Also contributing to this flooding are the three tributaries of the Sheyenne River, the Maple, Rush and Lower Rush Rivers, which converge with the Sheyenne River immediately northwest of Fargo. The Red River basin, including the adjacent floodplain in the project area, has been altered by past land use activities (e.g., floodplain development, drainage, and changes to cover types), which has resulted in changes to the historic natural flow and hydrologic regime of the Red River and contributed to flooding in the area. Flood flows and associated stages along these rivers through the F-M area would be affected by the Project.

The Red River has exceeded flood stage approximately half of the years during the past century. The recent past has seen a higher frequency of large flood events with 2009 being a record setting year with a flood stage of 40.8 feet at the United States Geological Survey (USGS) Fargo stream gage.

3.1.1.1 Hydrologic and Hydraulic Evaluation for Project Design

Official estimates vary for the 100-year flood flow and stage. With the revised Clay County Flood Insurance Study (FIS) in 2012 and Cass County FIS in 2015, Federal Emergency Management Agency (FEMA) has raised their 100-year flood stage from 38.3 to 39.3 feet. FEMA continues to use a 100-year flow of 29,300 cubic feet per second (cfs) based on hydrology that dates back to the 1970s. An updated standard hydrologic analysis would increase the 100-year flow from 29,300 cfs to 33,000 cfs, which would increase the 100-yr flood stage to something between 40.7 feet and about 41.5 feet, the exact value depending on levee effectiveness and a more detailed analysis than has been completed to date for a flow of 33,000 cfs.

The USACE went beyond a standard hydrologic analysis by engaging a panel of experts (Expert Opinion Elicitation Panel (EOEP)) in hydrology and climate change to discuss flooding trends in the Red River basin. The EOEP concluded that the hydrologic record showed a “dry” period in the early decades of the 20th century and a “wet” period in later years continuing to the present. The EOEP use of the terms “wet cycle” and “dry cycle” are not intended to imply wet or dry climatic conditions. Rather, the EOEP used those terms to identify periods of generally lower and higher river flows. The EOEP did not reach any conclusion about why flows on the Red River at Fargo have been higher since the 1940s. Flood discharge frequency data (e.g., the 100-year flood discharge) are based on statistical analyses of historical gage station records when those data are available – not precipitation data. The EOEP recommended developing revised flow frequency curves separately for the dry and wet periods that resulted in a 100-year flood flow of 34,700 cfs instead of the 33,000 cfs value that would have been used without the EOEP input. While the EOEP recommendations result in a larger 100-year flood flow, they result in a lower 500-year flood flow (61,700 cfs EOEP vs. 66,000 cfs using a standard updated hydrologic analysis). Both of these flows are greater than the 500-year flood flow of 50,000 cfs being used by FEMA.

Appendix N reviews and discusses the possible hydrology methodologies to determine which methodology would be appropriate to use (i.e., FEMA, updated period of record, EOEP) for the Project. The MNDNR utilized the recommendations of the EOEP in this EIS. Unless mentioned otherwise, all discussions in this EIS use EOEP hydrology. Similarly, all elevations are relative to North American Vertical Datum of 1988 (NAVD 88), unless noted.

The hydraulic modeling (assessment of flood stages) continues to be improved as the complicated flow conditions in the flat Red River floodplain are studied and then captured in the models. The flood insurance models were used at the time of the economic analysis, resulting in a 100-year flood stage of 42.4 feet. The current hydraulic modeling indicates that the 100-year flood stage is 42.1 feet with levees and 40.9 feet without levees providing protection for the F-M Area (Supplemental EA, Appendix D, Table 4). The following table (Table 3.1, below) is a subset of Table 4 from Appendix D of the USACE Supplemental EA. This table shows the flow and stage information used by FEMA and USACE and estimates of stages that would be used if the USACE simply used an updated standard hydrologic analysis (period of record hydrologic analysis) for the flows.

Table 3.1 Peak Flow and Stage Data - USGS Gage 05054000 Red River at Fargo, ND

Event	Discharge (cfs) at USGS Gage at Fargo, ND	Stage (feet (ft)) at USGS Gage at Fargo, ND[1]
10-year FEMA	10,300	29.5
10-year Updated Period of Record	13,865	32.5
10-year USACE EOEP (Wet)	17,000	35.0
50-year FEMA	22,300	36.6
50-year Updated Period of Record	26,000	39.5
50-year USACE EOEP (Wet)	29,300	40.4
100-year FEMA	29,300	39.3
100-year Updated Period of Record	33,000	41.3
100-year USACE EOEP (Wet)	34,700	42.1
500-year FEMA	50,000	43.5
500-year Updated Period of Record	66,000	46.5
500-year USACE EOEP (Wet)	61,700	46.3

[1] Stages are dependent: 1) FEMA data are from the Clay County Flood Insurance Study, April 17, 2012; 2) USACE stages are from the current existing-condition-with-full-protection unsteady Hydrologic Engineering Center River Analysis System (HEC-RAS) model – Phase 7.0 Environmental Assessment (EA) results (2013); 3) Flood stage is 18 feet when minor flooding begins (National Weather Service).

The hydrologic analyses also made use of watershed-wide gage data and detailed Hydrologic Engineering Center Hydrologic Modeling System (HEC-HMS) models that were created for each of the contributing watersheds. These models include all of the major rivers and local drains that are tributaries to the Red River starting from the upper end at Lake Traverse, to the city of Drayton, North Dakota, at the downstream end.

The hydraulic analysis was a Hydrologic Engineering Center River Analysis System HEC-RAS unsteady flow model calibrated to the 2009 Flood, and verified by comparing the results to the 1997, 2006, 2010, and 2011 events, as summarized in Table 3.2, using discharge and stage hydrographs and high water marks.

Table 3.2 Historic Flood Events – USGS Gage 05054000 Red River at Fargo, ND

Event	Discharge (cfs) at USGS Gage at Fargo, ND	Stage (ft) at USGS Gage at Fargo, ND
1997 Historic	28,000	39.7
2006 Historic	19,900	37.1
2009 Historic	29,500	40.8
2010 Historic	21,200	37.0
2011 Historic	27,200	38.8

Source: USGS recorded data

A brief summary and adequacy review of the H and H modeling analyses as currently completed for the Project is provided below. It does not constitute a detailed review or quality assurance of the H and H models. As the models are very complex, it is not practical to conduct an independent review of all associated elements. A discussion on review of information provided by the H and H models and other methods of analysis is also included.

The models were built by a team of consultants and USACE staff to allow for continual checks and balances during model development and refinement. The models are subjected to continual refinement as additional information is obtained. For example, the domain of the HEC-RAS model was extended downstream because initial results indicated greater than anticipated adverse downstream impacts from the diversion and an increased model extent was needed to better define these impacts. The latest updates, referred to as the Phase 7 model updates, reflect the alignment alternative selected based on the Value Engineering Option 13 A (HMG, 2012) and include gates at the inlet control structures to the diversion channel as well as in-town protection to the 35-foot stage.

The Adequacy of Hydrology and Hydraulic Modeling Completed for the Fargo-Moorhead Flood Risk Management Project, provided in Appendix E (Wenck, 2014), includes a summary of all the updates that have been completed for the models since the Phase 4 updates, which are the earliest published modeling results. Appendix B of the Project Study Phase 4 Report (HMG, 2011) includes detailed descriptions of the model development at Phase 4 including changes made to incorporate floodplain storage, upstream staging, and downstream impacts using the unsteady state HEC-RAS models. A list of the current documents that were reviewed to evaluate the hydrology and hydraulics of the Project are provided in Appendix E (Wenck, 2014).

Along with the above summary of modeling completed, the following are the considerations regarding the adequacy of H and H modeling as it relates to the EIS and the appropriate level of review of available data:

- The level of detail and extent of the models completed for the Project are appropriate.
- The types of models used are appropriate for the purpose of the analysis and use of results generated.
- The use of area specific H and H models by Diversion Authority and local watershed districts for various localized analysis projects, indicates independent review of the models.
- The calibration of the model to different datasets and different runoff conditions, suggests that the level of detail and underlying assumptions are adequate and appropriate.

3.1.1.1.1 Accuracy of Modeling Results and Available Information

This analysis is dependent on available information provided by others such as the Diversion Authority, USACE, and Red River Basin Commission (RRBC). The first step of the Quality Assurance/Quality Control (QA/QC) process begins with the Diversion Authority or USACE as they are the source of the technical data and information. As this information is being provided by professional engineers and scientists, it is reasonable to assume that the information that is transmitted and available has gone through a QA/QC process specific to the Project and meets the standard of care appropriate for this Project. The USACE QC guidelines for civil projects along with the project specific QC guide are included in Appendix E (Wenck, 2014).

The following list of documents found in the Final Feasibility Report Environmental Impact Statement (FFREIS) (located at http://www.fmdiversion.com/eis.php) lists the QA/QC steps that have been followed during the development and refinement of the model:

- Appendix B, Section B.3.0
- Attachment 5 (Consultant's Report), Appendix B (Section B6.0 and Exhibit H).
- Attachment 5 (Consultant's Report), Appendix C (Section 2.15 and Exhibit 5).

The model is based on a number of modeling decisions and assumptions; these assumptions can have a measurable impact on the results. To better understand the key assumptions as they relate to the Project and Project alternatives, an additional layer of review of the model was completed as part of the this EIS process, by MNDNR Hydrologist and Wenck Associates, Incorporated (see Appendix E). The focus of this review is on the Red River HEC-RAS unsteady flow model(s). This model extends from Abercrombie, North Dakota to Grand Forks, North Dakota and includes the main stem, major and minor tributaries, lateral inflow, and hundreds of interconnected storage areas. This complex model was developed, calibrated, and refined over a period of several years.

An overall review of the model structure was completed for components that define the Project and two No Action alternatives. Only the portion of the model in the immediate vicinity of the F-M urban area was reviewed. A detailed examination of the HEC-RAS model was not completed (e.g., checking specific cross sections or the stage-volume curves for individual storage areas).

<u>Overall Model Review</u>

The model output was compared against a spreadsheet provided by Houston-Moore Group, the design consultant for the Diversion Authority – “MNEIS HEC-RAS Profiles_201-40307” and the plotted water surface profiles. An exact match was found that indicated the tabulated results were generated by the provided models.

Due to the complexity and magnitude of the model, selected data and locations were verified rather than verifying the entire model. A cursory review of selected boundary conditions (inflow hydrographs) was completed and no issues were identified. Several stream confluences were checked to verify the computed downstream flows were found to be reasonably consistent with the flows upstream of the confluence.

While reviewing the overall model structure, numerous cross sections and computed water surface profiles were plotted by Wenck Associates, Incorporated. No potential coding errors with the model setup or results were identified.

Floodplain Modeling Using Storage Areas

The Red River HEC-RAS model makes extensive use of lateral structures. This model component, in large part, defines how the various versions of this model represent the Project and the No Action alternatives.

Along the rivers and tributaries, the HEC-RAS cross sections reflect the main flow path of the channel and immediate overbank area. The connection between the channel and the broader floodplain is generally defined in this Red River HEC-RAS model by lateral structures. Lateral structures are typically represented by a combination of weirs and culverts. Placement of the lateral structures is a modeling decision; typically they are placed on top of roads or along the ground near the extent of the assumed effective flow area. While the top elevation of a lateral structure in HEC-RAS is defined by a feature called a weir/embankment, it does not necessarily mean the actual feature on the landscape is a road, levee, or floodwall; sometimes the weir/embankment simply defines the highest controlling ground along that reach of the river.

If, at a given point in time during a simulation, the computed river stage at a given cross section is higher than the associated lateral structure's weir/embankment, flow is computed across that lateral structure into the adjacent storage area (assuming the water surface elevation in that storage area is also lower than the level in the river). Once the flood peak has passed, water can drain back into the river across that same lateral structure. Flow between and/or among the adjacent storage areas is also controlled by weirs and/or culverts in a similar manner. This use of channels, lateral structures, and storage areas provides a reasonably realistic depiction of the very complex flow dynamics of the Red River and its broad floodplain. The model should accurately account for a given volume of water leaving the channel and entering an adjacent storage area; that volume of water may then traverse several more storage areas before re-entering the river many miles downstream.

These lateral structures were used along the entire reach of the Red and Sheyenne Rivers as well as the smaller waterways within the F-M urban area for the No Action Alternative model runs. Two No Action alternative models were developed for this EIS: the Base No Action Alternative and the No Action Alternative (with Emergency Measures), which incorporate the actual height of existing and planned flood control measures, providing for an improved estimate of flood inundation areas and depths for the no action alternatives. The Base No Action Alternative includes existing and planned (currently funded) levees in the city of Fargo and the city of Moorhead. The gaps in the levees are left open and are modeled as lateral structures to account for flow passing between the levee segments during larger flood events. The No Action Alternative (with Emergency Measures) includes the existing and planned (currently funded) levees, along with emergency measures that follow the 2009 flood protection filling the gaps between the permanent levees.

Project HEC-RAS Model Review

The key elements of the Project were incorporated into the HEC-RAS model, including the control structures on the Red River and Wild Rice River, the diversion channel and its inlet control structure, the aqueducts on the Sheyenne and Maple Rivers, and the connections with the North Dakota tributaries.

The three control structures have operable features, but designs for the control structures have not been finalized, which would better define how the three control structures would operate over a wide range of possible flood scenarios. For this modeling exercise, the operation appears to match the general description of how the Project would function.

Distributed Alternative HEC-RAS Model Review

The Distributed Storage Alternative (DSA) is a combination of distributed Red River basin storage sites upstream of Halstad, Minnesota, and an in-town levee plan for flood protection of the F-M urban area. The distributed storage component of the DSA relies on the recent Halstad Upstream Retention Study (HUR) completed by the Red River Basin Commission in December 2013. The HUR identified 96 specific retention sites throughout the basin to achieve a 20-percent flow reduction on the Red River. The in-town levee component of the DSA relies on a maximum levee protection plan that was developed by the USACE.

The HUR study made extensive use of the existing HEC-HMS hydrologic models for the major river tributaries and the HEC-RAS unsteady flow model for the Red River. A separate model, based on the Project model, was developed for the DSA. Model refinements and methodology are documented in the RRBC's final report.

Northern Alignment Alternative HEC-RAS Model Review

A separate model, based on the Project model, was developed for the Northern Alignment Alternative. The Red River control structure and tieback embankment were moved downstream in the model approximately 1.5 miles. The associated connecting channel and its control structure were also added to this model. As with the Project model, the top elevation of the lateral structures along the Red River is based on a 44-foot gage height water surface profile.

Accuracy Assessment

Based on the USACE QA/QC procedure used for development and analysis of information for the Project, there is a reasonable level of confidence that the information included in this EIS is valid and accurate. Overall, the extent and completeness of the H and H information available and provided for the Project is significant. Project elements have changed since some of the reports and information were developed and have continued to change during the environmental review process, creating the need to review the data for relevancy and apply the relevant information to the current Project design or to answer questions that come up during environmental review. Appropriate QA/QC procedures are followed and documented as new data and information is generated to further ensure data quality as the Project design changes or is further refined.

Therefore, it is reasonable to conclude that the H and H models developed for the Project are adequate and appropriate to evaluate the Project. It is important to note this assessment is based on a general, high-level review of the HEC-RAS models and their boundary conditions, by qualified RGU hydrologists, along with review of available reports about the Project.

3.1.2 Environmental Consequences

The Project would affect flood flows and river stages on the Red River and its tributaries throughout the F-M area. Red River peak flows were used to evaluate the majority of the impacts associated with the Project and are illustrated on the figures for the EIS. Detailed discussions of H and H impacts from Project operation, the Base No Action Alternative, the No Action Alternative (with Emergency Measures), and Northern Alignment Alternative (NAA) are provided below.

3.1.2.1 Proposed Project

Operation of the Project would occur when it becomes known that a stage of 35.0 feet would be exceeded at the USGS gage in Fargo (the Fargo gage). At this stage, the flow through Fargo would be approximately 17,000 cfs. A flow of 17,000 cfs at the Fargo gage is approximately a 10-year flood (10-percent chance flood). Operation begins by partially closing the gates at the Red River and Wild Rice River hydraulic control structures. Once the gates are partially closed (i.e., partially lowered), water would begin to accumulate upstream of the control structures. Water would not be released through the diversion inlet control structure gates until the Red River and Wild Rice River control structures are partially closed and only after the initial diversion tributary (Sheyenne River, Maple River, Lower Rush River, and Rush River) flow peaks have made it to the diversion channel.

Flood stages through the F-M urban area and upstream of the control structures would depend on the shape and size of the Red River and Wild Rice River flood hydrographs coming towards Fargo-Moorhead. While the decision to operate would not be based on a forecast, the target stage at the Fargo gage would be based on a forecast if it appears that the flood would exceed the 1-percent Annual Exceedance Probability (AEP) (100-year flood) peak flow of 34,700 cfs. As long as it is clear that 34,700 cfs would not be exceeded, the stage at the Fargo gage would be limited to 35.0 feet and the maximum flow allowed through the diversion inlet control structure would be 20,000 cfs. The Project 100-year flood would produce an elevation of 922.2 feet just upstream of the control structures in the staging area.

After the Project is operating, if the forecasted peak flow at Fargo is greater than 34,700 cfs, the target stage at the Fargo gage would be increased from 35.0 feet up to 40.0 feet, depending on the flood forecast. Emergency flood fighting measures are required once the target stage is increased above 35.0 feet. The maximum target stage of 40.0 feet is comparable to the stage experienced during the 2009 flood. Since this operating procedure allows more flow to be passed through town (resulting in the higher stages), it allows the staging area to crest at 922.2 feet for 100-year through 500-year floods. The maximum flow allowed through the diversion inlet control structure would be 20,000 cfs up through the 500 year flood.

For events greater than a 500-year flood, a stage of 40.0 feet would be maintained at the Fargo gage and the staging area elevation would be allowed to rise above 922.2 feet, up to the point of minimum acceptable freeboard (four to five feet at the dam). The rise of the staging area would be minimized as much as possible by further opening the diversion inlet control structure gates to allow more flow into the diversion. At the point of minimum acceptable freeboard, flow out of the staging area would be maximized at the diversion inlet structure and over the overflow embankment along the west side of the staging area. Flow exiting the staging area via the overflow embankment would flow overland into the Sheyenne River basin.

3.1.2.1.1 Diversion Channel

The main focus of the Project, as mentioned previously, is reduction of flood risk potential for the F-M urban area. This would be accomplished by diverting a major portion of the peak flow rates during low frequency events through the F-M urban area along the main stem of the Red River and its tributaries through a diversion channel that bypasses the F-M urban area. The connecting and diversion channels intersect with the Wild Rice, Sheyenne, Maple, Lower Rush, and Rush Rivers, subsequently reconnecting with the Red River downstream of the F-M urban area. The Project would cause a hydraulic impact of flood stage reduction along the main stem of the Red River through the F-M urban area. This hydraulic impact would result in reduced flood risk for the F-M urban area downstream of the tieback embankment.

The diversion channel changes the way the Sheyenne, Maple, Lower Rush, and Rush Rivers connect with the Red River. Project features maintain channel forming flows through the F-M urban area for the Sheyenne and Maple River channels, but divert the entire flow from the Lower Rush and Rush Rivers into the diversion channel and eventually flow into the Red River near Georgetown, Minnesota. This would change the system dynamics (e.g., geomorphology, runoff, base flows, peak flows) of the abandoned channels for the Lower Rush and Rush Rivers. The abandoned channel areas east of the diversion channel are anticipated to convert to a more wetland type land cover, as discussed in Section 3.4.

Flow controls for the Sheyenne and Maple River connections with the diversion channel allow bankfull flows to continue along the existing channel reaches. The Project would divert a portion of the excess flow rates in the Sheyenne and Maple Rivers to the diversion channel. This would change the hydrology to those river reaches between the diversion channel and the Red River, such as the Sheyenne River reach east of the diversion channel. This reach would behave similarly to a low flow stream fed by flows up to the bankfull flow from the upper watershed and local runoff from areas in Horace and West Fargo, for example. The risk of sedimentation in the streambed and potential impacts to geomorphology are further discussed in Section 3.3 – Stream Stability. Lack of higher peak flow rates can have an impact on geomorphology and land cover.

From the outlet of the proposed diversion channel to Grand Forks, the project would raise the 10-year to 100-year flood levels by approximately 0.1 feet. The 500-year flood levels would increase by approximately 0.4 feet. The elevation changes between the No Action Alternative (with Emergency Measures) and the Project for five different downstream locations is listed in Table 3.3 below. The Operation Plan would need to be optimized to address balancing the need to minimize downstream impacts with the need to drain the staging area.

Table 3.3 Sampling of Downstream Impacts

	Location	Diversion Outlet (confluence w/ Buffalo River)	Georgetown	Halstad	Thompson Gage	Grand Forks	Average Difference (ft)
	Station	**2203356**	**2193638**	**1981580**	**1667877**	**1558518**	
10-year flood	Exist.[1]	880.47	879.89	864.54	837.62	825.18	-
	Project	880.52	879.95	864.69	837.73	825.22	-
	Diff (ft)	0.05	0.06	0.15	0.11	0.04	0.08
50-year flood	Exist.	882.42	881.77	868.14	845.58	831.7	-
	Project	882.59	881.89	868.19	845.73	831.84	-
	Diff (ft)	0.17	0.12	0.05	0.15	0.14	0.13
100-year flood	Exist.	882.75	882.09	869.03	847.88	834.34	-
	Project	882.92	882.21	869.09	848.03	834.44	-
	Diff (ft)	0.17	0.12	0.06	0.15	0.1	0.12
500-year flood	Exist.	883.08	882.42	871.11	851.28	837.87	-
	Project	883.59	882.82	871.45	851.59	838.25	-
	Diff (ft)	0.51	0.4	0.34	0.31	0.38	0.39

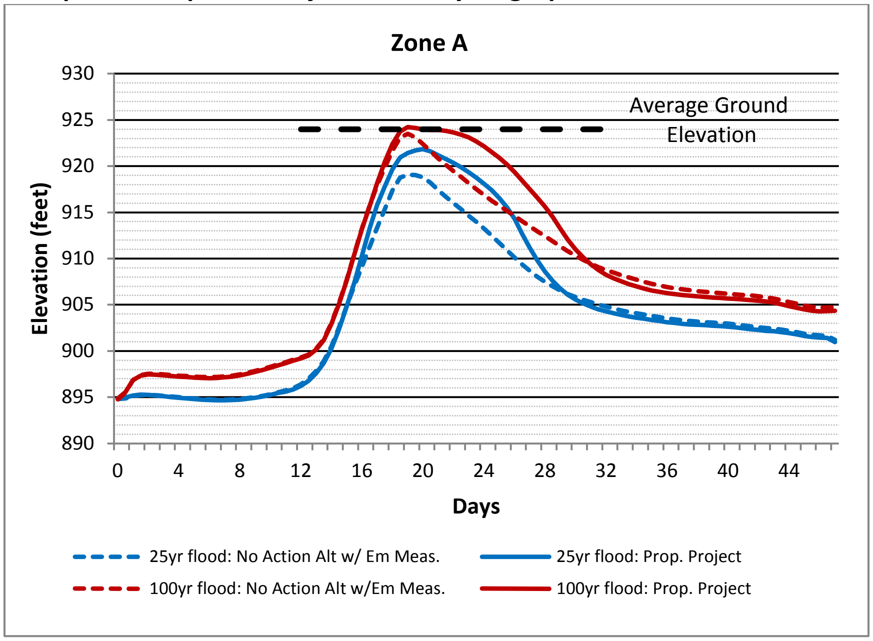
Source: MNEIS HEC-RAS Profiles_20140307
[1] Exist=No Action Alternative (with Emergency Measures)

3.1.2.1.2 Staging Area

The staging area provides approximately 150,000 acre-feet of additional water storage. The staging area is the significant change that occurred during the Phase 4 modeling updates and revisions that were required to mitigate downstream impacts from the Project. Further details on this analysis are available in Section 3.3 of the Phase 4 General Report, dated April 2011. Unsteady state modeling showed that water storage is required to mitigate the adverse impacts that would occur along the Red River, downstream of the project area. The change in staging area flooding from existing conditions to Project operation conditions is shown in Figure 3. Project operation would cause the depth and extent of flooding to increase and cause flooding in currently non-flooded areas. Flood hydrograph data are shown in Graphs 3.1 – 3.4. to illustrate the change in flood duration from existing conditions (with emergency measures) to Project operation conditions for the 25- and 100-year events for select upstream, center, and downstream locations (zones) of the staging area (see Illustration 3.1 following the graphs).

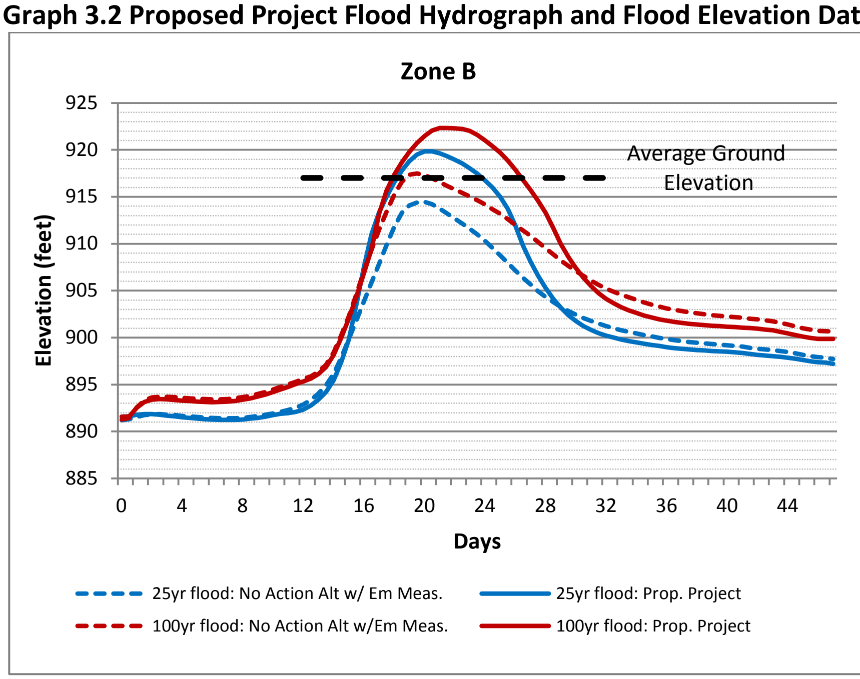
Graphs 3.1 – 3.4 show flood hydrographs at four locations along the Red River comparing the No Action Alternative (with Emergency Measures) with the Proposed Project (source: Phase 7 HEC-RAS unsteady flow model).

Graph 3.1 Proposed Project Flood Hydrograph and Flood Elevation Data – Zone A



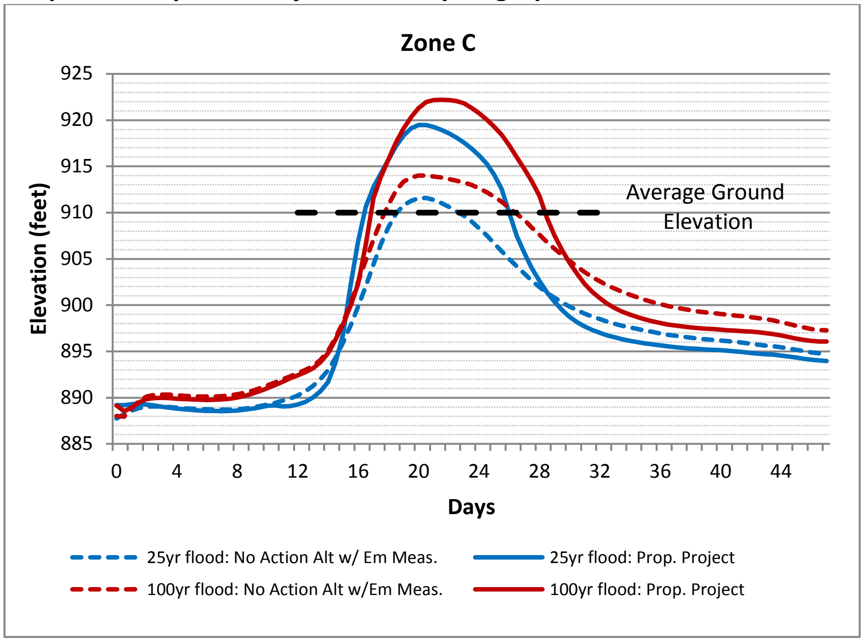
Source: MNDNR, 2015

Graph 3.2 Proposed Project Flood Hydrograph and Flood Elevation Data – Zone B



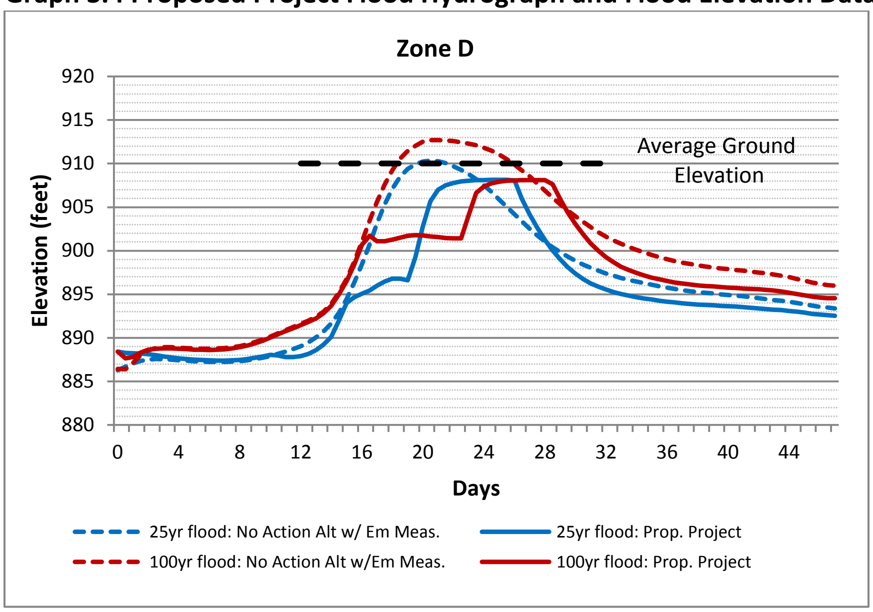
Source: MNDNR, 2015

Graph 3.3 Proposed Project Flood Hydrograph and Flood Elevation Data – Zone C



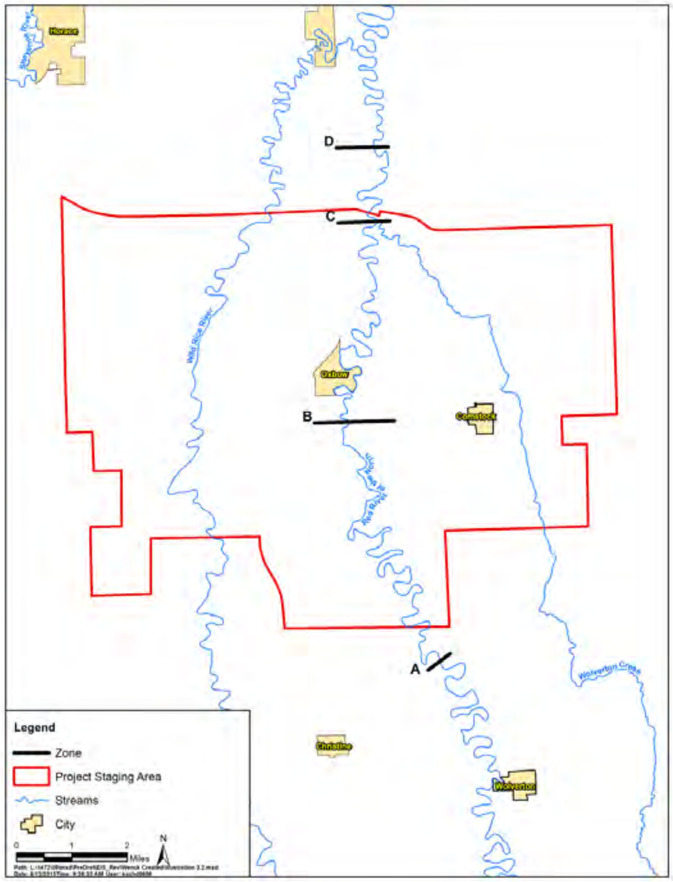
Source: MNDNR, 2015

Graph 3.4 Proposed Project Flood Hydrograph and Flood Elevation Data – Zone D



Source: MNDNR, 2015

Illustration 3.1 Proposed Project Zone Location Map



Source: Wenck, 2015

Inundation is contained upstream of the tieback embankment that runs along the connecting channel from the Red River control structure. The tieback embankment also extends east and connects to high ground on the Minnesota side of the inundation area. During Project operation for low frequency flooding events (larger flood events), the tieback embankment would be designed to hold back water more than six feet deep.

3.1.2.2 Base No Action Alternative

Detailed discussion of the Base No Action Alternative is presented in Chapter 2. Figure 11 shows the flood extents that are associated with the Base No Action Alternative. The flood extents of the Base No Action Alternative are similar to the existing conditions, as this alternative essentially represents the existing condition when all the planned levee systems, as listed in Chapter 2 are constructed. As depicted on the figure, flooding occurs behind current and planned levees for the Base No Action Alternative during the 100-year flood event. There are gaps between the levee tie-in points and the top of levee elevations that allow the 100-year flood event to continue to flood the F-M urban area. While the current and planned levees would cause some stage increase resulting in additional floodplain storage upstream of the levee system, the non-continuous Base No Action Alternative levee system has only minor hydrologic or hydraulic impacts within the project area. There is also an existing Sheyenne River diversion project located near West Fargo; the reach of the Sheyenne in this area is already affected by this diversion project.

3.1.2.3 No Action Alternative (with Emergency Measures)

A detailed discussion of the No Action Alternative (with Emergency Measures) is presented in Chapter 2, including a list of current and planned levees. Emergency measures, such as sandbags and other flood fighting measures, are used to fill in the gaps between the levees that are constructed and are planned for construction and provide flood risk reduction to the F-M urban area during low frequency events. The No Action Alternative (with Emergency Measures) essentially represents the conditions that are needed currently to protect the F-M urban area from flooding during a 100-year flood. Figure 12 shows the extent of emergency protection measures used to prevent flooding from the Red River and Wild Rice River in the F-M urban area. This figure also shows the flood extent under this alternative. As shown in Figure 12, the flow for the 100-year flood is maintained within the channel sections between the levees through the main stem of the Red River through the F-M urban area. Compared to the Base No Action Alternative the No Action Alternative (with Emergency Measures) increases the flood depth and flood extent immediately upstream of the F-M urban area. The increased flood extents immediately upstream of the protected area are due to the surcharge in water surface elevation caused by the constriction of flow between the levees and emergency measures through the F-M urban area. This surcharge provides storage upstream of the levee which decreases peak flow rates through the F-M urban area. The permanent levees of this alternative would not have sufficient freeboard to meet FEMA's accreditation standards for 100-year flood protection.

3.1.2.4 Northern Alignment Alternative

As with the Project previously discussed above, the NAA would not change the hydrology downstream of the diversion. The extent and elevation of the inundation area would slightly differ from the Project as described below for the 100-year flood. Flood inundation associated with the NAA would not directly impact the community of Comstock, which would eliminate the need for a proposed ring levee, but the Comstock wastewater lagoons would need protection. The Red River and Wild Rice River control structures would be operated to raise water surface elevations to approximately 919.3 feet at the diversion inlet for all events up to a 500-year flood. Operation of the NAA would be similar to the Project with the exception of the upstream inundation area elevation. Portions of the diversion channel would also be slightly modified for the NAA compared to the Project.

3.1.2.4.1 Diversion Channel

The diversion channel would remain similar to that described for the Project. The main differences between the Project and the NAA diversion channels are the length of the channel and the inlet structure location. The length of diversion channel alignment between the Sheyenne River aqueduct and the inlet structure is slightly longer for the NAA (8,000 linear feet) compared to the Project (7,700 linear feet). The alignment of the diversion channel east of the Sheyenne River is modified for the NAA, as it would curve south to avoid the subdivision located in Section 30 south of Horace. This portion of the NAA diversion channel alignment would cross County Road 17, the approximate location of the overflow embankment, and then curve northwest, eventually joining the Project diversion channel alignment just east of the Sheyenne River aqueduct, where the remainder of the diversion channel alignment would be the same as described for the Project.

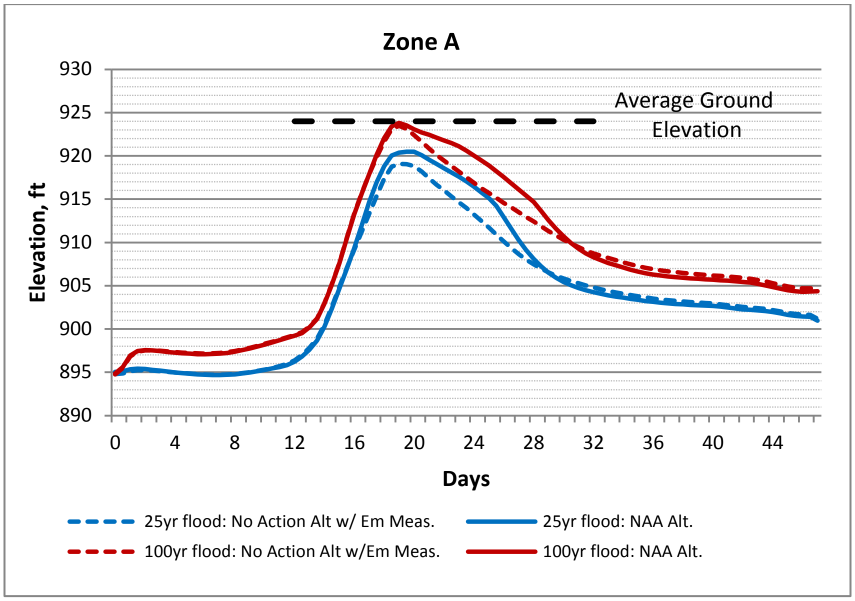
3.1.2.4.2 Staging Area

For the NAA, approximately 150,000 acre-feet of additional storage is required immediately upstream of the dam and diversion channel inlet. The NAA staging area design would be similar to what was previously described for the Project.

Operation of the NAA would be similar to the Project with the exception of the inundation area elevation. A maximum stage of 35.0 feet would be maintained at the Fargo gage until the inundation area elevation reaches 919.3 NAVD 88, at which point the Red and Wild Rice River control structures would be opened as necessary to maintain a staged elevation of 919.3 while not exceeding a stage of 40.0 feet at the Fargo gage, which would be maintained similar to how the Project would be operated and maintained.

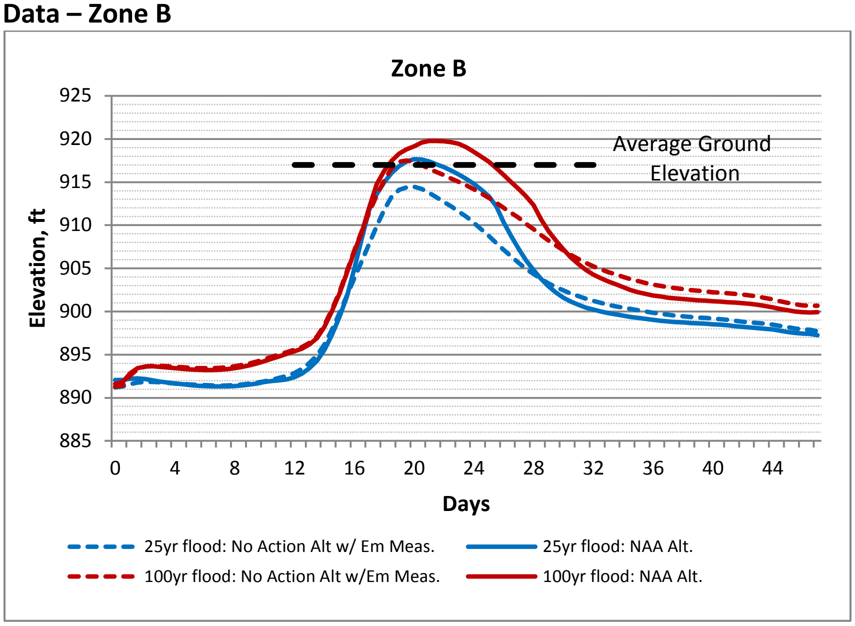
In general, the NAA inundation area is anticipated to result in similar flood durations for the 100-year flood as described for the Project. Flooding related to NAA operation would differ in the inundation area compared to the Project in the extent and geographic areas that would be affected. The greatest flooding from NAA operation would be moved north from the Project location. This would shift flood inundation to the north and would change the extent of flooding based on topography and other features that have the potential to affect the hydraulic impact compared to the Project. The change in staging area flooding from existing conditions to Project operation conditions is shown in Figure 13. Similar to the Project, NAA operation would cause the depth and extent of flooding to increase and cause flooding in currently non-flooded areas during the 100-year flood compared to existing conditions. Flood hydrograph data are shown in Graphs 3.5 – 3.8 to illustrate the change in flood duration from existing conditions(with emergency measures) to NAA operation conditions for the 25- and 100-year flood events for select upstream, center, and downstream locations of the staging area for reference (see Illustration 3.2 below).

Graph 3.5 Northern Alignment Alternative Flood Hydrograph and Flood Elevation Data – Zone A



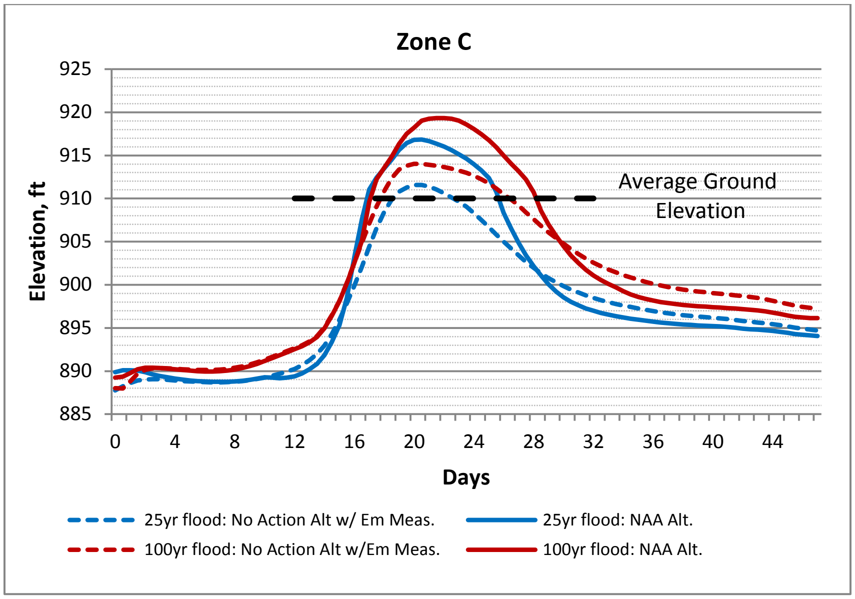
Source: MNDNR, 2015

Graph 3.6 Northern Alignment Alternative Flood Hydrograph and Flood Elevation Data – Zone B



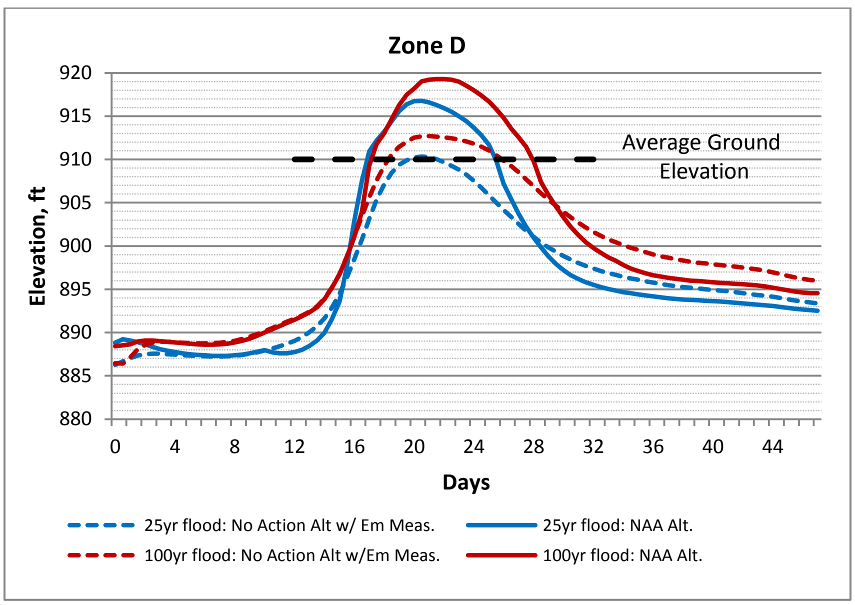
Source: MNDNR, 2015

Graph 3.7 Northern Alignment Alternative Flood Hydrograph and Flood Elevation Data – Zone C



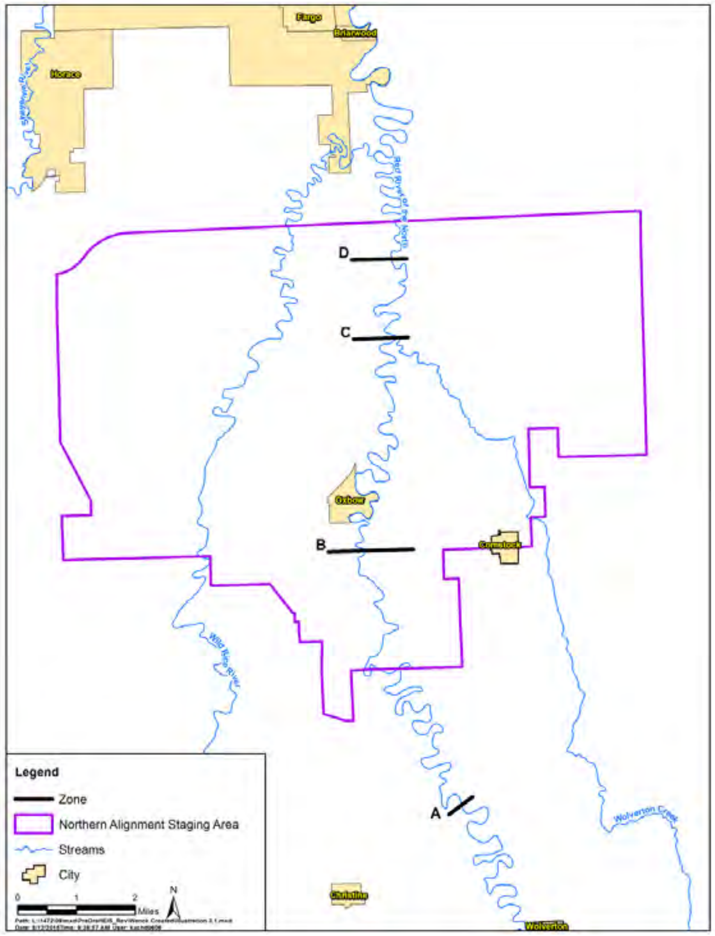
Source: MNDNR, 2015

Graph 3.8 Northern Alignment Alternative Flood Hydrograph and Flood Elevation Data – Zone D



Source: MNDNR, 2015

Illustration 3.2 Northern Alignment Alternative Zone Location Map



Source: Wenck, 2015

Inundation is contained upstream of the tieback embankment that runs along the connecting channel from the Red River control structure. The tieback embankment also extends east and connects to high ground on the Minnesota side of the inundation area. During Project operation for low frequency flooding events (more intense flood events), the tieback embankment would be designed to hold back water more than six feet deep.

3.1.3 Proposed Mitigation and Monitoring Measures

The Phase 7 EA unsteady HEC-RAS model was used during the evaluation of mitigation measures for the Project. Specific mitigation measures proposed for the Project are discussed in other sections of Chapter 3 for each resource topic. Evaluation of the proposed mitigation and monitoring is discussed in Chapter 6 for each resource topic, along with any additional recommended mitigation. Chapter 6 also includes a discussion on the Draft Adaptive Management and Monitoring Plan (AMMP) (Appendix B).

3.2 FEMA REGULATIONS AND THE CLOMR PROCESS

FEMA recognizes the critical function of the floodplain as a natural resource, having environmental, economic, and social value, and therefore regulates development in the floodplain. The National Flood Insurance Program (NFIP), created by Congress in 1968 and governed by the FEMA, is intended to mitigate future flood losses nationwide through community enforced building and zoning ordinances and to provide access to federally-backed flood insurance protection for property owners. The NFIP is a voluntary program. An eligible community (i.e., one that regulates floodplain zoning) that chooses to join the program agrees to enforce floodplain regulations by restricting development in the 100-year floodplain and in turn FEMA underwrites flood insurance policies for structures in that community. When project construction would result in changes to the regulatory floodway, Base Flood Elevations (BFEs) or extent of Special Flood Hazard Areas (SFHAs); FEMA reviews the projects for modifications of the existing FIS mapping through the Letter of Map Revision (LOMR) process. This process includes the CLOMR for revisions from proposed projects and the LOMR for completed projects or improved data.

The USACE has coordinated with FEMA and developed a FEMA/USACE Coordination Plan (Coordination Plan) (April 2015) that outlines floodplain management requirements for the Project, including CLOMR requirements for floodplain map revisions and FEMA related Project mitigation. This plan would be used to implement mitigation as it relates to FEMA CLOMR requirements in the project area and is included as Appendix F.

3.2.1 Affected Environment

The NFIP participating communities with Flood Insurance Rate Maps (FIRMs) affected by the Project are listed in Table 3.4. Effective FIS Reports and FIRMs for all communities impacted by the Project are available at the FEMA Map Service Center site at: http://www.msc.fema.gov/. FEMA has updated the FIRMs for the four affected counties and associated incorporated areas into their digital format with the exception of the unincorporated area in Cass County and Warren Township. The final digital maps are effective for Clay and Wilkin County, Minnesota and unincorporated areas; Richland County and unincorporated areas; and most of Cass County, North Dakota as noted above. Non-Federal sponsors have access to the FIS and FIRMs both effective and issued preliminary for their jurisdictions.

The updated FIS mapping shows no SFHAs in Comstock, Minnesota or Christine, North Dakota. Comstock and Barnes Township do not participate in the NFIP, but they have NFIP identification numbers (270079 and 380256, respectively) meaning they are eligible to join the voluntary NFIP if they choose.

Table 3.4 National Flood Insurance Program Participating Communities Affected by the Project With Flood Insurance Rate Maps

Community	Community Identification Number	State
Cass County	38017	ND
Richland County	380098	ND
Harwood Township	380259	ND
Pleasant Township	380263	ND
Raymond Township	380261	ND
Reed Township	380257	ND
Stanley Township	380258	ND
Warren Township	380265	ND

Community	Community Identification Number	State
Wilkin County	270519	MN
Christine	380291	ND
Fargo City	385364	ND
Harwood City	380338	ND
Reile's Acres City	380324	ND
West Fargo City	380024	ND
Clay County	275235	MN
Moorhead	275244	MN
Wolverton	270524	MN

Source: FEMA 2015

3.2.1.1 Flood Hazard Areas

The NFIP requires FEMA to identify and map flood hazard areas as high, medium, and low flood risk. The SFHA is the high risk area defined as any land that would be inundated by a flood having a 1-percent chance flood (100-year flood) of occurring in a given year, where the NFIP's floodplain management regulations must be enforced, and where the mandatory purchase of flood insurance applies. The SFHA is also commonly referred to as the "base flood" or the 100-year flood. The 100-year flood is labeled on the FIRM as Zone-A (A, A1-30, AE, AO, AH, A99, and AR). The medium risk areas are labeled on the FIRM as Zone-B (older maps) or shaded Zone-X (on newer maps). The areas identified as medium risk on the FIRM are protected by a FEMA accredited levee, have less than one square mile drainage area, are inundated by less than one-foot of sheet flow or are inundated by the 0.2-percent chance flood, also known as the 500-year flood. Other areas on the maps are considered low risk.

The regulatory floodway is an important designation on the FIRM. A floodway is the portion of the floodplain where development and filling is very restricted. The restrictions maintain a flow conveyance area that limits increases in flood stage to allowable tolerances. Typically the floodway is the portion of the floodplain where the water is the deepest and fastest. Projects in the floodway must show there is no-rise in the BFE. The floodplain outside of the floodway is considered the flood fringe. Filling in the flood fringe is allowed but restricted. The allowable tolerance in North Dakota is one foot, which is the national standard. In Minnesota, it is 0.5 feet. Since the Red River falls on the border between the states of North Dakota and Minnesota, the allowable floodway surcharge for the Red River has been set at 0.75 feet (9 inches). In Minnesota, only structures accessory to open space uses (i.e., uninsurable structures) can be built in the floodway.

3.2.1.2 National Flood Insurance Program Map Revisions

NFIP maps can only be revised through the FEMA LOMR process, and therefore, the current NFIP maps, would be in effect until a LOMR is approved. A LOMR cannot be approved until after a project is completed. Proposed conditions are reviewed with a CLOMR which is the formal review and comment FEMA uses to determine whether a proposed project complies with minimum NFIP standards. Upon approval, a CLOMR also describes eventual changes to the NFIP maps within the affected community if the project is completed as designed. CLOMRs are required for any project causing any increase in flood stage based on H and H analyses (44 CFR 60.3(d) 4).

3.2.1.3 Floodplain Management Requirements

In order to obtain a CLOMR approval from FEMA, the H and H modeling and other supporting information would need to meet NFIP regulations codified in the CFR for the NFIP, parts 60.3, 65.3, 65.6, 65.8, and 65.12. General and specific requirements of the Project are discussed in the Coordination Plan (Appendix F) and the Joint Memorandum titled: *Federal Emergency Management Agency / U.S. Army Corps of Engineers Joint Actions on Planning for Flood Risk Management Projects* (FEMA/USACE 2012).

3.2.2 Environmental Consequences

3.2.2.1 Proposed Project

Results of the H and H modeling indicate that the Project would result in increases in the BFE as well as other flood hazards, such as the 500-year flood elevations at specific locations within the project area and the surrounding region. As a result of the increased flood risk within the SFHA and floodway, there are projected increases to insurable structures greater than 0.00 feet. (Potential impacts and changes to H and H from the Project are discussed in Section 3.1 and supporting documents to the EIS.) Because the Project causes an increase in the SFHA and BFEs, a FEMA approved CLOMR is required. Because the Project causes an increase in the SFHA and BFEs, a FEMA approved CLOMR would be required.

The mitigation discussed within the Coordination Plan is defined primarily by the FEMA revision reach. The FEMA revision reach extent is defined by an effective tie-in at the upstream and downstream limits for each flooding source impacted by the Project. This is obtained when the revised base flood elevations from the post-Project conditions model are within 0.5 feet of the pre-project conditions model at both the upstream and downstream limits. Or, more simply put, the FEMA revision reach is defined by the Red River profile and limited to where the Project would alter the river profile flood elevation by more than 0.5 feet. The current upstream and downstream limits of the FEMA revision reach is near model station 2650000 on the northern boundary of Richland County and the outlet of the diversion channel, respectively. The staging area is located entirely within the FEMA revision reach. The actual FEMA revision reach would be determined once the Project design is finalized and updated H and H modeling (Phase 8) becomes available; however, it isn't anticipated that the limits would change from where they currently are mapped (Appendix F).

After completion of the Project, local sponsors would submit a LOMR request for the Project based on the Project as-built and supporting technical data including updated hydrologic and hydraulic analysis and delineation of new floodplain boundaries and floodways. Affected structures cannot be removed from the SFHA until the LOMR or Physical Map Revision is final and effective.

3.2.2.1.1 100-year Flood

Increases are anticipated in the SFHA (flood inundation from the 100-year flood) upstream of County Road 16 (Figure 14). In contrast, the Project would remove large portions of existing areas from the SFHA downstream of County Road 16 and within the F-M area (Figure 14).

3.2.2.1.2 500-year Flood

Increases are anticipated in the extent of the 100-year flood and 500-year floodplain upstream of County Road 16 (Figure 15). The Project would remove large portions of existing areas from the 100-year flood and 500-year floodplain downstream of County Road 14 and within the F-M urban area (Figure 15).

3.2.2.2 Base No Action Alternatives

The Base No Action Alternative includes the potential flood risk reduction impact of already completed and currently funded permanent flood damage reduction (FDR) projects such as levee construction (i.e., structural measures) and property buyouts (i.e., non-structural measures). The FDR projects presented in the tables in Chapter 2, Section 2.2 for Fargo and Moorhead are the included in this alternative. This alternative does not include emergency measures currently pursued in the project area as necessary due to flooding, and therefore, the Base No Action Alternative would have flooding where the water level exceeds the tie-in of levees to natural ground (Figure 11).

Any alterations to the flood hazard risk due to currently funded and completed projects would need a LOMR to officially update the effective FIRMs. These projects are eligible for LOMRs before completion of the Project if they meet the criteria outlined in subsection 3.2.1.

3.2.2.3 No Action Alternative (with Emergency Measures)

The No Action Alternative (with Emergency Measures) includes the potential flood risk reduction impact of already completed and currently funded permanent FDR projects such as levee construction and property buyouts as discussed under the Base No Action Alternative. This alternative also assumes that emergency measures similar to those that have been historically implemented in the project area would continue to be implemented as necessary due to flooding (Figure 12).

Future flood damage reduction projects should be evaluated to determine if a CLOMR is required as outlined in subsection 3.2.1 above. Any official change to the flood hazard risks shown on the FIRM would need a LOMR, but if the project functions independently of the Project a smaller scale CLOMR could be obtained.

3.2.2.4 Northern Alignment Alternative

The NAA would result in changes to flood inundation similar to those described for the Project, resulting in increased flood risk within the 100-year floodplain and floodway to insurable structures greater than 0.00 feet. After construction, a LOMR request by the non-Federal sponsors and FEMA approval of that request would be required. The LOMR request would include updated hydrologic and hydraulic analysis and new floodplain and floodway boundary delineation.

Increases are anticipated in the 100-year floodplain from both the 100-year flood and 500-year flood upstream of County Road 14. In contrast, the NAA would remove large portions of existing areas from the 100-year floodplain downstream of County Road 14 and within the F-M urban area. Figure 13 shows the 100-year flood inundation under NAA conditions.

3.2.3 Proposed Mitigation and Monitoring Measures

Section 65.12 of the CFR requires communities to apply to FEMA for conditional approval (see 44 CFR Part 72 of the NFIP regulations) of actions which will cause increases in BFEs in excess of the limits.

In accordance with the NFIP, mitigation would be required for the Project for structures that are subject to increases in BFE greater than the tolerances set in 44 CFR 60.3(c) and (d) in which FEMA interprets this increase in BFE as any increase greater than 0.00 feet for areas newly inundated on the FIRM. Based on the requirements in the NFIP regulations, appropriate mitigation would be determined through the CLOMR process. Because of the magnitude of the Project, FEMA has discussed interpreting standards so that the CLOMR includes a list of properties that would be mitigated before Project completion but that the mitigation of those properties can be delayed until the Project affects the property flood risk.

3.2.3.1 Mitigation for Impacts to Structures

The April 2015 FEMA/USACE Coordination Plan (Appendix F) states that all impacted insurable structures within the FEMA revision reach would be mitigated. Impacts resulting from the Project would be mitigated through agreed methods consistent with those specified by the NFIP based on the depth of flooding at each structure. For residential structures, mitigation options include elevation, relocation, buy-outs, and ring levees. For non-residential structures, mitigation includes dry flood proofing, elevation, relocation, buy outs, and ring levees. Non-structural mitigation measures were developed based upon the actual risk to properties within the project area. The Natural Resources Conservation Service (NRCS) information, farmstead ring levee programs, and USACE experience was used to determine that farmstead ring levees greater than five feet were not practicable. The use of farmstead ring levees was not yet determined at the time of the EIS production.

3.2.3.2 Changes to Flood Hazard Mapping Designations

The Coordination Plan also requires that the areal extent of flood inundation required for operation of the Project, the staging area, be mapped as floodway in order to ensure that the required volume is available for the Project during the 100-year flood. Flowage easements would be obtained for all floodway designated areas (further discussion on flowage easements is included below). Any additional flood inundation within the FEMA revision reach that is outside of the staging area would be mapped as floodplain in order to portray the elevated flood risk outside of the required staging area.

The Coordination Plan included mitigation measures for residential structures (including homes, structures, and businesses), non-residential structures and agricultural lands. Residential structure mitigation options are primarily dependent upon the depth of flooding under a 100-year flood and location within the project area; e.g., whether it is located within the FEMA revision reach or staging area. Table 3.5 below provides a summary of the Coordination Plan proposed mitigation. The CLOMR would include a general plan as to how structures would be mitigated.

Table 3.5 FEMA/USACE Coordination Plan Structure and Land Mitigation Categories and Descriptions

Project Area Location	Resource Impacted[1]	Impact Magnitude	Mitigation Requirement or Approach and Description
FEMA Revision Reach	Residential and Non-residential Insurable Structures	More than 2 feet, 100-Year Flood Depth	Acquisition or relocation of structures in manner consistent with applicable federal and state law.
FEMA Revision Reach	Residential and Non-residential Insurable Structures (*including* Farmsteads)	Up to 2 feet, 100-Year Flood Depth	Evaluate for non-structural measures, such as ring levees, relocation, or elevating structures. Acquisition may be considered in areas where risk and safety analysis indicated remaining in place may be inappropriate.
Staging Area	All Land	100-Year Flood Inundation	Areal extent required for Project operation would be mapped as FEMA floodway; other inundated areas would be mapped as FEMA floodplain. Flowage easements would be obtained.
Outside Staging Area/Within FEMA Revision Reach	All Land	100-Year Flood Inundation	Mapped as FEMA floodplain – an analysis to determine if a taking has occurred would be performed and flowage easements would be obtained only where impacts rise to the level of a taking.[2]

Source: FEMA/USACE Coordination Plan, April 2015; Diversion Authority, USACE, and Project Consultants Communications, April 2015

[1]All structures discussed are those that are "existing" structures.

[2]See subsection 3.16.3.2.4 "What is a taking?" and Appendix O for more information.

3.3 STREAM STABILITY

Fluvial geomorphology is the study of stream channels and their associated valley types, substrate, bank stability, flow and sediment characteristics (driving variables) and features or events influential in altering or maintaining stability (controlling variables) in the river and its floodplain. Evaluation of the stability of a particular river or tributary can provide information about the cause and effect of processes such as erosion, bank failure, and sediment transport and deposition. This is accomplished in part by analyzing short and long-term changes in channel width, depth and slope, pattern, degradation or aggradation, water depth, velocity, shear stress and riparian condition; all of which affect the shape and condition of a stream. This information can be used to understand and predict potential impacts resulting from constant conditions and isolated events, such as floods.

Stream stability is defined as a river or stream's ability in the present climate to transport the stream flows and sediment of its watershed over time in such a manner that the channel maintains its dimension, pattern and profile without either aggrading or degrading (Rosgen 1996, 2001c, 2006b). As a result, stream stability departure can be quantified and characterized by monitoring aspects of the channel dimension, pattern and profile.

The proposed diversion channel with associated hydraulic control structures, embankments and flood storage (staging area) would be used to modify and control water flow, and change the existing floodplain for certain flooding events (flood elevations) in the project area. Specific geomorphologic processes of concern include stream stability in the inundation area, channel bed scour at the water control structures, and susceptibility for geomorphological changes in the stream and river channels and at the confluence of the diversion channel with the natural river channel at the Red River due to hydrology and hydraulic Project modifications.

This section provides a discussion on the existing conditions of rivers and streams in the project area, potential impacts to stream stability in those stream and river channels due to construction and operation of the Project, and proposed mitigation and monitoring measures. An evaluation of the proposed mitigation and monitoring measures discussed herein as well as any additional recommended mitigation and/or monitoring measures for stream stability are discussed in Chapter 6, subsection 6.2.3 and within the EIS Draft Adaptive Management and Monitoring Plan (Draft AMMP) (Appendix B).

Several resources were used in the preparation of this section. These include correspondence between the USACE, Diversion Authority and the MNDNR. In addition, the USACE and Diversion Authority have conducted and/or partnered with agencies on several studies that characterize the historical and current stream stability and geomorphologic patterns observed in the project area and estimate potential Project impacts to these processes. Some of studies include Light Detection and Ranging (LiDAR) data collected for the Red River basin during 2008 and 2009; bathymetric data collected in 2010 for the Red River from Abercrombie, North Dakota to Perley, Minnesota; and sediment transport data for the Red River and select tributaries during the spring floods of 2010 and 2011 (USGS 2010, USGS 2011) and summer and fall flow conditions in 2011 (USGS 2012). Several of these studies, and others, have been discussed and/or included in previous USACE documents that precede this EIS. The studies have also been used in the ongoing design of Project features as well as in the continued development of proposed mitigation and monitoring measures.

One study in particular, the *Geomorphology Study of Fargo, North Dakota and Moorhead, Minnesota Flood Risk Management Project* (WEST, 2012) (Geomorphology Report) served as a primary resource for this section. Because of the relevance of this study to the stream stability discussion, a summary of the Geomorphology Report is provided below.

<u>Geomorphology Report</u>

The Scope of Work (SOW) for performing the geomorphic assessment was developed as part of the FFREIS and included as part of the adaptive management monitoring plan (Attachment 6: Discussion of Habitat Loss, Mitigation Needs and Adaptive Management (FFREIS, 2011)). The Geomorphology Report included analysis of hydrology, bank stability, sediment transport and morphological classification that would be used to provide key pre-Project construction and operation observations to form the basis for future comparison. Work under this SOW was initiated in 2010.

The geomorphic study area included the following locations in the project area:

- Red River from Abercrombie to Perley, Minnesota
- Wild Rice River from Abercrombie, North Dakota to the Red River
- Sheyenne River from Kindred, North Dakota to the Red River
- Sheyenne River Diversion Channel from Horace to West Fargo, North Dakota
- Rush River from Prosper, North Dakota to the Sheyenne River

- Lower Branch Rush River from Prosper, North Dakota to the Sheyenne River
- Maple River from Mapleton, North Dakota to the Sheyenne River
- Buffalo River from 1 mile upstream of Georgetown, Minnesota to the Red River
- Wolverton Creek for 3 miles upstream of the Red River

A total of 31 detailed study reaches, as shown in Figure 16, were defined within these general study reaches and physical conditions within each detailed reach were evaluated and documented. Results obtained from each detailed study reach are considered applicable to the entire general study reach in which it is located. The data collected for this effort was applied to various study analyses.

The preparation of this report included an extensive literature review and data compilation effort. In total, forty-eight documents from a variety of sources were utilized. These documents included peer-reviewed and agency literature and data, including USACE, USGS, FEMA, United States Department of Agriculture (USDA), United States Bureau of Reclamation, and the University of Minnesota. Data analysis included a combination of fluvial geomorphic, hydrologic, and hydraulic engineering approaches that were applied to define historical and current conditions and to predict potential future condition effects.

3.3.1 Affected Environment

The project area is located within the Red River drainage basin. The surficial topography and geologic features of the Red River basin are primarily the result of deposition and erosion associated with continental glaciation. Glacial Lake Agassiz left clay-rich sediments in a flat lake plane along the Red River axis (Stoner et al., 1993). The streams within the project area flow through the extremely flat clay deposits. These cohesive soils are up to 95 feet thick in some locations (Stoner et al., 1993). Lake Agassiz also deposited large quantities of sand along its shoreline. The Sheyenne River flows through the sand deposits upstream of the project area, supplying sand to the downstream study reaches.

The Red, Wild Rice, Sheyenne, Maple, Lower Rush, Rush and Buffalo Rivers, Wolverton Creek and their associated floodplains flow through the project area as shown on Figure 1. Geomorphologic changes naturally occur on each of these rivers and can be influenced by specific changes in water flow. The project area currently experiences flooding associated with spring snowmelt and summer runoff events. Flood flows from these events are prone to exceed the natural banks of the reaches for extended durations, as the flood levels rise much faster than they recede. This results in extended durations of saturated bank conditions and inundation of riparian vegetation. These flood flows also result in sediment deposition along the banks of the reaches.

The reaches of the Red River, Wild Rice River and Wolverton Creek within the inundation area are currently prone to and commonly exhibit bank slumping as a result of the flood flows described above, especially on the outside bends. Riverbanks in the project area are particularly vulnerable to slumping as they consist of an upper layer of sediment called the Sherack Formation, resting on a more easily deformable clay of the Brenna Formations (Harris and others 1974 and Harris 2003). Cracks that form in the surface sediment from wetting and drying cycles can cause planes of weakness in the Sherack Formation. The cracks tend to form parallel to river valleys. As gravity acts on the sediment blocks, it stresses the underlying clay, the block slides down the failure plane to form a bank slump. Increased Increased shear stress from high (i.e., flood) velocity flows and bank saturation increase the potential for bank slumping.

Bank instability from riparian vegetation removal, either resulting from flood flows, as described above or through local land use practices, is also another factor in bank slumping. However, in general, the streams show a resistance to significant channel migration with sufficient capacity to transport nearly all of the sediment, which is primarily composed of silt and clay-sized material.

3.3.1.1 Geomorphic Stream Classification

There are a number of reasons for classifying a stream; Rosgen (Rosgen method) listed four: 1) To be able to predict the behavior of the river in regard to its physical aesthetics; 2) To develop relationships for given stream types in regard to hydraulics and sediment; 3) To extrapolate data specific to the site and apply them to similar rivers; and 4) To classify a river is to be able to provide a consistent reference for describing the river's morphology for those working in various disciplines (Rosgen, 1994). Currently, there are several acceptable stream classification methods in use. To help define streams within the project area, their current conditions, and attempt to predict potential changes that may occur within these systems from Project operation; the Geomorphology Report considered three geomorphic stream classification systems; Rosgen Level II, Rosgen Level III, and the Schumm Stream Classification. The results of the stream classification study are discussed below.

Rosgen Level II provides a detailed morphological description of stream types from field-determined reference reach information. This level breaks the channel into discreet slope ranges and introduces particle sizes of channel material. Other variables include entrenchment, width/depth, and sinuosity. Results indicated that the majority of the channel types within the project area are stable (i.e., in a state of natural evolution or migration); however, the detailed study reaches completed on the Red River were found to be potentially unstable both laterally and vertically due to changes in flow and sediment supply.

Rosgen Level III describes the state of streams and helps measure existing conditions in response to channel change. This method is often used to aid in restoration efforts as it provides a qualitative rating with regard to vertical and lateral stability and assesses the potential for a channel to change types. Variables studied include riparian vegetation, depositional patterns, meander patterns, confinement features, fish habitat indices, flow regime, river size category, debris occurrence, channel stability index, and bank erodibility (Rosgen, 1994). The riparian vegetation analysis is discussed further below. Analysis indicated that all of the reaches in the geomorphic study area are classified as being either stable or only moderately unstable laterally. Detailed study reaches are predicted by the Level III method to experience no or only slight degradation over time.

The Schumm Method is a process-based stream classification system that uses the type and amount of material transported as its defining criterion for classification that identifies the processes causing the channel to be either stable or unstable. There are three types of material transport methods considered: suspended load, mixed load, and bedload. The three types of alluvial channels considered are: stable, depositing, and eroding. The results indicated that streams within the geomorphic study area are considered to be stable suspended load channels.

3.3.1.2 Riparian Vegetation Analysis

The Geomorphology Report included two riparian vegetation analyses that were completed; one, through a desktop review of historical aerial photographs and the second that was also conducted as part of the Rosgen Level III analysis discussed above. These analyses were completed to provide a qualitative description of riparian vegetation types and how bank vegetation, or lack of bank vegetation, may be influencing bank stability within the project area. Along with hydraulic forces and bank material, riparian vegetation is one of the primary influences on bank stabilization (Thorne, 1982). The root structure of bank vegetation can increase the shear strength of soil, while aboveground vegetation can reduce stream velocities and act as a protective layer, decreasing the influence of surface erosion processes.

For the aerial photography analysis, bank vegetation was classified in order to identify historical trends in bank vegetation types and to determine if a relationship exists between vegetation type and the rate of channel migration (WEST 2012). Estimates of the dominant category of bank vegetation along each general study reach were based on a desktop review of the available aerial imagery for Years 1, 2, and 3 (Table 3.6). The review determined what percentage of the total length of each reach is dominated by what category of vegetation. Bank vegetation was classified into one of four categories: canopy (trees), mixed vegetation (consisting of a combination of trees, grass, and shrubs), non-canopy (grass and shrubs), and bare earth (no vegetation).

Table 3.6 Aerial Imagery Source Dates

Stream	Year 1	Year 2	Year 3
Buffalo River	2010	1965	1939
Lower Rush River	2010	1997	1962
Maple River	2010	1997	1962
Red River	2010	1978	1939
Rush River	2010	1997	1962
Sheyenne River	2010	1997	1962
Wild Rice River	2010	1997	1941
Wolverton Creek	2010	1965	1939

Source: WEST 2012

The aerial photograph analyses can be used as a tool to assess potential stream stability trends related to vegetation presence and type within the project area from the past 70 years. It is important to note that the aerial images had differing quality and are subject to higher error rates than field investigation studies based on photo interpretation subjectivity and canopy cover. Canopy cover on aerial photographs blocks the view of understory and groundcover vegetation, which results in less accurate determinations of bank vegetation, and therefore, the Rosgen Level III vegetation analysis provides a more accurate assessment of actual vegetation conditions.

The riparian vegetation analysis completed during field investigations in 2010/2011 as part of the Rosgen Level III investigation looked at the percent of site covered by canopy, shrub, herbaceous, leaf or needle litter, and bare ground within each study reach. Observations of the vegetative conditions for each detailed study reach are shown in Table 3.7.

The average value of the percent of bare earth on all of the reaches in the study was about 55 percent. While Rosgen indicates that riparian vegetation has a marked influence on the stability of streams (Rosgen, 1996), observations and other analyses completed and discussed in this report indicates that vegetation coverage does not influence stream stability in this river system as much as the cohesive clay soils that form the stream banks. However, it is important to note that root mass bank investigations were not part of this study. Vegetation roots can span large areas and provide support to banks even in the absence of surface vegetation. Typical benefits from vegetation, including surface protection and increased strength from root penetration, are important contributing factors to stream stability, and vegetation plays an important role in soil moisture conditions.

Table 3.7 Rosgen Level III Riparian Vegetation Summary

Detailed Study Reach	Percent Canopy	Percent Shrub Layer	Percent Herbaceous	Percent Litter Layer	Percent Bare Earth
Buffalo River-1-1.19	10	2	3	0	85
Lower Rush River-1-1.10	0	20	48	2	30
Lower Rush River-2-6.03	0	15	85	0	0
Maple River-1-0.78	1	58	36	0	5
Maple River-2-11.39	1	48	49	0	2
Red River-1-410.65	5	20	10	0	65
Red River-2-419.14	10	15	10	0	65
Red River-3-440.57	1	2	2	0	95
Red River-4-452.52	1	2	5	1	91
Red River-5-463.56	1	3	5	0	91
Red River-6-470.23	2	1	1	0	96
Red River-7-492.47	15	40	20	5	20
Red River-8-521.18	10	35	15	5	35
Rush River-1-0.08	0	10	10	0	80
Rush River-2-6.15	0	0	94	1	5
Sheyenne River-1-4.20	2	10	22	6	60
Sheyenne River-2-11.56	2	3	10	10	75
Sheyenne River-3-18.15	1	0	5	0	94
Sheyenne River-4-22.27	3	10	7	20	60
Sheyenne River-5-26.47	3	40	27	10	20
Sheyenne River-6-35.82	2	40	43	10	5
Sheyenne River-7-43.27	1	5	2	1	91
Sheyenne River-8-55.75	3	38	7	2	50
Wild Rice River-1-3.01	3	3	5	10	79
Wild Rice River-2-4.23	5	10	10	5	70
Wild Rice River-3-17.52	10	25	5	5	55
Wild Rice River-4-22.94	15	5	15	5	60
Wild Rice River-5-38.49	15	10	5	10	60
Wild Rice River-6-42.36	20	20	5	5	50
Wolverton Creek-1-0.64	1	27	27	15	30
Wolverton Creek-2-2.02	0	13	15	2	70

Source: WEST 2012

3.3.1.3 Hydrologic Assessment

The Geomorphology Report completed a hydrologic assessment to help characterize the channel-forming discharges for current and historical conditions. The analysis also looked at the discharge-duration and elevation-duration curves for current, historical and future (with Project) conditions as well as completed a specific gage record analysis to check the accuracy of the rating tables. The revised flow frequency curves developed by the EOEP were applied for this analysis (see Sections 3.1 and 3.2 for more information on the EOEP).

The dominant, effective, or bankfull discharge is associated with the peak of cumulative sediment transport for a given streamflow magnitude and frequency of occurrence. The majority of work (channel forming) over time is accomplished at moderate flow rates. Within the project area, current channel-forming discharge recurrence intervals averaged approximately 1.28 years, ranging from 1.05 years to 1.67 years, which is consistent with other studies in the Upper Midwest. The channel-forming discharge for historical conditions resulted in a 2.4-recurrance interval compared to a 1.26-year recurrence interval in more recent years. This was determined using a recurrence interval method due to limited historical stream gage information. While this is based on one data point, qualitatively it can be assumed that the historical channel-forming discharges across the entire study area were likely less than the current channel-forming discharges.

A discharge-duration curve show the percent of time a given discharge is equaled or exceeded under a certain hydrologic regime. Discharge-duration curves indicated that the current discharge-duration curves have greater discharges than the historical conditions curves. Elevation-duration curves also indicated that water surface elevations have increased from historical to current conditions. These results suggest that the magnitude and frequency of flood events have increased from historical to current conditions.

Specific gage analysis indicated that the water surface elevations at the USGS gages within the project area have remained relatively stable or have exhibited a slight decrease in water surface elevation which generally coincides with historical cross section comparisons made during this study and as discussed below.

3.3.1.4 Stability Analysis

The Geomorphology Report completed a stability analysis by comparing historical and current aerial photography and cross section data. Parameters investigated for both the aerial photography and the cross sections help to assess if the changes observed indicate whether the channels are stable or if they are unstable and trending away from channel geometry (i.e., experiences adverse changes in channel geometry that effects channel stability).

3.3.1.4.1 Aerial Photography

Current and historical aerial imagery was studied to provide information related to channel planform including sinuosity, channel migration rates, meander amplitudes and frequencies, trends in sedimentation features, bank erosion rates, and changes in riparian vegetation over time. Riparian vegetation was previously discussed in subsection 3.3.1.2 above.

This analysis indicated that channels in the project area are relatively stable or in dynamic equilibrium showing little changes between subsequent years. Trends in migration, bank erosion, planform, and other indicators of geomorphic stability are predominantly controlled by flow rates, and sediment type and loads. Other factors include root density and bank saturation duration and frequency. This river system may be transitioning to a non-stationary system (discharges and durations increasing over time are discussed in subsection 3.3.1.3 above). The Geomorphology Report suggests that stream migration may be occurring at a slow rate with significant changes occurring over larger time scales than what could be analyzed in the study, which examined available historical records from approximately 1940 to 2012. Accelerated erosion rates and meander migration, if they occur, would be evident with aerial photography over a shorter timeframe, such as within a 20-year period.

3.3.1.4.2 Cross Section Comparison

To further evaluate the stability of the channels, current and historical cross sectional comparison was completed for 30 cross sections to provide information related to changes in top width, average depth, and channel area over time. Comparing current to historical channel cross sections is a way to study stream stability since overall dimensions of stable streams tend to stay similar with little movement horizontally or laterally. If the dimensions become noticeably wider, straighter, more entrenched or accumulate sediment, it may indicate instability.

Table 3.8 provides a summary of the data sources used by year and stream for the cross section comparison completed for the Geomorphology Report. Available data for the cross section comparison may be too short of a time period (approximately 67 years of data was studied, less in most cases) to identify trends in migration or width changes. Significant migration or changes to these channels may occur over timescales of hundreds or thousands of years. Current cross section survey data was obtained in 2010 and 2011 as part of the Geomorphology Report study. Historical cross section information was obtained from the USACE St. Paul District.

Table 3.8 Cross Section Geometry Source Dates

Stream	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6
Buffalo River	2010	2004	1967	-	-	-
Lower Rush River	2010	1964	-	-	-	-
Maple River	2010	2003	1947	-	-	-
Red River	2010	1999	1983	1978	1960	1943
Rush River	2010	1966	-	-	-	-
Sheyenne River	2010	1940	-	-	-	-
Wild Rice River	2010	1988	-	-	-	-
Wolverton Creek	2010	2000	-	-	-	-

Source: WEST, 2012

Table 3.9 below shows the results of the historical cross section comparison. The cross section comparison of top width found that 13 channels were narrowing, 10 were widening and seven had no discernable trend (WEST 2012). Review of hydraulic depth for the 30 cross sections, 18 appear to be degrading/deepening, two appear to be aggrading, and 10 had no discernable trend in changes to hydraulic depth. The Geomorphology Report used thresholds to individually categorize cross section changes. Thresholds included a top width of at least 0.5 feet per year and hydraulic depth of at least 0.1 feet per year. Twelve of the 30 cross sections were found to be above the thresholds (bold text).

Table 3.9 Cross Section Geometric Change Rates

Stream	Station	XS ID	Top Width Rate of Change (feet/year)	Hydraulic Depth Rate of Change (feet/year)
Buffalo River	1305	B1	-0.1	0.0
Buffalo River	7224	B2	0.2	**0.2**
Maple River	2437	M1	-0.4	**0.2**
Maple River	6343	M2	0.2	0.0
Maple River	36198	M3	**-0.6**	0.0
Red River	2219762	R1	**1.6**	**0.1**
Red River	2254328	R2	0.1	0.0
Red River	2288183	R3	**1.3**	**0.1**
Red River	2359548	R4	-0.3	0.0
Red River	2380772	R5	-0.2	0.0
Red River	2400488	R6	**-3.2**	**0.2**
Red River	2437441	R7	**1.5**	**0.1**
Red River	2448951	R8	0.3	**0.1**
Red River	2515596	R9	0.4	**0.1**
Red River	2537700	R10	**-0.6**	**0.1**
Red River	2562789	R11	-0.3	0.0
Red River	2672724	R12	-0.4	0.0
Red River	2762274	R13	0.2	0.0
Rush River	394	Ru1	-0.1	0.0
Sheyenne River	63841	S1	-0.1	0.0
Sheyenne River	115599	S2	0.1	0.0
Sheyenne River	117965	S3	-0.1	0.0
Sheyenne River	158429	S4	-0.2	0.0
Sheyenne River	189121	S5	-0.2	0.0
Sheyenne River	230797	S6	0.1	0.0
Sheyenne River	255972	S7	-0.3	0.0
Sheyenne River	316964	S8	0.2	0.0
Sheyenne River	337323	S9	0.0	0.0
Wolverton Creek	3106	W1	0.2	**0.3**
Wolverton Creek	11329	W2	**0.9**	0.0

Source: WEST, 2012

Of the 12 cross sections that showed change above the thresholds, in Table 3.9 (bold), some of the apparent causes of why the stream reach appeared to be above thresholds or unstable include:

- Potential bank failures that raised the elevation of the channel bottom (Buffalo River – B2, Wolverton Creek – W2).
- Potential anthropogenic impacts from the installation, modification or removal of structures (Maple River – M1, Maple River – M3, Red River – R6, Red River – R7, Wolverton Creek – W1 and Wolverton Creek – W2).
- Erroneous historical data. The historical 1978 cross section for the Red River was determined to be erroneous due to a coordinate system mismatch (Red River – R1, R3, R8, and R9). There was no way to align the datasets to a common system. It does not

mean the data is wrong, there was just no direct correlation, and therefore, it would not be able to be included in the analysis.

This indicates that the 30 reaches exhibited variable rates of erosion.

3.3.1.5 Sediment Transport and Channel Bed Stability

To help evaluate sedimentation patterns currently observed in the project area, the Geomorphology Report looked at averaged channel velocity and shear stress for bankfull conditions for general study reaches and compared them to published threshold values for soil types typically found to make up sediment and channel beds in the project area. Several studies have been completed that identify the suspended sediment load of the project area to consist primarily of silt and fine clay (USGS 2010, USACE 2012). The Feasibility Study, Phase 4, Appendix F -Hydraulic Structures, Exhibit I "Sediment Transport" (HMG, 2011) found that all of the waterways within the project area, with the exception of the Sheyenne River, are dominated by the transport of fine suspended material. The fine clay and silt lake plain sediments are known to be easily suspended, and tend to stay in suspension even during relatively low-flow conditions (MPCA 2006). The Sheyenne River system has coarser bed material and more course suspended sediment than the other affected rivers; however, studies completed do not indicate that it is transported in large quantities through the system (HMG, 2011). Colloidal sand is typical of the fine, loose sands that make up the sediment from the surrounding watersheds. Streambanks in the area are found to typically consist of stiff clays.

The reach averaged bankfull, or channel forming velocities and shear stresses, are summarized in Table 3.10; the threshold values of soils provided in Table 3.11. The reach averaged values were found to be below the soil threshold value for stiff clay; however, almost all of the study reaches, with the exception of the Lower Rush Reach 2, were found to exceed averaged channel velocities and/or shear stresses for fine colloidal sand. This suggests that for flows equal to or less than bankfull flow, shear stress has enough force to mobilize fine sands in the channel but not enough force to erode the channel bed itself. For the flows higher than bankfull (flood flows) when the water has access to the floodplain, channel velocities and shear stresses do not significantly increase higher than at bankfull flow. It is important to note that the velocities presented in Table 3.10 below do not necessarily reflect the velocities found at the toe of the outside bend of a pool which would be higher and may likely exceed shear stress thresholds for stiff clay (Table 3.11). Average velocities are not useful predictors for erosion potential as it is the velocities present at the toe of an outside bend where erosion occurs.

Table 3.10 Reach Averaged Channel Velocity and Shear Stress for Bankfull Conditions

General Study Reach	Q (cfs)	Average Channel Velocity (feet/second)	Average Shear Stress (pound/foot^2)
Buffalo 1	420	1.14	0.03
Lower Rush 1	65	1.01	0.07
Lower Rush 2	60	0.53	0.02
Maple 1	650	1.64	0.04
Maple 2	650	1.44	0.04
Red River 1	4700	2.30	0.04
Red River 2	4280	2.68	0.06
Red River 3	2380	1.98	0.06
Red River 4	2380	1.82	0.07

General Study Reach	Q (cfs)	Average Channel Velocity (feet/second)	Average Shear Stress (pound/foot^2)
Red River 5	2380	1.42	0.03
Red River 6	1780	1.39	0.05
Red River 7	1650	1.53	0.04
Red River 8	1650	1.74	0.06
Rush 1	150	1.35[1]	0.08[1]
Rush 2	150	1.48	0.08
Sheyenne 1	1900	2.49	0.17
Sheyenne 2	1750	1.84	0.11
Sheyenne 3	1680	1.78	0.11
Sheyenne 4	1030	1.80	0.14
Sheyenne 5	580	1.59	0.09
Sheyenne 6	860	1.65	0.09
Sheyenne 7	1200	1.72	0.11
Sheyenne 8	1000	1.48	0.10
Wild Rice 1	6000	1.06	0.04
Wild Rice 2	6000	1.29	0.06
Wild Rice 3	517	1.08	0.02
Wild Rice 4	517	1.28	0.05
Wild Rice 5	517	0.98	0.03
Wild Rice 6	517	1.21	0.05
Wolverton 1	130	1.72	0.14
Wolverton 2	130	1.79	0.10

Source: WEST, 2012

[1] Velocity does not include velocity and shear stress from XS 11119 (weir) due to significant skewing.

Table 3.11 Threshold Values for Shear Stress and Velocity

Boundary Type	Permissible Velocity (feet/second)	Permissible Shear Stress (pound/foot^2)
Fine Colloidal Sand	1.5	0.02-0.03
Stiff Clay	3-4.5	0.26

Source: WEST, 2012

Results of the Geomorphology Report indicated the channels that would be affected by the Project are not prone to significant changes. However, the project area is made up of sediment types – Sherack and Brenn Formations (Harris 2003) that are prone to bank slumping. The channels appear to have sufficient capacity to transport nearly all of the sediment supplied from upstream and the surrounding landscape since it is generally composed of silt and clay-sized material with only minor amounts of sand-sized material. The clays and silts that form the bed of the streams originated from the buildup of successive layers of fine sediments that were deposited within glacial Lake Agassiz (Stoner et al., 1993). These layers of fine sediments have compacted over time, resulting in the formation of a "hardpan" channel bottom (WEST, 2012).

3.3.2 Environmental Consequences

Stream stability of the Red River and its tributaries are influenced by flood flows and changes in river stages. Stream stability can be influenced by the hydrology of the watershed as it impacts channel hydraulics, stream bank vegetation, and sediment transport. These impacts can lead to channel migration, bank sloughing, and changes in stream bed elevation, for example.

3.3.2.1 Proposed Project

The Project would create a diversion channel, aqueducts, and staging area, including new inundation area, which would limit the magnitude of high flow events for most of the river and stream channels, altering the natural hydrology of the project area. The extent of hydrology modification would be dependent on the location in the project area. Hydrology upstream of the tieback embankment would be modified by increased depth and duration of flooding in many areas and new inundation in other areas. Hydrology downstream of the tieback embankment would be more limited to less frequent flood flows within the protected area.

Project operation is anticipated to occur primarily during the spring melt months of March and April. Floods have been recorded in the project area in the months of May and June, but they have typically been shorter in duration and not as frequent (FFREIS 2011). Project operation would reduce flows for flood events greater than the 10-percent chance flood (10-year flood).

3.3.2.2 Project Area

Using the evaluation methods previously described in subsection 3.3.1, the Geomorphology Report evaluated susceptibility of the river reaches with hydrology modified by the Project and the confluence of the diversion channel with the Red River for historical geomorphological changes. The Geomorphology Report indicated that in general, except for two reaches (Rush River 1 and Lower Rush River 1) there would be no expected major changes to geomorphology as a result of the Project. The Rush River 1 and Lower Rush River 1 reaches are going to be completely diverted into the diversion channel with the natural channel downstream of the diversion channel abandoned. These stream segments would only receive local inflows downstream of the diversion channel and may become aggraded from sediment deposited by the Sheyenne River and flood events, if those reaches no longer have the stream power to transport the accumulated sediment.

Expected changes to the geomorphology of each channel reach studied in the Geomorphology Report are summarized in Table 3.12, where (0) indicates No Change, (+)indicates increasing, and (-)indicates decreasing. Additional details and discussions on these findings are provided in the sections that follow the table.

Table 3.12 Predicted Geomorphology Impacts Resulting from Locally Preferred Plan Diversion Channel Alternative[1]

General Study Reach	Bank Stability	Channel Migration Rate	Bankfull Depth	Bankfull Width	Riparian Vegetation Density	Predicted Discernible Changes to Geomorphology
Buffalo River 1	0	0	0	0	0	No
Lower Rush River 1	0	0	-	-	+	Yes
Lower Rush River 2	0	0	0	0	0	No
Maple River 1	+	0	0	0	+	Minor
Maple River 2	0	0	0	0	0	No
Red River 1	0	0	0	0	0	No

General Study Reach	Bank Stability	Channel Migration Rate	Bankfull Depth	Bankfull Width	Riparian Vegetation Density	Predicted Discernible Changes to Geomorphology
Red River 2	+	0	0	0	+	Minor
Red River 3	+	0	0	0	+	Minor
Red River 4	+	0	0	0	+	Minor
Red River 5	+	0	0	0	+	Minor
Red River 6 downstream of diversion	+	0	0	0	+	Minor
Red River 6 upstream of diversion	-	0	0	0	-	Minor
Red River 7	-	0	0	0	-	Minor
Red River 8	0	0	0	0	0	No
Rush River 1	0	0	-	-	+	Yes
Rush River 2	0	0	0	0	0	No
Sheyenne River 1	+	0	0	0	+	Minor
Sheyenne River 2	+	0	0	0	+	Minor
Sheyenne River 3	+	0	0	0	+	Minor
Sheyenne River 4	+	0	0	0	+	Minor
Sheyenne River 5	0	0	0	0	0	No
Sheyenne River 6	0	0	0	0	0	No
Sheyenne River 7	0	0	0	0	0	No
Sheyenne River 8	0	0	0	0	0	No
Wild Rice River 1	+	0	0	0	+	Minor
Wild Rice River 2	+	0	0	0	+	Minor
Wild Rice River 3	-	0	0	0	-	Minor
Wild Rice River 4	-	0	0	0	-	Minor
Wild Rice River 5	0	0	0	0	0	No
Wild Rice River 6	0	0	0	0	0	No
Wolverton Creek 1	+	0	0	0	+	Minor
Wolverton Creek 2	-	0	0	0	-	Minor

Source: WEST, 2012
(0) No Change, (+) increasing, (-) decreasing
[1]LPP Diversion Channel Alternative for the purposes of this EIS is considered the Project.

3.3.2.2.1 Benefited Area Stream Stability (Downstream of the Tieback Embankment)

For areas with modified hydrology due to the diversion channel, riparian vegetation would not experience extended periods of inundation by flood waters nor significant burial by overbank sediment deposits. Additionally, damage to riparian vegetation from ice flows is expected to be reduced because of the reduced probability of flooding. The trees and shrubs would be expected to encroach on the channel compared with current conditions which may result in less bank slumping. An example of the riparian conditions that may be expected to occur along reaches protected by the diversion channel is Sheyenne River Reach 5 which is currently protected from flooding by the West Fargo Diversion (WEST 2012).

3.3.2.2.2 Unbenefited Area Stream Stability (Upstream of the Tieback Embankment)

The inundation area would be created through the construction of a tieback embankment which would receive flood waters from the Red and Wild Rice Rivers through control structures on these rivers. It is anticipated that the area that would experience the majority of the inundation (both in depth, duration, and new inundation) would be within the defined staging area. The frequency of Project operation would be tied to a flow threshold (e.g., 17,000 cfs in the Red River at Fargo), which is substantially larger than the bankfull discharge of the Red River; e.g., greater than the 5-year flood event.

Duration of flooding during Project operation would correspond to the flood event. During a 100-year flood for example, inundation duration is estimated to be approximately 14 days. Extending duration of inundation has been shown to reduce soil strength in bankline areas (Simons et. al. 1982). The risk would be greatest at the outer face, or outside bend of the bank where velocities and shear stress is greatest. Results from the Geomorphology Report suggested that while the duration of flood events could vary, the incremental differences in durations (with Project versus existing conditions) generally under consideration are not expected to substantially change soil strength conditions; therefore, changes in the stability of the outer face of the lower bank due to Project operation would be expected to be small if they occurred. In addition, the Geomorphology Report concluded the stability of a larger portion of the lower bank, as well as the upper bank, would not likely be substantially affected by a small increase in duration of bankfull conditions. However, an important factor to consider is that bank failures currently occur within this system (project area) and extended inundation durations could exacerbate the issue.

Bank failures are often triggered or exacerbated by receding water levels, with failures most influenced under the following conditions: 1) drought conditions, where water elevations are reduced to levels below those that have occurred for many previous weeks, months or even years; and 2) receding water levels associated with the diminishing limb of a flood hydrograph (FFREIS 2011). Bank failures can also be caused by other factors that increase the weight or pressure on the soil of the bank including undercutting of the bank, sediment deposition, soil moisture, or loss of bank vegetation, or other characteristics.

The floodplain forest occurs within the narrow riparian zone in the inundation area that is typically associated with potential stream stability impacts and currently experiences flooding events. Compared to the existing 100-year flood, the Project would result in deeper water surface elevation and longer duration of flood inundation of the banks during flood events in the inundated area. Riparian vegetation along the bank is beneficial in removing water weight and pressure from the clayey soils of the banks. This may result in impacts to riparian vegetation, which may increase the risk of bank instability. Without the water removal assistance of the vegetation, the clayey banks could be more prone to collapse.

An example where an increase in bank failures may occur is along the Red River Segment 7 (Table 3.12 above). Although the Geomorphology Report results indicate that the Red River Segment 7 is expected to experience minor changes in geomorphology due to the Project, slumping increases would be expected in this reach (impoundment area) due to increased duration of high water, increased bank saturation, and increased deposition and bank height. Rotational bank failures in the area upstream of the F-M urban area occur more frequently where the forest has been removed from the corridor. Increased moisture in the soils due to reduced evapotranspiration rates from loss of trees and root structure are a likely cause of rotational bank failures in this area, usually occurring after receding high water events.

Pertaining to sedimentation, Project operation would likely increase the amount of sedimentation that occurs within the inundation area as a result of the impoundment. This would be expected to occur primarily within the defined staging area.

Sedimentation would be anticipated to occur incrementally over several decades (occurring during all flow events within the channel and throughout the floodplain and newly inundated areas during flood events) and therefore, is not anticipated to result in significant immediate effects to areas within the inundated area. Flood events that occur more frequently, such as the 10-year food event, would be expected to contribute more to the accumulated sediment over time than large, more infrequent flood events such as the 500-year flood. Long-term effects from sedimentation over several decades could lead to or contribute wetland-type changes, bank slumping, and changes in riparian vegetation composition and density for example.

The majority of the floodplain vegetation species are adapted to inundation by flood waters and partial burial by sediment during the dormant season (USACE 2012). However, riparian vegetation occurring in reaches within the inundation area would be subject to longer durations of inundation and greater burial by overbank sediment deposits. Flood events are more likely to occur in the months of March and April when the vegetation is dormant and less susceptible to die off; however, if the inundation by flood waters extends into the growing season, plants are likely to be stressed, which could make them susceptible to disease and insect infestations. Additionally, there could be greater damage from ice flows. As a result, trees and shrubs may tend to retreat from the stream channel. If this occurs, seasonal grasses or other vegetation types better suited to such conditions would become more prominent in these areas. Reduced tree and shrub density could contribute to an increased rate of bank slumping, as discussed previously. An example of the riparian vegetation conditions that might be expected within the riparian corridors is shown in Illustration 3.3 (Figure 9-7 from the Geomorphology Report), which is a photo that was taken along Sheyenne River Reach 1 following the spring and summer flood of 2011 (WEST 2012).

Illustration 3.3 Riparian Vegetation Conditions along Sheyenne River

Source: WEST 2012

Based on the available information, impacts on channel morphology as a result of changes in the riparian vegetation conditions are anticipated to be minimal as the average value of the percent bare earth on all of the reaches observed in the Geomorphology Report is about 55 percent (see Table 3.7 Rosgen Level III Riparian Vegetation Summary. Instead, it is concluded that bank saturation and possible buildup of sediments on the banks may likely be a greater factor in causing possible bank instability than vegetation conditions. However, there are some considerations for the Geomorphology Report conclusions. These analyses were based on aerial photograph (historical and current) interpretations and a riparian vegetation survey, as noted above. Observations for aerial photographs are limited to the top-most community present. It is not possible, for example, to determine understory density or composition if a tree is present. For both the aerial and field vegetation survey analyses, root density or root depth could not be verified or was not collected, respectively.

Roots, particularly for tree species, can spread far and help reduce soil moisture through evapotranspiration thus providing support to the bank. As mentioned above, sedimentation within the inundation would incrementally increase accumulation of deposits over decades. Further studies would need to be completed to determine how much of a role vegetation plays in bank stability within this system.

Potential impacts from additional flooding due to Project operation could occur to vegetation communities, such as floodplain forest, outside the riparian zone that are not adapted to periodic flooding. A discussion of these impacts is provided in Section 3.4 – Wetlands and Section 3.6 – Cover Types.

3.3.2.2.3 Bed Scour at Control Structures

Final design detail of the control structures and the operating plan were not available for inclusion in the EIS analysis. The potential for bed and channel scour at the water control structures would primarily be a result of outlet shear stress and velocity from the control structures. To counteract the potentially high shear stresses and velocities, energy dissipaters would be incorporated into the structure designs. Estimates of permissible shear stress and velocity for soils (channel bed substrate is cohesive clay) adjacent to water control structures are provided in Table 3.10 and Table 3.11.

3.3.2.3 Base No Action Alternative

The Base No Action Alternative does not interrupt the historical or current function and condition of the geomorphic processes. The Base No Action Alternative would result in the continued threat of flood damage to the cities and infrastructure in the project area during high water events. This would cause no significant change in the current geomorphic processes observed.

3.3.2.4 No Action Alternative (with Emergency Measures)

The No Action Alternative (with Emergency Measures) would be the same as the Base No Action Alternative but would provide additional protection for adjacent floodplain areas within the urbanized area of Fargo and Moorhead by utilizing emergency measures such as sandbagging and temporary levees. Implementation of emergency measures during significant flood events may cause some increases in upstream flood elevations. Implementation of these measures is not anticipated to change the depth, rate or duration of flow in the project area, resulting in no significant change in the current geomorphic processes.

3.3.2.5 Northern Alignment Alternative

The NAA would shift the control structure and tieback embankment on the Red River and Wild Rice River to the north approximately 1.5 miles. Similar to the Project, the NAA tieback embankment would cross Reach 2 of the Wild Rice River and Reach 6 of the Red River, but at points further downstream within the same reaches as the Project. The NAA tieback embankment would move further downstream from the confluence of the Red River and Wolverton Creek compared to the Project, as shown in Figure 7.

The assessment of stream stability (WEST, 2012) used several methods to evaluate the historic and current stream conditions in the project area. The Geomorphology Report found that stream reaches in the project area are stable, showing little significant change over time. Construction and operation of the NAA are expected to result in potential impacts similar in magnitude to those previously described for the Project. In general, construction and operation are not expected to impact the stability of the affected reaches within the project area.

The NAA would alter the inundation area and relative depths of inundation for the reaches within the staging area, as well as the extent and location of the overall flood inundation area. Portions of Reach 2 of the Wild Rice River and Reach 3 of the Red River would be inundated as part of the NAA staging area that would have been protected under the Project. Compared to the Project, the NAA would remove portions of some reaches that are further upstream from new inundation caused by operation. As discussed in 3.3.2.2.2 Unbenefited Area Stream Stability (Upstream of Tieback Embankment), potential impacts from the Project to stream stability could result from several factors that increase the weight or pressure on the soil of the bank including undercutting of the bank, rapid drawdown of water elevation (i.e., receding water levels) in the stream channel after saturation of the bank soil, sediment deposition, soil moisture, or loss of bank vegetation, and other characteristics. Operation of the NAA could result in similar impacts to stream stability to affected reaches in the inundation area.

Mitigation and monitoring measures for the NAA would be similar to those identified and described for the Project. Similar to the Project, NAA mitigation and monitoring would include implementation of the Draft AMMP included as Appendix B. The Draft AMMP includes monitoring to assess potential impacts to stream stability, pre-construction and post-Project operation. These potential monitoring activities, as well as others, are discussed further in subsection 3.3.3 – Proposed Mitigation and Monitoring Measures.

3.3.3 Proposed Mitigation and Monitoring Measures

The Geomorphology Report and other supporting data collected (e.g., sediment transport studies) suggests that based on the information collected so far, the Project would not likely to have a significant effect on stream stability and geomorphology throughout the potentially impacted/affected environment. However, because of the magnitude and variation of changes (impoundment, diversion channel, cutoff channels, mainstem) and the extent of stream and riparian area potentially affected (+80 miles of river channel) by a project of this size, and the uncertainty that exists within the associated fields of science (climate, hydrology, sediment erosion and transport), monitoring and adaptive management would be essential for tracking and validating assumptions and adjusting management of the project according to significant findings.

Monitoring plans and potential mitigation measures for the Project were identified in Attachment 6 of the FFREIS. Pertaining to potential impacts to geomorphic processes, the USACE proposed completing geomorphic assessments that would be used to determine whether or not the Project would impact physical aquatic habitat and river processes and to what extent. These would be completed through an adaptive management approach. Pre- and post-Project construction and operation monitoring for stream stability through geomorphic assessments would be completed with results evaluated to determine if Project operation would have an impact on stream stability, which may require mitigation or other measures, such as altered operation of the Project or stream stability mitigation.

As discussed above, the Geomorphology Report and additional data to support the geomorphic assessments such as LiDAR (2008 and 2009), bathymetry (2010) and sediment transport studies (2010 and 2011) used in the preparation of this section, were conducted in part, to fulfill the pre-Project monitoring identified in Attachment 6.

According to the Attachment 6, Monitoring Plan for Geomorphology, geomorphic surveys would be performed once prior to construction, which was already completed as part of the Geomorphology Report, and at least twice following construction. The timing of post-construction monitoring is still being identified. Geomorphic changes are often triggered by flood events, and therefore, changes may not occur until one or more 10-year floods have occurred in the project area, making scheduling specific years for post-construction geomorphic surveys difficult. However, the first post-construction assessment would potentially be five to ten years following Project completion. The second assessment would potentially be twenty years following Project completion. Additional future geomorphic surveys could be warranted, the need for which would be collaboratively discussed by the Adaptive Management Team (AMT) composed of local, state, and federal agency personnel working collaboratively to address adaptive management needs.

Since the FFREIS, the USACE and Diversion Authority have continued working with the MNDNR as well as other agencies and local governments on developing and revising approaches outlined in Attachment 6 for pre- and post-Project construction and operation monitoring. The Draft AMMP, included as Appendix B, which includes additional and more detailed pre- and post-Project construction and operation monitoring plan, is an example of this collaborative effort. The Draft AMMP is built off of the Attachment 6 proposed survey monitoring plan, ongoing communications, and studies completed to date, such as the Geomorphology Report, as discussed above.

Further evaluation of the Attachment 6 Monitoring Plan, subsequent studies, findings and additional recommendations are discussed in Chapter 6 and within the Draft AMMP included as Appendix B. It It is important to note, however, that although the Draft AMMP was a collaborative agency and local government effort, the Draft AMMP was prepared for use in this EIS and therefore also includes MNDNR recommendations for the AMMP approach, specific protocol, and additional studies different to or above that which the USACE and Diversion Authority have proposed. The USACE Adaptive Management Plan (AMP) and the Draft AMMP would continue to be revised through ongoing cooperation efforts, as pre-Project construction and operation monitoring results are assessed, Project designs are finalized, and as Project permitting requires.

3.4 WETLANDS

Wetland is a general term that refers to land where saturation with water is the dominant factor determining the nature of soil development and the types of plant and animal communities living in the soil and on its surface (Cowardin, December 1979). The Clean Water Act (CWA) defines the term wetland as "those areas that are inundated or saturated by surface or groundwater at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands generally include swamps, marshes, bogs and similar areas." Differences in soil, topography, climate, hydrology, and human disturbance, along with other factors influence wetlands.

The FFREIS and Supplemental EA federal documents evaluated the potential impacts the Project would have on the wetlands in the project area. The FFREIS included a wetland assessment of the project area that provided a baseline for existing conditions. Additional wetland evaluation was completed for the Supplemental EA and updated in the Minnesota Scoping Environmental Assessment Worksheet (SEAW) to identify Project impacts. The FFREIS and Supplemental EA addressed specific wetland resources for the diversion channel, tieback embankment, and associated facilities (i.e., Project footprint) as described within those documents. Other indirect potential wetland impacts from the new inundation area upstream of the tieback embankment have been estimated using the United States Fish and Wildlife Service (USFWS) National Wetlands Inventory (NWI) as described in this section.

This section provides updated and additional detail beyond the information provided in federal environmental review documents. Conditions under the Project, Base No Action Alternative, the No

Action Alternative (with Emergency Measures), and the NAA are described below. Proposed mitigation and monitoring measures for wetland replacement are also described below.

3.4.1 Affected Environment

3.4.1.1 Existing Conditions

The project area is largely a flat plain which at one time was the lake bed of ancient glacial Lake Agassiz. The lakebed contains fertile silty and clayey soils, which when drained, provide land suitable for agriculture. Historically this area was comprised of tall grass and wet prairies. According to the 1997 Minnesota Wetlands Conservation Plan (MNDNR 1997) less than 20 percent of the native wetlands in the Moorhead area and upstream sub-basins remain.

3.4.1.1.1 Wetland Acreage and Type

Existing wetland resources within the Project footprint were previously inventoried and assessed for direct impacts as part of the FFREIS. Inventoried wetlands were then classified using off-site review methodology with field verification/determinations. Off-site review utilized remote sensing of NWI mapping, soil survey mapping, USGS topographic maps, LiDAR imagery, and multiple years of aerial photography. A wetland functional assessment was also completed and results included in the FFREIS.

The 8,727 acre Project footprint (i.e., diversion channel, embankment and associated facilities), is categorized by six main cover types (see Section 3.6 – Cover Types for further details) which include wetlands. Of the six different cover types in the project footprint, wetlands represent approximately 20 percent, or about 1,780 acres.

To assist with overall impact assessment, the somewhat generic “wetland” cover type has been further broken down or classified using the Circular 39 system (Shaw and Fredine, 1971) and Eggers and Reed (Wetland Plants and Plant Communities of Minnesota and Wisconsin, USACE, St. Paul District, 1997). The Circular 39 wetland classification system was created for Minnesota wetlands. Table 3.13 provides a description of the wetland types and acreages in the Project footprint as described by Eggers and Reed classification and Circular 39 classification systems.

Table 3.13 Wetland Types, using the Eggers & Reed and Circular 39 Classification Systems, Present in the Project Footprint

Eggers and Reed	Circular 39	Current (acres)	Current (%)
Seasonally Flooded Basin: poorly drained, shallow depressions that may have standing water for a few weeks each year, but are usually dry for much of the growing season; frequently cultivated; when not cultivated, wetland vegetation can become established.	Type 1	1,483	83
Fresh (Wet) Meadow: grasses and forbs growing on saturated soils; may represent younger communities that indicate recent disturbances of other inland fresh meadows by drainage, siltation, cultivation, pasturing, peat fires and/or temporary flooding. Once established, the forbs and grasses of the fresh (wet) meadow community may persist for extended periods of time.	Type 2	127	7

Eggers and Reed	Circular 39	Current (acres)	Current (%)
Shallow Marsh: soils are saturated to inundated by standing water up to 6 inches in depth, throughout most of the growing season (Shaw and Fredine 1971). Herbaceous emergent vegetation characterizes this community.	Type 3	108.5	6
Floodplain Forest: Dominated by mature, deciduous hardwood trees growing on alluvial soils associated with riverine systems. Soils are inundated during flood events, but are usually somewhat well-drained for much of the growing season (Shaw and Fredine 1971). Floodplain forests typically include the northern and southern wet- mesic hardwood forest associations described by Curtis (1971). The shrub layer is typically sparse to lacking because of frequent flooding.	Type 1	62	4
Shallow Open Water Communities: general water depths of less than 6.6 feet (2 meters). Submergent, floating and floating-leaved aquatic vegetation.	Type 5	1	0.1
Shrub-Carr: tall, deciduous shrubs growing on saturated to seasonally flooded soils; ground layer species diversity dependent on degree of shrub canopy cover, degree of disturbance, and water source. Relatively undisturbed shrub-carrs may have a ground layer with a rich diversity of species.	Type 6	1.5	0.1
	Total area	*1,783*	*100*

Source: Eggers & Reed, Circular 39, FFREIS, Supplemental EA, and SEAW

NOTE: Percentages were rounded to nearest whole number with the exception of Types 5 and 6, which were rounded to the nearest 1/10.

There are wetlands located outside of the Project footprint that currently become inundated with flood water during high flow events as well as wetlands that would become newly inundated with the Project. Some of these wetlands are identified on the NWI and could be classified using Eggers and Reed and Circular 39. Wetlands outside of the Project footprint within new inundation areas have not been field verified to quantify and accurately classify. Additional discussion on wetland impacts from the Project, including an analysis of potential wetland impacts in new inundation areas, are discussed in subsection 3.4.2.

3.4.1.1.2 Wetland Function

Wetlands provide a variety of functions such as flood water storage, nutrient and sediment removal, fish and wildlife habitat, and recreational opportunities. The Minnesota Routine Assessment Method (MnRAM), Version 3.3 (Minnesota Board of Water and Soil Resources, 2009) was used by the USACE for the FFREIS to determine the functional assessment of wetlands in the project area and assess existing wetland functions (USACE, 2009). Field data gathering and MnRAM was completed on approximately 25 representative wetlands of all types and classifications as presented in Appendix F of the FFREIS.

The MnRAM assessment tool is a qualitative rating based on a field assessment of a variety of wetland features including plant community, water regime, flood and stormwater storage, water quality, fish and wildlife habitat, and aesthetics and recreational value. The MnRAM assessment produces a functional value rating for an assessed wetland, with a rating at one of four levels. The four MnRAM functional value ratings are described in Table 3.14.

Table 3.14 MnRAM Functional Assessment Ratings

Functional Rating	Description
Exceptional	Highly diverse native plant community; rare/unique habitat or features related to wildlife, fish; aesthesis, groundwater, or water quality.
High	Limited disturbance to wetland; diverse native plant community; provides some combination of high quality wildlife and aquatic habitat, flood storage, water quality protection, and/or aesthetics and recreational opportunities.
Medium	Low to moderate amount of disturbance; mixture of native and invasive species; mixture of low quality wildlife and aquatic habitat, flood storage, water quality protection, and/or aesthetics and recreational opportunities.
Low	High level of disturbance; dominated by non-native or invasive species; provides limited to no wildlife or aquatic habitat, flood storage, water quality protection, and/or aesthetics and recreational opportunities.

Source: Minnesota Routine Assessment Methodology for Evaluation Wetland Functions, Version 3.3

As indicated in Table 3.15, the vast majority of wetlands are seasonally flooded basins (potholes) that are located on agricultural land. Based on the representative functional assessments completed, wetlands found within the active agricultural lands provide limited levels of function due to the extensive drainage and overall alteration that has taken place. Due to extensive drainage systems, seasonally flooded wetlands generally provide low function for the following functional assessment categories: Maintenance of Hydrologic Regime and Maintenance of Wetland Water Quality.

Depressional wetlands within agricultural fields can, however, generally provide moderate to high function for the following functional assessment categories: Flood /Stormwater Attenuation and also for Downstream Water Quality. Those wetlands that have been shaped into shallow field ditches provide a moderate level of flood /stormwater attenuation because they are able to hold some of the water on the landscape for at least a short period of time. All field wetlands provide a moderate level of function for protection of downstream water quality because they are able to filter at least some of the nutrients from the agricultural runoff before the water enters nearby waterways.

3.4.1.2 Regulatory Framework

Wetlands are protected in Minnesota under state and federal laws, including the Minnesota Wetland Conservation Act (WCA) (Minnesota Rules, part 8420), and the CWA Section 404. In addition, some wetlands are also designated as Minnesota Public Waters and subject to Minnesota Rules, part 6115. North Dakota does not have a state wetland law; however, CWA Section 404 does apply and any drainage of a wetland with a watershed area greater than 80 acres would require an Application for Surface Drain be submitted to the North Dakota Office of the State Engineer.

Both the state and federal wetland regulations require that a permit, approval, and/or certification be issued by the regulatory agency for wetland impacts as defined by the respective regulations (hereafter referred to as "permitted" for this EIS). For the Project, both the St. Paul and Omaha USACE Districts are working together as the permitting authority for federal CWA Section 404 permits. The Minnesota Pollution Control Agency (MPCA) has authority in Minnesota to issue a CWA Section 401 water quality certification on the CWA Section 404 permit. In North Dakota, the North Dakota Department of Health (NDDH) has authority to issue a 401 water quality certificate.

Regulatory processes require documentation of existing wetland boundaries, proposed wetland impacts (sometimes including functional assessment analyses), and documentation of project sequencing. Project sequencing includes wetland impact avoidance and minimization efforts, as well as proposed mitigation for unavoidable impacts. State and federal regulatory processes differ with respect to the definition of wetlands/waters that are regulated in each process and can also differ in determination of mitigation requirements.

CWA applies to Waters of the United States, which include jurisdictional wetlands and lakes. However, most isolated wetlands and other water bodies, such as those identified in 40 CFR 230.3(o)(2), effective August 28, 2015, are not regulated under Section 404 of the CWA. In contrast, WCA regulates isolated wetlands, but does not regulate wetlands created for a purpose other than to create the wetland, i.e., incidental wetlands (Minnesota Rules, part 8420.0105, subpart 2D). Therefore, most, if not all, of the wetlands and other water bodies within the Project footprint would be regulated through either CWA or WCA (or both for Minnesota wetlands). Regardless, all wetlands in Minnesota are regulated by MPCA under nondegradation rules; Minnesota Rules, part 7050.0185.

The Public Waters Inventory (PWI) described in Minnesota Statutes 2008, section 103G.005 identifies waters and wetlands (i.e., protected waters) under the jurisdiction of the MNDNR Division of Waters (now Division of Ecological and Water Resources). Public Waters within the project area in Minnesota include the Red River, Wolverton Creek, Unnamed Tributary to the Red River (T138 R48), Unnamed Tributary to the Red River (T140 R48), and the Buffalo River. North Dakota does not have a PWI classification system or a similar system; however, the rivers within the project area in North Dakota are the Wild Rice, Sheyenne, Maple, Lower Rush, and Rush Rivers.

The USACE has jurisdiction over waterbodies and wetlands that are considered waters of the United States (40 CFR 230.3). USACE jurisdiction is typically identified through a jurisdictional determination process or by jurisdictional rule (CFR §328.3). If it is determined that a waterbody is under the jurisdiction of Section 404 of the CWA, certain impacts and or activities to jurisdictional wetlands may be regulated under Section 404 of the CWA.

3.4.2 Environmental Consequences

The location of rivers, existing structures, and Project functionality influence the Project route, and therefore route design options to completely avoid wetland impacts are not practicable at the scale necessary to meet the purpose of the Project. Design constraints include natural river channels, transportation infrastructure, safety, economics, and property ownership issues. For these reasons, no complete wetland avoidance alternatives are practicable for the Project.

The sections that follow describe the anticipated direct wetland impacts, potential indirect wetland impacts, and proposed mitigation for unavoidable wetland impacts.

3.4.2.1 Proposed Project

3.4.2.1.1 Direct Impacts

Direct impacts are those impacts that would include Project construction associated with permanent alteration of wetland, which could include dredging, draining, filling and the excavation of wetlands. Construction of Project components that would directly impact wetlands include: the diversion channel, connecting channel, excavated material berms, shallow drainage ditches outside the berms, embankments, roads, control structures in the Red and Wild Rice Rivers, and control structures in the Maple and Sheyenne Rivers. The City of Oxbow, Village of Hickson, and Bakke Subdivision (OHB) ring levee and Comstock ring levee construction would also directly impact wetlands (note that Comstock ring levee impacts have yet to be quantified). Direct wetland impacts are not anticipated for the inundation areas. These areas would be temporarily inundated with flood water, which currently occurs in some areas, but would not include Project construction.

As mentioned above, construction of the Comstock ring levee would result in direct impacts to wetlands that are not included in the Project footprint impacts shown in Table 3.15. Exact wetland acreage impacts are currently unknown and it is the responsibility of the Diversion Authority to follow WCA and Section 404 requirements for delineating wetlands during project development. An aerial photograph review of the general area of the Comstock ring levee indicates that the current land use is predominantly agricultural row crops. These fields include existing surface ditches and subsurface drain tiles that have effectively drained the majority of pre-settlement wetlands. Therefore, it is estimated that less than five acres of wetland could be impacted by the Comstock ring levee construction. The wetland impacts from the construction of the Comstock ring levee, once quantified, would require permitting through WCA and Section 404, including implementation of applicable mitigation.

The Drayton Dam Mitigation project would include work in the Red River and its floodplain. The majority of project work would occur directly in the river. This habitat is primarily riverine and not wetland. However, the project site does include small areas of adjacent floodplain, and these low lying floodplain areas could be considered wetlands, which would be determined through the WCA process administered by Kittson County.

The USFWS NWI data was reviewed to identify and confirm the presence of wetlands outside the project footprint (as described above). Prior to construction, additional wetland delineation would be completed as part of the WCA process. Most of the wetland areas within the Drayton Dam project footprint are along the Minnesota bank. The 0.5-acre area along the Minnesota bank where erosion protection and weir placement would occur would likely be considered wetland. This footprint area would be permanently changed. The grading area on the Minnesota bank just upstream of the proposed structure also may include wetland. This area would be disturbed through grading but is proposed to be revegetated. Its form may change slightly; however, it is small (approximately 0.2 acres) and would remain as river floodplain.

The total direct impact to wetlands (forested and non-forested) from the Project footprint and the OHB ring levee is estimated to be 1,820 acres (Table 3.15). Table 3.15 compares and summarizes the total wetland impacts in the Project footprint and OHB ring levee by Eggers and Reed Classification and Circular 39. Table 3.15 indicates that 99 percent of the wetlands existing within the Project footprint are likely to be impacted. Small remnant wetlands may remain adjacent to the Project footprint but would likely be considered an indirect impact by changing the type and would require applicable mitigation. It should be noted that direct wetland impacts for the Comstock ring levee and Drayton Dam project are not included in the table below as impacts have not been determined as previously discussed above.

Table 3.15 Estimated Direct Wetland Impacts by Wetland Type

Wetland Type (Eggers and Reed)	Diversion/Embankments (acres)	Control Structures in Red, Wild Rice, Maple and Sheyenne Rivers (acres)	OHB ring levee (acres)
Type 1 (Seasonally Flooded Basin)	1,477	0	44
Type 1 (Floodplain Forest)	31	31	0
Type 2 Fresh (Wet) Meadow	120	0	5
Type 3 (Shallow Marsh)	106	0	4
Type 5 (Shallow Open Water Communities)	1	0	0
Type 6 (Shrub-Carr)	1	0	0
Total Acres	**1,736**	**31**	**53**

Source: USACE 2009 Wetland Inventory

The majority of the impacted wetland acreage in the Project footprint and OHB ring levee is farmed Seasonally Flooded Basins (1,477 and 44 acres respectively). As noted above, the remaining function of these basins is generally low since they are farmed, temporarily wet basins usually devoid of emergent vegetation. However, the basins meet the wetland definition since the “Atypical” section of the 1987 USACE Wetlands Delineation Manual (USACE 1987) allows the vegetation parameter to be assumed if, in the best professional judgment of the wetland delineator, hydrophytic vegetation would be present in the absence of farming. Therefore, these farmed basins meet jurisdictional wetland criteria, but are considered to be of low function.

In total, the USACE estimated that 124 acres of forest would be impacted by the Project. For this EIS, additional review of the Project footprint on aerial photographs was completed to evaluate floodplain forest, upland shelterbelts, and other wooded non-wetland areas. Based on this review, it is estimated that approximately half of the 124 acres of forest impacts would be to floodplain forest wetlands. This would equate to a total estimated floodplain forest wetland impact of 62 acres as shown on Table 3.15.

3.4.2.1.2 Indirect Impacts

In general, indirect wetland impacts are considered those impacts that result from the Project, but are not caused by the direct impact from construction of the Project footprint. Indirect impacts from the Project include changes in hydrology of wetlands, sedimentation occurring over time in the inundation area, and temporary flood inundation occurring due to Project operation.

Indirect wetland impacts could occur from: changes in hydrology of wetlands as a result of drainage patterns being cut off by the diversion channel or the OHB ring levee construction; the diversion channel creating a lower potential drainage gradient toward which subsurface water might flow; and/or drainages being created that would drain wetlands toward the channel or into the shallow drainage ditches that have been designed along the outside of the berms.

Most of the wetlands in the project area are underlain with fine-textured soils, and therefore, wetland loss that might occur from cutting off drainage to wetlands is expected to be minor since most wetlands outside the Project footprint rely on surface water runoff and have relatively small catchment areas. Potential drainage impacts on wetlands outside the Project footprint are unlikely since any such wetlands would be far enough away that a hydrologic connection would not exist.

Indirect wetland impacts by changing the wetland type could occur from the diversion channel bisecting the Rush and Lower Rush Rivers. Where the diversion channel intersects these rivers, the two rivers would be diverted into the diversion channel and the lower 2.3 miles of Rush River and 2.7 miles of the Lower Rush River would be abandoned and no longer receive water from the historic upstream catchment area. After Project construction, the contributing watershed to these channels would be limited to local runoff, which is not anticipated to cause wetland loss, but a change in function to the remaining wetlands. Acreages associated with the change of wetland function for the Lower Rush River and Rush River would be offset by the channel design within the diversion channel, which would be considered mitigation for the change in wetland function from river channel abandonment.

The NWI dataset was reviewed to approximate the potential indirect wetland impact caused by new inundation within the project area (Table 3.16). NWI classifications were interpolated to Eggers and Reed classifications, and Circular 39 types for comparison. Field verification would be necessary to more accurately reflect existing acreages and types as well as confirm potential impacts. The majority of potential impacts would be to Type 5 shallow open water and shallow open water communities.

Table 3.16 Estimate of Indirect Wetland Impacts from New Inundation During the 100-year Flood

Wetland Type	Current (acres)
Open Water	0
Type 1 (farmed)	18
Type 1 (floodplain forest)	0.2
Type 2 (fresh (wet) meadows)	0
Type 3 (Shallow Marsh)	13
Type 4 (deep marshes)	2
Type 5 (shallow open water and shallow open water communities)	116
Type 6 (shrub swamp)	1
TOTAL ACRES	**151**

Source: NWI, Cowardin et al. 1979; Wenck, 2015

Additionally, Project operation may increase inundation of some wetlands in the project area compared to flood events occurring under existing conditions. The additional inundation from the Project could result in changes to the existing vegetation communities; however, length of inundation is anticipated to be temporary and cause seasonal flooding similar to existing conditions. Flood duration, depth, and associated drainage or infiltration rate changes within the wetland basins could cause changes in wetland type over time.

Portions of the area that would be inundated during Project operation have a history of row-cropping wetlands made feasible through the use of field tiling. Existing agricultural activities result in a high potential for sediment transport due to loose fine-textured surface soils exposed through plowing. The greatest potential for sediment to cumulatively fill shallow wetlands over time would be near the tieback embankment, where flood inundation would be greatest and more frequent. The 10-year flood would inundate wetlands within the floodplains of Wolverton Creek, Red River, and Wild Rice River. Wetland types could change over time in the inundation area due to sediment deposition during Project operation. Sedimentation in the wetlands adjacent to waterways is not expected to be accelerated because of the Project and is anticipated to maintain similar rates of sedimentation to the existing condition.

Coarse textured soils have a tendency to fall out of suspension sooner, likely closer to the tieback embankment and terraces of adjacent stream beds. Wetlands in closer proximity to the tieback embankment or stream bed terraces would therefore be more likely to be impacted by potential sedimentation. In general, sediment would fall out of suspension as the inundation area slowly progresses away from the tieback embankment. Other factors that affect the potential impact of sedimentation include: changes in frequency of inundation, duration of inundation, and inundation of new area compared to existing areas that are more adapted to inundation. Each of these factors would affect the rate and occurrence of sedimentation. Wetland impacts in the inundation area are not anticipated to be significant. However, monitoring of impacts would be a part of the USACE Adaptive Management Plan (FFREIS 2011) for the Project as further discussed in subsection 3.4.3 – Proposed Mitigation and Monitoring Measures, and as included within the Draft AMMP (Appendix B).

3.4.2.2 Base No Action Alternative

Under the Base No Action Alternative, wetland impacts from flood events would remain the same. Flooding that could occur would be temporary, and wetland impacts would occur slowly over a long period of time as part of flood dynamics and from other system influences.

Fargo and Moorhead each have ongoing and planned flood risk reduction projects that reduce flooding for the cities and properties located along the Red River within the F-M urban area. These projects may reduce the risk of impacts during future floods by reducing or eliminating flood water impact on certain lands, which includes wetlands.

Direct and indirect impacts could occur with the natural expansion of the F-M urban area as wetlands become developed; however, mitigation would be required.

3.4.2.3 No Action Alternative (with Emergency Measures)

Under the No Action Alternative (with Emergency Measures), wetland impacts from flood events would remain the same. Emergency measures would be used to reduce flooding in certain areas, which could alter the flow causing flooding or changes in other areas. Flooding that could occur would be temporary, and wetland impacts would occur slowly over a long period of time as part of flood dynamics and from other system influences.

As discussed for the Base No Action Alternative, Fargo and Moorhead have planned flood risk reduction projects that reduce flooding potential for properties along the Red River within the F-M urban area. Additionally, the No Action Alternative (with Emergency Measures) would use emergency measures, such as sandbagging and temporary levees, to protect certain areas that may require additional protection. These actions could reduce impacts to the Benefited Areas, largely the area downstream of the tieback embankment, but potentially increase impacts to other areas.

Direct and indirect impacts could occur with the natural expansion of the F-M urban area as wetlands become developed; however, mitigation would be required.

3.4.2.4 Northern Alignment Alternative

Direct and indirect impacts from operation of the NAA are anticipated to be similar to those previously described for the Project. It is estimated that the NAA diversion channel construction footprint and OHB ring levee direct wetland impact acreage would remain equal to the wetland acreage impacts for the Project, totaling approximately 1,820 acres. The type and quality of these wetlands are anticipated to be similar as described in subsection 3.4.1. Under the NAA, Comstock is not anticipated to have significant inundation, and therefore, the Comstock ring levee may not be needed, which would eliminate any associated direct wetland impacts.

Wetlands located between the Project and NAA control structures and embankment system locations have not been field verified. Based on NWI data, NAA operation during the 100-year flood event would cause approximately 148 acres of indirect wetland impacts from new inundation (Table 3.17). Similar to the Project, indirect impacts from NAA operation include: changes in temporary flood inundation, increased hydrology of existing wetlands, and sedimentation occurring over time. Some wetlands currently experience flood inundation during high flow events. Some of these wetlands may experience an increased inundation and/or duration during operation of the NAA compared to existing conditions during flood events. Similar to the Project, the additional inundation from the Project could result in changes to the existing vegetation communities; however, length of inundation is anticipated to be temporary and cause seasonal flooding similar to existing conditions. Flood duration, depth, and associated drainage or infiltration rate changes within the wetland basins could cause changes in wetland type over time. If long-term inundation would occur, there would be a greater potential for impacts to vegetation communities.

Table 3.17 Estimate of Indirect Wetland Impacts from New Inundation during the 100-year Flood

Wetland Type	Current (acres)
Open Water	0
Type 1 (farmed)	18
Type 1 (floodplain forest)	0.2
Type 2(fresh (wet) meadows)	0
Type 3 (Shallow Marsh)	8
Type 4 (deep marshes)	2
Type 5 (shallow open water and shallow open water communities)	117
Type 6 (shrub swamp)	1
Type 7 (wooded swamp)	2
TOTAL ACRES	**148**

Source: NWI, Cowardin et al. 1979; Wenck, 2015

Direct and indirect impacts to wetlands from the NAA would be further evaluated and field verified if and when a final design is completed. A wetland mitigation plan would also be developed based on final design and estimated wetland impacts, which is further discussed in subsection 3.4.3.

3.4.3 Proposed Mitigation and Monitoring Measures

A wetland mitigation plan would be used during the federal and state permitting/approval processes to assess wetland impacts and determine appropriate replacement of those impacts. Wetland mitigation is proposed to be approached in two ways, habitat based and wetland function. Mitigation proposed for forested wetlands would be habitat-based with a goal of replacing impacted wetland habitat and certain functions rather than designing the plan purely on wetland design criteria. Mitigation proposed for non-forested wetlands would be based on wetland function.

USACE compensatory mitigation policy is directed at replacing the lost functions and values associated with unavoidable impacts to aquatic resources, including wetlands. The standards and criteria for compensatory mitigation required by CWA Section 404 permits are contained in the Federal Mitigation Rule at 33 CFR 332 which include a variety of tools to accomplish this such as perpetual easements and financial assurances. In the state permitting process for WCA, Minnesota Rules, part 8420.0522, subpart 9, item A would require financial assurance if project specific mitigation is proposed. A local government could waive the requirement if it determines that financial assurance is not necessary to ensure successful replacement. Mitigation completed through wetland bank credit purchase in advance of the impact would not require financial assurance.

The USACE, MNDNR, MPCA, and local governments in Minnesota have jurisdiction over wetland impacts for the Project and would review and approve the proposed wetland mitigation plan to satisfy compensatory mitigation (CWA term – applicable to USACE mitigation interpretation) or replacement requirements (WCA term- Minnesota state and local governments mitigation term) for unavoidable wetland impacts. In Minnesota, wetland impact would be replaced under WCA and CWA standards. The MPCA would have permitting jurisdiction in Minnesota through CWA Section 401 Water Quality Certification. The MNDNR would have permitting jurisdiction for structures and fills below the ordinary high water level of any protected wetlands or waters. In Minnesota, local governments, typically counties, administer WCA. The North Dakota Regulatory Office of the USACE Omaha District has responsibility for implementing the CWA Section 404 permitting program in North Dakota, including decisions regarding the type and amount of compensatory mitigation required to offset unavoidable impacts to waters of the United States.

Under current WCA rules, mitigation would need to be located within a defined area in Minnesota and possibly of a defined type depending on whether mitigation banking is used or a project-specific mitigation plan is developed. Currently, there are limited wetland bank options in Minnesota that would provide the necessary credits for Project impacts occurring in Minnesota. Preferred sites for wetland bank options are those that are within the bank service area local or near where the impacts would occur. Therefore, a site or sites would need to be identified, acquired, restored, and protected through a deed restriction or perpetual easement in order to provide the necessary mitigation credit for the Minnesota impacts. Mitigation sites located in Minnesota require a conservation easement is established per WCA.

USACE guidance requires a protective covenant over the North Dakota mitigation areas. *The U.S. Army Corps of Engineers' Guidance for Compensatory Mitigation and Mitigation Banking in the Omaha District*

(USACE 2005) states, on page 8, states that *"[a]ll mitigation will need site protection. This can be in the form of an easement, deed restriction or similar legal instrument."*

The USACE plans to use adaptive management (see AMP, FFREIS also included within the Draft AMMP, Appendix B) for mitigation and monitoring of impacts to wetlands, which includes the diversion channel conceptual wetland mitigation plan (wetland mitigation plan). MnRAM would be used to evaluate the mitigation wetlands at the end of the monitoring period.

A habitat-based approach was proposed instead of quantifying mitigation acreage in order to provide suitable replacement habitat. It is assumed the entire 30-mile diversion channel and six-mile connecting channel bottoms and some areas of the side slopes would be designed and managed as wetland replacement, resulting in approximately 1,597 acres of wetland credit. This would equate to a replacement ratio of 0.94 to one ratio. If the remaining inside upland slopes of the berms were assumed to generate 25 percent credit as upland buffer, this would add approximately 438 acres of credit for mitigation acreage totaling 2,035, a 1.19 to one ratio. The revegetation plan proposes to use native species to seed and manage the inside upland slopes.

Additionally, Ducks Unlimited (DU) in North Dakota has launched an in-lieu fee mitigation program that has been coordinated and approved through an Interagency Review Team (IRT) consisting of North Dakota Game and Fish Department (NDGF), Federal Highway Administration, Natural Resources Conservation Service, USACE, United States' Environmental Protection Agency (USEPA), and USFWS. In summary, the DU program would locate, purchase, construct and monitor wetland restoration/creation sites for a per-acre fee. This program is only being used to mitigate wetland impacts for the OHB levee construction.

The Draft AMMP, developed for this EIS, includes specific recommendations for monitoring measures and outlines monitoring protocols. Monitoring is recommended in the Draft AMMP to include potential indirect wetland impacts in the inundation area. This monitoring is discussed within the Geomorphology Monitoring Plan as part of the Draft AMMP (Appendix B).

3.4.3.1 Forested Wetlands

An estimated 62 acres of forested wetland impacts (diversion channel and control structure impacts) would be replaced at a two to one ratio by restoring farmed Seasonally Flooded Basin wetlands along rivers, including the Red and Wild Rice Rivers as forested floodplain wetlands (FFREIS 2011). The USACE St. Paul District as well as the USFWS have used "Blue Books" (USFWS habitat assessment models) to determine adequate replacement for the forested wetland impacts. This approach was agreed upon by North Dakota Game and Fish and MNDNR. Some mitigation sites have been preliminarily identified by the USACE.

All forested wetland impacts in North Dakota are proposed to be replaced per CWA Section 404 standards. Forested wetland impacts in Minnesota would require mitigation to comply with WCA. WCA requires two to one ratio replacement for the impacts in Minnesota which would equate to an estimated six acres of mitigation.

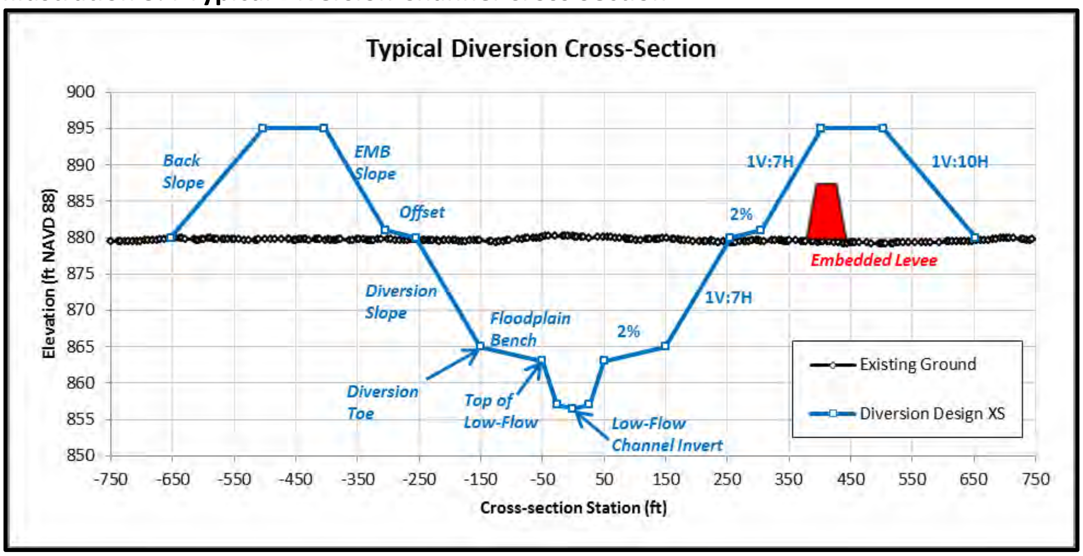
Whether in Minnesota or North Dakota, temporal loss of wetland function and value while the mitigation sites mature is important to consider. The USACE has proposed a 2 to 1 ratio for mitigation to forested wetlands which partially is attributable to an appreciation of the time it takes for these areas to reach a mature condition. Restoration of the mitigation sites should be completed in advance or at least concurrently with the proposed impacts to minimize temporal loss of wetland functional.

3.4.3.2 Non-Forested Wetlands

3.4.3.2.1 Diversion Channel

This section discusses proposed mitigation occurring in the diversion channel. Illustration 3.4 (below) provides an illustration showing the typical diversion channel cross-section, including low-flow channel and side slopes.

Illustration 3.4 Typical Diversion Channel Cross Section



Source: USACE, 2015

3.4.3.2.2 Bottom of Diversion Channel

The conceptual mitigation plan, as a habitat-based approach for impacts to non-forested wetlands, would be to create wetlands on the floodplain bench in the bottom of the diversion channel. The wetland created would be used to compensate for wetland impacts in North Dakota; however, no compensatory wetland mitigation credit is assumed for the low-flow channel. The mitigation in the diversion channel bottom would not qualify as adequate replacement per WCA, because the mitigation would take place outside Minnesota.

<u>Two Percent Side Slopes</u>

The proposed mitigation plan assumes 100 percent credit for the two percent sloped areas on either side of the low-flow channel. Existing wetlands within the two percent slope areas would be lowered topographically. Hydrology for the two percent slope areas would come from the low-flow channel when it overtops its banks and also from runoff from the inside diversion channel embankment slopes. There would be periods before the growing season in March and April when the Project is in operation during the 10-year flood or greater event, which would cause several feet of water to be present in these areas. Hydrology would be expected in the early part of the growing season which is typical of a Seasonally Flooded Basin. This mitigation approach is different than the impacts from the shallow drainage ditches outside of the diversion channel berms and requires additional mitigation.

There may be times when the side slope mitigation area has deep water flowing downstream instead of shallow standing water. This zone would experience highly disruptive hydrologic events when water elevations are higher. Without intensive management, this zone could establish a mudflat environment characterized by frequent changes in the mix and extent of dominant species, many of which would be expected to be weedy annuals such as flat sedge (*Cyperus)* and knotweed (*Persicaria)*. In areas where standing water persists for longer periods, non-native invasive species such as bulrushes/cattails (*Typha)* could establish, and canary grass (*Phalaris)* could establish in drier areas without intensive management.

Variable hydrologic events could be a limiting factor for establishing mitigation sites within the diversion channel. If the Project normally operates in the non-growing season, hydrology for the mitigation area in the diversion channel would be reliant on bank overtopping of the low-flow channel as well as runoff from interior slopes of the channel and channel embankment berms. If the Project operates during the growing season, the hydrology depth and duration in the mitigation areas would be dependent upon the individual event. While the focus for these mitigation areas is the replacement of lost function and value, due to fluctuating water levels the mitigation area would not be tied to a specific performance standard for hydrology.

In addition to variable hydrologic events, sedimentation may also become a limiting factor to the success of the plantings in the two percent slope zones. Sediment loads would be expected to be highest near the Wild Rice and Red River tieback embankment toward the south end of the diversion channel. As sediment falls out of suspension, accumulation may impede the growth of or kill the plantings. Areas of accumulated sediments would likely be patchy and the impact of this disturbance is unknown. Monitoring and adaptive management is proposed to mitigate for observed impacts.

<u>Seven to One Ratio Slope Zones of the Diversion Channel</u>
The proposed mitigation plan assumes the lower 50 feet of the seven to one ratio slope zone would be given 100 percent mitigation credit which infers that portion of the slope would normally have wetland hydrology at least in the early part of the growing season. The proposed species mix for the seven to one ratio slope zone is typical of sedge meadow/wet meadow environments where soils are commonly saturated for a significant portion of the growing season. Hydrology would not be expected for long periods during the growing season, even in the lower 50 feet of the slope, making it challenging to establish the plants which live in water (e.g., hydrophytes) as proposed in the seed mix. Some of the grasses proposed in the seed mix would be tolerant to hydrologic variability. The remaining upper part of the seven to one ratio slope zones is assumed to generate 25 percent credit.

3.4.3.2.3 Tieback Embankment
Tieback embankment impacts that occur in Minnesota east of the Red River would be approximately 19 acres as summarized in Table 3.18, and are proposed to be replaced per WCA.

Table 3.18 Estimated Direct Wetland Impacts Associated with Tieback Embankment in Minnesota

Wetland Type	Embankment Impact (acres)
Type 1 (Seasonally Flooded Basin)	17
Type 2 (Fresh (Wet) Meadow)	1
Type 3 (Shallow Marsh)	1
Total Acres	**19**

Source: USACE 2009 Wetland Inventory

The WCA requires two to one ratio replacement for these impacts which is an estimated 38 acres of mitigation in Minnesota. Mitigation would also be required under the CWA Section 404.

3.4.3.2.4 Oxbow/Hickson/Bakke Ring Levee

The USACE Omaha District determined adequate wetland replacement for the OHB ring levee through its permit process which requires that a proposed project be in the public interest and that acceptable wetland mitigation is provided. Mitigation sites for OHB ring levee impacts are stated in the OHB ring levee USACE permit, issued June 20, 2014. The OHB ring levee permit requires 30.11 acres of compensatory wetland mitigation. Of the required wetland mitigation acreage, 2.92 acres would be of onsite and in-kind mitigation for existing roadside wetland ditch segments, 9.92 acres would be of high functioning wetland mitigation sites and 17.27 acres of wetland mitigation were secured through the DU North Dakota Aquatic Resource In-Lieu Fee Program. Once credits were purchased from the DU In-Lieu Fee, the non-Federal sponsor satisfied the compensatory wetland mitigation portion of the mitigation requirements in the CWA 404 Permit. Mitigation sites for OHB ring levee impacts would be managed to comply with mitigation plans and permit conditions. A habitat-based mitigation plan would be used that includes performance standards. The OHB ring levee permit indicates the MnRAM would be used to evaluate the mitigation wetlands at the end of the monitoring period.

The OHB Wetland Mitigation Plan includes several mitigation sites including the Forest River site which has already been constructed. Other sites proposed include the Oxbow Country Club site and the remaining sites would be developed through the DU In-Lieu Fee Program. The Forest River site has had earthwork and native grass seeding completed. Tree plantings would be completed once the native grasses are established. The Oxbow Country Club site is currently part of an existing golf course. Following completion of the OHB ring levee, new wetland areas would be constructed as an extension of an existing oxbow, and native grasses and floodplain forest species would be planted.

Maintenance of the local mitigation sites would be carried out by the non-Federal sponsor and other properties owned by the corresponding Local Government Units (LGUs). Monitoring reports would be submitted to the North Dakota Regulatory Office at the end of each growing season for the first three growing seasons, and a final report would be due at the end of the fifth growing season. Reports must include logs of the wetland development, photographs and a narrative summary of the site’s development, wetland delineation, and MnRAM scores of the site for years three, four, and five. Onsite monitoring would be required from June 15 to the end of the growing season. The monitoring requirements may be waived, extended, or modified depending on the success of the wetland development.

3.5 COLD WEATHER IMPACTS ON AQUEDUCT FUNCTION AND BIOTICS

The Project includes two open-air aqueducts for the Sheyenne and Maple Rivers to cross over the diversion channel, maintaining connectivity to the natural river channels on either side (see Chapter 2, subsection 2.1.1.7, Illustration 2.6—Maple and Sheyenne Rivers Aqueduct Design). Portions of the natural river channels would be removed as the proposed diversion channel would run through them. In addition, other portions of the river channels would be abandoned adjacent to the cut off channel as a new alignment is followed to carry the river flows through the aqueducts over the diversion channel.

The aqueducts are designed to maintain connectivity for fish upstream and downstream of the aqueducts in the Sheyenne and Maple Rivers. However, water flows are naturally less in the winter which results in shallower water depths. Shallow water within the aqueducts is more likely to freeze than within the natural river channel. Freezing water within an aqueduct could result in negative impacts to fish and other water-dependent resources as a result of temporary blocking of species passage or by reducing or eliminating water flows downstream. Ice buildup within an aqueduct could also alter channel flows and result in increases in the upstream water levels. This section describes the potential impacts to the channel flows and water-dependent resources in aqueducts during cold weather conditions.

Aqueducts in cold regions are rare; and none are currently operated by the USACE. To help quantify the amount of ice that could form in the Maple River aqueduct during the winter months, the USACE Engineer Research and Development Center Cold Regions Research and Engineering Laboratory (CRREL) completed a report, *Development of Conceptual Designs for the Prevention of Ice Formation in the Proposed Maple River Aqueduct* (USACE, 2014a) (CRREL Report). The report included the analysis of different operating scenarios for the Maple River utilizing existing condition data and applying predicted results from computer modeling and analysis. The Sheyenne River aqueduct was not included in the CRREL Report analysis referenced above. The Maple River is a smaller river and serves as a tributary of the Sheyenne River. It is assumed that if there were cold weather impacts observed during aqueduct operation, that they would be likely be observed within the Maple River aqueduct first. Also, the Sheyenne River aqueduct has not been fully designed yet. When the Sheyenne River aqueduct design commences, it would be further evaluated by the USACE for potential cold weather impacts. For the purposes of this EIS and to the extent practical, cold weather impacts to aqueduct function and biotics for the Sheyenne River aqueduct have been extrapolated from the Maple River information reviewed and discussed below.

The CRREL report was the primary document referenced for technical information provided in the summary below that addresses ice formation and flow conditions for various aqueduct heating and insulation design scenarios. To help assess potential impacts of aqueduct function during freezing weather on biotics, Indexes of Biological Integrity (IBI) developed for the Project can be used to inform future monitoring efforts. IBI scores are a useful tool for assessing impacts from habitat fragmentation and connectivity barriers. IBI scores provide indicators of species tolerance; tolerant species generally have low sensitivity to barriers, while intolerant species are often eliminated upstream of barriers. Other habitat evaluation assessments were also reviewed for this discussion including the Qualitative Habitat Evaluation Index (QHEI). For this section, this information is only briefly discussed as it relates to current conditions and for mitigation and monitoring purposes. IBIs and other additional information about fish and aquatic biota and habitats are more thoroughly discussed in Section 3.8 – Fish Passage and Biological Connectivity.

3.5.1 Affected Environment

Currently the reaches of the Sheyenne and Maple Rivers within the project area are flowing in their present channels. Existing structures on the Maple River, the Sheyenne Diversion, and the West Fargo Diversion have resulted in previous impacts to fish passage and biological connectivity. Both rivers are subject to seasonal conditions and variations in flow. The Maple River is smaller than the Sheyenne River and is a tributary to the Sheyenne River.

3.5.1.1 Cold Regions Research and Engineering Laboratory Report Maple River Hydrology and Meteorology

Hydrology (flow) data was collected from two USGS gages to establish existing conditions for the Maple River. Gage 05060000 MAPLE RIVER NR MAPLETON, ND is located about 14 river miles upstream of the proposed Maple River Aqueduct, and Gage 05060100 MAPLE RIVER BL MAPLETON, ND is located about seven river miles upstream of the proposed Maple River Aqueduct. Gage 05060000 has data recorded from April 1944 to September 1958. Gage 05060100 has data recorded from October 1958 through September 1975. This gage was restarted in March 1995 and had recorded through the present (USGS 2015). Combining the data from the two gages, data for the Maple River is available for two periods of time, 1944 through 1975, and 1995 through 2013 (timeframe reflective of data available through the CRREL Report study period), with a twenty-year data gap in between, as summarized in Table 3.19 below.

Table 3.19 Summary of Gage Data Records

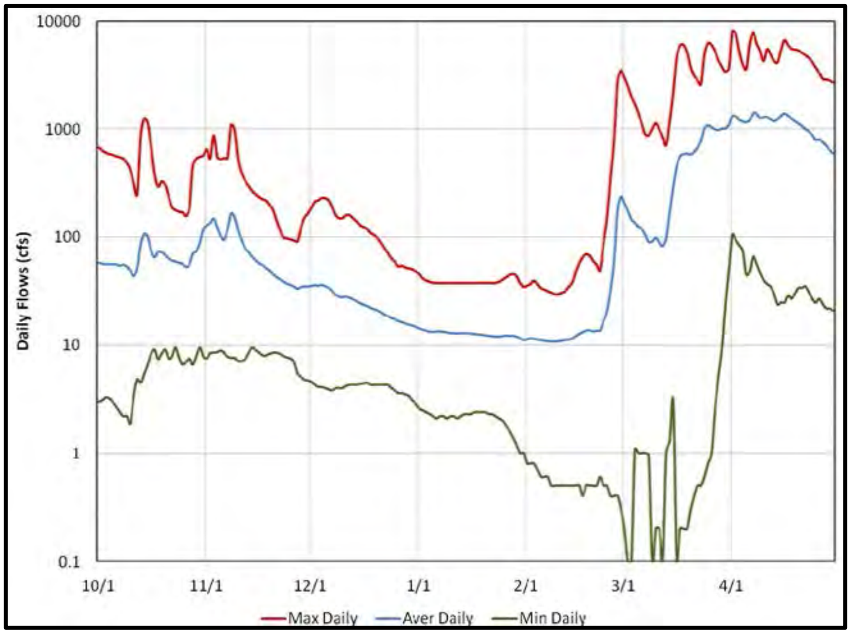
Gage 05060000	Gage 05060100
April 1944 through September 1958	-
-	October 1958 through September 1975
-	March 1995 through 2013

Source: USACE, 2014a

There is a notable difference in the magnitudes of the low winter flows between the two time periods of data (1944–1975 and 1995–2013). For the period 1944–1975, both gages display consistent and lower winter discharges compared to data from Gage 05060100 recorded after 1995. The cause of these changes was determined to be due to changes in the data collection procedures or other factors, such as modifications to upstream drainage systems, land use changes, sedimentation, and climatic variation (USACE, 2014a).

The Aqueduct Flow and Ice Simulation Model was applied over the most recent 18 winters, Water Year 1996 through the present. This period begins with the reestablishment of the USGS gage on the Maple River (USACE, 2014a). Flow data indicates that flows in the Maple River typically decline throughout the fall and winter (Graph 3.9). The wintertime discharge shows some variation, but often the river is in recession. Discharge is continually decreasing when ice is likely to form. The average daily discharge typically drops from 50 cfs at the beginning of December to about 10 cfs in late January to mid-February. During this time, the air temperatures remain below freezing (32 degrees (°) Fahrenheit (F)). There is little to no liquid precipitation or snowmelt available for runoff, and the flow in the river derives from water draining from unfrozen soil and ground-water layers. The historical lows of daily discharges are in early to mid-March when the daily discharge can drop to near zero. On average, the flow typically increases near the beginning to middle of March. In some years, the increase in flow can be rapid (USACE, 2014a).

Graph 3.9 Range of daily winter flows in the Maple River for 1995–2012.



Source: USACE, 2014a

Temperature and precipitation data was collected from the Fargo Hector International Airport (GHCND: USW00014914 and WMO: 727530), which is located about six miles east-southeast of the proposed Maple River aqueduct. Data is available for January 1948 through May 2013 (USACE, 2014a).

An analysis of winter temperatures near the Maple River aqueduct indicates that the lowest temperatures occur in the end of January, with a typical range of zero °F to 20°F and extremes ranging from −35°F to just above 40°F (USACE, 2014a). The average temperature generally remains below freezing from mid-November to mid-March. Daily average highs are typically below freezing from early December to early March. As expected, ice growth is strongly correlated to temperature and freezing degree days. The following table (Table 3.20) provides information on the coldest one, three, five, 10, and 30 day periods of the temperature record.

Table 3.20 Coldest Periods of Temperature Record

Number of days in the Period	Water Year	Date	Average Temperature (°F)	Average Flow (cfs)	Accumulated Freezing Degree Days (°F-days)
1	1996	2/1	−29.5	1.0	1612
3	1996	2/1–2/3	−27.7	1.0	1730
5	1996	1/30–2/3	−24.5	1.2	1730
10	1996	1/25–2/3	−18.8	1.6	1730
30	1982	1/7–2/5	−7.7	-	1617

Source: USACE, 2014a

3.5.1.2 Sheyenne River Hydrology and Meteorology

As noted above, a cold weather impact report has not been completed for the Sheyenne River aqueduct. Meteorology for the Sheyenne River would be expected to be relatively similar to that described above for the Maple River. Hydrology would be expected to be different from the Maple River as the Sheyenne River has approximately twice the contributing watershed size as the Maple River. When the Sheyenne River aqueduct design commences, potential cold weather impacts to the aqueduct and biotics would be assessed by the USACE. Information provided in the Maple River CRREL Report would be considered in determining what level of cold weather impact analysis is necessary for this larger river.

3.5.1.3 Maple and Sheyenne Rivers Habitat Assessments- Current Conditions

The health of the biological communities in the Sheyenne and Maple Rivers are dependent on a number of factors, including, but not limited to, water quality, habitat, and the specific needs of a certain species. Monitoring has been completed to identify the species within the system, and ranking the potential health of the system using the QHE) for macroinvertebrates and IBI for fish communities (see Section 3.8 – Fish Passage and Biological Connectivity for more details).

3.5.2 Environmental Consequences

Aqueducts have the potential to alter channel flows and impact water-dependent resources during cold weather low-flow and no-flow conditions. Freeze out can occur in a natural channel if flows, depth of water and temperatures decrease too much; blocking or reducing species passage. Aqueducts have the potential to increase the likelihood of ice formation due to the elevated structure and accelerated cooling (like a roadway bridge) compared to the surrounding ground temperatures, because an aqueduct is exposed to cold air on all sides. Freeze out of an aqueduct has the potential to reduce or impede connectivity in an affected river, as well as connectivity to the upstream tributaries. Freeze out could also increase upstream water stages.

The design dimensions of the Maple and Sheyenne River aqueducts could be different, but current plans for both river crossings are for fifty foot wide aqueducts. A larger aqueduct would likely respond differently to icing because of potentially larger volumes of water, differences in cross sections, and different water velocities. The CRREL Report provided analysis for the Maple River aqueduct. However, once frozen to the same degree, the impact of freezing on aqueduct function would be similar between the two aqueducts, but the rate at which ice develops in each aqueduct would likely be different.

Fish passage or connectivity impacts are likely to be less critical during the winter than in spring. Most fish species would make overwintering migrations well before the aqueducts could freeze; however, specific species studies are limited and therefore connectivity impacts to individual species are difficult to predict. Spring connectivity is more of a concern as many fish species initiate pre-spawning migrations well before spawning commences.

Freezing within the aqueducts could possibly be less of a concern for the Sheyenne River than for the Maple River. The Sheyenne River likely has a more stable winter flow than the Maple River as the Sheyenne has a much larger watershed and a large dam regulating flows. Therefore, low-flow or no-flow conditions that would increase the likelihood of freezing conditions in the normal channel are less likely to occur or at a minimum, would likely occur at less duration than what is observed in the Maple River.

There are other influences to fish passage within the aqueducts that may need to be considered in addition to freeze out. Influences within the aqueduct, such as Project flow velocities and bed materials, may also influence the effectiveness of fish passage within the aqueducts. To assess for impacts, flow variations and other location conditions such as temperature and precipitation would need to be observed over several years following construction and during Project operation.

3.5.2.1 Proposed Project

3.5.2.1.1 Potential Alteration of Channel Flow

Installation and operation of the proposed aqueducts in the cold weather climate of the project area has the potential to alter existing channel flow especially during the winter months. Icing in the aqueduct would likely occur at different rates (i.e., faster) compared to the rest of the natural Maple and Sheyenne River channels. Ice development in the aqueduct has the potential to cause upstream stage increases (up to the fixed crest elevation of the upstream spillway) by reducing flow and potentially blocking the aqueduct with ice, preventing water flow downstream.

To quantify the volume of ice that may form in the aqueduct, it was necessary to determine the flow conditions in the aqueduct throughout the winter. Bed ice and surface ice form only in the areas of the aqueduct covered by flow. Flow velocity and water depth are dependent not only on weather conditions but on aqueduct design (see Illustration 2.6- Maple and Sheyenne Rivers Aqueduct Design and the FFREIS – Attachment 5-Appendix F – “Hydraulic Structures” (USACE 2011) for more details on preliminary engineering plans for aqueduct designs). As the ice grows, it modifies the channel geometry, changes the water surface elevation throughout the aqueduct and controls the areas of the aqueduct where ice forms. All of these parameters are interrelated and together determine the amount of ice that forms. Hydraulic and ice modeling was used to account for this multi-variable interaction. The Aqueduct Flow and Ice Simulation Model used to estimate ice formation includes five parameters: flow, water temperature, surface ice growth, bed ice growth, and ice interaction (if surface and bed ice converge).

There are five conceptual ice control approaches for aqueduct operation in winter (USACE, 2014a). These include:

1. *Uninsulated and no heat applied*. Water flow through the proposed aqueduct would lose heat to the frigid atmosphere directly through the air and through the concrete mass of the aqueduct. The heat loss would cause surface ice to form and bed ice to form everywhere that the aqueduct is inundated. The area where ice is formed would be limited by the area inundated by the flow. This means that the flow can have a strong impact on ice production. The formation of ice in the proposed aqueduct would block the cross section flow area of the aqueduct, reduce the available flow area, and raise upstream water levels.
2. *Insulation applied to the aqueduct structure and no heat applied*. Insulating the aqueduct reduces the heat transfer through the aqueduct structure itself to the frigid air and would reduce the amount of bed ice formed. Insulation would not affect the formation of surface ice, which is formed by heat transfer from the top surface of the ice to the frigid air.
3. *Downstream control with no heat applied*. Downstream control (DSC) would maintain aqueduct flow by increasing the downstage stage through the use of a hydraulic control structure, such as an inflatable dam. Surface ice and bed ice would form, but the flow area would be maintained beneath the surface of the ice. The control structure would

result in a stage increase upstream and throughout the aqueduct to the level of the downstream control structure.

4. *Application of heat to the aqueduct with and without insulation*. The installation of heaters in the bed of the aqueduct low-flow channel would prevent the formation of bed ice in the low-flow channel and would reduce the thickness of surface ice. Eliminating the formation of bed ice in the low-flow channel would maintain a channel for the flow, which would most closely mimic a natural/existing channel process of forming ice. Surface ice would form in the low-flow channel even with bed heaters, but the ice thickness would be reduced compared to unheated scenarios. A benefit to maintaining the flow area in the low-flow channel is that flow would be confined to the low-flow channel and would not spread out across the width of the aqueduct. Minimizing the width covered by flow would minimize ice production.
5. *Additional Options*. Alternative approaches to heating the aqueducts included active and passive solar heating, and the application of retractable and permanent roofs. It is assumed that the behavior of these types of heating would likely be similar to heat application or insulation approaches; however, parameters were not included in modeling scenarios.

The CRREL Report simulated five basic scenarios:

1. The aqueduct with no applied heating or downstream control (Base scenario).
2. The aqueduct with downstream control and no applied heating (Base scenario with downstream control). Downstream elevation was maintained to keep a depth of about 11.5 ft in the aqueduct throughout the winter.
3. The aqueduct with applied heating of 5 British thermal units (Btus) per hour (hr) per foot squared (ft^2) (Btu/hr/ ft^2) in the low-flow channel and no downstream control.
4. The aqueduct with applied heating of 30 Btu/hr/ft^2 in the low-flow channel and no downstream control.
5. The aqueduct with applied heating of 60 Btu/hr/ft^2 in the low-flow channel and no downstream control.

Each of these five basic scenarios was modeled for three different options of insulation: no insulation, three inches of insulation, and six inches of insulation. Table 3.21 summarizes the 15 simulations plus a model run that did not allow ice formation. This allowed a comparison of the open water surface elevations with the scenarios in which ice formed.

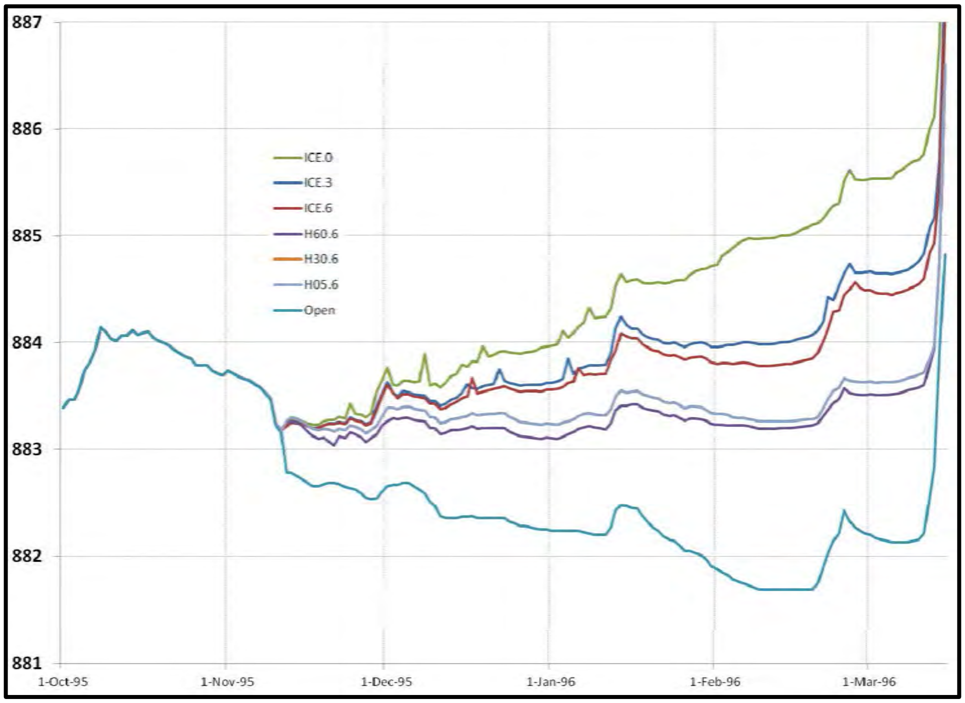
Table 3.21 Summary of Simulations

Insulation	Scenario Title	Description
No insulation on the aqueduct	ICE.0	No heat. No downstream control.
	DSC.0	No heat. Downstream elevation maintained at 892.5.
	H05.0	5 Btu/ hr/ft^2 heat in the low-flow channel. No downstream control.
	H30.0	30 Btu/hr/ft^2 heat in the low-flow channel. No downstream control.
	H60.0	60 Btu/hr/ft^2 heat in the low-flow channel. No downstream control.
3 in. of insulation on the aqueduct	ICE.3	No heat. No downstream control.
	DSC.3	No heat. Downstream elevation maintained at 892.5.
	H05.3	5 Btu/hr/ft^2 heat in the low-flow channel. No downstream control.
	H30.3	30 Btu/hr/ft^2 heat in the low-flow channel. No downstream control.
	H60.3	60 Btu/hr/ft^2 heat in the low-flow channel. No downstream control.
6 in. of insulation on the aqueduct	ICE.6	No heat. No downstream control.
	DSC.6	No heat. Downstream elevation maintained at 892.5.
	H05.6	5 Btu/hr/ft^2 heat in the low-flow channel. No downstream control.
	H30.6	30 Btu/hr/ft^2 heat in the low-flow channel. No downstream control.
	H60.6	60 Btu/hr/ft^2 heat in the low-flow channel. No downstream control.
No insulation on the aqueduct	Open	Open water comparison. No ice formation.

Source: USACE, 2014a

An additional scenario, number 16, was run for the aqueduct with no heat and no insulation and assuming no ice formation. This scenario provides an open water comparison or a baseline approximation to the existing gage depth of the Maple River in the wintertime for the Water Year 1996.

Graph 3.10 Upstream Water Levels for Water Year 1996 for Different Scenarios and for Open Water

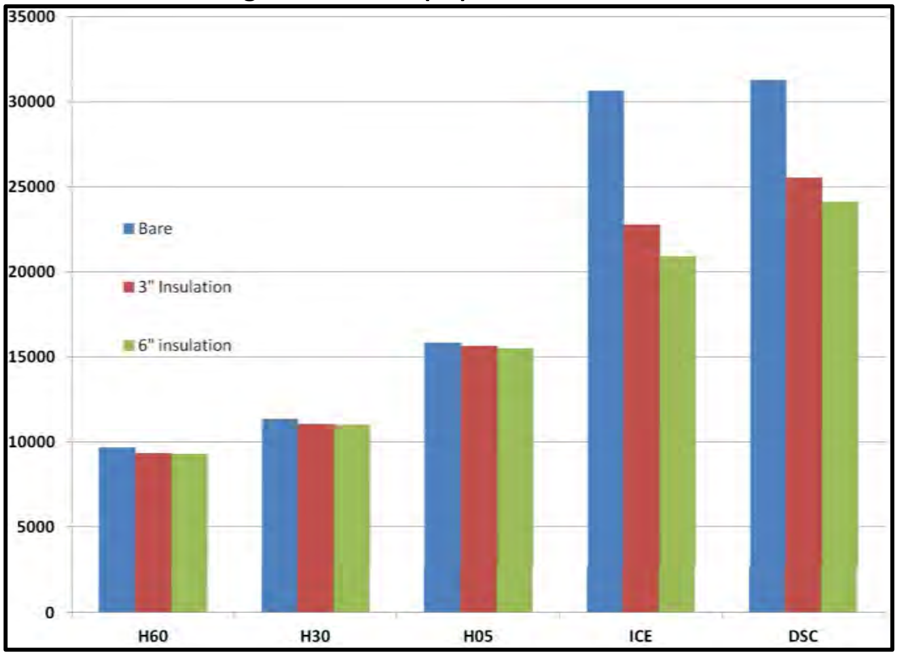


Source: USACE, 2014a

Graph 3.10 shows that select scenarios are identical prior to November 11 when ice formation commenced and compares the quantitative difference in upstream elevation based on ice thickness. In all cases the formation of ice in the aqueduct raises the upstream water level compared to the open water scenario. The largest increase in the upstream water level results for the scenario of no applied heat and no insulation (ICE.0). The scenarios with three inches (ICE.3) and six inches (ICE.6) of insulation resulted in smaller upstream water level rises over the course of the winter. The scenarios using heat application resulted in smaller increases in upstream stage. Most of the increase in the upstream stage for these scenarios results from the increase of the downstream stage boundary condition due to surface ice formation (USACE, 2014a).

Chart 3.1, below, displays the ice volume averaged over all 18 winters of the simulation periods for each scenario and for the three insulation levels. Under DSC, the downstream stage was set at 892.5, which essentially created a pool about 11.5 feet deep above the center of the low-flow channel throughout the aqueduct. This scenario generated large volumes of ice but could maintain a large flow area, if required. Insulation caused the largest reduction in ice volume for these two scenarios.

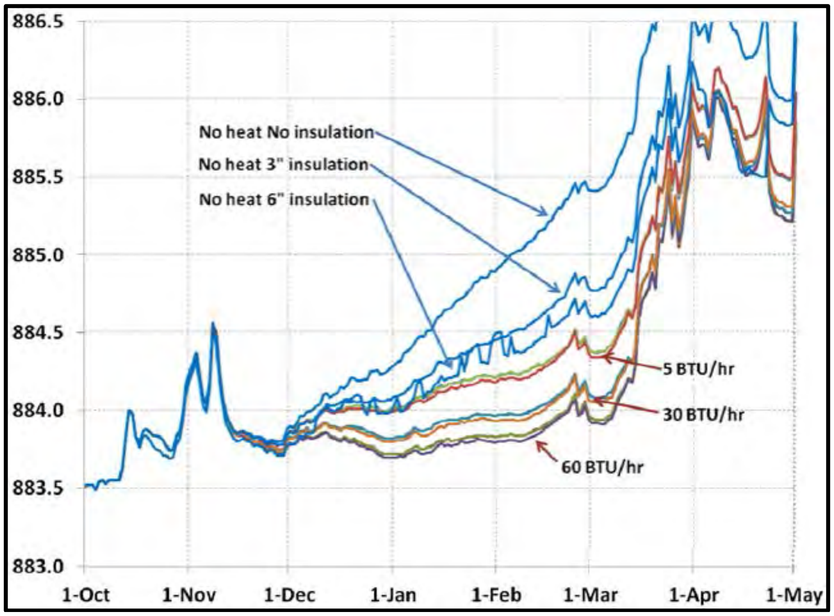
Chart 3.1 The Average Ice Volume (ft^3) Formed Under Each Scenario.



Source: USACE, 2014a

The formation of ice in the aqueduct under all the scenarios averaged over all 18 winters of the simulation periods reduced the conveyance of the aqueduct and caused the upstream stages to rise. Graph 3.11 displays the stage upstream of the aqueduct for each scenario. The unheated scenarios saw the largest stage rise. The use of insulation in the unheated scenarios resulted in the greatest impact. Applying heat to the aqueduct reduced stages compared to the unheated scenarios. However, when the aqueduct was heated, the overall impact of the insulation was greatly reduced. In the heated cases, the decrease in the upstream stages was determined almost entirely by the amount of heat applied; and the thickness of the insulation had little impact.

Graph 3.11 Average Stage at the Spillway Location for Each Day of the Winter Season Under Each Scenario.[1]



Source: USACE, 2014a

[1]The heated scenarios include no insulation, three inches of insulation, and six inches of insulation.

The use of insulation and/or heat influenced ice volume, which in turn influenced potential for upstream stage increases. Table 3.22 summarizes how insulation thickness impacted ice volume in the basic aqueduct.

Table 3.22 Insulation Impacts on Ice Volume

Aqueduct Type	Insulation Thickness (inches)	Percent Reduction in Ice Volume (%)
Basic Aqueduct	3	25.8
	6	31.8
Basic Aqueduct with Downstream Control	3	18.3
	6	22.9

Source: USACE, 2014a

Table 3.23 summarizes how the application of heat reduced the volume of ice formation in the uninsulated aqueduct. Application of heat reduced the volume of ice formed compared to the ice volume of the basic aqueduct without heat.

Table 3.23 Heat Impacts on Ice Volume

Aqueduct Type	Application of Heat (Btu/hr/ft^2)	Percent of Ice Volume Compared to Non-heated Aqueduct (%)
Uninsulated Basic Aqueduct	60	31.6
	30	37.0
	5	51.6

Source: USACE, 2014a

The use of insulation on the outside of the aqueduct did little to improve the ice reduction performance of the heated aqueduct. Table 3.24 provides a summary of results associated with the use of both insulation and heat on the aqueduct.

Table 3.24 Comparison of Heat Application and Insulation

Aqueduct Type	Application of Heat ($Btu/hr/ft^2$)	Insulation Thickness	Percent Reduction in Ice Volume (%)
Insulated Aqueduct with heat	60	3	3.5
		6	4.1
	30	3	2.8
		6	3.2
	5	3	1.3
		6	2.2

Source: USACE, 2014a

Under all the scenarios, the formation of ice in the aqueduct reduced the conveyance of the aqueduct and caused the upstream stages to rise. The average upstream stage varied between three feet (above datum) for the heat scenario and 3.4 to 3.9 feet (above datum) for the unheated scenarios.

Surface ice would typically form in the low-flow channel even with the bed heaters, but the ice thickness would be reduced compared to the unheated scenario. Historically the Maple River typically does not freeze through, sustaining an average around 10 cfs flow.

Additionally, there is potential for ice flows and other debris to accumulate in the aqueduct structure, which could cause debris jamming and blocking of the aqueduct. Debris dams could block the aqueduct and cause upstream stage increases up to the fixed crest elevation of the upstream spillway, which is separate from the aqueduct structure and would allow flow into the diversion channel, before flooding would occur to areas upstream. The spillway is intended to direct flow into the diversion channel at about a 2-year flood. This would likely prevent upstream flooding from debris or ice jams at the aqueduct.

3.5.2.1.2 Potential Impacts to Aquatic Habitat and Biological Connectivity

Section 3.8.2 discusses fish passage and biological connectivity on the Maple and Sheyenne Rivers. If the aqueducts are properly designed and constructed to convey flows from the Maple and Sheyenne Rivers under all flow conditions, impacts to fish migration and/or habitat connectivity would likely be minimal. However, as previously discussed, cold weather conditions (i.e., potential freezing of the aqueduct), along with typically low river flows during a particular season, regardless of design considerations, have the potential to impact fish passage and biotic connectivity within the aqueduct. Timing of freeze, extent of freezing (e.g., partial blockage or full blockage), duration of freeze, all are important factors that would contribute to potential fish passage and biological connectivity impacts.

3.5.2.2 Base No Action Alternative

The Base No Action Alternative would not interrupt the historic or current function and condition of the Maple and Sheyenne Rivers. The Base No Action Alternative would result in the continued threat of flood damage to the project area and infrastructure during high water events. The Sheyenne Diversion and West Fargo Diversion were constructed to reduce flood risk to the F-M urban area and its infrastructure during flood events.

3.5.2.3 No Action Alternative (with Emergency Measures)

The No Action Alternative (with Emergency Measures) would be similar to the Base No Action Alternative in that the historic and current function of the Maple and Sheyenne Rivers would not be interrupted. Emergency measures are not currently used or anticipated around the Maple and Sheyenne Rivers. If sandbagging and temporary levees are used in this area to protect adjacent floodplain areas, more flow would remain in the river channels and could increase flow velocities.

3.5.2.4 Northern Alignment Alternative

The NAA would not change the location or anticipated design of the aqueducts on the Maple and Sheyenne Rivers, and therefore, potential impacts from these aqueducts would be the same as those described for the Project.

3.5.3 Proposed Mitigation and Monitoring Measures

Based on the CRREL Report modeling results and summary, different design options and operation of an aqueduct would result in various thicknesses of ice formed in the aqueduct, the amount of flow allowed through the aqueduct, and the additional level of upstream stage rise due to flow constriction. These could have varying effects on fish passage and biological connectivity within these river systems. Current preliminary engineering plans have included heating components to reduce the thickness of ice in the low flow channels within the aqueducts to a level that prevents flow from passing through the aqueduct. (FFREIS, Attachment 5, Appendix F – "Hydraulic Structures"). The USACE Ground Source Heat Pump Renewable Energy Center of Expertise has been engaged to determine the feasibility of using ground source heat pump (GSHP) to heat the winter channel and compare the life cycle costs associated with heating the winter channel between the GSHP, electric heating elements, and boiler/hot water system. The investigation is ongoing.

However, due to the complex, dynamic nature of river systems, it is difficult to predict actual impacts of the aqueducts or the true functionality and value of the proposed mitigation projects until the actual conditions can be observed. As a result, post-construction and Project operation monitoring efforts would be a key component in determining aqueduct impacts to the riverine systems and any adaptive management response.

The following provides a brief summary of proposed mitigation and monitoring measures for fish and biotic connectivity, and habitat loss. Additional discussion on proposed mitigation and monitoring measures for the Maple River and Sheyenne River is provided in Section 3.8 – Fish Passage and Biological Connectivity. Section 6.2.8 Mitigation and Monitoring and the Draft AMMP included as Appendix B provide further details of proposed mitigations, the evaluation of proposed mitigation and monitoring along with additional recommendations, if necessary.

3.5.3.1 Fish and Biological Connectivity

Monitoring to assess potential impacts to fish migration on the Maple and Sheyenne Rivers would occur once Project features are in place and the Project is put into operation. The Draft Adaptive Management and Monitoring Plan (Appendix B) includes an Aquatic Biological Monitoring Plan that details proposed and recommended monitoring (see also Chapter 6 for a summary of proposed mitigation and monitoring measures). The Aquatic Biological Monitoring Team in coordination with the Adaptive Management and Monitoring Team (teams identified through the adaptive management approach) would collaborate on how best to identify and define fish passage effectiveness. This could include assessing the number of species observed to pass through a structure; and the relative percentage of a population that accumulates below a structure that is able to migrate around or through a structure (FFREIS 2011).

3.6 COVER TYPES

Cover type is a general term that refers to the specific land cover of an area. Six general cover types occur in the project area: cropland, wetlands, lawn/landscaping, wooded/forest, impervious surfaces, and brush/grassland. This section describes current cover types in the project areas that would experience impacts from Project construction and operation, and mitigation measures to avoid or minimize impacts. Cover type information was obtained from the USACE FFREIS, Supplemental EA, and SEAW.

3.6.1 Affected Environment

Due to the size of the project area, cover types were narrowed down to areas that would be impacted by the Project: the Project footprint (i.e., direct impacts from construction of Project features) and the inundation area (i.e., indirect impacts from flood inundation).

A total of six cover type are represented in the project area and would be directly impacted. Of these, cropland is the primary cover type comprising over 75 percent of the Project footprint. The second greatest cover type is wetlands, covering over 20 percent of the Project footprint. Some of the wetland acreage may be currently drained and used as cropland. Other cover types present within the Project footprint and project area: brush/grassland, wooded/forest, lawn/landscaping, and impervious surfaces. Table 3.25 provides a summary of the cover types present in the Project footprint.

Table 3.25 Cover Types Present in the Project Footprint

Land Cover Type[1]	Current Project Footprint (acres)
Wetlands[2]	1,780
Lawn/Landscaping[3]	<100
Wooded/Forest	70
Impervious Surface[4]	50 (approx.)
Brush/Grassland[5]	100
Cropland[6]	6,500
TOTAL (approximate)	**8,600**

Sources: FFREIS, Supplemental EA, SEAW, USGS 2001 National Land Cover Dataset (NLCD)

[1] The USGS 2001 NLCD was used to estimate cover types. This data was not field verified, and is intended to provide rough estimates.

[2] NWI, using Eggers & Reed classification and Circular 39, was used to estimate newly inundated wetland. This data was not field verified, and is intended to provide rough estimates.

[3] Lawn/landscaping correlates to Developed-Open Space in the USGS 2001 NLCD.

[4] Impervious surface correlates to Developed: High, Medium and Low Intensity in the USGS 2001 NLCD.

[5] Brush/grassland includes USGS 2001 NLCD pasture and hayland classification.

[6] Cropland correlates to the USGS 2001 NLCD cultivated crops classification.

Indirect impact acreages were evaluated for areas outside of the Project footprint in portions of the project area for areas that would be newly inundated under Project conditions. The project area includes the same cover types as those identified for the Project footprint with ratios of cover types anticipated to be similar to those within the Project footprint. Field verification has not been completed on cover types and wetlands located outside of the Project footprint. Wetlands are classified into six types using the Circular 39 system (Shaw and Fredine, 1971) and Eggers and Reed classification. The majority of wetlands are Type 1 wetland (farmed), which have previously been converted from their natural condition to an agricultural use. Other wetland types comprise a much smaller component of the overall cover (see Section 3.4 – Wetlands for further details).The brush/grassland cover type is primarily tame grassland or hayland; native grassland is not present in the project area. Wooded/forest cover type is primarily shelterbelts and planted windbreaks. The natural woodland in the project area is floodplain forest (discussed in detail in Section 3.4 – Wetlands and Section 3.9 – Wildlife and Wildlife Habitat), and lawn/landscaping and impervious surfaces are associated with developed, urban areas.

3.6.2 Environmental Consequences

Cover type impacts have implications for numerous resources, such as wildlife, state listed species, and wetlands. Potential impacts on other resources in the project area as a result of changes in cover types are discussed in their respective sections of the EIS. The focus of this assessment is on permanent changes in cover type (i.e., direct impacts from the Project footprint of the diversion channel, tieback embankment, and associated facilities). Project operation would result in indirect impacts due to flood water staging upstream of the tieback embankment for any flood event greater than the 10-percent chance flood (i.e., 10-year flood).

3.6.2.1 Proposed Project

Areas that would be permanently converted to a different cover type after construction of the Project include the footprint of the diversion channel, tieback embankment, control structures and the Comstock and OHB ring levees. Other permanent structures such as in-town levees and floodwalls would be constructed in already urbanized areas and would not result in a substantial change in cover type.

Project operation would result in indirect impacts to cover types due to inundation during flood events and would not cause a permanent conversion of existing cover types from individual flood events. During Project operation, new inundation (i.e., indirect impacts) is anticipated to occur to approximately 20,000 acres for the 1-percent chance flood (100-year flood). Some current cropland would be purchased as part of the Project and would no longer be farmed. These areas may be reseeded with native plant species, and therefore, converted to grassland or other appropriate cover type. It is also anticipated that sedimentation would occur incrementally over time in portions of the inundation area upstream of the tieback embankment, primarily nearest the tieback embankment. This could result in cover type conversion in areas that are not actively used for agriculture. Most impacts from newly inundated areas would occur to cropland. Table 3.26 provides a summary of both indirect and direct Project impacts.

Table 3.26 Cover Types: After Construction and Operation of the Project

Land Cover Type	Direct Impacts: Project Footprint After Construction (acres)	Indirect Impacts: Inundation Area Additional 100-year Flood Area With Project Operation (acres)[1]
Wetlands[2, 7]	1,780	151
Lawn/Landscaping[3]	0	1,305
Wooded/Forest	0	112
Impervious Surface[4]	50 (approx.)	1
Brush/Grassland[5]	4,000-4,700[8]	1
Cropland[6]	2,100[9] (approx.)	18,630
TOTAL[1,2] (approximate)	**8,600**	**20,200**

Sources: FFREIS, Supplemental EA, SEAW, USGS 2001 NLCD

[1] The USGS 2001 NLCD was used to estimate cover types. This data was not field verified, and is intended to provide rough estimates.

[2] NWI, using Eggers & Reed classification and Circular 39, was used to estimate newly inundated wetland. This data was not field verified, and is intended to provide rough estimates.

[3] Lawn/landscaping correlates to Developed-Open Space in the USGS 2001 NLCD.

[4] Impervious surface correlates to Developed: High, Medium and Low Intensity in the USGS 2001 NLCD.

[5] Brush/grassland includes USGS 2001 NLCD pasture and hayland classification.

[6] Cropland correlates to the USGS 2001 NLCD cultivated crops classification. Some of the cropland in the project area is depicted as farmed wetland on the 2001 NLCD, and therefore is included under wetland acreage

[7] The current wetland mitigation plan uses the bottom of the diversion channel for wetland creation. The wetland type in the diversion channel bottom may be a combination of Type 2 and Type 1 emergent wetland, but the entire acreage has been included as Type 2 since differentiating based on available information is not possible.

[8] There is uncertainty as to how much of the diversion channel would be considered wetland, upland, and cropland. Operation of the channel would dictate the difference between wetland and upland cover types. Therefore, Grassland has considerable uncertainty.

[9] Acreage for cropland is the area on the outside of the diversion channel.

3.6.2.1.1 Cropland

Construction of the diversion channel would result in the greatest cover type change by converting approximately 4,500 acres of cropland to grassland and wetland (see Table 3.26 and associated footnotes). The change in cover type from cropland to grassland or wetland would span a long distance (greater than 30 miles, with an average width of approximately 1,300 feet), minimizing potential direct impacts to individual areas of cropland. There is some uncertainty as to how much of the diversion channel embankment would become grassland cover, as Project construction would require specific wetland mitigation based on impacts (see Section 3.4 – Wetlands for details).

Additionally, it is anticipated that agricultural production on the cropland would continue outside of the tieback embankment area further reducing direct impacts to cropland. Total potential cropland impacts are estimated to be approximately 4,500 acres, which is less than one-half percent of the total cropland in Cass and Clay Counties (FFREIS 2011). Relative to the larger project area and the Red River Valley region, this permanent loss of cropland would not be substantial. Project operation would result in approximately 18,630 acres of indirect cropland impacts in the inundation area upstream of the tieback embankment during the 1-percent chance flood (100-year flood).

3.6.2.1.2 Brush/Grassland

The current estimated brush/grassland (i.e., grassland) in the Project footprint is approximately 100 acres. Grassland would increase between 3,900 and 4,600 acres as a result of Project construction. This increase is mainly a result of seeding the diversion channel side slopes with grass species to aid in soil stabilization post-construction. This grassland would transition to wetland at the bottom of the diversion channel and on some of the side slope areas. Project operation would result in approximately one acre of indirect impacts to grasslands in the inundation area during the 100-year flood.

3.6.2.1.3 Wetlands

Direct impacts to wetlands in the Project footprint are estimated to result in a total of approximately 1,780 acres. Type 1 Wetlands (farmed) would be the primary wetland cover type impacted in the Project and OHB Levee footprint, with impacts totaling approximately 1,477 and 44 acres, respectively. Impacts to these wetlands would be mitigated by creation of approximately 1,597 acres of Type 2 Wetlands within the diversion channel. Additional detail about specific wetland types and potential acreage impacts to those types is discussed in Section 3.4 – Wetlands.

The floodplain forest is the only natural forest habitat in the project area, with impacts totaling approximately 62 acres. Impacts to this habitat type would be mitigated at a two to one ratio by creation of 124 acres of floodplain forest habitat in existing floodplain and agricultural land. For additional information, see Section 3.4 – Wetlands and Section 3.9 – Wildlife and Wildlife Habitat.

Project operation would result in approximately 151 acres of indirect impacts to wetlands in the new inundation area during the 100-year flood. Floodplain forest wetland impacts (0.2 acres) are anticipated to occur along the Red River and Wild Rice River corridors. The estimated indirect wetland impacts are based on USFWS NWI, Eggers and Reed classification, and Circular 39 and have not been field verified.

3.6.2.1.4 Wooded/Forest

Shelterbelts and windbreaks are grouped under the Wooded/Forest cover type. After construction, 70 acres of this cover type would be converted to grassland or wetland cover in the diversion channel. In general, this cover type has been planted and would not represent a natural forest condition. Conversion of this cover type is not anticipated to result in substantial impacts.

Project operation would result in approximately 112 acres of indirect impacts to wooded/forest cover type in the inundation area during the 100-year flood event. Based on review of the USGS 2001 NLCD, the majority of these impacts would occur to shelterbelts and windbreaks.

3.6.2.1.5 Lawn/Landscaping

Lawn/Landscaping impacts would occur primarily around urban or residential areas, where natural cover has already been converted to human uses. Less than 100 acres of this cover type would be converted to grassland or wetland cover in the diversion channel.

Based on review of the USGS 2001 NLCD, operation of Project would result in approximately 1,305 acres of indirect impacts to lawn/landscaping cover type in the inundation area during the 100-year flood.

3.6.2.1.6 Impervious Surface

Impervious surface cover would not change as a result of the Project. Operation of Project would result in approximately one acre of indirect impacts to lawn/landscaping cover type in the inundation area during the 100-year flood. Based on the USGS 2001 NLCD, the majority of these impacts would be to roadways in the staging area. The Project would raise or alter some of these roads (Section 3.13 – Infrastructure and Public Services).

3.6.2.2 Base No Action Alternative

Under the Base No Action Alternative, flooding would continue in the project area. Cover types are expected to stay relatively similar, with natural changes in vegetation communities occurring over time after flooding or other natural disturbance events. Additional wetlands may be converted to agricultural use at the discretion of individual landowners and permitting authorities. This area of North Dakota and Minnesota has been developing at a fairly consistent rate. As the F-M urban area grows, various cover types would likely be converted to lawn/landscaping and impervious surfaces with the development.

3.6.2.3 No Action Alternative (with Emergency Measures)

Flooding would continue throughout the project area, with temporary changes in cover during flood events. Overall, cover types would be anticipated to remain similar to their current condition, with natural changes in vegetation communities occur over time. Emergency measures are not anticipated to cause substantial changes in cover types. Localized, indirect impacts to cover types may occur where sandbagging and temporary levees are constructed for the duration of a flood event. Direct impacts are not anticipated.

3.6.2.4 Northern Alignment Alternative

Direct and indirect impacts from operation of the NAA are anticipated to be similar to those previously described for the Project with the exception of the overall cover type acreage affected by new inundation. Cover types were not field verified for the NAA and the design of the NAA has not been completed; however, it is anticipated that the NAA construction footprint impacts (i.e., direct impacts) would be similar to the total cover type acreage impacts for the Project, totaling approximately 8,000 acres. During NAA operation, new inundation (i.e., indirect impacts) is anticipated to occur to approximately 15,450 acres for the 100-year flood.

The 2001 USGS NLCD and NWI, using Eggers and Reed classification and Circular 39, were used to evaluate the cover types and wetlands occurring in areas that would be newly inundated by the NAA. Table 3.27 provides a summary of cover types that would be impacted by new inundation during NAA operation.

Table 3.27 Cover Types Impacted by New Inundation During NAA Operation For the 100-year Flood

Land Cover Type	Indirect Impacts: New Inundation Area for the 100-year Flood During NAA Operation (acres)[1]
Wetlands[2]	148
Lawn/Landscaping[3]	970
Wooded/Forest	60
Impervious Surface[4]	1
Brush/Grassland[5]	1
Cropland[6]	14,270
TOTAL	**15,450**

Sources: FFREIS, Supplemental EA, SEAW, USGS 2001 NLCD
[1] The USGS 2001 NLCD was used to estimate newly inundated cover types. This data was not field verified, and is intended to provide rough estimates.
[2] NWI, using Eggers & Reed classification and Circular 39, was used to estimate newly inundated wetland. This data was not field verified, and is intended to provide rough estimates.
[3] Lawn/landscaping correlates to Developed-Open Space in the USGS 2001 NLCD.
[4] Impervious surface correlates to Developed: High, Medium and Low Intensity in the USGS 2001 NLCD.
[5] Brush/grassland includes USGS 2001 NLCD pasture and hayland classification.
[6] Cropland correlates to the USGS 2001 NLCD cultivated crops classification.

Indirect impacts to cover types from flood inundation are not anticipated to result in changes to vegetation communities or cover types for individual flood events. Sedimentation has the potential to occur incrementally over time in portions of the inundation area nearest the tieback embankment. Sedimentation may occur slowly over time and could lead to changes in vegetation communities and cover types in some areas, particularly areas where sediment may accumulate or areas that are not actively used for agriculture. Additional information on potential impacts to wetlands and specific wetland types is provided in Section 3.4 – Wetlands.

Some areas currently used as cultivated cropland may be purchased and potentially converted to grassland or another cover type as part of mitigation for the Project. Additional discussion on proposed mitigation and monitoring is provided in subsection 3.6.3.

3.6.3 Proposed Mitigation and Monitoring Measures

Cover type impacts would occur primarily to croplands and wetlands. Cropland impacts would be mitigated by compensation to landowners for direct cropland impacts, such as land purchase for Project construction. Owners of croplands that are purchased for the Project would be compensated at fair market value (FFREIS 2011). The area where agricultural use is not feasible in certain areas of the tieback embankment would be seeded and revegetated with native plant species and managed as grassland. Flowage easements have also been proposed for mitigation of cropland, which would allow agricultural use to continue on the land.

Preliminary North Dakota mitigation plans call for wetland impacts to be replaced on a functional level and not by specific wetland type. This could result in a specific wetland type having an overall acreage loss within the project area. The vast majority of the impacted wetland acreage is Type 1 Wetland (farmed) and would be mitigated by creation of wetlands within the diversion channel on the bottom and some side slope areas. Mitigation for non-forested wetland impacts associated with the diversion channel is revegetation at the bottom of the diversion channel and management of upland inside slopes.

All direct impacts to the floodplain forest would be mitigated at a two to one ratio. The USACE St. Paul and Omaha Districts, as well as the USFWS, have used “Blue Books” (USFWS habitat assessment models) to determine adequate replacement for the forested impacts. Some of these sites have been preliminarily identified by the USACE. Additional wetland mitigation discussion is provided in Section 3.4 – Wetlands.

All direct impacts to Wooded/Forested cover types are proposed to be mitigated by converting farmed wetland along the Red River into floodplain forest at a 2 to 1 ratio.

Uncertainty associated with both the level and type of impacts and the effectiveness of mitigation would be addressed as part of an adaptive management plan (see AMP, FFREIS and Draft AMMP, Appendix B). This plan requires pre- and post-construction studies of biota and physical habitat for both impact sites and mitigation sites. This would allow impacts to be verified and mitigation effectiveness to be evaluated. A key component of adaptive management is a thorough monitoring program with performance measures, action thresholds, and response actions. Monitoring activities, including review of results, would be performed by an adaptive management team.

3.7 POTENTIAL ENVIRONMENTAL HAZARDS

The project area has numerous parcels of land and associated structures that may have potential hazardous, toxic, and radioactive wastes (HTRWs) issues. The HTRWs have the potential to contaminate soil and groundwater resources. To identify the potential extent of HTRW issues that may be present in an area or specific parcel of land, Phase I Environmental Site Assessments (ESAs) are typically conducted. A Phase I ESA is an investigation of a parcel of land and its associated structures for potential environmental issues. During a Phase I ESA survey, potential issues are identified by site visits to document current uses and features; searching current and historical records; or interviewing current users, owners, and city/county offices. The goal of Phase I ESAs is to identify the potential for recognized environmental conditions (RECs) that exist at a site. RECs are defined as: the presence or likely presence of any hazardous substances or petroleum products in, on, or at a property that have the potential to release into the environment, and therefore, pose a threat due to the potential for contamination of soil, groundwater, or surface water (ASTM 2013).

If Phase I ESAs identify RECs and consider a site to be potentially contaminated with hazardous substances or petroleum products, Phase II ESAs are recommended to provide a more detailed investigation, which involves chemical analysis of soil and groundwater to detect the presence of hazardous substances and/or petroleum hydrocarbons. The additional details gathered would provide information necessary to determine what types of RECs may be present, if any, and if avoidance, mitigation or monitoring measures necessary.

This section discusses the Phase I ESAs that have been completed in the project area and the results and recommendations of those assessments. In addition, this section also discusses proposed and potential mitigation and monitoring actions and what could result if HTRWs are not handled properly. A more detailed discussion and evaluation of the proposed mitigation and monitoring as well as any additional recommendations for mitigation and monitoring is included in Chapter 6.

3.7.1 Affected Environment

Several Phase I ESAs have been conducted within the project area; however, these were completed along the alignments where Project features were proposed to be constructed as described in the FFREIS. Therefore, investigations have not been completed for the current Project design, in consideration of the NAA, or for those areas outside the staging area that would be affected during Project and or NAA operation, except where the earlier Project design included a constructed feature. Those areas where investigations have not been conducted include the western alignment shift, southern alignment shift, Comstock ring levee, parts of the staging area or proposed mitigation sites, and parts of the inundation areas outside of the staging area. The USACE has stated that additional Phase I ESAs would be completed for properties in the inundated areas as Project designs are refined and as the areas that would be impacted are more clearly defined.

The Phase I ESAs included recommendations for Phase II ESAs to be completed for those sites in which it was determined that further investigation was necessary. These recommended Phase II ESAs were not completed at the time of EIS publication. As Project designs have changed and continue to be revised, the need for the recommended Phase II ESAs would be reevaluated. Any necessary previously recommended Phase II ESAs and newly recommended Phase II ESA needs would be completed as needed as Project designs are refined.

The following Phase I ESAs were reviewed for this EIS.

- *Phase I Environmental Site Assessment, Moorhead Metro Feasibility Study HTRW, Clay County, Minnesota,* prepared for the USACE by Stanley Consultants, Inc. and dated November 2010 (2010 Moorhead ESA) (Stanley Consultants, 2010b).
- *Phase I Environmental Site Assessment, Fargo Metro Feasibility Study HTRW,* prepared for the USACE by Stanley Consultants, Inc. and dated November 2010 (2010 Fargo ESA) (Stanley Consultants, 2010a).
- *Fargo-Moorhead Metropolitan Area Flood Risk Management Project, Phase I Environmental Site Assessment (ESA) 2012 Supplement*, prepared for the USACE St. Paul District, by the USACE St. Louis District and dated September 2012 (2012 Supplemental ESA) (USACE, 2012b).
- *In-Town Levees Project Phase I Environmental Site Assessments* (a number of specific properties were assessed), prepared for the Fargo-Moorhead Diversion Authority by HDR Engineering Inc. and dated July 2013 (2013 In-Town Levee ESAs) (HDR Engineering, Inc., 2013a-f).
- *Phase-I Environmental Site Assessment Report, Oxbow-Hickson-Bakke, North Dakota, Flood Risk Reduction Project*, prepared for the USACE St. Paul District, by the USACE St. Paul District and dated August 15, 2014 (2014 OHB ESA) (USACE, 2014b).

A summary of each completed Phase I ESA and the associated REC(s) is provided below.

3.7.1.1 2010 Moorhead Environmental Site Assessment

The 2010 Moorhead ESA evaluated parcels that would be directly affected by the construction footprint of an approximately 26-mile proposed diversion channel and associated tieback levee for three alternative alignments located in the Moorhead, Minnesota area.

The 2010 Moorhead ESA identified ten RECs, consisting of hazardous substances and release of hazardous substances. However, since the completion of the 2010 Moorhead ESA, this alternative diversion channel alignment and structures were not included in and are not applicable to the Project, and therefore, RECs identified in the 2010 Moorhead ESA no longer pertain and will not be discussed further.

3.7.1.2 2010 Fargo Environmental Site Assessment

The 2010 Fargo ESA evaluated parcels that would be directly affected by the construction footprint of the approximate 35-mile proposed diversion channel and associated tieback embankment for three alternative alignments.

The 2010 Fargo ESA identified four RECs containing hazardous substances. One of the four RECs included 13 parcels adjacent to railroads at four intersections with the Project in North Dakota. The RECs are summarized in Table 3.28.

Table 3.28 Summary of Recognized Environmental Conditions Identified in the 2010 Fargo ESA

REC Number	Affected Parcel(s)	Description of REC
1	70000013646010	Junk vehicles and large storage building that may potentially store petroleum and/or other hazardous substances
2	4400000012820	Junk vehicles with visual staining
3	150091001	Junk vehicles, hobby shop with stored petroleum and/or hazardous substances
4	09020011902000, 59000010866000, 590000108687000, 530000009023000, 530000009023010, 02300001455000, 530000008024000, 67000012709000, 67000012714020, 67000012714010, 15000050, 150092500, 150091000	13 parcels (4 Railroad crossings in ND). Contaminants may include: arsenic, chromates, coal, creosote, and lead

Source: Stanley Consultants, 2010a

3.7.1.3 2012 Supplemental Environmental Site Assessment

The 2012 Supplemental ESA covers the Project design evaluated for the FFREIS, which has changed since 2012. The Project design evaluated in the 2012 Supplemental ESA consists of a North Dakota diversion channel, upstream staging and storage areas, and associated structures. This ESA includes areas that were not previously included in the 2010 Fargo ESA, including an alignment shift along the northern portion of the diversion channel, extensions on the tieback embankment in Minnesota, overflow embankment along Highway 17, staging area, and storage area. The 2012 Supplemental ESA also revisited RECs noted in the 2010 Fargo ESA to identify any potential changes. The 2012 Supplemental ESA did not provide specific details about RECs for each property, but rather general information about where possible RECs may occur in the staging area.

The 2012 Supplemental ESA identified the following potential RECs generally occurring in the project area:

- Aboveground storage tanks (ASTs) – Propane, Diesel, Gasoline, Heating Oil
- Underground storage tanks (USTs) – Heating Oil
- Potential Asbestos Containing Materials (ACMs)
- Polychlorinated Biphenyls (PCBs) – Transformers

- Underground Gas Lines
- Underground Utilities – Wells, Communication, Power
- Railroad Crossings – Poly Aromatic Hydrocarbons (PAHs), Metals

The above RECs are in addition to the RECs identified in the 2010 Fargo ESA.

3.7.1.4 2013 In-Town Levee Environmental Site Assessments

The 2013 In-Town Levee ESAs cover properties that would be affected by the construction of six in-town levees, which include:

- City Hall Parking Lot Property
- Fargo Public Schools Property
- Feder Realty Property
- Howard Johnson Property
- Park East Apartments Property
- Case Plaza Property

Of the six properties that would be affected by in-town levees, potential RECs were identified on three of the properties: City Hall Parking Lot, Howard Johnson, and Casa Plaza. The 2013 In-Town Levee ESAs did not identify any RECs on the Fargo Public Schools, Feder Realty, or the Park East Apartments properties. A summary of identified RECs is provided in Table 3.29.

Table 3.29 Summary of Recognized Environmental Conditions Identified in 2013 In-town Levee ESAs

REC Number	Property	Description of RECs
1	City Hall Parking Lot Property	Soil/Groundwater contamination from adjacent sites, which historically included a tannery, foundry, and machine & welding services
2		At least three feet of fill below surface, which may be contaminated
3	Howard Johnson Property	One unmaintained underground storage tank
4	Case Plaza Property	Soil/Groundwater contamination from adjacent sites, which historically included a lumber yard and farm equipment manufacturer
5		Soil/Groundwater contamination from adjacent site, which historically included a gas station with underground storage tanks

Source: HDR Engineering, Inc., 2013 a-f

3.7.1.5 2014 Oxbow/Hickson/Bakke Environmental Site Assessment

The 2014 OHB ESA covers properties that would be affected by the construction of a ring levee around the City of Oxbow, the Village of Hickson, and Bakke Subdivision, North Dakota, which include residential properties and tilled farmland.

A search performed by Environmental Data Resources identified one potential REC, an UST listed on the North Dakota UST database. Follow-up research for the potential REC was completed by contacting the North Dakota Department of Health Hazardous Waste Program, who had no record of the UST. Additional follow-up was conducted by contacting the company listed (Petro-Serve USA) who also stated they have never had a station or UST in the vicinity. The

UST is considered likely to be an error in the database. Also, a listing on the North Dakota UST database does not necessarily mean the site is a REC. Other possible RECs visually identified in the area included:

- Aboveground Storage Tanks (propane);
- Below ground utilities (water, power, communications);
- Potential asbestos shingles; and,
- Aboveground utilities (power, communications).

The visually identified sites are not necessarily RECs, but could affect construction if not given consideration and further evaluation prior to construction.

3.7.2 Environmental Consequences

In general, flooding can carry contaminants and soils as it moves across the watershed. The concentration of these contaminants and soils is dependent on the nature of the flood event and the condition of the watershed. For example, a large flood event occurring in an agricultural area would have different non-point sources of water pollution concentrations than a flood event occurring in an urbanized area. Non-point sources of pollution may include pesticides, fertilizers, detergents, motor oil, and sediments that are typically found untreated on impervious surfaces and in soils or waterbodies in a watershed. Flooding can carry or spread these non-point pollution contaminants and soils as water flows and recedes with flood events, which can lead to contamination or concentrations of contamination in other areas of a watershed. RECs are point sources of pollution. However, if over time, RECs have leaked or leached into soil or waterbodies, they may contribute to overall non-point sources of pollution in the watershed, which would then be spread to other areas during flood events.

3.7.2.1 Proposed Project

Project construction would directly impact parcels with identified RECs as summarized in Table 3.30 and Table 3.31. These RECs include junk vehicles, petroleum products, and railroad crossings that may contain contaminants or may have contaminated soil or groundwater. One REC identified in the 2010 Fargo ESA (Table 3.30, REC Number 2) is no longer included in the Project due an alignment shift in the Project design. Additional Phase I ESAs would be needed to address Project design changes that have occurred since the Phase I ESAs, reviewed for this EIS, were completed. These design changes include, for example, the western alignment shift, southern alignment shift, Comstock ring levee, parts of the staging area, and areas outside the staging area that would be affected during Project operation, as well as proposed mitigation sites. Construction has the potential to impact identified RECs, which has the potential to spread contaminants in soil and groundwater. This could result in potentially adverse impacts to human health and water quality. Operation of the staging area also has the potential to spread contaminants of identified RECs if not handled properly.

Of the four RECs identified, the railroad crossings and associated contaminants have the greatest potential for contamination and subsequent remediation. Subsequent Phase I ESAs conducted in the project area, as a result of design changes, may result in additional identified RECs. A general discussion of the potential impact each of the possible contaminants could have on the environment is provided in Table 3.30.

Operation of the staging area would periodically impact parcels that may have RECs. Phase I ESA information indicates possible RECs generally exist in the staging area, as summarized in subsection 3.7.1.3, including ASTs, USTs, ACMs, and PCBs. Flooding of the staging area could cause damage to structures and spread contaminants in soil and groundwater. These flooding consequences could result in adverse impacts to human health, soil conditions, groundwater quality, agricultural crops, and fish and wildlife populations. General discussion of the potential impact each of the possible contaminants could have on the environment is provided in Table 3.30.

Table 3.30 Summary of Potential Environmental Consequences from Identified Recognized Environmental Conditions

Identified Possible RECs	Potential Environmental Consequences
Junk Vehicles and Visible Soil Staining	Junk vehicles stored on properties could be releasing various petroleum (gasoline/motor oil) or other hazardous materials (antifreeze) into the soils and groundwater if the holding vessels have corroded or deteriorated over the years from weathering.
	Existing soil or groundwater contamination could be spread when flood waters inundate an area, which could further contaminate soil, groundwater, surface water, and potentially wells used for irrigation or drinking water.
	Flood waters could cause further corrosion of a vehicle and associated tanks and reservoirs, leading to leaking of petroleum and hazardous materials, which could impact soil, groundwater, surface water, and potentially wells used for irrigation or drinking water.
	Flood waters could cause direct release of petroleum and hazardous materials if water entered directly into tanks and vessels releasing petroleum and hazardous materials into the flood waters, which could contaminate soil, groundwater, surface water, and potentially wells used for irrigation or drinking water.
	Depending on the levels of petroleum and hazardous material contamination, human or animal consumption of crops could be limited; and have negative impacts on fish and wildlife.
Stored Petroleum and Hazardous Materials	Existing soil or groundwater contamination could be spread when flood waters inundate an area, which could further contaminate soil, groundwater, surface water, and potentially wells used for irrigation or drinking water.
	Flood waters could cause the corrosion of the holding vessels, resulting in leakage which could impact soil, groundwater, surface water, and potentially wells used for irrigation or drinking water.
	Petroleum and hazardous materials could be released if flood water entered directly into tanks and vessels, which could contaminate soil, groundwater, surface water, and potentially wells used for irrigation or drinking water.
	Depending on the levels of petroleum and hazardous material contamination, it could prevent the use of crops for human or animal consumption; have negative impacts on fish, wildlife, and wetlands.
Railroad Crossings	Railroad ties are often times treated with chemicals such as: arsenic, chromates, coal, creosote, PAHS, lead, and other metals to prevent/slow deterioration of the wood. These chemicals can leach over time into adjacent soils and groundwater.

Identified Possible RECs	Potential Environmental Consequences
	Flooding could lead to the migration of these items to impact adjacent soils, ground water, surface water, and potentially wells used for irrigation or drinking water.
	Depending on the levels of contamination, it could prevent the use of crops for human or animal consumption; have negative impacts on fish, wildlife, and wetlands.
USTs/ASTs	Existing soil or groundwater contamination could be spread when flood waters inundate the area, which could further contaminate soil, groundwater, surface water, and potentially wells used for irrigation or drinking water.
	Flood waters could cause the corrosion of the tanks, leading to leaks which could impact soil, groundwater, and potentially wells used for irrigation or drinking water.
	Depending on the levels of petroleum contamination, human or animal consumption of crops could be limited; and have negative impacts on fish and wildlife.
ACMs	ACMs may be present in houses, barns, and farmstead buildings. Flood waters could cause damage directly to ACMs or structures containing ACM to collapse causing asbestos to potentially contaminate the air and surrounding soils.
	ACMs located in structures to be demolished or relocated require ACM to be removed prior to demolition activities. If not removed, asbestos can contaminate the air and surrounding soils.
	ACMs may be present on underground pipelines. Flood water could cause damage to the ACMs causing soil contamination.
	ACMs located on underground pipelines to be removed or relocated may require ACM to be removed prior to those activities. If not removed, asbestos could contaminate the air and surrounding soils.
	Asbestos is a known carcinogen and a threat to human health.
PCBs	Leaking transformers contain PCBs that can potentially cause soil contamination.
	Flood waters could cause pole-mounted transformers to become damaged if the pole were to collapse or cause pad mounted transformers to corrode causing leaking of PCBs. This could result in impacts to soil, groundwater, surface water, and potentially wells used for irrigation or drinking water.
Underground Gas/Petroleum Lines	Existing soil or groundwater contamination could be spread when flood waters inundate the area, which could further contaminate soil, groundwater, surface water, and potentially wells used for irrigation or drinking water.
	Flood waters could cause the corrosion of the pipes, leading to leaks which could impact soil, groundwater, surface water, and potentially wells used for irrigation or drinking water.
	Depending on the levels of petroleum contamination, negative impacts on fish and wildlife could occur, and human or animal consumption of crops may require limitations.
Underground Utilities (wells, septic	Drinking water and irrigation wells could become contaminated with migration of chemicals or contaminated flood waters.

Identified Possible RECs	Potential Environmental Consequences
systems, communication, power)	Flood waters could inundate septic systems, causing sewage to be released; flooding could lead to the migration of wastes and could potentially affect drinking water wells.
Soil/Groundwater Contamination from Adjacent Sites	Flooding could lead to the migration chemicals, petroleum products, creosote, green treat chemicals, or lead, resulting in impacts to soils, groundwater, surface water, and potentially wells used for irrigation or drinking water.
	Depending on the levels of contamination, negative impacts could occur to fish, wildlife, and wetlands.
Contaminated Fill	Flooding could lead to the migration of chemicals, petroleum products, asbestos, and heavy metals.
	Depending on the levels of contamination, negative impacts could occur to fish, wildlife, and wetlands.

Source: Stanley Consultants, 2010a, 2010b; HDR Engineering, Inc., 2013 a-f; USACE, 2012b; USACE, 2014b; Wenck, 2014

Once specific properties in the inundated areas are identified for acquisition, additional assessments, such as a Phase I ESA or subsequent Phase II ESA, would be conducted to provide details on the extent of potential contamination and specific removal and remediation measures that may be required to avoid impacts. The Diversion Authority would acquire a flowage easement from the property owner on properties not purchased for the Project but anticipated to be impacted in the staging area. Completion of Phase I ESAs or remediation is not anticipated for properties that are not acquired for the Project.

A possible REC that was not identified in the Phase I ESAs, but could be of potential concern is lead based paint (LBP), which is discussed in Table 3.31.

Table 3.31 Summary of Environmental Consequences from Potential Additional Recognized Environmental Conditions

Potential RECs	Potential Environmental Consequences
LBP	Flood waters could cause the deterioration of the LBP causing it to lift from its substrate, leading to the migration of lead that could impact soils, groundwater, or potentially wells used for irrigation or drinking water.
	Existing soil contamination from deteriorated LBP from past floods and weathering may already be present; flooding could lead to migration into adjacent soils or ground water supplies, such as drinking water and irrigation wells.

Source: Wenck, 2014

3.7.2.2 Base No Action Alternative

Under the Base No Action Alternative, all parcels with identified RECs would remain as-is, which would maintain the possibility of contamination of soil and groundwater during each flood event unless the RECs are removed or the potential for flooding no longer exists.

The Cities of Fargo and Moorhead each have ongoing and planned flood risk reduction projects that reduce flooding for the cities and properties located along the Red River. These projects may reduce the risk of contamination from identified RECs during future floods by reducing or eliminating flood water impact on parcels with identified RECs.

3.7.2.3 No Action Alternative (with Emergency Measures)

Under the No Action Alternative (with Emergency Measures), all parcels with identified RECs would remain as-is, which would maintain the possibility of contamination of soil and groundwater during each flood event unless the RECs are removed or the potential for flooding no longer exists. Emergency measures would be used to reduce flooding in certain areas, and reduce the risk for contamination from RECs. As discussed for the Base No Action Alternative, the Cities of Fargo and Moorhead have planned flood risk reduction projects that reduce flooding potential for properties along the Red River. Additionally, the No Action Alternative (with Emergency Measures) could use emergency measures, such as sandbagging and temporary levees, to target any identified RECs to protect certain areas, further reducing the risk of potential contamination.

3.7.2.4 Northern Alignment Alternative

The NAA diversion channel design and its location is similar to the Project. The NAA tieback embankment and control structure design are anticipated to be similar to the Project, but would be located approximately 1.5 miles downstream. This would result in a different flood inundation and staging area.

Phase 1 ESAs for the Project were completed for the majority of the diversion channel, the in-town levees, OHB ring levee, and parts of the staging area, but not for the latest Project design or for inundation areas located outside of the staging area. Portions of the NAA that are in the same locations as the Project that have completed Phase I ESAs include parcels with previously identified RECs. Potential RECs were identified in the 2010 Fargo ESA, 2012 Supplemental ESA, 2013 In-Town Levee ESAs, and 2014 OHB ESA as discussed above under Proposed Project. It is anticipated that all of these identified RECs would also be impacted as part of the NAA with the exception of possibly some identified within the 2012 Supplemental ESA, as that report does not provide specific locations for RECs, but rather a general discussion on the presence of certain types of RECs primarily in the staging area. The areas that have not been surveyed for the Project that also apply to the NAA would still need Phase I ESA completion, as well as additional areas for the NAA, such as the tieback embankment, control structures, staging area, and possibly inundated areas outside of the staging area that are specific to the NAA design.

The possibility of contamination of soil and groundwater during each flood event exists where RECs have been identified for the NAA, unless the RECs are remediated or the potential for flooding no longer exists. Areas within the NAA which have not had ESAs completed would need to be evaluated and a Phase I ESA completed. Types of potential RECs in the vicinity of the NAA are anticipated to be similar to those identified for the Project as these areas have similar land uses. RECs and their potential impacts are discussed in Table 3.30 above.

3.7.3 Proposed Mitigation and Monitoring Measures

Results from the previously completed Phase I ESAs indicated that Project construction and operation would directly impact parcels with identified and possible RECs. Phase II ESAs have been recommended where additional investigations were warranted. As Project designs have continued to evolve since the Phase I ESAs were complete, both the Phase I ESAs and the recommended Phase II ESAs would be further evaluated for applicability due to Project design changes that have occurred since they were completed. This primarily applies to the findings of the 2010 Fargo ESA, 2012 Supplemental ESA findings, and 2013 In-Town Levee ESAs.

Once Project designs are more refined, acquisition of the properties necessary for Project construction and operation would be determined. The USACE would then conduct additional Phase I ESAs and subsequent Phase II ESAs, as necessary, that were not previously covered by or were inaccessible at the time of the original ESAs completed in 2010, 2012, and 2013. Subsequent Phase II ESAs would be conducted, as recommended by the Phase I ESAs. Based on the identified contamination levels, a response action plan, detailing remediation plans and additional testing requirements may be generated. Impacts associated with the RECs could then be mitigated through soil and groundwater remediation projects or other measures as identified during the Phase II ESA.

It should be noted that further investigations would be conducted to include properties that may be affected if the Project design is altered prior to or during construction.

The Diversion Authority would be responsible for property acquisition. The Diversion Authority would also be responsible for any required remedial actions or mitigation for the property prior to Project construction as identified in the Phase II ESAs, including asbestos/lead and regulated materials building surveys. Any identified regulated materials would be mitigated according to existing rules and regulations by a licensed remediation contractor, such as removal and proper disposal of all hazardous substances, contaminated soils, relocation of utilities, and potentially the removal of various structures that may contain asbestos, lead, or other hazardous materials. Potential mitigation measures would reduce or eliminate the potential for impacts from HTRW.

In addition to RECs, numerous residential homes, agricultural structures and commercial businesses would also be impacted during the construction of the diversion channel and in-town levees. Structures that are located within the construction footprint of the diversion channel or in-town levees would require demolition or relocation to allow for the construction of the diversion channel and levees. Prior to the demolition or relocation of these structures in Minnesota, a building survey is required by Minnesota Rules, part 7035.0805. A building survey would identify ACMs, LBP, and any regulated/hazardous materials that require special handling and/or recycling or disposal. Any regulated materials would be mitigated according to local, state, and federal laws by a licensed hazardous waste remediation contractor or licensed asbestos abatement contractor, and disposed of properly.

Inundation impacts to structures within and adjacent to the staging area may require mitigation and additional investigations such as Phase I ESAs to determine potential RECs. The need for these investigations would be determined once Project designs are more refined. Impacts to structures and proposed mitigation for impacts to structures due to inundation is further discussed in the Section 3.16 - Socioeconomics.

Table 3.32 provides a summary of the potential remedial actions and mitigation measures typically associated with each type of REC that may be implemented or may be required depending on the REC, HTRW and/or level of potential contamination. The Diversion Authority would be required to comply with all applicable laws and regulations related to potential HTRW.

Table 3.32 Summary of Potential Mitigation Measures for Potential Recognized Environmental Conditions

Identified Possible RECs	Potential Mitigation Measures
Junk Vehicles and Visible Soil Staining	Conduct a Phase II ESA to test for soil and groundwater contamination
	Removal and disposal of contaminated soils
	Removal and disposal of junk vehicles
	Remediation of any contaminated groundwater or wells
Stored Petroleum and Hazardous Materials	Conduct additional site visits to identify the materials present
	Conduct a Phase II ESA to test for soil and groundwater contamination
	Removal and disposal of stored petroleum and hazardous materials
	Relocation of stored petroleum and hazardous materials above flood stage and in a secondary containment
	Removal and disposal of contaminated soils
	Remediation of any contaminated groundwater or wells
Railroad Crossings	Conduct a Phase II ESA to test for soil and groundwater contamination
	Removal and disposal of railroad ties, relocation, or elevating railroad tracks
	Removal and disposal of contaminated soils
	Remediation of any contaminated groundwater or wells
USTs/ASTs	Conduct a Phase II ESA to test for soil and groundwater contamination
	Removal and disposal of tanks and associated piping
	Construct secondary leak containment systems around ASTs
	Replace USTs with ASTs that include secondary containment systems
	Removal and disposal of contaminated soils
	Remediation of any contaminated groundwater or wells
ACMs	Conduct a building survey to test for asbestos in and on structures
	Test any materials found in soil excavations for asbestos
	Removal and disposal of soils contaminated with ACM
	Removal and disposal of asbestos containing materials, especially damaged or friable
	Relocation or elevation of structures containing ACM
PCBs	Conduct a Phase II ESA to test for soil and groundwater contamination
	Removal and disposal or relocation of transformers
	Removal and disposal of contaminated soils
	Replace with mineral oil transformers
Underground Gas/Petroleum Lines	Conduct a Phase II ESA to test for soil and groundwater contamination
	Relocation of utilities

Identified Possible RECs	Potential Mitigation Measures
	Removal and disposal of contaminated soils
	Remediation of any contaminated groundwater or wells
Underground Utilities	Conduct a Phase II ESA to test for soil and groundwater contamination
	Sealing of wells and septic systems
	Relocation of utilities
	Removal and disposal of contaminated soils
	Remediation of any contaminated groundwater or wells
Soil/Groundwater Contamination from Adjacent Sites	Conduct a Phase II ESA to test for soil and groundwater contamination
	Removal and disposal of contaminated soils
	Remediation of any contaminated groundwater or wells
Contaminated Fill	Conduct a Phase II ESA to test for soil and groundwater contamination
	Removal and disposal of contaminated soils
	Remediation of any contaminated groundwater or wells
LBP	Conduct a building survey to test for LBP in/on structures
	Stabilization or removal of LBP
	Relocation of structures with LBP

Source: Stanley Consultants, 2010a, 2010b; HDR Engineering, Inc., 2013 a-f; USACE, 2012b; USACE, 2014b; Wenck, 2014.

3.8 FISH PASSAGE AND BIOLOGICAL CONNECTIVITY

Passage, or the ability to migrate upstream or downstream, on rivers and tributaries is important to the overall health of an aquatic community, which includes both macroinvertebrate and fish species. Various factors can affect fish passage, which can be naturally occurring, such as flow velocity or changes in stream stability; and human-caused, such as river impoundments, or dams and other structures acting as barriers (e.g., high velocities through culverts and perched culverts). The Project has the potential to disrupt fish passage through the construction of the diversion channel, associated control structures, and tieback embankment, as well as Project operation through modification of the natural hydrology of the project area by controlling water flow and staging water during flood events. Section 3.3 – Stream Stability describes potential impacts to fluvial geomorphology.

This section describes the potential environmental impacts to macroinvertebrates and fish species within the Red River, as well as several tributary streams in the project area in both Minnesota and North Dakota, including Wolverton Creek, Wild Rice River, Sheyenne River, Maple River, Buffalo River, Lower Rush River, and Rush River. Existing conditions for each stream were established using available data from the QHEI, macroinvertebrate assessment, and the IBI for fish communities. Sensitive and significant species, including the lake sturgeon, were also identified for the project area for the purposes of potential impact evaluation. For each stream, potential impacts to aquatic habitat, fish passage and biological connectivity, and fish standing and mortality were evaluated. This evaluation assessed the potential for interruption to fish migration and movement, and impacts on fish and macroinvertebrate communities. This section also discusses proposed mitigation measures, which include stream channel restorations; reestablishing fish migration and connectivity, such as dam modifications; construction avoidance periods; monitoring measures, and adaptive management. An assessment of proposed mitigation and monitoring and additional recommendations discussion is included in Chapter 6. More details on proposed mitigation and monitoring can be found in the Draft AMMP included as Appendix B.

3.8.1 Affected Environment

The primary rivers and streams in the project area include the Red River, Wild Rice River, Sheyenne River, Maple River, Lower Rush River, Rush River, and Wolverton Creek. The Red River begins in Wahpeton, North Dakota at the confluence of the Otter Tail River and the Bois De Sioux River. The Red River flows north and forms the border of North Dakota and Minnesota from Wahpeton, North Dakota to Pembina, North Dakota, where the river then continues north into Canada. There are also a number of smaller tributary streams that are part of the larger Red River basin. A summary of historical fish surveys compiled for the Red River basin (Aadland et al, 2005) revealed there were 57 fish species identified in the Red River from surveys conducted between 1962 and 2000. This is a conservative estimate since most Red River surveys are completed with boat electrofishing which is ineffective for small-bodied species. Most species found in tributaries (roughly 80 native fish species in total) likely use the Red River main stem seasonally for habitat and as a migration route.

There is a world class trophy catfish fishery present within the Red River as well as numerous other important game fish species including northern pike, walleye, and sauger. Lake sturgeon, a species once common throughout the Red River basin, have recently been reintroduced into the Red River basin. Fish surveys on the Sheyenne River resulted in a similar number of fish species as the Red River, 56, while surveys on the Wild Rice, Maple, and Rush rivers indicated that each had approximately half as many fish species as the Red River. Recent surveys on Wolverton Creek revealed there are roughly one-third as many fish species as in the Red River.

The health of a biological community is dependent on a number of factors, including, but not limited to, water quality, habitat, and the specific needs of a certain species. Other factors, such as exposure to periodic flood events naturally occur under existing conditions and may be necessary as part of life cycle events (such as annual spring melt off) or may be detrimental to individual species such as the case with large, less frequent flood events that could result in fish stranding in isolated pools or in the floodplain where water eventually recedes, causing mortality. These factors are typically measured through monitoring to identify the species within the system, and ranking the potential health of the system using the QHEI for macroinvertebrates and IBI for fish communities. The following sections provide information on the current river and stream conditions within the project area where data was available.

3.8.1.1 Habitat Assessment

The QHEI is a tool that is used to assess physical habitat quality of a stream reach and the ability for that reach to potentially support a biological community. The QHEI uses a variety of metrics to calculate a score for the assessed stream reach. The metrics include: substrate; in-stream cover; channel morphology; riparian zone; pool/riffle quality; and map gradient. The QHEI value ratings and rankings for an assessed reach are shown in Table 3.33.

Table 3.33 Qualitative Habitat Evaluation Index

Rank (maximum value 100)	Headwaters (less than or equal to 20 square mile drainage area)	Large Stream
Excellent	$\geq$70	$\geq$75
Good	55 – 69	60 – 74
Fair	43 – 54	45 – 59

Rank (maximum value 100)	Headwaters (less than or equal to 20 square mile drainage area)	Large Stream
Poor	30 – 42	30 – 44
Very Poor	< 30	< 30

Source: Rankin, 1989, USEPA 2006

A QHEI assessment was completed by the Diversion Authority and USACE (URS, 2013) as part of the fisheries and macroinvertebrate inventory and assessment of streams in the project area. QHEI assessments were conducted at 21 reaches on the primary rivers and streams in the project area including: Red River, Wild Rice River Sheyenne River, Maple River, Rush River, and Wolverton Creek. Sampling of the Lower Rush River was planned, however, the Lower Rush River did not meet the requirements of a sampleable stream when reconnaissance was performed and therefore, assessment data is not available for this river and future sampling is not planned. The QHEI data is summarized below in Table 3.34.

Table 3.34 Qualitative Evaluation Index Average Rankings of Project Area Rivers and Streams

River/Stream	Reaches Sampled	QHEI Ranking Range	QHEI Average Ranking
Red River	6	30.5% – 45% Poor – fair	38.5% Poor
Wild Rice River	4	35% – 42.5% Poor	40% Poor
Sheyenne River	5	36.5% – 45% Poor – fair	36% Poor
Maple River	3	33% – 39.5% Poor	36% Poor
Rush River	2	16% – 35.5% Very Poor - Poor	26% Very Poor
Wolverton Creek	1	41.5% Poor	41.5% Poor

Source: Fargo Fisheries Assessment Final Report (2-20-2013) – URS, Corporation (URS)

3.8.1.2 Macroinvertebrates

The Diversion Authority and USACE conducted macroinvertebrate assessments of the rivers and streams in the project area including: Red River, Wild Rice River Sheyenne River, Maple River, Rush River, Lower Rush River and Wolverton Creek (URS, 2013). Samples were sent to Valley City State University for analysis. The macroinvertebrate data was used to calculate several indices used to assess the stream community, population and quality. The Simpson Diversity Index, which quantifies the diversity of species present within a sampled population and how evenly individuals are distributed among species, was calculated for the aquatic macroinvertebrates collected from each reach. For a given study reach where D equals the Simpson Diversity Index, n(n-1) was calculated, where n is the numbers of individuals within a species, and summed for all species present. The summation was then divided by N(N-1), where N is the total numbers of individuals for the study reach.

$$D= (\Sigma\ n(n\text{-}1\ ))/\ N(N\text{-}1)$$

Where:
n = total number of individuals in a particular species, and
N = total number of individuals of all species

The value of D ranges between 0 and 1. A dataset with a high diversity presents a D value of 0, whereas a low diversity presents a D value of 1. The Maple River had the greatest diversity according to Simpson's Index and the Red River had the least. The macroinvertebrate data is summarized below in Table 3.35.

Table 3.35 Summary of Macroinvertebrate Diversity, Most Common Species and Percent Abundance within the Project Area

River/Stream	Reaches Sampled	D Value	Number of Different Species	Most Common Species and % of Abundance
Red River	6	0.675	17 – 26	Water boatman (Corixidae family) 70.4% - 90.6%
Wild Rice River	4	0.462	21 – 27	Water boatman (Corixidae family) 50% - 80%
Sheyenne River	5	0.225	23 – 43	Water boatman (Corixidae family) 26.2% - 51.9%
Maple River	3	0.132	33 – 35	*The species with the highest relative abundance varied at each reach.*
Rush River	2	0.194	27-35	*The species with the highest relative abundance varied at each reach.*
Wolverton Creek	1	0.413	26	*Caenis, (*Order Ephemeroptera) 63.2%

Source: Fargo Fisheries Assessment Final Report (2-20-2013) – URS Corporation

3.8.1.3 Sensitive and Significant Species

Sensitive species are defined as those which are often the first to decline in environments that experience anthropogenic disturbance and associated environmental stressors (Sandberg, 2014). While many species decline under severe stress, sensitive species are responsive to low and moderate degrees of stress, and would decline or disappear before other, more tolerant species. Sensitive species may possess specialized ecological traits and life history attributes that require specific environmental conditions be met for continued survival. These conditions can be degraded or eliminated by anthropogenic disturbance, inhibiting sensitive species' survival and reproduction.

The MPCA developed a Fish IBI in 2011 (with an update in 2014) to assess fish communities in streams and rivers across the entire state of Minnesota (Sandberg, 2014). Sensitive species within Minnesota Streams have been identified within the MPCA Fish IBI. Fish community data compiled from the MPCA, NDDH, MNDNR, and USACE compared to the MPCA Fish IBI sensitive species list reveals that there are nine sensitive species that have been recently documented in the Red River and tributaries (Table 3.36). There are likely additional sensitive species beyond those listed in Table 3.36 in the Red River and its tributaries within the project area, but those species, discussed further below, are not typically collected by standard IBI electrofishing methods.

Table 3.36 MPCA Fish IBI Sensitive Species Collected in the Project Area

Species	Waterbody	Agency
Carmine Shiner	Red River	MPCA
Iowa Darter	Rush River, Wild Rice River	NDDH
Lake Sturgeon	Red River	MNDNR[1]
Mooneye	Red River	MPCA
Rock Bass	Red River, Maple River, Wild Rice River, Sheyenne River	USACE, MPCA
Smallmouth Bass	Red River, Sheyenne River	USACE, MPCA
Spottail Shiner	Red River	USACE
Stonecat	Red River, Wild Rice River	USACE

Source: MPCA 2011, updated 2014
[1]Lake sturgeon were identified within the project area from angler hook and line records.

Connectivity of aquatic habitat is an important factor for river fishes. Many of the 57 species documented in the Red River make significant migrations. Potential impacts to a separate group of sensitive species, outside of those defined within the MPCA IBI metric, include significant species that are sensitive to the loss of channel connectedness and subsequent loss of access to various associated habitats. Significant species known to migrate within the Red River include lake sturgeon, channel catfish, freshwater drum, walleye, sauger, goldeye, and greater redhorse (Aadland, 2010). While only the lake sturgeon is included in the MPCA sensitive species metric, these other important species of the Red River are considered sensitive to the construction and operation of the Project if their ability to migrate throughout the watershed is disturbed or blocked. Freshwater drum and channel catfish are especially vulnerable to extirpation by barriers and are known to be reproductive hosts for 11 and 13 freshwater mussel species respectively. Mussels are keystone species that serve critical roles in water quality (by filtering water), channel stability (by stabilizing substrates), and benthic biodiversity (by maintaining interstitial spaces in sediments and through the release of pseudofeces).

3.8.1.3.1 Lake Sturgeon

Lake Sturgeon are a benthic species that are not routinely collected using standard fish community monitoring methods such as electrofishing used by the MPCA for IBI assessments. The recent USACE fish monitoring assessment of the project area (URS, 2013) did not collect Lake Sturgeon from the 23 monitoring sites on the Red River and associated tributaries. Because Lake Sturgeon are not collected by traditional IBI monitoring gear, recent IBI efforts by the MPCA, NDDH or USACE are not good data sources for the presence of Lake Sturgeon within the Red River watershed.

As mentioned above, the Lake Sturgeon is included in the MPCA sensitive species metric and is considered a Minnesota state listed species of Special Concern (Section 3.10 – State-Listed Species and Special Status Species). It is a native species to the Red River watershed that is particularly sensitive to the potential impacts of the Project due to its life history strategy and large migration patterns so tracking the status of this species is important and provides key information regarding the health and quality of the system.

A variety of factors have led to the decline of the species in the Red River watershed, including dam construction limiting migration, siltation, channel modifications, and loss of necessary in-stream habitat. Significant efforts have been undertaken to reestablish a self-sustaining Lake Sturgeon population within the Red River through stocking, removal of fish passage barriers, and habitat improvements. Multiple tribal, state, and international agencies are involved in Lake Sturgeon reintroduction efforts. Details of the Lake Sturgeon restoration plan and activities are provided in "Restoration of Extirpated Lake Sturgeon (*Aciperser fulvescens*) in the Red River Watershed" MNDNR, 2002, revised 2013.

Barriers to fish passage are thought to be the most significant obstacle to the restoration of Lake Sturgeon populations. Efforts have been made over the last decade by the MNDNR and other groups to remove or bypass migration barriers (such as low-head dams) on the Red River as well as tributaries throughout the watershed. These continued efforts to remove barriers to migration are an integral part of the program to reestablish a spawning population of Lake Sturgeon within the Red River watershed.

The MNDNR has been tracking angler hook and line catches of Lake Sturgeon since the stocking program began in 1997, including both tagged and untagged fish. MNDNR records indicate there have been 50 records of Lake Sturgeon caught by anglers within United States, including 13 in the F-M area between 1998 through 2013 (111 total records).

3.8.1.4 Index of Biotic Integrity

Fisheries biologists have developed a protocol for assessing and measuring stream community health called an IBI. An IBI is a tool that uses a component of a biological community, such as fish, to determine the health of a system. Health is assessed by using a variety of individual metrics related to the biological community to calculate a score for the stream or river. The metrics compare the mix of taxa (i.e., species) and individuals present at a monitoring site to a reference condition that would be expected for that stream type. Typically higher IBI scores indicate better community health, closer to reference conditions, while lower scores indicate alteration of the biological community and/or water body. IBI scores are also affected by fragmentation since tolerant species generally have low sensitivity to barriers while intolerant species are often extirpated upstream of barriers. An IBI scoring protocol and individual metrics are normally specific to a watershed or ecological region. This is to ensure the criteria being used to assess the community are applicable and relevant to that particular monitoring reach or system.

In the project area, IBIs were reviewed to assess the current condition of the rivers and streams. This information, along with evaluation of potential Project impacts, presented in subsection 3.8.2, would be used to develop a monitoring plan to measure Project impacts and the effectiveness of mitigation.

3.8.1.4.1 Red River

The USEPA completed an IBI for the fish communities of the Red River and selected tributaries in 1998. The USEPA IBI for the Red River reported a classification of fish community health from fair to good at five sites on the Red River within or near the project area (Figure 17 in the FFREIS, USACE 2011).

Since the initial USEPA IBI, there have been fish community assessments conducted by several entities from Minnesota and North Dakota on the Red River near the project area over the last 20 years. The MPCA has conducted fish community sampling events at eight stations along the Red River within or in close proximity (15 miles upstream or downstream) to the project area. Another assessment was completed by the USACE at six stations on the Red River in 2012 (URS, 2013).

Within the MPCA Fish IBI there were nine identified stream categories with a unique set of scoring metrics and impairment thresholds (Table 3.37). The MPCA Fish IBI divides Minnesota into northern and southern groups with four categories each and then a separate low gradient category. The Red River and its tributaries fall within the southern group of the IBI categories. This MPCA Fish IBI is the most up-to-date protocol for the Red River used by the MPCA to assess fish community health and determine fish community impairment. The NDDH also uses the MPCA Fish IBI protocol to assess monitoring on the Red River.

Table 3.37 MPCA Fish Index of Biotic Integrity Categories for the Red River in Minnesota

MPCA IBI Category	Impairment Threshold	General Use Threshold	Exceptional Use Threshold
Southern Rivers	≤ 48	≥ 49	≥ 71
Southern Streams	≤ 49	≥ 50	≥ 66

Source: MPCA

The fish community monitoring sites along the Red River are all scored within the Southern Rivers category of the Fish IBI, which includes rivers of the Glacial Lake Agassiz Basin ecoregion with drainage areas greater than 300 miles. For monitoring sites in the Southern Rivers category, IBI scores of 49 or higher are considered to meet the general use threshold and be above the impairment standard (Sandberg, 2014). IBI scores below 49 are not considered to be fully supporting of the general use criteria of the fish community and considered impaired. The MPCA identified an IBI score of 71 for the Southern Rivers category as meeting the exceptional use threshold. The Southern Rivers Fish IBI includes the following 12 individual scoring metrics:

- Relative abundance (%) of taxa consume dead, organic matter
- Relative abundance (%) of individuals that are generalist feeders
- Relative abundance (%) of individuals that are insectivore species (excludes tolerant species)
- Taxa richness of fish eating species
- Relative abundance (%) of individuals that are short-lived
- Relative abundance (%) of taxa that are serial spawners (multiple times per year)
- Relative abundance (%) of individuals that are tolerant
- Relative abundance (%) of taxa that are very tolerant
- Relative abundance (%) of taxa that are sensitive (scoring adjusted for gradient)
- Taxa richness of simple lithophilic (lived in rocks) spawning species (scoring adjusted for gradient)
- Combined relative abundance of two most abundant taxa
- Relative abundance (%) of individuals with Deformities, Eroded fins, Lesions, or Tumors (DELT)

Positive points are awarded for 11 of 12 metrics, with only the last metric, the relative abundance of DELT anomalies, resulting in negative points. For this metric, the IBI score is zero points unless DELT anomalies are found on collected fish. The total possible maximum IBI score is 100. The 11 remaining metrics with positive points contributes a maximum score of up to 9.1 points per metric.

Fish IBI scores are available for eight MPCA stations near the project area. These sites were established as part of the MPCA watershed wide assessment which occurs once every ten years. Fish community monitoring data from the six monitoring sites in the USACE assessment (URS, 2013) were also used by the MPCA to calculate IBI scores. Fish IBI scores for the Red River using the Southern Rivers scoring category are provided in Table 3.38. The sites are listed from upstream (near Breckenridge, Minnesota) to downstream (near Halstad, Minnesota). There are two sites where the MPCA and the USACE monitored in the same location (Figure 18).

Table 3.38 Red River Fish Index of Biotic Integrity Scores Using the MPCA Southern Rivers Scoring Protocol[1]

MPCA Site ID	Monitoring Year	IBI Score	USACE Site ID	Monitoring Year	IBI Score[(1)]
06RD001	2006	76	-	-	-
06RD002	2006	77	-	-	-
05RD010	2006	71	Site 1	2012	24
-	-	-	Site 2	2012	46
-	-	-	Site 3	2012	53
06RD003	2006	71	-	-	-
-	-	-	Site 4	2012	58
05RD030	2006	31	Site 5	2012	43
-	-	-	Site 6	2012	43
06RD004	2006	35	-	-	-
05RD047	2006	52	-	-	-
10EM032	2010	67	-	-	-

Sources: URS, 2013; MPCA 2011, updated 2014

[1]USACE monitoring did not include IBI scores. The IBI scores were calculated by the MPCA for the purpose of this EIS.

IBI scores on the Red River, have a range from 24 to 77. Six of the eight MPCA sites exceed the general use threshold, while only two of six USACE sites exceed the general use threshold.

There are two instances where the MPCA and USACE monitored at the same location (Table 3.38). The first is at MPCA site 05RD010 (USACE Site 1) and the second was at MPCA site 05RD030 (USACE Site 5). Comparisons of IBI scores from the same site revealed that site 05RD010 had very different scores, which can be attributed to normal sampling variability that occurs from different samples and sampling conditions on a given day. The score from the MPCA was above the exceptional use threshold and the score from the USACE was below the impairment threshold. Site 05RD030 (MPCA) and Site 5 (USACE) had similar scores, with both falling below the impairment threshold (Table 3.38).

IBI scores for the Red River below the impairment threshold of 49 were driven by low to very low metric scores for:

- taxa richness of piscivorous species
- relative abundance (%) of taxa that are very tolerant
- relative abundance (%) of taxa that are sensitive
- relative abundance (%) of taxa that are serial spawners
- taxa richness of simple lithophilic spawning species
- negative points for the presence of DELT anomalies

The Red River sites that had IBI scores above the impairment threshold or approach exceptional use had good to very good metric scores for:

- relative abundance (%) of individuals that are generalist feeders
- taxa richness of piscivorous species
- relative abundance (%) of individuals that are short-lived
- relative abundance (%) of individuals that are tolerant

3.8.1.4.2 Minnesota Tributary

There is one primary tributary to the Red River located in Minnesota within the project area, Wolverton Creek. The creek is approximately 23 miles long and flows into the Red River approximately five miles downstream of Oxbow, North Dakota. The total drainage area for the Wolverton Creek watershed is approximately 100 miles. There are two records of fish monitoring conducted by the MPCA on Wolverton Creek, both in 2008. The MPCA stations for the Wolverton Creek monitoring sites are 08RD063 and 08RD051. The USACE assessment of streams also included one fish monitoring site on Wolverton Creek (URS, 2013). The USACE monitoring Site 23 was located near MPCA site 08RD051 (Figure 18). There were nine species collected from station 08RD063, while at 08RD051/Site 23 there were 11 species collected by the MPCA and 12 species collected by the USACE.

Wolverton Creek falls within the Southern Stream category of the MPCA IBI scoring protocol. This category includes large streams and small rivers in the Glacial Lake Agassiz Basin ecoregion where watershed area is between 30 and 300 square miles. There are nine metrics in the Southern Streams category of the MPCA Fish IBI (Sandberg, 2014):

- Relative abundance (%) of taxa benthic insectivores (excludes tolerant)
- Relative abundance (%) of taxa that are detritivores
- Relative abundance (%) of individuals with a female mature age <=2
- Relative abundance (%) of individuals with DELT Anomalies
- Relative abundance (%) of taxa that are sensitive
- Taxa richness of short-lived species
- Relative abundance (%) of taxa that are tolerant
- Relative abundance (%) of individuals that are tolerant
- Relative abundance (%) of individuals the dominant 2 species

The total maximum IBI score is 100 points. The Southern Streams category uses the metric Abundance of DELT Anomalies, which has a score of zero unless anomalies are present, in which case negative points are given. The other eight metrics add up to a total of 100, which equates to a maximum metric score of 12.5. The Fish IBI scores for the Wolverton Creek monitoring data are presented in Table 3.39. Site 08RD063 scored above the MPCA general use threshold of 50 for fish communities in the Southern Streams category, while both scores from site

08RD051/Site 23 fell below this threshold. The two different monitoring years at Site 08RD051/Site 23, while only separated by three years, produced similar IBI scores.

Table 3.39 Wolverton Creek Monitoring Data

MPCA Station ID	Monitoring Year	Total Species	IBI Score	USACE Site ID	Monitoring Year	IBI Score[1]
08RD063	2008	9	54	-	-	-
08RD051	2008	11	43	Site 23	2011	48

Sources: URS, 2013; MPCA 2011, updated 2014
[1]USACE monitoring did not include IBI scores. The IBI scores were calculated by the MPCA for the purpose of this EIS.

Wolverton Creek scored well on several individual metrics including:
- Taxa richness of short-lived species
- Relative abundance of individuals that are tolerant
- Relative abundance of taxa that are tolerant metrics

The Wolverton Creek sites scored poorly on:
- Relative abundance of sensitive taxa
- Relative abundance of the two dominant species metrics

3.8.1.4.3 North Dakota Tributaries

There are five tributaries to the Red River in North Dakota that would be directly impacted by the construction or operation of the Project. These are the Wild Rice River, Sheyenne River, Maple River, Lower Rush River, and Rush River. The Wild Rice River flows directly into the Red River south of the F-M urban area. The Sheyenne River is located west of the Red and Wild Rice Rivers, and flows north through West Fargo, eventually flowing into the Red River downstream of the F-M urban area. The Maple River, Lower Rush River, and Rush River are all located west of the F-M urban area. These three rivers flow into the Sheyenne River downstream of West Fargo.

A bioassessment of wadeable streams in the Red River basin was developed by the NDDH, and was used to develop a Fish IBI of streams in the Lake Agassiz Plain ecoregion (Larsen, 2013). The North Dakota Fish IBI uses seven individual metrics to assess fish community health of a stream, including:
- Fish per minute (number of individual fish collected / total minutes spent fishing)
- Percent of taxa that are lithophilis
- Percent of individuals that are lithophilis
- Percent individuals that are insectivorous cyprinids
- Percent dominant taxa
- Percent abundance of tolerant individuals
- Total Taxa (i.e., number of species)

The total IBI score is out of 100. Based on the evaluation of all monitoring reaches and reference sites within the assessment, the NDDH established thresholds for fish community quality. Scores over 62 indicate the least amount of community disturbance, scores from 62 to 47 indicating a moderate amount of disturbance, and scores below 47 indicate the most disturbance. Fish IBI scores from NDDH monitoring within the project area are available for the Wild Rice, Sheyenne, Maple, and Rush Rivers. There are one or two sites on each river and were monitored from one to three years. There is no previous monitoring on the Lower Rush River in the project area. Fish IBI scores from NDDH are presented in Table 3.40.

Table 3.40 Fish Index of Biotic Integrity Scores from NDDH Monitoring Efforts in the Project Area

System	Approximate Location	Monitoring Year	IBI Score	Health Condition
Wild Rice River	2.5 Miles South of St. Benedict, ND	1994	28	Most Disturbed
Wild Rice River	2.5 Miles South of St. Benedict	1995	19	Most Disturbed
Wild Rice River	2.5 Miles South of St. Benedict	1997	34	Most Disturbed
Sheyenne River	1.5 Miles South of Kindred	1996	31	Most Disturbed
Maple River	1 Mile South of Mapleton	1994	28	Most Disturbed
Maple River	1 Mile South of Mapleton	1995	29	Most Disturbed
Rush River	4 Miles North of Mapleton	1994	40	Most Disturbed
Rush River	4 Miles North of Mapleton	1995	15	Most Disturbed
Rush River	4 Miles North of Mapleton	2010	72	Least Disturbed
Rush River	2 Miles East of Amenia	2010	69	Least Disturbed

Source: NDDH, 2014

The majority of the sites scored in the most disturbed category having IBI scores of 46 or below. These low IBI scores were monitored from 1994 through 1997 for four of the rivers. The low IBI scores were driven by low metric scores for:

- Fish collected per minute
- Percent individuals that are insectivorous cyprinid
- Percent individuals that are lithophilis
- Total taxa

Two IBI scores from 2010 monitoring on the Rush River scored in the least disturbed category. The Rush River site near Mapleton had the highest IBI score of 72 in 2010. This is in contrast to the 1995 results when this same site had the lowest IBI score of 15. The two Rush River sites in 2010 also scored poorly on the fish per minute metric, which is similar to the low IBI scores from the monitoring in the mid-1990s. However, the high IBI from the two Rush River sites in 2010 are driven by high individual metric scores for the majority of the other metrics including:

- Percent of individuals that are lithophilis
- Percent of dominant taxa
- Percent abundance of tolerant individuals
- Total taxa

Monitoring of fish communities was completed by the USACE (URS, 2013). The USACE assessment included 14 stations on the five North Dakota tributaries including four sites on the Wild Rice River, five sites on the Sheyenne River, three sites on the Maple River and two sites on the Rush River (Figure 18). The sites on the Wild Rice, Sheyenne, and Maple Rivers were assessed in 2012, while the sites on the Rush River were assessed in 2011. The USACE monitoring did not include calculation of IBI scores from the collections. NDDH assessed the data from the USACE to calculate IBI scores using the Fish IBI for Wadeable Streams of the Red River (Larsen, 2013). Fish IBI scores from the fourteen USACE monitoring sites are presented in Table 3.41.

Table 3.41 Fish IBI Scores from USACE Monitoring Efforts in the Project Area

USACE Site ID	System	Location Compared to Project Features or Defined Project Areas	Monitoring Year	IBI Score[1]	Health Condition
7	Wild Rice River	Upstream Location	2012	61	Moderately Disturbed
8	Wild Rice River	Upstream Location	2012	45	Most Disturbed
9	Wild Rice River	Footprint Site	2012	44	Most Disturbed
10	Wild Rice River	Benefited Area	2012	51	Moderately Disturbed
11	Sheyenne River	Upstream Location	2012	61	Moderately Disturbed
12	Sheyenne River	Footprint Site	2012	67	Least Disturbed
13	Sheyenne River	Benefited Area	2012	64	Least Disturbed
14	Sheyenne River	Benefited Area	2012	65	Least Disturbed
15	Sheyenne River	Benefited Area	2012	60	Moderately Disturbed
16	Maple River	Upstream Location	2012	44	Most Disturbed
17	Maple River	Footprint Site	2012	49	Moderately Disturbed
18	Maple River	Benefited Area	2012	47	Moderately Disturbed
21	Rush River	Upstream Location	2011	66	Least Disturbed
22	Rush River	Downstream location (control structure)	2011	48	Moderately Disturbed
7	Wild Rice River	Upstream Location	2012	61	Moderately Disturbed
8	Wild Rice River	Upstream Location	2012	45	Most Disturbed
9	Wild Rice River	Footprint Site	2012	44	Most Disturbed
10	Wild Rice River	Protected Area	2012	51	Moderately Disturbed
11	Sheyenne River	Upstream Location	2012	61	Moderately Disturbed
12	Sheyenne River	Footprint Site	2012	67	Least Disturbed
13	Sheyenne River	Protected Area	2012	64	Least Disturbed
14	Sheyenne River	Protected Area	2012	65	Least Disturbed
15	Sheyenne River	Protected Area	2012	60	Moderately Disturbed
16	Maple River	Upstream Location	2012	44	Most Disturbed
17	Maple River	Footprint Site	2012	49	Moderately Disturbed
18	Maple River	Protected Area	2012	47	Moderately Disturbed
21	Rush River	Upstream Location	2011	66	Least Disturbed
22	Rush River	Downstream location (control structure)	2011	48	Moderately Disturbed

Sources: URS, 2013; NDDH, 2014
[1]USACE monitoring did not include IBI scores. The IBI scores were calculated by the NDDH for the purpose of this EIS.

The 14 sites on North Dakota rivers had scores within all three Health Condition categories (least, moderate, and most disturbed). However, the range of IBI scores in 2012 (44 to 67) was less than past monitoring (15 to 72). Almost all 14 sites scored well on the following metrics:

- Percent of dominant taxa
- Percent abundance of tolerant individuals
- Total taxa

Most sites scored poorly on the following metrics:

- Fish collected per minute
- Percent of individuals that are lithophilis

3.8.2 Environmental Consequences

Changes to the riverine systems within the project area, including the floodplain, through direct or indirect ways can have effects on aquatic habitat, macroinvertebrates, fish passage and biological connectivity, and fish mortality. Construction of aqueducts, channels, and levees for example, alter the natural bed and bank and affect the quality and availability of aquatic habitat. Changes in hydrology and hydraulics as well as floodplain extents could have effects on aquatic habitat, fish and macroinvertebrate populations and life cycles (e.g., migrations and spawning). The extent of changes or effects of changes are dependent on whether or not they are temporary or permanent; when they occur; the frequency of occurrence; and for flood events, the depth and duration the inundation is experienced.

3.8.2.1 Proposed Project

Construction and operation of the Project would alter rivers in the project area, including potential impacts to aquatic habitat, macroinvertebrates, fish passage and biological connectivity, and fish mortality. Loss or alteration of aquatic habitat can lead to changes in the species composition of a river as specific habitats become less abundant or unavailable. Creation of the diversion channel could lead to new habitat for macroinvertebrates. Direct impacts to macroinvertebrates could occur in areas that experience increased sedimentation from bank erosion and flood events, which could lead to mortality from burial and eventually suffocation. Habitat alteration from sedimentation can also have an impact. Potential impacts from bank erosion and sedimentation are further discussed in other sections of the EIS, including Section 3.3 – Stream Stability, Section 3.9 – Wildlife and Wildlife Habitat, Section 3.10 – State Listed Species and Special Status Species, and Section 3.4 – Wetlands.

Interruptions or blocking of fish migrations could result in a reduction of spawning success which impacts population sustainability. This also could have an effect on mussel establishment and recolonization as these species rely on fish (as hosts for their larval) to move them upstream. Stranding of fish in upland areas outside of the river channels could result from receding water after Project operation, resulting in direct mortality of fish. Significance of potential impacts on fish populations is dependent on features or Project operation specific to a river.

3.8.2.1.1 Red River

Project construction has the potential to directly impact macroinvertebrates and fish. Project operation would interrupt and redirect flows on the Red River into the inundation area upstream of the tieback embankment and diversion channel. This has the potential to impact macroinvertebrate and fish populations within the Red River by altering aquatic habitat and fish migration. In addition, there is potential for fish stranding when flood waters recede from the inundation area.

<u>Aquatic Habitat</u>

Aquatic habitat would be directly impacted by Project construction, which could lead to impacts to macroinvertebrates and fish. The Project includes construction of two features on the Red

River, a control structure at the upstream end of the Project and a rock ramp diversion outlet structure at the outlet of the diversion channel. The construction would be sequenced. The control structure would be constructed on lands adjacent to the existing river channel. When construction of the control structure is complete, a new channel would then be excavated to connect the existing river to the new control structure. The existing river channel would be blocked by the new dam embankment connected to the control structure. The abandoned section of channel would not be filled more than necessary to construct the dam and would be left as open channel similar to an oxbow basin or wetland. The abandoned area is anticipated to convert from flowing river habitat to some form of wetland habitat.

The rock ramp diversion outlet structure is located where the diversion returns to the Red River of the North and would be a rock spillway with a low-flow channel capable of accommodating fish passage. No Red River channel would be abandoned at the outlet structure.

Project construction and excavation could result in direct mortality to macroinvertebrate species from crushing, excavation, or other disturbance. This would occur in the immediate construction area. It is anticipated that newly constructed channels would be repopulated by macroinvertebrates once aquatic habitat is reestablished. Fish are anticipated to temporarily relocate to other areas of the water body to avoid Project construction activities occurring to aquatic habitat. Some fish mortalities may occur due to construction, but this is expected to be minor. These impacts could occur within the Project footprint during construction. After completion of Project construction, fish would move back into the areas where aquatic habitat has been reestablished.

The designs of the control structures and rock ramp diversion outlet structure have not been finalized. It is possible that final design may determine that the abandoned channel needs to be filled for engineering purposes in order to maintain the integrity and design of the new structure. If the final design requires filling of the abandoned river channel, impacts for aquatic habitat/wetlands would be assessed, and additional mitigation would be included with the Project to offset habitat loss. This sequence of construction minimizes the amount of work within the active river channel thereby minimizing the potential for direct macroinvertebrate and fish mortality. Impacts to the channel and habitat on the Red River are summarized in Table 3.42.

Table 3.42 Impacts to Aquatic Habitat on the Red River from Construction of the Project

Water Body	Project Feature	Channel Length Impact	Habitat Impact
Red River	Control Structure	0.8 miles	14 acres[1]
Red River	Diversion Channel Rock Ramp Diversion Outlet Structure	0.2 miles	3 acres[2]

Source: USACE FFREIS, 2011

[1]Construction of the Control Structure would result in abandonment of river channel, which is considered lost aquatic habitat.

[2]Construction of the Diversion Channel Outlet Structure would include placement of rock and structure features within river channel impacting existing habitat. There would be no abandonment of river channel through the creation of this structure.

The impacts to aquatic habitat listed in Table 3.42 are relatively small compared to length of the river channel and the amount of available habitat within the river system. The Red River channel is hundreds of miles long and the individual footprint impacts of each feature would not result in significant loss of habitat that would cause population level impacts to individual macroinvertebrate and fish species, such as sensitive species (e.g., lake sturgeon) or the macroinvertebrate and fish communities in the Red River. However, individual footprint impacts could affect channel stability and effect habitat and stream stability upstream and downstream of the directly impacted site (see Section 3.3 - Stream Stability). While some features of the new channel, control structure, and rock ramp diversion outlet structure could provide aquatic habitat for macroinvertebrates and fish, it is not known how the quality of habitat provided by the new features would compare to the quality of the existing habitat that would be lost. As a result, all aquatic habitat disturbed or altered on the Red River would be assumed lost and considered an impact. The existing habitat in the Red River channel near Project features was rated as moderate to poor quality (URS, 2013), meaning Project impacts would occur to lower quality aquatic habitat.

Project operation has the potential to alter velocities and depth on the Red River. This could lead to impacts on aquatic habitat, such as changes to the prevalence and location of deep or shallow pools. Sedimentation could occur in the inundation areas, which could result in impacts to aquatic habitat over time. A Draft Operation Plan (USACE 2014c) (Appendix A) is included with this EIS, but has not been finalized and does not include some of the other components necessary in addition to the plan such as the Water Control Manual and the Operation, Maintenance, Repair, Replacement, and Rehabilitation (OMRR&R) Manual, and therefore, the level of potential impacts to aquatic habitat are currently not fully quantified. Proposed mitigation for loss of aquatic habitat would go towards minimizing Project impacts. Details on proposed mitigation and monitoring measures are discussed in subsection 3.8.3.

Fish Passage and Biological Connectivity

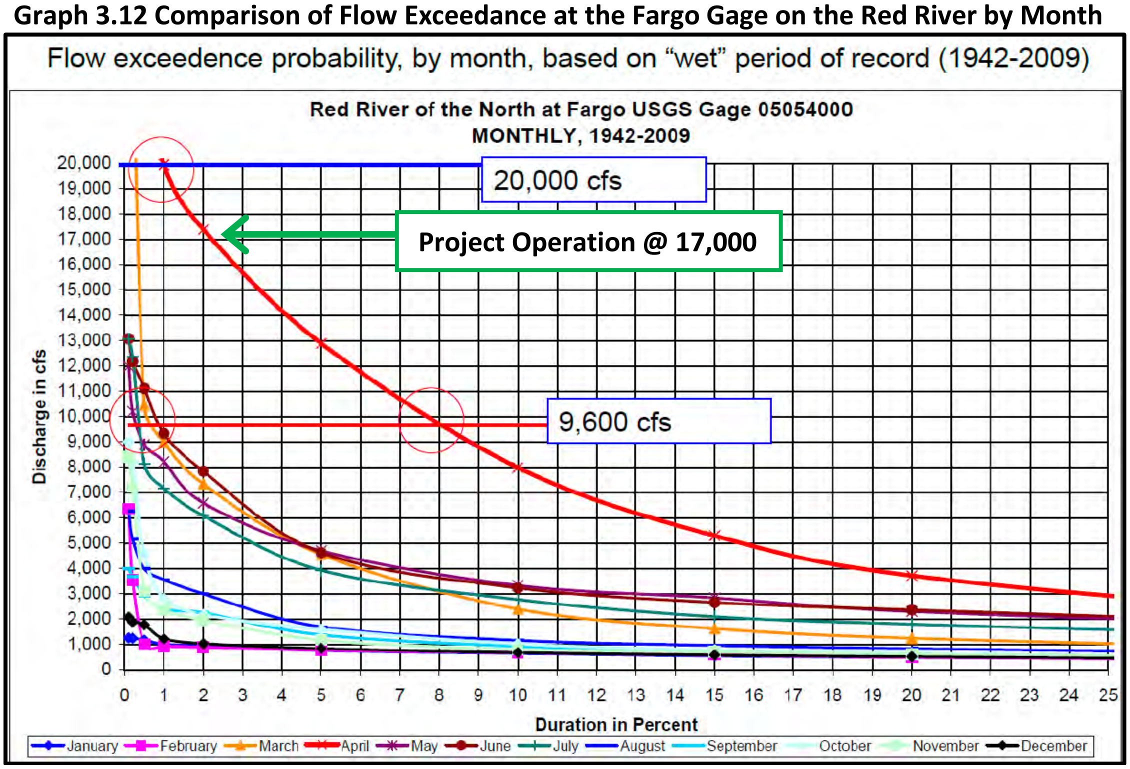
The Project would include the construction of a control structure on the Red River. Preliminary designs of the control structures were described in the FFREIS (FFREIS Section 3.7) and discussed below. Final designs were not available during EIS production. The structures would include gates across the river channels which would be utilized to control flood flows. Preliminary designs provide a combination of rocks and possibly concrete baffles within the control structures to provide flow complexity along the bottom of the channels. Concrete baffles have been observed to be less effective in slowing velocities and providing for fish movement as compared to using natural material, including variable size boulders. Natural materials are known to provide more complex flow patterns as well as variation in flow velocities, as compared to concrete baffles (Aadland, 2010), which allows for a wider variety of species (i.e., fish body types and sizes) to pass through a feature. As mentioned above, design of the control structure has not been finalized and the specific elements to be included to facilitate fish movement are not known. Incorporation of multiple design elements addressing specific flow conditions within the channels would be required to ensure impacts to fish movement are minimized. When the Project is not in operation the gates would be open, flow would pass through the control structures, and there would be limited anticipated impacts to fish passage.

Under the current proposed operation scenario, the gates of the control structure would be open and not in operation when river stages are below 35.0 feet, with limited impacts anticipated to fish passage and biological connectivity. When the control structures are in operation, the gates would be partially closed to force flows into the diversion channel and staging area. This would result in increased flow velocities through the control structures.

The FFREIS did not model flows within the control structures at the current operation of 17,000 cfs, but estimated that flows could exceed eight to ten feet per second within the partially closed structure gates, which would be impassable to fish. Flood conditions reached approximately 17,000 cfs in the Fargo area in 1978, 1979, and 1989, with flows exceeding 17,000 cfs several times in recent years including 2006, 2009, 2010 and 2011. The number of days the Project would be operated would depend of the magnitude of flood flows. For example, based on the latest modeling, the 100-year flood operation extends 12 days and the 500-year flood operation would last approximately 14 days. Flow velocities would produce impassable conditions for fish during this period of operation which would be a potential barrier to fish migration.

An analysis of the flow recorded for the wet period of record in the Red River from 1942 through 2009 was included within the FFREIS to determine how often flows of certain levels would be exceeded and which months the flows would occur. The analysis focused on flows of 9,600 cfs which was tied to the operation of the Project at the time of the analysis. The same analysis can be used to evaluate the likelihood of flows for proposed operation of the Project at 17,000 cfs. Graph 3.12 (FFREIS 2011) shows the duration percentage of Red River flows from January through December, with each month represented by a specific flow curve on the graph. This analysis covers a significant period of record (67 years) and past flood events. Based on the past flow record, the Project would begin to operate in March or April, as these are the only months when a flow of 17,000 cfs has been exceeded (Graph 3.12).

Graph 3.12 Comparison of Flow Exceedance at the Fargo Gage on the Red River by Month



Source: FFREIS, 2011

Depending on the timing of flood events, an operation period of 12-14 days (based on modeling) would result in impassable flow velocities for a portion of fish migration periods, but would be unlikely to completely block all fish migrations that year. As described above, historically the Project would have only operated in March or April. Depending on the species, fish migrations within the Red River have been approximated to be 30 to 60 days in length (Aadland, 2010). The fish migration periods for sensitive species of the Red River and major tributaries, such as the Otter Tail River, vary across the spring and early summer (Illustration 3.5 below). Earliest northern pike and walleye migrations within the Red River begin from mid-March into early April. Species such as catfish and lake sturgeon begin later in the spring and extend into summer, from early May through June, sometimes extending into early July. While these are general times that spawning runs and migrations occur for these species, migrations during a given year can vary and could occur later or earlier than the typically observed period depending on specific conditions triggering migrations that season.

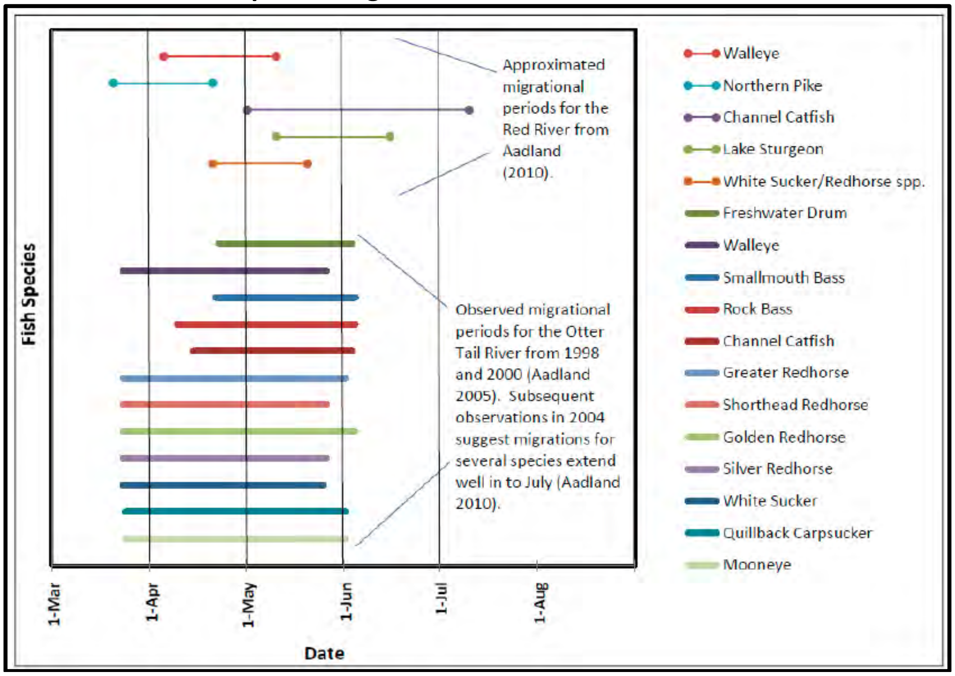
Based on the fish species migration periods and the likely operation of Project in either March or April, portions of the migrations of walleye, northern pike, and possibly redhorse/white sucker are most likely to be interrupted. It is unlikely that Project operation (12-14 days based on modeling) would completely block the migration of these species, because the migration period of these species is generally longer (more than 30 days). However, there are several factors that could influence the level of impacts to migration including the actual operation of the Project, final design of the control structure, and specific timing of Project operation compared to migration triggers and species movements in a given year. Based on modeling, larger flood events may require longer Project operation for the 2-percent chance flood (50-year flood), 1-percent chance flood (100-year flood), and the 0.2-percent chance flood (500-year flood). Longer Project operation has the potential to lengthen the time when velocities through the control structure would be impassable and increase the chances that Project operation overlaps with and/or disrupts migration of a species.

An additional factor is the timing of peak migrations of a given species. While migrations for a given species vary in length from 30 to 60 days, the timing of peak migration within the overall migratory period may be much shorter, on the order of several days. If flooding events and timing of Project operation occurred at the same time as the peak migration for a species, the impacts to migrations and spawning would likely be greater than impacts when Project operation coincides with the beginning or end of a species migration. The exact timing of Project operation compared to specific migration period impacts would not be known until actual flooding events resulting in operation occur.

The location of the structure in relation to species movements throughout the watershed could also be an influencing factor on impacts to species migrations from Project operation. For example, in order for peak migrations of a species such as lake sturgeon to occur in May in the Otter Tail River upstream of the project area, the peak migration within the Red River would have to occur at an earlier time in April. As a result, the timing of the species migration within the overall watershed compared to the location and operation of the structure would influence the level Project impacts on fish movements.

The design of the control structures and associated diversion and connecting channels have not yet been finalized. If not properly designed to convey river flows and channel roughness elements, such as variable size boulders or concrete baffles, the control structure and associated channel could potentially impede fish passage during flow conditions when the Project is not in operation.

Illustration 3.5 Fish Species Migration Periods on the Red River and Otter Tail River



Source: FFREIS, 2011

Based on these factors it is likely some impacts to migration would occur on years the Project is operated. When the Project is in operation, it is unlikely that it would completely disrupt the entire migration period of an individual fish species or the fish community for that year. However, the timing of Project operation compared to specific species migration during a given year, including the timing of the peak migration period, has the potential to occasionally cause disruption of species migration. This analysis is based on the current operating plan. Modifications to either the frequency or duration of project operation would affect the assessment of impacts to fish passage.

<u>Fish Stranding and Mortality</u>

Fish stranding is dependent upon the timing of receding water after a flood. If water recedes too quickly, fish may become stranded in remaining pools or eventually on land that dries. This process naturally occurs during flood events in the project area along river floodplains. The Project has two potential locations where stranding may occur after Project operation: the upstream inundation area and the diversion channel.

Stranding in the Inundation Area

When in operation the gates on the control structures would be partially closed. This would begin to hold flood waters into the upstream inundation area. Fish may leave the Red River channel and access the adjacent floodplain. The FFREIS analyzed the potential for fish to become stranded within the adjacent floodplain or in the staging area after operation has ended. The important factor to consider when examining fish stranding in the floodplain is the timing and rate of receding flood waters. The analysis determined that when flood waters are outside the banks of the Red River, they would recede at an estimated 0.2 to 0.6 feet per day. At these rates, fish should have sufficient time to follow the receding waters back into the channel of the Red River. However, some fish could become isolated or stranded, but the magnitude is not expected to be significant. Sensitive species are not likely to be more or less prone to stranding or mortality than other fish species.

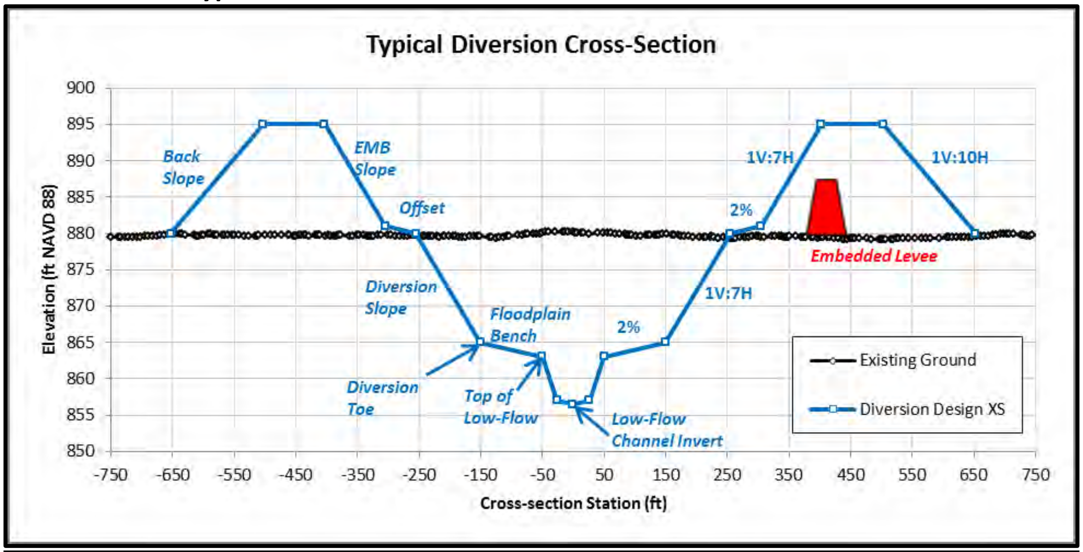
The analysis also found that rates of receding flood waters that could result in stranding of fish (from 2.0 to 3.5 feet per day) would be present at certain times. Review of the water elevations in the models showed that flood waters would no longer be spread out over the adjacent floodplain and instead would be back within the channel of the Red River. Therefore, these high rates of receding flood water would not result in stranding. The exact timing and rate of receding flood waters would not be known until the Project is constructed and operated. As stated, based on modeling, fish stranding or mortality is not expected to be significant. However, monitoring of Project operation and observations of incidents of fish stranding would need to be conducted before it can be fully determined if fish stranding is a significant impact of the Project.

Stranding in the Diversion Channel

Operation would result in fish entering the connecting channel and the diversion channel under certain flow conditions. Fish could enter into the diversion channel swimming downstream from the Red River or Wild Rice River into the connecting channel and then into the diversion channel under high flow conditions. Fish may also swim downstream from the Rush and Lower Rush Rivers with normal or flood level flows that would be directed into the diversion channel. Fish may also access the diversion channel by swimming upstream from the Red River through the rock ramp diversion outlet structure at the downstream end of the Project.

A low flow channel would be constructed within the diversion channel for the entire length. The low flow channel is expected to have flow conditions similar to the surrounding tributary flow conditions (i.e., average flow conditions in the Red River basin). The downstream end of the diversion channel could be used by fish year-round, as flows allow, as the Rush and Lower Rush Rivers would be diverted into the diversion channel into the low-flow channel. Other portions of the diversion channel may have some water present when the Project is not in operation but may lack flow, as water would come from seepage, tile lines, and ditches. The proposed Project includes a larger low flow channel, with a cross section approximately 50 feet wide and five feet deep (Illustration 3.6). These are general preliminary design elements and a final detailed design has not been completed for the diversion channel or the connecting channel. The final design elements and specific habitat features of the low flow channel would be important factors in minimizing the potential for fish stranding.

Illustration 3.6 Typical Diversion Channel Cross Section



Source: USACE

When operation is stopped, flows within the diversion channel would begin to recede. The USACE modeled the rate of flow recession within the diversion channel for the 10-year flood. The models indicate that waters within the diversion channel would drop from 1.0 to 2.5 feet per day depending on the water depth. A gated control structure would be installed at the diversion channel inlet to slowly reduce flows into the diversion channel after Project operation. This was a design change from the FFREIS and was evaluated in the Supplemental EA as a measure to minimize or eliminate fish stranding. Operation of the gated control structure would allow some flow into the diversion channel after Project operation, which would allow flow to gradually decrease. The design of the diversion inlet control structure has not been finalized, and therefore, the amount and rate of water flowing into the diversion channel through the gated control structure is not known. Proper operation of the gated control structure has the potential to minimize fish stranding within the diversion channel. However, the potential impact cannot be fully assessed until design elements and operation plans for the Project are finalized.

As water recedes, fish would be expected to follow the receding waters downstream. There is the potential for fish stranding if isolated pools exist, similar to conditions on the Maple, Rush and Lower Rush Rivers. The increased size and depth of the low flow channel is anticipated to minimize the potential for stranding, and is not expected to be significant or result in population level impacts to individual fish species, sensitive fish species, or the fish community. Tributaries would continue to flow into the diversion channel after Project operation, which would provide flow and further minimize the potential for fish stranding. The potential for fish stranding within the diversion channel or low flow channel is not anticipated to be a significant impact.

3.8.2.1.2 Minnesota Tributaries

Wolverton Creek is the only Minnesota tributary to the Red River that has the potential to be impacted by the Project due to additional inundation occurring from Project operation. Potential impacts to aquatic habitat, macroinvertebrates, fish passage, and fish stranding and mortality were reviewed and assessed.

Aquatic Habitat

There is no Project construction proposed for Wolverton Creek, and therefore, construction impacts to aquatic habitat are not anticipated. Project operation has the potential to disrupt aquatic habitat within Wolverton Creek. Waters from the inundation area would backup into Wolverton Creek and the adjacent floodplain, which could potentially result in increases to water depths and a change in flow velocity. This could alter the amount of available habitat such as reducing the amount of shallow pools and increasing the amount of deep pools. Fish species utilize different habitats from one another, while also utilizing different habitats through stages of their life cycle (Aadland, 1993). As a result of Project operation, sedimentation could accumulate in the inundation areas, which could result in impacts to aquatic habitat over time, such as to habitat quality or a change in the type of habitat available. A draft Project operation plan was provided for the EIS (Appendix A), but has not been finalized, and therefore, the level of potential impacts to Wolverton Creek are currently not quantified. Monitoring of Wolverton Creek during and after Project operation would be needed to assess impacts on aquatic habitat and determine adaptive management strategies to lessen or offset impacts. Potential fish stranding impacts to Wolverton Creek from the Project are discussed below.

Fish Passage and Biological Connectivity

The confluence of Wolverton Creek with the Red River is upstream of the control structure on the Red River. The Project does not include control structures or other features that would be a barrier to fish migrations on Wolverton Creek and fish would be able to move freely into and out of the Red River similar to existing conditions. During operation, fish on the Red River would not be able to pass through the control structure and access Wolverton Creek. The Red River serves as the main travel corridor and pathway for fish migrations and spawning runs throughout the overall watershed. As a result, it is likely that fish from Wolverton Creek access the Red River at different times depending on flow conditions and life cycle requirements. Project operation, including the closure of the gates on the Red River control structure and increase of water backing up into Wolverton Creek, could result in disruptions to fish migration within the creek. The length and level of disruption to fish migration would be dependent on the length of Project operation for a specific flood event, as well as the timing of Project operation compared to the timing of fish migration that season. Fish within the Red River above the control structure would be able to access the Wolverton Creek channel.

Fish Stranding and Mortality

Project operation would cause water levels in Wolverton Creek to increase into the adjacent floodplain to a greater extent than what currently occurs during the 100-year flood. This would result in fish potentially leaving the channel of Wolverton Creek into a larger inundation area than what occurs under the existing flood conditions.

An analysis was conducted to examine the rate of receding flood waters following Project operation (see FFREIS, subsection 5.2.1.7.4). The analysis indicated that when flood waters are outside the banks of the river channels, the rate that waters would recede were estimated to be 0.2 to 0.6 feet per day. At these rates, fish should have sufficient time to follow the receding waters back to the channel of Wolverton Creek. Project impacts to fish in Wolverton Creek due to stranding and mortality is not expected to be significant.

The final operation plan for the Project has not been developed, including the rate at which flood waters would recede. However, the Draft Operation Plan states that the diversion inlet gates would be operated such that inflows are gradually decreased, further supporting a gradual reduction in diversion flow that would allow fish to sense that they need to swim downstream to the diversion outlet (USACE, 2014c). Depending on the level of Project-related flooding outside of the current floodplain and the topography of the land in the area, it is possible that some fish could potentially become isolated or stranded. Based on model analysis for the Project, fish stranding due to the Project is not expected to be significant. Sensitive species are not likely to be more prone to stranding or mortality than other fish species. The current models are preliminary and so there is uncertainty associated with estimating impacts from the Project. The exact timing and rate of receding flood waters would not be known until the Project operated. Monitoring of Project operation and observations of incidents of fish stranding would need to be conducted before it can be fully determined if fish stranding is a significant Project impact.

3.8.2.1.3 North Dakota Tributaries

There are five tributaries (i.e., Wild Rice, Sheyenne, Maple, Lower Rush, and Rush Rivers) to the Red River in North Dakota that would be altered by the Project, including construction of a control structure, aqueducts, new river channels, and rock ramps. Project operation would interrupt and redirect flows from the North Dakota tributary rivers into the diversion channel and staging area. This has the potential to impact fish populations, aquatic habitat and fish populations, migration and stranding.

Aquatic Habitat

The Project includes constructing a control structure on the Wild Rice River. The diversion channel would cross the Sheyenne and Maple Rivers and aqueducts would be constructed to transport flows of these rivers over the diversion channel. For the Rush River and Lower Rush River, 2.1 and 3.4 miles, respectively, of river channel on each river would be abandoned from Project construction, as the flows from each river would be directed into the diversion channel. The Rush and Lower Rush Rivers would be connected to the diversion channel via rock-ramp spillways. Impacts to the channels and habitats caused by the construction of Project components of the North Dakota tributaries are summarized in Table 3.43. Rivers and streams are dynamic systems and impacts from the Project to aquatic habitat beyond the direct physical impacts, listed in Table 3.43, have the potential to extend beyond the Project construction footprint. Project impacts would likely not be fully known until the Project was operated for multiple flood events.

The control structure on the Wild Rice River and aqueducts on the Sheyenne and Maple Rivers would be constructed on lands adjacent to the existing river channel. When construction of a structure is complete, a new channel would then be excavated to connect the existing river to the new project feature. The old channel would then be abandoned. This sequence of construction minimizes the amount of work within the active river channel, thereby limiting the potential for direct fish mortality.

Table 3.43 Impacts to Aquatic Habitat on North Dakota Tributaries from Construction of the Project

Water Body	Project Feature	Channel Length Impact	Habitat Impact
Wild Rice River	Control Structure	0.9 miles	12 acres
Sheyenne River	Aqueduct over Diversion Channel	0.9 miles	9 acres
Maple River	Aqueduct over Diversion Channel	1.1 miles	11 acres
Rush River	Flows directed into Diversion Channel	2.1 miles	-
Lower Rush River	Flows directed into Diversion Channel	3.4 miles	-

Source: USACE FFREIS, 2011

Fish are anticipated to temporary relocate to other areas of the water body to avoid Project construction activities. Some crushing of fish may occur due to construction, but this is expected to be minor. The impacts to habitat listed in Table 3.43 are relatively small compared to the length of the river channels and the amount of available habitat. The loss of aquatic habitat would not specifically impact sensitive fish species such as lake sturgeon. The channels of the Wild Rice, Sheyenne, and Maple River are hundreds of miles long, and the individual footprint impacts of each Project feature would not result in significant loss of habitat that would cause population level impacts to individual fish species or the fish community in these rivers. After Project construction is complete, fish would move back into the areas that were avoided during construction.

While some features of the new channel, control structure, and aqueducts could provide aquatic habitat for fish, it is not known how the quality of habitat provided by the new features would compare to the quality of the existing habitat that would be lost. The new features created by the Project are not considered aquatic habitat that would be used to offset the potential impacts. However, the USACE assumes that some habitat would exist within the newly excavated channels leading into and out of Project structures. These areas would be evaluated during post-Project monitoring to determine what habitat they provide. To be conservative with the impact assessment, the USACE considered all aquatic habitat in the Wild Rice, Sheyenne and Maple Rivers disturbed or altered by Project construction would be lost and considered an impact.

The quality of the habitat was assessed in the channel of the rivers near where the Project features would be constructed (URS, 2013). The existing habitat in the Wild Rice, Sheyenne, and Maple River channels rated as moderate to poor quality, which lessens the potential for adverse impacts on aquatic habitat. However, even though the impacts to aquatic habitat on these rivers are likely to be small, proposed mitigation for loss of aquatic habitat would minimize Project impacts.

The Rush and Lower Rush Rivers would lose river channel (2.1 and 3.4 miles, respectively), starting at the diversion channel to the confluence with the Sheyenne River. Flows form the Rush and Lower Rush Rivers would be directed into the low flow channel within the diversion channel. This would result in the loss of habitat within both the Rush River and Lower Rush Rivers. The low flow channel would provide some habitat for fish, but it is not known what quality of habitat the new channel would provide.

The Rush and Lower Rush River are channelized rivers that flow intermittently and are considered to have low quality habitat, and therefore, habitat loss in these river channels are not considered significant. For the Rush River, the Project would result in impacts to aquatic habitat that would be offset through habitat provided in the low flow channel of the project diversion. Although Project impacts to habitat on the Rush and Lower Rush Rivers are not anticipated to be significant, based on existing IBI scores, the Rush River currently has a healthy fish community (Figure 17). The rock ramp spillway on the Rush River into the diversion channel has been designed to facilitate fish passage to ensure watershed connectivity of this river is maintained. Continued monitoring of the fish community and IBI scores on the Rush River (as well as other impacted streams) would help determine if additional adaptive management measures need to be implemented. Details on proposed mitigation are discussed in subsection 3.8.3.

<u>Fish Passage and Biological Connectivity</u>

The Project would include the construction of a control structure on the Wild Rice River. Preliminary designs of the flood control structures were described in the FFREIS (FFREIS Section 3.7) and are discussed below. Final designs were not available during EIS production. The control structure would include gates across the river channel which would be utilized to control flood flows. A combination of rocks, and possibly concrete baffles, would be added within the control structure to provide flow complexity along the bottom of the new channel. Concrete baffles have been observed to be less effective in slowing velocities and providing for fish movement as compared to using natural material, including variable size boulders. Natural materials are known to provide more complex flow patterns as well as variation in flow velocities, as compared to concrete baffles (Aadland, 2010), which allows for a wider variety of species (i.e., fish body types and sizes) to pass through a feature. As mentioned above, the design of the structure and fish passage has not been finalized. Design details would determine the effectiveness of fish passage. When the Project is not in operation the gates would be open, flow would pass through the control structure, and there would be limited anticipated impacts to fish passage compared to existing conditions on the Wild Rice River.

The control structure on the Wild Rice River would be operated in conjunction with the control structure on the Red River. The gates of the control structure would be open and not in operation most years, with no impacts to fish movement within the Wild Rice River. The current operation plan indicates the control structure on the Wild Rice River would begin operation when the measured flows at the upstream end of the Project (Red River at Enloe and Wild Rice River at Abercrombie) reach a sum of 17,000 cfs (35.0 feet) at the Fargo gage unless the hydrographs indicate that the flow may be close to peaking at which point the flows at the structures would be monitored to be sure 17,000 cfs (10-year flood) would occur at Fargo before Project operations would begin. Project operation would be dependent on actual weather and flood conditions and could occur at variable frequencies, not necessarily once every ten years. When the control structures are in operation, the gates would be partially closed to force flows into the diversion channel and staging area. This would result in increased flow velocities through the control structure on the Wild Rice River. The exact flows through the Wild Rice River control structure are not known as the design of the new channel and control structure have not been finalized but are estimated to increase to eight to ten feet per second (similar to what is expected at the Red River control structure) which would be impassable to fish. The USACE plans to include roughness elements into the design of the control structure, however, during Project operation it is unlikely the roughness elements would be sufficient enough to allow for fish passage when velocities reach ten feet per second.

The Wild Rice River would be expected to experience similar impacts to fish migrations and biotic connectivity as are described for the Red River in subsection 3.8.2.1.1. Based on the fish species migration periods and the likely operation in either March or April, portions of the migrations of walleye, northern pike, and redhorse/white sucker are most likely to be interrupted. Migration of channel catfish typically occurs in May and June, and therefore, is less likely to be impacted by Project operation. It is unlikely that operation would completely block the migration of these species because the migration period of these species is generally longer (more than 30 days) than operation of the Project. For larger flood events the Project would be operated for longer periods of time, which increases the potential that operation would overlap with the peak migration of a species, and therefore, disrupt fish movement.

As described in subsection 3.8.2.1.1, there are several factors that influence the level of impacts on fish migration. These include the final operational plan for the Project, frequency the Project is operated, the duration the Project is operated for a specific flood event, and species timing of the peak migration compared to Project operation. These potential impacts would not be known or fully understood until after the Project is constructed and operated several times. Through the combination of these factors, it is likely some impacts to migration would occur during years the Project is operated. This analysis is based on the current operating plan. Modifications to either the frequency or duration of project operation would affect the assessment of impacts to fish passage.

The Project is less likely to impact fish migration on the Maple and Sheyenne Rivers. The Maple and Sheyenne Rivers would have their river channels and flows transported over the diversion channel via an aqueduct. As a result, the channel flows from the Maple and Sheyenne Rivers are independent of flows within the diversion channel. The designs of the aqueducts are currently in progress. If the aqueducts are properly designed and constructed to convey flows from the Maple and Sheyenne Rivers under all flow conditions, there would not be a barrier to fish migration or habitat connectivity. However, the design of the aqueducts has not been finalized. Final design features, Project flow velocities, and bed materials would determine the effectiveness of fish passage. Additionally, during cold, winter conditions, which is also the time when river flows are typically lowest, cold air would pass below the aqueduct channel, potentially causing freezing of the river channels within the aqueduct. More detailed discussion on the aqueducts and the potential impacts from cold weather is provided in Section 3.5 – Cold Weather Impacts on Aqueduct Function and Biotics.

Existing structures on the Maple River, the Sheyenne Diversion, and the West Fargo Diversion have resulted in previous impacts to fish passage and biological connectivity. The Project would construct aqueducts on the Maple or Sheyenne Rivers that could further contribute to impacts or barriers to fish migration and habitat connectivity. The potential for impacts from the Project to fish migrations on the Sheyenne and Maple Rivers is not expected to be significant.

Lower portions of both the Rush River and Lower Rush River channels (2.3 and 2.7 miles, respectively) would be abandoned and would no longer provide habitat for river fish. This could have an impact on fish from the Red and Sheyenne Rivers that currently migrate upstream into either the Rush or Lower Rush Rivers. It is not known to what extent fish from the Sheyenne River use the Rush or Lower Rush Rivers for seasonal migrations, and it is possible that some impacts could occur as a result channel abandonment and complete disconnection of the Rush River from migrations from the Red and Sheyenne Rivers.

The inclusion of the low flow channel within the diversion channel may allow fish to migrate up the low flow channel within the diversion under certain flow conditions and levels. The Rush and Lower Rush Rivers would empty into the diversion channel via means of rock-ramp spillways. The spillway on the Rush River has been designed to accommodate fish passage using a series of stepped drops totaling 13.2 feet along a general slope of one vertical to 50 horizontal from the Rush River to the invert of the low-flow channel. The stepped drops would be created with riprap and boulders to create a pool-riffle system to accommodate fish passage for all types of flow conditions. For the Lower Rush River, due to the elevation changes across the rock-ramp spillways into the low flow channel, it would be difficult for fish to migrate out of the diversion channel or low flow channel upstream into the Lower Rush River. The Rush and Lower Rush Rivers would flow into the Red River via the diversion channel.

The Rush and Lower Rush Rivers would be disconnected from the Sheyenne River by the diversion channel. The interaction of fish from the Rush and Lower Rush Rivers with the fish community of the Sheyenne River is not known. Therefore, potential impacts to fish migrating within these individual rivers and collective river system is unknown. Any future restoration projects on the Rush and Lower Rush Rivers would no longer have potential to occur in the abandoned channel area of these two rivers. The extent of adherence to natural channel design techniques (dimension, pattern, and profile) within the diversion channel would determine effects on habitat and fish passage.

<u>Fish Stranding and Mortality</u>
Fish stranding is dependent upon the timing of receding water after a flood. If water recedes too quickly, fish may become stranded in remaining pools or eventually on land that dries. The Project has two potential locations where stranding may occur after Project operation: the upstream inundation area and the diversion channel. Potential impacts from the construction and operation of the control structure on the Wild Rice River would be similar to those described for the control structure on the Red River.

Stranding in the Inundation Area
During operation the gates on the control structure in the Wild Rice River would be partially closed, holding water into the staging area. Fish may leave the Wild Rice River channel and access the adjacent floodplain within the inundation area. An analysis was conducted to examine the rate of receding flood waters after Project operation (see FFREIS subsection 5.2.1.7.4). The analysis determined that when flood waters are outside the banks of the Wild Rice River channel, the rate that waters would recede were estimated to be 0.2 to 0.6 feet per day. At these rates, fish should have sufficient time to follow the receding waters back into the channel of the Wild Rice River. Some fish would potentially become isolated or stranded, but it is not expected to be significant. Sensitive species are not likely to be more prone to stranding or mortality than other fish species. Based on model analysis, fish stranding is not expected to be significant.

Stranding in the Diversion Channel
Fish in the Sheyenne and Maple Rivers are unlikely to access the diversion channel or low flow channel as the flows of these rivers would pass over the diversion channel via aqueducts. Fish in the Rush and Lower Rush Rivers would travel downstream over the rock-ramp spillways into the diversion channel and low flow channels. The Sheyenne, Maple, Rush, and Lower Rush Rivers

are located downstream of and outside the upstream inundation area. The aqueducts on the Maple and Sheyenne Rivers would convey flows up to bankfull conditions, with higher flows being directed into the diversion channel to avoid impacts to the downstream protected area of the Project. As a result, Project operation would ensure flood flows leave the banks of these rivers less often than what occurs under existing conditions. Project operation is not likely to result in an increase in fish stranding or mortality for fish communities on the Sheyenne, Maple, Rush, and Lower Rush Rivers. Cessation of Project operations at the control structure would cause dewatering of the diversion channel and potential stranding unless low flows are maintained. The length of the diversion channel and large numbers of fish that could congregate in the diversion channel could result in mortality unless all phases of Project operation provide adequate flow or flow ramping to allow out-migration.

3.8.2.2 Base No Action Alternative

Under the Base No Action Alternative, aquatic habitat, fish migration and fish mortality would remain similar to the existing conditions, including variable flow rates and other factors that influence aquatic habitat, fish passage and mortality in the Red River, Wild Rice River, Sheyenne River, Maple River, Rush River, Lower Rush River, and Wolverton Creek. Habitat within these rivers would continue to be influenced by the flooding patterns that currently occur and potentially contribute to channel scouring and/or siltation of aquatic habitat.

Fish migration within the Red River watershed, including all tributaries to the Red River, would remain the same as under current conditions. There are existing structures present in the Red River basin that currently impede fish passage including the Drayton Dam on the Red River and the Wild Rice Dam on the Wild Rice River. Under this alternative there would be no changes to these existing structures. There have been significant efforts in the last ten to twenty years by the MNDNR to remove barriers to fish passage and improve overall connectedness and fish migration within the Red River Watershed. Under the Base No Action Alternative, the MNDNR would continue these efforts to improve fish passage within the Red River Watershed. This would include pursuing funding sources to complete fish passage improvement projects currently identified by the MNDNR, such as the Drayton Dam removal and reconstruction project.

Fish mortality in the form of fish stranding within floodplain areas adjacent to rivers would be expected to continue in to a similar magnitude as currently occurs, which is dependent on the frequency of current flood patterns on the Red River and its tributaries.

The Cities of Fargo and Moorhead have planned flood risk reduction projects that would target reducing flood risk within the cities and properties along the Red River. Depending on the nature of the projects (such as levee construction), there could be some localized impacts to aquatic habitat associated with the flood reduction projects. These flood control projects are not anticipated to create barriers to fish migration in the watershed or contribute to fish stranding and mortality in adjacent floodplain areas in the watershed.

3.8.2.3 No Action Alternative (with Emergency Measures)

Under the No Action Alternative (with Emergency Measures), impacts to aquatic habitat would be similar to the Base No Action Alternative, with the exception that there may be some localized impacts from the implementation of flood control measures. In most cases, emergency measures would include adding height to existing levees or adding temporary levees to protect additional areas. However, these actions are unlikely to be conducted directly within river channels and result in aquatic habitat impacts beyond those described for the Base No Action Alternative.

The utilization of emergency measures would result in less inundated areas in the immediate F-M urban area compared to the Base No Action Alternative, specifically in the City of Fargo south of Highway 10 and in areas near the towns of Frontier and Briarwood. The loss of access to the floodplain from the increased levee heights is unlikely to impact fish feeding or spawning activities as the levee protected areas are generally urban and offer limited suitable habitat adjacent to the Red River channel. By reducing access through increased levee heights to these, urban areas with low habitat value there is less chance that fish would become stranded behind levees in unsuitable urban areas.

As with the Base No Action Alternative, the No Action Alternative (with Emergency Measures) would not add or remove barriers to fish passage within the Red River and its tributaries, and therefore, fish passage and migration within the watershed would not change from existing conditions. The MNDNR would continue efforts to remove fish barriers and improve fish passage within the Red River watershed, by pursing improvement projects they have identified, including finding a funding source for the Drayton Dam project.

3.8.2.4 Northern Alignment Alternative

The NAA would shift the control structure and tieback embankment on the Red River and Wild Rice River to the north approximately 1.5 miles. The assessment of stream habitat (URS, 2013) included a survey location near the NAA that was found to have habitat conditions similar to those evaluated at the Project location as the river channel and associated floodplain are similar for the Red River and Wild Rice Rivers. The assessment of in-stream habitat was rated poor to moderate quality with little diversity in substrate or habitat type at all reaches. Fish IBI scores from near the NAA location were slightly higher in both the Red and Wild Rice Rivers as compared to the Project control structure location. Table 3.38 above presents the IBI data for the Red River in surveyed locations. Site 3 is located on the Red River downstream from the NAA and had an IBI score of 53, which is considered in fair condition. The NAA is not anticipated to result in impacts to the overall fish community, habitat, or migration and connectivity different than those that were previously described for the Project along these four rivers.

The impacts to aquatic habitat from construction of the NAA control structures would include the abandonment and loss of approximately one mile of river channel to connect the new structure to the existing channel on both the Red River and the Wild Rice River. Impacts to aquatic habitat from construction of the NAA control structures are anticipated to be of a similar magnitude to those described for the Project, approximately 14 acres on the Red River (Table 3.42) and approximately 12 acres on the Wild Rice River (Table 3.43).

The NAA may lessen some impacts to fish and biological habitat and connectivity on Wolverton Creek. By moving the control structure to the north, the construction zone within the Red River would be over one mile further away from the confluence of Wolverton Creek with the Red River. This could lessen the potential for disturbance to Wolverton Creek during construction but also lessen the likelihood that operation of the Red River control structure would impact fish passage into Wolverton Creek. Additionally, the NAA movement of the control structure and the staging area to the north would lessen the total river miles of Wolverton Creek channel that would be impacted.

Operation of the NAA control structures would be similar to those described for the Project. This is anticipated to result in impacts to fish migration and connectivity within the watershed similar to those described for the Project. Operation of the control structures on the Red and Wild Rice Rivers has the potential to interrupt fish migration during the years when flow conditions cause the structures to be operated. The mitigation measures for impacts to connectivity and fish passage for the NAA, as with the Project, would be the reconstruction of the Drayton Dam to include fish passage and the removal of the Wild Rice River Dam.

The remaining portions of the NAA (i.e., diversion channel and aqueducts) would remain the same as what is described for the Project. This includes construction of aqueducts on the Maple and Sheyenne Rivers to flow over the diversion channel, which is anticipated to result in 8.4 and 11 acres of impacts to aquatic habitat, respectively (Table 3.43), and abandonment of approximately one mile of channel on each of these rivers. The Rush and Lower Rush Rivers would also result in 2.3 and 2.7 miles, respectively, of channel abandonment on each river and have drop structures installed at the confluence into the diversion channel. Impacts on the fish and aquatic community from construction and operation of the current Project design were previously described and are anticipated to be the same for the NAA.

Additional mitigation and monitoring measures, beyond those identified for the Project, are not anticipated to be required to address potential impacts from the NAA. Stream restoration within the Red River basin would be completed for impacts to aquatic habitat from the NAA, which was previously discussed for the Project.

3.8.3 Proposed Mitigation and Monitoring Measures

The Project would result in a variety of impacts to the Red River and tributary systems in Minnesota and North Dakota, including loss of aquatic habitat and potential disruption of fish migrations. Mitigation actions have been proposed with the intent of offsetting Project impacts. This section includes a discussion of the proposed mitigation, as presented by the USACE in the FFREIS and Supplemental EA and as further detailed in the Draft AMMP (Appendix B). Proposed mitigation effectiveness and recommended additional monitoring is discussed in Chapter 6.

3.8.3.1 Proposed Mitigation

3.8.3.1.1 Stream Channel Restorations

The construction of the control structures, aqueducts, inlet structures, rock ramps and the diversion channel would impact aquatic habitat on the Red, Wild Rice, Sheyenne, Maple, Rush, and Lower Rush Rivers. The Project proposes to locate all features in upland or wetland areas adjacent to the existing river channels. Upon completion, connection would be made to the existing river channels. As it is not known what extent the new channels would replace the loss of the existing habitat, the use of habitat features of the new channels and structures is not proposed as mitigation for fish habitat impacts. Mitigation has been proposed in the form of stream restoration projects.

Stream restoration projects would be anticipated to offset the direct impacts to aquatic habitat in the Red, Wild Rice, Sheyenne, and Maple Rivers. The mitigation plan discussed in Attachment

6 of the FFREIS includes two potential stream habitat restoration options 1) full stream restorations and 2) stream improvement that relies on riparian buffer corridor restoration. Full stream restoration is the preferred option. Stream restoration projects have not yet been identified. One of the limiting factors in planning a stream restoration project is landowner consent. The non-Federal sponsor would need to find willing landowner partners who are interested in allowing a stream restoration project to be constructed on their property. The stream restoration project would then need to have the land enrolled into an easement or deed restriction. As it is unknown where the stream restoration projects would occur at this time; it may be necessary to construct stream restorations on a river that is not impacted by the Project or that may be located outside of the project area. Stream buffering would be considered for mitigation if full stream restoration cannot be used to fulfill needed mitigation needs.

Funding for the stream restoration projects estimated in the FFREIS totaled approximately $9.7 million for the full stream restoration option and $10.9 million for the riparian corridor improvement option. The breakdown of funding allocated toward offsetting impacts to aquatic habitat in each river is shown in Table 3.44 for the riparian corridor improvement option, as an example of estimated mitigation cost.

Table 3.44 Stream Restoration Projects to Serve as Mitigation for Impacts to Aquatic Habitat

Water Body	Proposed Mitigation Project	Funds Allocated Toward Project
Red River	Stream Channel Restoration	$5 million
Wild Rice River	Stream Channel Restoration	$790,000
Sheyenne River	Stream Channel Restoration	$3.1 million
Maple River	Stream Channel Restoration	$2.1 million
Rush River[1]	Sinuous Low Flow Channel	-
Lower Rush River[1]	Sinuous Low Flow Channel	-
TOTAL		**$10.9 million**

Source: USACE FFREIS 2011
[1]Construction of the sinuous low flow channel is part of the cost of the diversion channel construction and not listed as a separate mitigation cost in the FFREIS for the riparian corridor restoration.

The Project would impact aquatic habitat on the Rush and Lower Rush Rivers. The quality of habitat within the Rush and Lower Rush Rivers is considered to be of low quality and therefore, stream restorations are not proposed as mitigation for aquatic habitat impacts to the Rush and Lower Rush River. From the Maple River downstream to the outlet of the diversion into the Red River, the low flow channel would be constructed in a sinuous, meandering nature. This would be done to provide habitat within the low flow channel, mimicking a more natural stream channel. The current design for the low flow channel has dimensions of approximately 84 feet wide by five feet deep for habitat creation.

Impacts to aquatic habitat on the Maple and Sheyenne Rivers would be verified through the comparison of IBI scores developed before and after construction. Impacts would also be quantified by calculating a “Habitat Unit” as Impact Area multiplied by Habitat Quality (as identified from one or more of the above metrics). Mitigation would be considered effective if Habitat Units lost through impact are less than Habitat Units gained through mitigation. This would also take into account the Habitat Units that are present within any newly constructed river channels to facilitate routing flow through Project features (e.g., water control structures and aqueducts) (FFREIS 2011).

3.8.3.1.2 Fish Migration and Connectivity

One of the impacts that would potentially result from the Project would be the interruption of fish migration and loss of biological connectivity during Project operation. There are two projects that have been identified to offset impacts to fish passage and biotic connectivity of habitats; these include the Drayton Dam fish passage project and the Wild Rice Dam removal project. Fish passage channels at the Red River and Wild Rice River control structures, originally proposed as mitigation, were eliminated from current Project design due to anticipated reduced operation (from a discharge of 9,600 cfs [see FFREIS subsection 5.2.1.7.2] to a 10-year flood at 17,000 cfs).

Drayton Dam Project

The Drayton Dam is located within the city of Drayton, approximately 125 miles downstream of the project area on the Red River. A separate EA has been completed by the USACE for the Drayton Dam fish passage project (USACE, 2012a). The EA evaluated a variety of factors and potential environmental impacts associated with the proposed passage project. The EA states that of the eight dams on the Red River within the United States that pose a barrier to fish migrations and habitat connectivity, the Drayton Dam is the last structure that has not been reconstructed or modified to facilitate fish passage. Information in the EA stated that the Drayton Dam may be passable by fish up to 70 percent of the time in April but likely passable less than 50 percent of the time in all other months, which makes providing fish passage at the Drayton Dam a potential mitigation measure for impacts associated with the Project pertaining to fish passage.

A design of the Drayton Dam fish passage project was presented in the EA modeled after other USACE dam reconstruction efforts on the Red River. An example of a similar rock-ramp spillway with fish passage is the Riverside Dam in Grand Forks displayed in Illustration 3.7 below. The Drayton Dam fish passage project would construct a new rock-ramp spillway and removal of portions of the existing dam. The rock-ramp spillway would consist of rip-rap, boulders and sheet pile and start 300 feet upstream of the existing dam and end at the existing dam.

Illustration 3.7 Example of a fish passage dam project on the Red River at the Riverside Dam, Grand Forks, North Dakota.

Source: Drayton Dam EA, 2012

The new spillway would be sloped at the sides to maintain flows within the center of the channel, directing them away from the banks to reduce erosion, while also allowing fish passage through the center of structure. A variety of factors were considered and incorporated into the Drayton Dam fish passage project design including:

- Maintaining the intake area for reliable water supply for the city of Drayton, North Dakota,
- Ensuring the current water level elevation maintained by the existing dam was not lowered , which could lead to upstream channel erosion and bank failures,
- Maintaining the public use and access point on the Red River located on the North Dakota bank, and
- Minimize construction downstream of the existing dam, which would avoid filling the downstream scour hole that currently provides habitat for the local fishery.

<u>Wild Rice Dam Project</u>

The Wild Rice Dam removal project is proposed as mitigation for Project impacts to fish passage and biological connectivity on the Wild Rice River. This low-head dam is located downstream of the proposed control structure location, approximately four and a half miles east of the town of Horace, North Dakota. The Wild Rice Dam fragments habitat and interrupts fish passage on the

Wild Rice River under most normal and low-flow conditions, and is likely only passable at high flows. The USACE has prepared an Environmental Assessment for this project and a Finding of No Significant Impact was signed on October 9, 2014.

3.8.3.2 Proposed Monitoring

The FFREIS described monitoring efforts that would be conducted, including pre-construction and post-construction fish, macroinvertebrates, and aquatic habitat surveys. Pre-construction surveys were proposed to be performed at least twice prior to construction. Survey locations were to include areas near the footprint of the Project structures (i.e., control structures, aqueducts, rock-ramps), as well as sites above or below the features. These pre-construction efforts would be used to established baseline conditions and a point for monitoring future changes potentially associated with the Project. Post-construction included a minimum of two surveys over the first 20 years following Project construction completion. Surveys would be completed in the same locations as those for the pre-construction surveys to identify any changes to habitat quality.

The FFREIS Attachment 6 also included monitoring for aquatic connectivity and fish passage to assess the effects of Project features on fish migration. Monitoring would be completed once Project features were in place and Project operation had occurred (post-construction). No pre-construction monitoring was proposed to assess fish movements. However, pre-construction monitoring was proposed to assess potential connectivity impacts specific to Wolverton Creek as a control structure was proposed to be constructed on Wolverton Creek during that design phase (no longer part of the current Project design). Details of the proposed monitoring were not available at the time of the FFREIS.

Monitoring was proposed to observe for stranded fish that included cursory visual assessments, following Project operation. Areas of focus would include pre-identified problem areas, such as low areas in topography such as near the river channel upstream of the Red River and Wild Rice River control structures, as well as within the diversion channel. Observations would include notes on numbers, species, and size of fish. These results would be discussed with and adaptive management team (developed as part of the adaptive management approach). At a minimum, observations would be made following the first two or three times the Project is operated.

Since the completion of the FFREIS, a pre-construction assessment of the aquatic habitat and fish and macroinvertebrate communities within the Red River and associated tributaries was completed for the project area (URS, 2013). This assessment, completed in 2011 and 2012, was conducted on 23 sites across the project area (Figure 18), including all rivers that would be impacted by the Project. The results from these surveys were included in the discussions above.

Since the FFREIS, the USACE and Diversion Authority have continued working with the MNDNR, and other agencies, on developing and revising approaches outlined in the FFREIS Attachment 6 for pre- and post-Project construction and operation monitoring. The Draft AMMP, included as Appendix B, includes additional and more detailed pre- and post-Project construction and updated operation monitoring plan, is an example of this collaborative effort. The Draft AMMP is built off of the Attachment 6 proposed survey monitoring plan, ongoing communications, and studies completed to date, such as the macroinvertebrate, habitat, and fish communities surveys completed by URS in 2011 and 2012, as discussed above.

Further evaluation of the Attachment 6 Monitoring Plan, subsequent study findings and additional recommendations are discussed in Chapter 6 and within the Draft AMMP included as Appendix B. It is important to note, however, that although the Draft AMMP was a collaborative agency effort, the Draft AMMP was prepared for use in this EIS and therefore also includes MNDNR recommendations for the Draft AMMP approach, specific protocol, and additional studies different to or above that which the USACE and Diversion Authority have proposed. The USACE AMP and the Draft AMMP would continue to be revised through ongoing cooperative efforts, as pre-Project construction and operation monitoring results are assessed, Project designs are finalized, and as Project permitting requires.

3.9 WILDLIFE AND WILDLIFE HABITAT

This section describes wildlife and wildlife habitat within the project area, potential environmental impacts related to Project construction and operation, and measures proposed to avoid, minimize or mitigate impacts. Key habitats and associated sensitive species are the focus as they represent those species and habitats that are in need of protection and that would be the most sensitive to any disturbances. Detailed discussions on fish and aquatic habitat; state listed species and special status species; and invasive species are discussed within Sections 3.8, 3.10, and 3.11, respectively. Wetlands (Section 3.4) and Cover Types (Section 3.6) are referred to frequently as more detail about habitat types and acreage amounts are included within those sections. The FFREIS and Supplemental EA were reviewed for information on wildlife and wildlife habitat within the project area. The Minnesota and North Dakota Comprehensive Wildlife Conservation Plans or Strategies (i.e., State Wildlife Action Plans, or SWAPs) were reviewed for specific key habitats and associated species that could be located within the project area.

3.9.1 Affected Environment

In general, the project area can be viewed as consisting of both an urban and rural environment. The urban center (i.e., the F-M urban area) consists largely of manicured lawns and landscaped areas and provides only limited habitat for wildlife species. Therefore, species observed include those that would be considered more as generalist species such as some species of songbirds, reptiles, amphibians, and small mammals. The rural area provides a variety of habitat for both generalist and specialist species. Primarily consisting of cropland, generalist species include beaver, muskrats, striped skunks, fox squirrels, white-tailed deer, red fox, raccoons, raptors, waterfowl, and pheasant for example (FFREIS 2011). The specialist species are those associated with key habitats (focus areas) and are further described below. The riparian areas (floodplain forests) associated with the Red, Wild Rice, and Sheyenne Rivers provide the majority of the terrestrial habitat that exists within the project area. Other than the floodplain forests, wildlife resources are limited to those that can acclimate to drainage ways, shelterbelts, agricultural fields, road right-of-ways or within remnant key habitats that may be present.

Both Minnesota and North Dakota have developed SWAPs (funded through federal grants and programs) that identify key habitats and their associated Species of Greatest Conservation Need (SGCN) (MNDNR, 2006) as well as conservation plans and strategies for the key habitats. The term SGCN is used in Minnesota, while North Dakota uses the term Species of Conservation Priority (SoCP). For the purposes of this EIS, the term SGCN will be used when discussing species in the context for both Minnesota and North Dakota.

SGCN are wildlife species that are “rare, declining, or vulnerable to decline and are below levels desirable to ensure their long term health and stability” (MNDNR, 2006). These species are often considered indicators to the overall health of wildlife communities (Hagen et al., 2005). Key habitats are those habitats that are identified as being the most important for SGCN and have been identified as those habitats that: are used by the greatest number of SGCN; experienced the most alteration over the past 100 years; contain high percentages of SGCNs that are habitat specialists; or are designated by The Nature Conservancy as important stream segments (MNDNR 2006). The following discussion is focused on habitats where SGCN could be present within the project area. More specific SGCN details are discussed in Section 3.10 – State Listed Species, and Special Status Species.

Key habitats are identified within discrete ecological boundaries. This allows conservation actions to be focused on specific interrelated ecological areas. Since key habitats exist in relationship to each other, understanding the relationships between them would allow management within their broader ecological context.

Minnesota and North Dakota use different methods to divide the states into ecological boundaries in their respective SWAPs. In Minnesota, the specific ecological classification system (ECS) divides areas into broad provinces, which are further divided into sections, and finally into subsections. In Minnesota, the project area is in the Prairie Parkland ecological province, within the Red River Valley section, within the Red River Prairie subsection (MNDNR, 2006). Key habitats that can be found in the Red River Prairie subsection include: prairie, wetland-nonforest, river-headwater to large, river-very large, and forest-lowland deciduous.

In North Dakota, ecological areas are divided into landscape components, which are sub-divided into focus areas. Under North Dakota terminology, the project area would contain three landscape components: Tallgrass Prairie (Red River Valley); Rivers, Streams, and Riparian; and Wetlands and Lakes. Specific focus areas in these landscape components include: Saline Area; Sand Deltas and Beach Ridges; and the Red River and Tributaries.

Although Minnesota and North Dakota use different methods to identify ecological regions, the purpose is the same: to define discrete ecological boundaries where conservation efforts can focus on protection of key habitats, and in turn preserve and protect SGCN. For the purposes of this EIS, the Minnesota classification system will be used to define key habitats and SGCNs within the project area. A comparison of the two systems providing each state's habitat classification system and its equivalent for the other state is shown in Table 3.45.

Table 3.45 Comparison of Minnesota and North Dakota Habitat Classification Systems

Key Habitat (MN)	Landscape Component (ND)
Prairie	Tallgrass Prairie (Red River Valley)
Wetland-Nonforest	Wetlands or Lakes
River-Headwater to Large	Rivers, Streams, and Riparian
River-Very Large	Rivers, Streams, and Riparian
Forest-Lowland Deciduous	Rivers Streams and Riparian

Source: MNDNR 2006; Hagen et al. 2005

Using the names associated with the Minnesota classification system, each key habitat in Table 3.45 is described further below, including the occurrence of SGCNs. Each of the habitats is within the Red River Prairie subsection of Minnesota's Ecological Classification System and is further described in a subsection profile (MNDNR, 2006).

3.9.1.1 Prairie

Prairie habitats are dominated by grasses and forb species. Woody species, such as trees and shrubs, were historically absent from these habitats due to natural fire regimes. Within the Prairie Parkland ecological province, tallgrass prairies were the dominant land cover prior to European settlement and supported a variety of upland wildlife species.

Land use practices over the last century, including urban development and widespread agriculture, have reduced the amount of native prairie habitat across Minnesota and North Dakota, including within the project area. While the prevalence of prairies has been reduced compared to pre-settlement levels, grassland and surrogate upland habitats are present. These include hayland, pasture, and planted shelterbelts (FFREIS 2011). Shelterbelts, planted near farmsteads and homes or along field edges, are composed mostly of small shrubs and fast growing tree species, but can also include some coniferous trees, as well as grassy understory. These habitats support wildlife species at varying levels depending on the size of habitat tracts and their proximity to existing human developments or activities. Pasture and hayland also support a variety of migratory birds for foraging and nesting. The type of agricultural activities, as well as the timing of weather conditions and migratory activity during a given year, influence the extent to which birds and other wildlife are able to use these habitats.

Remnant prairie within the Red River Prairie subsection provides habitat for several insect and bird SGCNs, including examples such as those below (MNDNR, 2006). Each of these species is sustained by one or more specific components of prairie habitat. In the case of insects, these include plants that provide nectar or serve as hosts for egg laying. For birds, specific habitat types, such as dry prairie with native short grasses, are important. Some of these species are considered to be declining in number within their ranges, their habitat is the core of the species breeding range, and/or the species is at risk throughout its range (Hagen et al., 2005).

- Regal fritillary (*Speyeria idalia*)
- Arogos skipper (*Atrytone arogos)*
- Uncas skipper (*Hesperia uncas)*
- Red-tailed leafhopper (*Aflexia rubranura)*
- Dakota skipper (*Hesperia dacotae)*
- Chestnut-collared longspur (*Calcarius omatus*)
- Sprague’s pipit (*Anthus spragueii)*
- Baird’s sparrow (*Ammodramus bairdii)*
- American bittern (*Botaurus lentiginosus*)
- Upland sandpiper (*Bartramia longicauda)*
- Wilson’s phalarope (*Phalaropus tricolor*)
- Canadian toad (*Bufo hemiophrys*)

There are no known prairie remnants located within the project area. Other surrogate habitats are present, as described above, that may provide some habitat for these species. However, it is presumed that there is a low potential for these SGCNs to be present.

3.9.1.2 Wetland-Nonforest

Wetland-Nonforest (non-forested wetlands) habitats are dominated by herbaceous plants adapted to saturated soils for all or most of the growing season. These habitats occur in several major types across Minnesota, including marshes, wetland meadows, fens, and bogs, each with a characteristic plant community and period of inundation. Non-forested wetlands have declined in many subsections of Minnesota's ecological classification system, especially in the Prairie Parkland province, which includes the Red River Prairie subsection (MNDNR, 2006). As previously mentioned, wetlands present in the project area, and associated impacts, are discussed in detail in EIS Section 3.4 – Wetlands. Cover types are discussed in Section 3.6, which includes a summary of the total wetland acreages within the project area.

Due to the decline of non-forested wetlands, several species of birds that depend on this habitat are considered SGCN. Optimal habitat for these birds includes requirements for depth of water; height, density, and type of vegetation; and prevalence of open water. Also within this landscape are several species of mammals, reptiles, and amphibians. Examples are listed below (MNDNR, 2006; Appendix B of Hagen et al., 2005).

- Sedge wren (*Cistothorus platensis)*
- Yellow rail (*Coturnicops noveboracensis)*
- Nelson's sharp-tailed sparrow (*Ammodramus nelson)*
- Two-spotted skipper (*Euphyes bimacula Illinois*)
- Least bittern (*Ixobrychus exilis*)
- American bittern (*Botaurus lentiginosus*)
- Marsh wren (*Cistothorus palustris*)
- Virginia rail (*Rallus limicola*)
- Forster's tern (*Sterna forsteri*)
- Wilson's phalarope (*Phalaropus tricolor*)
- Horned grebe (*Podiceps auritus*)
- American bittern (*Botaurus lentiginosus*)
- Yellow rail (*Coturnicoops noveboracensis*)
- Canadian toad (*Bufo hemiophrys*)

There are very few non-forested wetland areas located within the project area within North Dakota. Within Minnesota, the non-forested wetlands are primarily Seasonally Flooded Basins that are farmed, temporary wet basins, typically void of emergent vegetation and would not necessarily qualify as a key habitat. Therefore, it is presumed that the potential of these SGNC within the project area is low. Bird usage may occur during migration.

3.9.1.3 River Habitat

The Red River Prairie subsection has two key river habitats within the project area: river – headwater to large; and river – very large. Rivers and streams within the Red River Valley ecological section have been altered since the time of settlement. The main stem of the Red River itself remains a sinuous stream. However, the watershed has been altered through intensive agriculture, wetland drainage, channelization of streams, and addition of dams (Aadland et al., 2005). Historically the pre-settlement vegetation of the Red River Prairie subsection was dominated by tall grass prairies and wet prairies but has been replaced by wide-spread agriculture (MNDNR, 2006). In order to facilitate crop production, the land has been extensively drained through tiling of wetlands, creation of ditches, and channelization of streams, including streams within the project area such as the Rush and Lower Rush Rivers. All of these land use alterations lead to changes in river habitat such as alteration of flow regimes and increased sedimentation that reduces pool depth or covers hard substrates.

One of the other most significant changes to river habitats with the Red River watershed is the creation of dams and flow control structures. The addition of these structures has altered the ability of fish to migrate within individual rivers and also through multiple rivers and streams across the overall watershed. This limitation of fish movement throughout the Red River watershed limits the access of fish to certain important habitat types such as native spawning areas or wetlands located in the upstream portions of the watershed. Reduced fish migrations can also impact other aquatic organisms, such as mussels which depend on fish hosts for reproduction and dispersal (Aadland, 2010).

An environmental assessment examining fish passage in the Red River of the North basin in Minnesota was completed by the USFWS in 2005. This assessment identified over 400 dams and control structures that have been constructed throughout the watershed on the Red River and its tributaries. Additionally there have been thousands of culverts installed at road crossings on ditches and streams, which in some cases have become barriers to fish movement. These collective land use changes have impacted the habitat within and adjacent to rivers and streams in the Red River Prairie subsection, which ultimately impacts the types and prevalence of wildlife species present. Despite the past alterations, river habitats within the Red River Prairie subsection support several significant fish and wildlife resources such as a world class catfish fishery within the Red River. Efforts undertaken to remove barriers to fish migrations have been successful, including the reintroduction of lake sturgeon to the watershed starting in 1997. A description of the two key river habitats within the project area and example SGCN supported by each habitat is provided.

3.9.1.3.1 River-Headwater to Large

Rivers in this category range in size from a few feet to more than 150 feet wide, and include cold and warm water types. The size of these rivers is dependent on the area of the watershed they drain. These river channels range from three to 23 feet wide for Headwaters and from 50 to 150 feet wide for a large river. Water temperature, velocity, and depth also vary with river size; typically, cold water rivers are less common than warm water rivers. Water velocity is slower and pool depth increases as the size of the river increases. Human activities have affected all types of rivers in this habitat category. Water quality is affected by inputs of chemical and other pollutants. Typically, as river size increases, a greater variety of pollutants with a resulting greater decline in water quality is expected (MNDNR, 2006).

Within the project area, the Wild Rice River, Sheyenne River, Maple River, Rush River, Lower Rush River, Buffalo River and Wolverton Creek would be classified as River-Headwater to Large. These systems predominantly support fish species, which are discussed in detail in Section 3.8 – Fish Passage and Biological Connectivity. Terrestrial species are typically supported by riparian habitat associated with these systems, and are discussed in Forest-Lowland Deciduous, below.

Several fish species are among the SGCNs found in River-Headwater to Large habitat. As with other SGCNs, these species have particular habitat requirements. Water temperature and quality, water velocity, substrate type, and vegetation type and density are important features for refuge and spawning (MNDNR, 2006).

- Redside dace (*Clinostomus elongates*)
- Plains topminnow (*Fundulus sciadicus*)
- Creek heelsplitter (*Lasmigona compressa*)
- Largescale stoneroller (*Campostoma oligolepis*)

- Black redhorse (*Moxostoma duquesnei*)
- Great redhorse (*Moxostoma valenciennesi*)
- Least darter (*Etheostoma microperca*)
- Crystal darter (*Ammocrypta asprella*)

Portions of the Sheyenne River, Wild Rice River, South Branch of the Wild Rice River are considered key habitat (focus area) rivers that provide unique or declining habitat for specialized species within the project area. Many of these species are known or likely to occur.

3.9.1.3.2 River-Very Large

Rivers in this category typically have a large drainage area and are the terminus for smaller tributaries. Within the project area, the Red River would be classified as River-Very Large. Typically, these rivers have lower gradients and slower current velocities than their smaller tributaries, which lead to the creation of oxbows, islands, and backwater systems. Significant flooding, which can occur periodically, helps maintain these river characteristics. Considered the most biologically diverse type of river system in Minnesota, water quality is a common concern, as these rivers have large watersheds that can receive higher loads of nutrients and sediments (MNDNR, 2006). Higher sediment loads increase turbidity and reduce sunlight to the streambed, limiting densities of rooted aquatic plants.

Historically, the Red River and its backwaters supported several species of animals. Land settlement has affected the river through conversion of prairie to agriculture, which has led to loading of sediment, nutrients, and pollutants into the Red River and its tributaries. Many SGCNs, therefore, have been extirpated from the Red River (MNDNR, 2006), but some species, such as the Prothonotary warbler (*Protonotaria citrea*), may persist. Presently, the Red River supports a distinct fish community compared to smaller tributaries. This is discussed in detail in Section 3.8 – Fish Passage and Biological Connectivity.

Habitat of the Red River, its tributaries, and backwater areas include many species of birds, mammals, reptiles, amphibians, fish and mussels (Hagen et al., 2005) such as:

- Horned grebe (Podiceps auritus)
- American bittern (Botaurus lentiginosus)
- Swainson's hawk (Buteo swainsoni)
- Yellow rail (Coturnicops noveboracensis)
- Willet (Cataptrophorus semiplamatus)
- Upland sandpiper (Bartramia longicauda)
- Baird's sparrow (Ammodramus bairdii)
- Canadian toad (Bufo hemiophrys)
- Smooth green snake (Liochlorophis vernalis)
- Pearl dace (Margariscus margarita)

The Red River is considered a key habitat (focus area) river within the project area. Some of these species are known or likely to occur within the project area, particularly where there is adjacent floodplain forest habitat or grassland/pasture land that provides additional habitat needs.

3.9.1.4 Forest-Lowland Deciduous

For the purposes of this EIS discussion, Forest-Lowland Deciduous is defined as the riparian floodplain forest (i.e., floodplain forest). This key habitat represents most of the natural terrestrial wildlife habitat that presently exists in the project area (FFREIS 2011). Frequent flooding after spring snowmelt or unusually heavy rains has resulted in distinctive vegetation adapted to saturated soils, prolonged inundation, frequent erosion, and sediment deposition. Wetlands are frequently present in these forests (see Section 3.4 for detailed description of wetlands within the project area). Vegetation less tolerant to frequent flooding may be found on terraces. Floodplain forests in the project area are dominated by deciduous tree species such as cottonwood and green ash. Areas of contiguous overstory coverage may have some openings, which support herbaceous ephemerals. Frequent flooding sometimes results in excessive vegetation scouring and sediment deposition, which produces areas of bare ground. The understory is typically open, with few shrubs or saplings (MNDNR, 2006). Floodplain forests can support a variety of aquatic and terrestrial wildlife due to the transitional nature of riparian to upland habitat.

Large areas of floodplain forests have been lost since European settlement within the project area (MNDNR, 2006). Floodplain forests were formerly dominant in the wide floodplains surrounding streams and rivers. However, conversion to agriculture and urbanization has reduced the floodplain forests to narrow margins along rivers and streams. Within the project area, floodplain forest is less prevalent than it is in other parts of Minnesota, such as along the Mississippi River. The remnant margins are essentially the only floodplain forest habitat remaining in the project area. Five to seven percent of the Red River Prairie subsection consisted of floodplain forest pre-settlement, but its occurrence is now less than one percent (MNDNR, 2006; Hagen et. al, 2005). Since the project area was historically prairie, forest was uncommon but served as important nesting, breeding, and overwintering habitat for a variety of terrestrial wildlife species (FFREIS 2011).

Floodplain forest supports SCGNs that include several birds, such as those listed below. Factors affecting the persistence of these species include the presence and size of lowland hardwood or mature deciduous forest, characteristics of waterways, topographic features, and suitable nesting opportunities (MNDNR, 2006).

- Prothonotary warbler (*Protonotaria citrea*)
- Cerulean warbler (*Dendroica cerulean*)
- Red-shouldered hawk (*Buteo lineatus*)

Few floodplain forests remain within the project area. Those that remain are small and lack corridors to other floodplain forest tracts. Remaining floodplain forests are located both upstream and downstream of the F-M urban area.

3.9.2 Environmental Consequences

This section describes both temporary and permanent impacts that are anticipated to occur to the previously described wildlife and habitats present within the project area for the Project and Project alternatives. Temporary and permanent impacts are described for both Project construction and operation.

3.9.2.1 Proposed Project

Environmental consequences to wildlife and wildlife habitat depend on their presence in the project area and the presence of remnant or specific habitat requirements, as discussed in subsection 3.9.1. Studies of remnant habitat have not been completed specifically for the project area; however, an analysis of cover types has been done for the footprint of the diversion channel construction and within the inundation area. The project area is cropland with a high-density population urban area located in the middle. Low-quality remnants of non-native grassland or hayland and remnant floodplain forest account for less than one percent of the Project footprint (Section 3.6 – Cover Types). There is no evidence that parcels of native prairie habitat remain in the area. Forest-lowland deciduous habitat (i.e., floodplain forest) has been identified as the primary terrestrial wildlife habitat that remains in the project area (FFREIS 2011). Wildlife using the project area are thus likely to be those adapted to human activity and agricultural environments, with a limited presence of SCGNs with specific habitat needs. The discussion of impacts to wildlife is therefore general with a more detailed discussion about floodplain forest. Impacts to wetland habitat types are discussed in Section 3.4 – Wetlands.

3.9.2.1.1 Construction Impacts

Construction of the diversion channel, embankment systems, community ring levees, and aqueducts would primarily result in the conversion of cropland to grassland and wetland habitat (Section 3.6 – Cover Types). Most of the wildlife and wildlife habitat that would be disturbed are generalist species. Few key habitats that contain SGCNs would be disturbed; however, small areas that contain forest-lowland deciduous, river habitat (i.e., aquatic habitat), and non-forested wetlands would be directly impacted. Direct impacts include dredging, draining, filling, and excavation.

<u>Forest-Lowland Deciduous – Floodplain Forest</u>

The majority of impacts to floodplain forests would occur along the Red River during the construction of the OHB ring levee, control structures, and diversion outlet. Other floodplain forest impacts may occur along the diversion channel near river and stream intersections and during mitigation work, such as the Drayton Dam Mitigation Project. Potential floodplain forest impacts were estimated in the Supplemental EA. Impacts were calculated using aerial photographs showing impacted areas (i.e., footprint of the diversion channel, connecting channel, excavated material berms, and embankments) on the Wild Rice and Red Rivers, as well as construction of control structures on the Red River and Wild Rice River (Figures 19 and 20), outlet structure on the Red River, and aqueducts on the Maple and Sheyenne Rivers. Figures 19 and 20 show the aerial photo analysis used to estimate the excavated and fill areas for the Red River and Wild Rice River control structures, respectively. Similar aerial photo analysis was used to estimate the potential impacts for the diversion channel and other portions of the Project footprint. The Project footprint is currently approximately 20 percent wetlands, which includes approximately 0.007 percent floodplain forest or about 62 acres (Section 3.4 – Wetlands and Section 3.6 – Cover Types). (It should be noted that upland shelter belts and other non-riparian wooded areas were also included in the USACE floodplain forest calculation, which totals approximately 124 acres of forested wetland, of which about half, or 62 acres, is floodplain forest.) It is estimated that of the 62 acres of floodplain forest impacts from the Project, approximately three acres would occur in Minnesota and approximately 59 acres would occur in North Dakota. Impacts to floodplain forest would require mitigation at a two to one ratio as described in subsection 3.9.3 – Proposed Mitigation and Monitoring Measures.

River Habitat
Aquatic habitat with two key habitat (focus area) rivers would be impacted directly through local disturbance during construction activities and from the abandonment of several miles of river sections on the Rush River and Lower Rush River, i.e., river habitat, and through the construction of the control structures and aqueducts (see also Sections 3.5 – Cold Weather Impacts on Aqueduct Function and Biotics, and 3.8 – Fish Passage and Biological Connectivity). River habitat from the control structures and diversion channel would range from eight to 25 acres for the Red River, Wild Rice River, Sheyenne River and Maple River (FFREIS 2011). Compared to the amount of river habitat within these rivers, the amount of habitat impacted would be small, but depending on the quality of habitat present, could result in localized impacts to fish and other wildlife species. Impacts to riparian vegetation during construction may also cause stream bank destabilization.

Non-forested Wetlands
Twenty percent of the Project footprint would directly impact non-forested wetlands. The majority of direct impacts would occur to Seasonally Flooded Basins (approximately 85 percent). The remaining impacts would secondarily affect fresh (wet) meadows and shallow marshes (approximately seven and six percent, respectively).

The extent of construction impacts to wildlife and wildlife habitat impacts are dependent on a variety of factors such as construction timing, locations, actions (e.g. earth moving, dewatering, and etc.), and reestablishment of disturbed areas to desired outcome (i.e., mitigation approach). Federal, state, and/or local permits that may be required could include provisions such as date restrictions for when construction can occur for particular Project features or other requirements to help minimize effects on wildlife or wildlife habitat based on the factors involved. Project construction planning, such as the when certain Project features are constructed during this timeframe, are still in development and would be determined when Project plans are finalized and permits have been issued. Project construction is expected to occur over a 6.5-year timeframe or as funding becomes available.

Temporary Impacts
During construction of the Project features there could be potential for direct impacts to some wildlife and aquatic species in these areas. Impacts include potential for direct mortality, displacement or increased exposure of less mobile species (i.e., small mammals, amphibians, reptiles, ground-nesting birds, including some migratory birds) to predators. Increased human activity, increased noise, and visual disturbances may indirectly impact mobile species (i.e., medium to large mammals and birds, including migratory waterfowl and raptors), which may be displaced from their habitat or may disperse from the area. Vegetation may be disturbed through construction vehicle compaction, construction equipment storage, and construction material placement. Disturbed vegetation would be expected to recover or would be replanted to avoid the establishment of undesirable or invasive species. Due to the temporary nature of these impacts, they are not anticipated to cause long-term declines in populations. It would be anticipated that generally, wildlife would return to the area following construction activities.

Permanent Impacts
Permanent impacts would occur to wildlife habitat, specifically within and along stream channels, wetlands, and upland habitats (i.e., hayland/grassland) – floodplain forests and wetlands-non-forested key habitats. The duration of this impact would vary according to the

length of time required for construction of each portion of the Project features and for the time required for a particular type of habitat to become re-established. Impacts to upland habitats would likely be short-term as the new grasslands associated with the Project would be created concurrently with the Project and would become established within a few growing seasons. Impacts to non-forested wetland habitat such as shallow marshes would likely take several growing seasons to become established as new habitat replacing the function of the habitat lost due to the Project. The impacts to floodplain forest would have the longest potential temporal loss of habitat function as the loss of habitat would be immediate, but the creation of new forests as mitigation would likely take more than a decade to replace the function of what was lost. Mitigation of the floodplain forest and other wetland habitats is discussed in Section 3.4 – Wetlands.

The construction of the diversion channel would provide a net gain in overall wildlife habitat.

3.9.2.1.2 Operation Impacts

The level of impacts would be dependent on the timing and duration of flood events and operation of the Project.

Indirect impacts would occur both downstream and upstream of the tieback embankment; and within Project features (e.g., diversion channel, aqueducts). The river habitat would be impacted within the downstream reach from FDR projects and H and H changes as a result of Project operation. However, river habitat is already considered poor within this reach (Section 3.8 – Fish Passage and Biological Connectivity, Table 3.37) likely from manmade features such as dams and control structures, and land use conversion from prairie to agriculture or to developed communities.

The area upstream of the tieback embankment would experience the majority of impacts resulting from Project operation. Wildlife that is typically found in this area primarily includes generalist species. Key habitats (focus areas) and their respective SGCNs that may be indirectly impacted include floodplain forests, river habitats, and non-forested wetlands.
Constructed Project features (e.g., diversion channel and aqueducts), as currently designed, would create new non-forested wetland and river/aquatic habitat. During Project operation, those features would experience an influx of water and wildlife and wildlife habitat within those corridors would be impacted. As the quality of created habitat is unknown at this time, it is uncertain as to whether or not these features may include SGCNs. Generalist species are more likely anticipated at this time to populate these areas and be affected.

As the majority of impacts resulting from Project operation are likely to occur within the inundation area and to a lesser extent, within constructed Project features, the discussion below on temporary and permanent impacts is focused on those areas.

<u>Temporary Impacts</u>
As operation of the Project is anticipated to occur during early spring, temporary impacts to migratory species may occur. This includes generalist species as well as SGCN or other rare or listed species that may use the project area in route of breeding grounds. Migratory birds that may use undeveloped land as stop-overs would need to find other resting grounds. Flow velocities would produce impassible conditions for fish during Project operation which would be

a barrier to fish migration. In addition, there is a chance for fish stranding and mortality to occur within the inundated areas and diversion channel when flood waters recede.

Resident terrestrial species would be temporarily displaced from habitats that would become inundated. Although much of this area has experienced flooding under existing conditions, the extent, depth, and duration of flooding specifically within the inundation area would be increased. The area available to displaced wildlife would be less which may result in higher mortality rates to those species that are unable to travel distances or get to higher ground. As Project operation would not occur that frequently, it is expected that mortality, if it were to occur, would not have long-term effects on wildlife populations.

Wildlife in the floodplain forest corridors and associated floodplains are adapted to periodic flood events and would likely relocate to nearby areas until flood waters have receded. Periodic floods, particularly in the spring, are part of a natural disturbance regime necessary for the health of these systems. Silt deposition and development of microtopography during flood events creates suitable sites for tree germination and establishment, and floods also carry seeds and propagules of plant species (Epstien et al., 2002). Interaction between terrestrial and aquatic ecosystems occurs in floodplain forests through the processes of over-the-bank flooding, bank cutting, and sedimentation. Over-the-bank flooding can directly cause treefall or indirectly lead to windthrow through increased soil saturation. Spring flood waters often carry ice floes and debris that can scour trees, leading to the development of multiple-stemmed canopy trees. Woody debris from floodplain vegetation influences the development of channel morphology and provides necessary habitat for many aquatic organisms. Riparian vegetation within these corridors reduces overland water flow and sediment transport (Kost et al., 2007).

Temporary impacts to trees can occur from flooding. The extent of the impact depends on the individual tree species, age of the tree, health, and type of impact (e.g., sediment or other debris, inundation depth and duration). Generally, some native tree species are more tolerable to flood events compared to nonnative trees, such as those used for landscaping or other purposes.

<u>Permanent Impacts</u>

Permanent impacts to trees can occur from flooding. The extent of the impact depends on the individual tree species, age of the tree, health, and type of impact (e.g., sediment or other debris, inundation depth and duration). Typically, through natural selection processes over the long-term, tree species in flood prone areas are tolerable to flood events. Generally, nonnative trees, such as those used for landscaping or other purposes are not as tolerable to flood events. Native and nonnative tree species that have not been exposed to flooding in the past or those that may experience the higher extremes of flood inundation or durations as estimated for conditions in the staging area under Project operation may be affected more adversely affected during any given singular event (particularly for larger flood events, greater than or equal to a 100-year flood).

Indirect impacts to the floodplain forest communities could occur over time within the inundation area from sediment deposition during Project operation. The greatest potential for sediment to accumulate would be near the embankment. This would coincide generally with a 10-year flood as these flood events occur much more frequently than larger events. Less sediment deposition would be expected at the south side of the inundation area during the 100-

or 500-year floods. This is due to the anticipated infrequency of these events, and because sediment would tend to fall out of suspension as inundation slowly progresses from near the embankment to further upstream.

Sediment deposition is a naturally occurring phenomenon within the Red River floodplain; however, the tieback embankment acts as a large impoundment during flood events, distributing sediment to areas outside of the historical floodplain into areas (i.e., wildlife habitats) that would not normally receive it. Also, the rate of sedimentation may increase as a result of the altered hydrology and hydraulics. Extended duration of flood events would increase soil saturation times that could lead to stream bank destabilization, potentially resulting in increased sedimentation or bank failure (Section 3.3 – Stream Stability). These effects are anticipated be greater near the tieback embankment where the depth of flooding would increase over current conditions by greater than eight feet with lesser inundation depth increases anticipated further upstream and away from the tieback embankment. Sedimentation would be expected to occur incrementally over several decades; however, inundation of these depths and duration of flooding may result in some permanent habitat impacts depending on the scale of the flood event and the amount of deposition that occurs.

3.9.2.2 Base No Action Alternative

Under the Base No Action Alternative, flooding would be expected to continue in the project area. Wildlife and wildlife habitat would be expected to remain similar to existing conditions, with changes in habitat (e.g., vegetation communities) occurring over time after flooding or other disturbance or system-changing events. Increased pressure from agricultural practices, such as extensive drainage tile systems and/or irrigation usage, as well as hydrologic and hydraulic alteration changes caused by dams or other manmade features or development, would continue to have an influence wildlife and wildlife habitat in the project area.

3.9.2.3 No Action Alternative (with Emergency Measures)

Under the No Action Alternative (with Emergency Measures) could result in minor, temporary impacts to wildlife habitat along the Red River primarily within the cities of Moorhead and Fargo where levees and sandbags would be used to control flooding. During this time, wildlife may be temporarily displaced. These impacts would be minor as most emergency measures would occur in urban areas or communities, where wildlife habitat is already disturbed by human activities. Wildlife and wildlife habitat responses to flood events and other influences would be similar to those described under the Base No Action Alternative.

3.9.2.4 Northern Alignment Alternative

The NAA is similar to the Project in design, construction, and operation with the exception that the tieback embankment and control structures would be located approximately 1.5 miles north of the Project tieback embankment alignment. Habitat within the approximate 1.5 mile area consists of agricultural lands with some development. No key habitats are known to be located within this approximate 1.5 mile area with the exception of river habitat. This area would become part of the inundation area and would be inundated during Project operation. Similar to the Project, areas nearest the tieback embankment would experience the greatest depth and duration of flooding (greater than eight feet). New areas upstream of the tieback embankment would be inundated that do not experience flooding under existing conditions.

Temporary and permanent impacts to wildlife would be similar to those described for both Project construction and operation.

Specific habitat acreages could vary between the Project and the NAA, such as floodplain forest. Floodplain forest acreage was delineated and calculated for direct impacts from the Project construction footprint. A similar assessment of non-forested wetlands and floodplain forest has not been completed for the NAA, but is anticipated to result in a similar impact (Section 3.4 – Wetlands). Field studies would be needed prior to construction to determine the extent of impact to floodplain forest and other cover types.

Proposed mitigation and monitoring would also be similar to those described for the Project in subsection 3.9.3 – Proposed Mitigation and Monitoring Measures, below.

3.9.3 Proposed Mitigation and Monitoring Measures

Mitigation in the form of habitat restoration or creation is proposed to minimize impacts to wildlife habitat and populations. This mitigation was outlined in an adaptive management plan (AMP) included in Attachment 6 Monitoring Plan in the FFREIS (USACE 2011). The AMP for the Project would be further refined by an Adaptive Management Team (AMT), composed of local, state, and federal agency personnel, once Project design is finalized and prior to construction. This plan requires pre-construction and post-construction studies of biota and physical habitat for both impact sites and mitigation sites. This would allow impacts to be verified and mitigation effectiveness to be evaluated. A key component of the AMP is a thorough monitoring program with performance measures. Monitoring activities, including review of results, would be performed by an AMT. In addition, it would provide a contingency process where corrective actions could be pursued should impacts prove greater than anticipated; and/or if mitigation proves less effective at offsetting impacts.

As outlined in the AMP, construction-related impacts would be mitigated by replacement of habitat in disturbed areas or at mitigation locations near the project area. The goal of mitigation would be to replace the lost functions and values of the impacted floodplain forest, which means several, larger mitigation sites would be selected as opposed to a patchwork of small sites. All direct impacts to the floodplain forest would be mitigated at a two to one ratio in farmed wetlands along the Red River. This would replace floodplain forest habitat directly impacted by construction of the Project. As previously discussed, there would likely be some temporal loss of habitat function during the period after habitats are impacted by the Project but before created mitigation habitats have matured and replaced the lost habitat function. Mitigation ratios are higher in order to address temporal functional loss. The time for created floodplain forests to mature and replace lost habitat function could exceed ten years. The temporal loss could be minimized by beginning habitat mitigation projects prior to construction impacts occurring.

Some mitigation sites have been preliminarily identified by the USACE; however most sites have not been identified. For floodplain forests, sites that are likely to be successful for restoration would be historic floodplains along rivers that are currently used for intensive agriculture. The USACE is currently in the process of managing floodplain forest habitat creation as mitigation at other sites in the upper Midwest. One location is in Pierce County, Wisconsin where over 300 acres of floodplain forest has been created along the Rush and Trimble Rivers as mitigation for impacts due to navigation improvements near Mississippi River Lock and Dam No. 3. The floodplain forests were created in two seeding phases, which are currently within the third and sixth growing seasons. Species planted within the mitigation areas include several oak species, black walnut, hackberry, and green and black ash. Different species have matured to different levels depending on their growth rate and seeding phase.

The initial seeding phase (now in the sixth growing season) included oak species which have reached a height of six feet in some places and are beginning to form a canopy. The USACE is continuing to monitor progress of the floodplain forest, including managing understory species such as reed canary grass and thinning of trees that were not planted but have become established in the habitat, such as box elder. The early progress and success of this program illustrates that floodplain forest habitat restoration is possible as a viable mitigation program. However, proper planning and management of the habitat is necessary and the time between impacts to forests and maturation of new habitats is likely several years, possibly more than ten years, before habitat function is restored. It would be crucial to plan and implement floodplain forest habitat creation for the Project in the manner that is currently being carried out by the USACE in Pierce County, Wisconsin to ensure impacts to this key habitat from the project are not detrimental to the overall habitat within the project area.

It is also proposed that all non-cropped upland habitat that would be disturbed by Project activities would be replanted with native species, particularly native grasses that are anticipated to have positive impacts on overall habitat value (FFREIS 2011). Detailed discussion about wetland mitigation, including the floodplain forest, is discussed in Section 3.4 – Wetlands.

As part of this EIS process, the USACE and Diversion Authority have continued working with the MNDNR as well as other agencies and local governments on developing and revising approaches outlined in FFREIS Attachment 6 for pre- and post-Project construction and operation monitoring. The Draft AMMP, included as Appendix B, is an example of this collaborative effort. The Draft AMMP is built off of the Attachment 6 proposed survey monitoring plan, ongoing communications, and studies completed to date. The Draft AMMP includes refined monitoring plans for fish and streams - Aquatic Biological Monitoring Plan and the Geomorphology Monitoring Plan. These plans include proposed monitoring measures for fish connectivity, fish stranding, stream stability, water quality, and sedimentation.

Further evaluation of the FFREIS Attachment 6 Monitoring Plan and additional recommendations are discussed in Chapter 6 and within the Draft AMMP included as Appendix B.

3.10 STATE-LISTED SPECIES AND SPECIAL STATUS SPECIES

Minnesota's Endangered Species Statute (Minnesota Statutes 2008, section 84.0895) authorizes the MNDNR to designate species that are endangered, threatened, or species of special concern. The list is codified as Minnesota Rules, part 6134. Minnesota's Endangered Species Statute and the associated rules prohibit "taking, purchasing, importing, possessing, transporting, or selling endangered or threatened plant or animal including their parts or seeds without a permit" (MNDNR 2014a). Minnesota state regulations provide a separate level of regulation beyond that of the federal Endangered Species Act of 1973. In North Dakota, state laws have not been adopted to define a regulatory definition of rare or threatened species, but the Federal Endangered Species Act applies.

Endangered species analyses were completed in 2009 for the FFREIS, which focused on federally-listed species. Formal Section 7 consultation was done with the USFWS to determine potential impacts. For the purposes of this EIS, the Minnesota Natural Heritage Information System (NHIS) and North Dakota Natural Heritage Inventory (NDNHI) were queried for information about state listed animal and plant species that are in the project area. The NHIS provided updated information on Minnesota state-listed species that may be affected by the Project. The NDNHI data was consistent with data previously presented in the FFREIS and no significant changes in potential species impacts were noted within the project area from previous analyses for the FFREIS.

To provide updated information to that which was presented in the FFREIS, this section focuses on state listed species in Minnesota for compliance with Minnesota Endangered Species Statutes. It describes state listed plant and animal species potentially found within the project area and potential impacts associated with Project construction and operation.

3.10.1 Affected Environment

The Minnesota Endangered Species Statute requires the MNDNR to adopt rules designating species meeting the statutory definitions of endangered, threatened or species of special concern. Under the law, a person may not take, import, transport or sell any portion of an endangered or threatened species. Special Concern Species are not protected by Minnesota's Endangered Species Statute or the associated Minnesota Rules. Endangered species are defined by the law as those that are threatened with extinction throughout all or a significant portion of its range in Minnesota. Threatened species are those likely to become endangered in the foreseeable future throughout all or a significant portion of its range within Minnesota. Finally, special concern species are those that are extremely uncommon in Minnesota, or have a unique or highly specific habitat requirement in need of careful monitoring. Species at the edge of their natural range may be included in the species of special concern category along with those that were once threatened or endangered, but now have increased or protected, stable populations (MNDNR, 2013e).

Degradation and destruction of habitat are the primary reasons for the listing of most state listed species. In the project area in particular, the conversion of native prairie and floodplain forest habitats to agricultural land has resulted in the decline of many species. Analysis of cover types has been done for the footprint of the diversion channel construction and within the inundation area, which indicated the majority of the area is cropland (Section 3.6 – Cover Types). Low-quality remnants of non-native grassland or hayland and remnant floodplain forest account for less than one percent of the Project footprint. There is no evidence that parcels of native prairie habitat remain in the area. Forest-lowland deciduous habitat (i.e., floodplain forest) has been identified as the primary terrestrial wildlife habitat that remains in the project area (FFREIS 2011). Riverine habitats associated with the rivers and tributaries in the project area provide habitat for aquatic species, and have also been impacted over time by agricultural land use. Wildlife using the project area are thus likely to be those adapted to human activity and agricultural environments.

3.10.1.1 State Listed Species in the Project Area

The NHIS query identified six state listed species within the project area. Four of the six species are associated with riparian habitats along the Red River or its tributaries. The remaining two species are associated with native prairie habitats. Table 3.46 provides the status of each species and its potential habitat requirements. Additional discussion of habitat present in the project area is described in several other sections of the EIS (Section 3.4 – Wetlands, Section 3.8 Fish Passage and Biological Connectivity, Section 3.9 – Wildlife and Wildlife Habitat and Section 3.6 – Cover Types).

Table 3.46 Minnesota State Listed Species in the Project Area

Species	Type	State Rank/ Global Rank[1]	MN Status[2]	Preferred Habitat
Lake Sturgeon (*Acipenser fulvescens*)	Vertebrate Animal	S3 / G3G4	Special Concern	Red River and its tributaries. Recovery program has been implemented
Burrowing Owl (*Athene cunicularia*)	Vertebrate Animal	S1B, SNRM / G4	Endangered	Open, grazed pastures or native, mixed-grass prairies populated by burrowing mammals.
Black Sandshell (*Ligumia recta*)	Invertebrate Animal	S3 / G4G5	Special Concern	Typically found in the riffle and run areas of medium to large rivers in areas dominated by sand or gravel
Garita Skipper (*Oarisma garita*)	Invertebrate Animal	S2 / G5	Threatened	Native prairie habitats
Short-beaked Arrowhead (*Sagittaria brevirostra*)	Plant	SH / G5	Endangered	Mud or shallow water of streams and lakes

Source: NHIS 2014; MNDNR 2014c

[1] The international network of Natural Heritage Programs employs a standardized ranking system to denote global (G) or state (S) status. Species are listed on a scale from 1-5, 1 being the highest risk of extinction or extirpation and 5 being common, widespread, and abundant. “B” and “N” modifier used for migratory animals that are breeding populations (B) or represent a non-breeding population (N). “H” denotes species that were historically known from records usually greater than 20 years old. “NRM” denotes that the rank is not yet assessed.

[2] MN Status refers to listing under the Minnesota Endangered Species Statute.

3.10.2 Environmental Consequences

Natural Heritage data from both Minnesota and North Dakota were used to determine the potential general distribution and location of state listed species in the project area. Field surveys were not conducted to verify the data, and therefore, potential impacts to species were evaluated based on the potential habitat required for each species relative to the occurrence of that habitat or cover type in the project area (Section 3.6 – Cover Types). This evaluation approach provides a basis for determining potential impacts to state listed species that may occur in the project area.

3.10.2.1 Proposed Project

The Project has the potential to negatively impact state listed species directly and indirectly. Direct impacts may include fatalities of individuals due to construction activities, such as excavation, crushing, or burial. Operation of the Project may also cause fatalities due to flooding of the diversion channel and inundation area. Indirect impacts from the Project include habitat disturbance, degradation, or loss that may result in species relocation or death of individuals.

Since most of the project area is in an agricultural setting, impacts to wildlife habitat are anticipated to be minimal. The Project is not anticipated to cause long-term decline in species populations.

3.10.2.1.1 Riverine / Wetland Species

Lake Sturgeon (Special Concern)
The lake sturgeon is a long-lived, slow growing migratory species that was once common throughout Minnesota and native to the Red River watershed including major tributary streams and lakes (MNDNR, 2014b). Between 1910 and 1950, the lake sturgeon was eliminated from this watershed due to a variety of factors including dam construction limiting migration, siltation, channel modifications, and loss of necessary in-stream habitat. In 1997, efforts were undertaken to re-establish a naturally reproducing lake sturgeon population within the Red River through a stocking program led by the MNDNR. From 1998-2013, there have been 85 tagged and 26 untagged lake sturgeon caught by anglers (111 total records), including 13 in the Fargo-Moorhead area.

No direct mortality is anticipated to lake sturgeon in the project area. Construction would temporarily displace lake sturgeon that may be present near the footprint of individual river control structures. The individual footprint impacts of each Project feature would total approximately 49 acres of potential aquatic habitat distributed among the Red, Wild Rice, Sheyenne, and Maple Rivers (Section 3.8 – Fish Passage and Biological Connectivity). Project footprint impacts are relatively small compared to the length of the river channel and the amount of available habitat in the river system. These impacts are not anticipated to result in population level impacts to the lake sturgeon. After construction of the Project is complete, fish would move back into the areas that were avoided during construction. Mitigation is proposed for loss of aquatic habitat. Details on proposed mitigation are discussed in Section 3.8 – Fish Passage and Biological Connectivity.

Limitations to migration could occur during operation of the Project control structures at high flow velocities, but not during normal flow (Section 3.8 – Fish Passage and Biological Connectivity). Typically, the Project would operate in March or April. Flooding in May and June has typically been below the 17,000 cfs (10-year flood event) threshold when the Project would be operated. It is believed that the historic spawning period for lake sturgeon occurs from late April through the end of June with peak migration and spawning varying within that timeframe depending on annual conditions. The lake sturgeon population that was reintroduced into the Red River watershed has not yet reached maturity and begun spawning in the system. Project operation during the months of April through June could interrupt the migration period of this species once a mature population begins spawning.

The Project is not anticipated to completely block fish passage, but may interrupt fish passage or completely block it during a given year depending on timing of Project operation, flood flow variables, and lake sturgeon peak migration that year. Section 3.8 – Fish Passage and Biological Connectivity provides additional discussion on potential impacts to fish passage.

Black Sandshell (Special Concern)
The black sandshell was documented in the Red River within the project area during surveys conducted in 2008. This species was also documented in 2003 and 2004 in the Buffalo River within the project area. Mussels are long-lived animals that spend most of their lives buried in the bottom sediments of permanent water bodies and often live in multi-species communities called mussel beds (MNDNR 2014c). Mussels are generally sedentary, filtering organic matter from the water column. Their limited mobility makes them especially susceptible to habitat

degradation, specifically from non-point source water pollution and sediment pollution. Dams, channelization, and dredging increase siltation, physically alter habitat conditions, and block the movement of fish hosts. Invasive zebra mussels can also impact native mussels by attaching to native mussel shells in large numbers, eventually causing suffocation.

Excavation of the Project could result in mussel fatalities due to crushing, excavation, or other disturbance. These impacts could occur within the Project footprint during construction of the river control structures. There are no known occurrences of state-protected (endangered or threatened) mussels in the project area. Mussel surveys on the Red River in the project area was dominated by threeridge, pocketbook and pink heelsplitter (MNDNR Data; Valley City State University Data) with relative abundance considered low to moderate (FFREIS 2011). Special status species observed included Wabash pigtoe (ND), black sandshell (ND and MN) and mapleleaf (ND). Mussel surveys on the Wild Rice and Sheyenne Rivers (Valley City State University Data) indicated the black sandshell was most abundant (FFREIS 2011). Pre-construction surveys in the Project footprint are proposed to quantify the presence of the black sandshell.

Indirect impacts to the black sandshell could occur in areas of increased sedimentation, which could lead to fatality from burial and eventually suffocation. Habitat alteration from sedimentation can also have an impact of less tolerant mussel species. The greatest potential for sediment to accumulate would be just upstream of the tieback embankment for the Wild Rice River, Red River, and Wolverton Creek, with less sedimentation in the southern portions of the inundation area. Sediment is expected to accumulate incrementally over time. Sedimentation in locations with the black sandshell could have an impact on individuals depending on the degree of sedimentation, but is not expected to impact populations of the species.

Mussels are dependent on fish hosts for dispersal throughout a river system. Glochidia are larvae expelled from a female mussel, which find a host fish where they attach to fish gills or fins. The glochidia live as parasites on the host fish until they develop into juvenile mussels, at which point they detach from the fish and fall to the streambed as free-living mussels. Host fish for the glochidia of the black sandshell include the bluegill (Lepomis macrochirus), largemouth bass (Micropterus salmoides), sauger (Stizostedion canadense), and white crappie (Pomoxis annularis) (Watters 1994). Impacts to the dispersal of the black sandshell are possible if fish passage is inhibited on the river system due to Project operation, as the host fish would not be able to move freely within the system. This could limit glochidia dispersal during a given year. Additional discussion on fish passage is provided in Section 3.8 – Fish Passage and Biological Connectivity.

Impacts to native mussels from zebra mussel invasion are not anticipated as a result of the Project. Zebra mussels are anticipated to spread over time up the Red River whether the Project is implemented or not. Potential impacts from zebra mussels are discussed in Section 3.11 – Invasive Species.

<u>Short-beaked Arrowhead (Endangered)</u>

The short-beaked arrowhead is a native wetland plant species present in the Midwest prairie region from South Dakota to Texas (USDA NRCS 2014). This species was documented in 1956 along the Red River in Moorhead, more than five miles downstream of the diversion channel.

Given the historical record and the distance from the proposed Project, impacts to this species are not anticipated.

3.10.2.1.2 Prairie Species

Burrowing Owl (Endangered)

Historically, burrowing owls were present in the western prairie margin of Minnesota. Core habitat for the burrowing owl is in mixed and shortgrass prairie habitats west of Minnesota. Burrowing owls nest in areas of grazed pasture or native, mixed grass prairies populated by burrowing animals. Areas of intensive agriculture are typically avoided, although studies in Minnesota have shown that burrowing owls sometimes nest in alfalfa fields, indicating this species may have some capacity to adapt to agricultural habitats (MNDNR 2014c). Nesting burrows are the limiting factor for breeding owls. Declining American badger and ground squirrel populations and their associated burrows, in which the owls often live, have contributed to burrowing owl population decline.

The NHIS record is a single observation from 2007 of an individual during the breeding season. It is unknown whether nesting occurred in the area. Most of the project area would be in an agricultural setting. No native prairie is present (Section 3.6 – Cover Types). Although studies have shown that burrowing owls can use agricultural land, natural or artificial burrows are required to create necessary nesting habitat. Based on the cover types analysis (Section 3.6 – Cover Types), approximately 15 acres of brush/grassland, which includes pasture and hayland, currently flood during the 100-year flood. The Project would cause an additional estimated three acres of flooding to this cover types. Habitat for the burrowing owl is not likely to be affected by the Project. Operation of the Project would not limit conservation or reintroduction for this species.

Garita Skipper (Threatened)

The garita skipper is a grassland butterfly species found in native prairie habitats. In Minnesota, populations are primarily in aspen parkland in Kittson County. One record from the late 1960s in Clay County may represent a brief establishment from the Kittson County population, but likely did not establish a population (MNDNR 2014c). The garita skipper is dependent upon the persistence of its habitat, especially dry and moist native prairie with abundant forb (i.e., flower) species.

The Project would be in an agricultural setting. No native prairie is present in the project area (Section 3.6 – Cover Types). The agricultural setting would not support this species. Since no habitat is present, no Project impacts (direct or indirect) are anticipated.

3.10.2.2 Base No Action Alternative

Under the Base No Action Alternative, flooding would continue in the project area. Natural habitat would remain similar to existing conditions, with natural changes in vegetation communities occurring over time after flooding or other natural disturbance events. Collectively improvements through continued pursuit of opportunities for dam removal or modification projects would provide positive impacts on biological connectivity. Mussel species, such as the black sandshell, could be impacted by sedimentation from severe flood events. Continued spread of zebra mussels would also threaten the existing native mussel communities. No impacts to other state listed species would be anticipated.

3.10.2.3 No Action Alternative (with Emergency Measures)

Under the No Action Alternative, emergency measures could result in minor, temporary impacts to wildlife habitat along the Red River within the cities of Moorhead and Fargo where temporary levees and sandbags are used to control flooding. Direct impacts to the black sandshell or other native mussels from crushing or other disturbance could occur if emergency measures are implemented in the river channel. Other habitat would generally remain similar to existing conditions, with natural changes in vegetation communities over time after flooding or other natural disturbance events. Collectively improvements through continued pursuit of opportunities for dam removal or modification projects would provide positive impacts on biological connectivity. Native mussel species could be impacted by sedimentation from severe flood events. Continued spread of zebra mussels would also threaten the existing native mussel communities. No impacts to other state listed species are anticipated.

3.10.2.4 Northern Alignment Alternative

Natural Heritage data for Minnesota and North Dakota was reviewed to determine potential impacts to threatened and endangered species in the project area. The NAA is similar to the Project in design, construction, and operation. Under the NAA, impacts to the state listed species are not anticipated to be different from those expected under Project conditions. Available data and information does not indicate a noticeable difference in potential impact to threatened and endangered species by moving the location of the southern embankment downstream approximately 1.5 miles from the Project location. The location of the NAA does not indicate a direct impact to known locations of threatened and endangered species. Impacts to the lake sturgeon, black sandshell, and short-beaked arrowhead are anticipated to be similar to those identified for the Project. Cover type impacts, affecting habitat for prairie species (i.e., burrowing owl and garita skipper) identified for the Project, are anticipated to be similar to those described for the Project under the NAA. Additional discussion on impacts to cover types is provided in Section 3.6 – Cover Types.

3.10.3 Proposed Mitigation and Monitoring Measures

Mitigation and monitoring measures are proposed that would avoid impacts to state listed riverine species. An AMP has been proposed for the Project. This plan would be further refined by an AMT, composed of local, state, and federal agency personnel, once Project design is finalized and prior to construction. This plan proposes pre-construction and post-construction studies of biota and physical habitat for both impact sites and mitigation sites. This would allow impacts to be verified and mitigation effectiveness to be evaluated. A key component of the AMP is a thorough monitoring program with performance measures. Monitoring activities, including review of results, would be performed by an AMT.

3.10.3.1 Lake Sturgeon

Monitoring plans have been proposed to effectively measure potential impacts to this species. Fish passage structures could be constructed to mitigate impacts to migrating lake sturgeon populations if monitoring indicates impacts from the Project. These topics are discussed in detail in Section 3.8 – Fish Passage and Biological Connectivity.

3.10.3.2 Black Sandshell

A mussel survey was completed by the USACE in October 2011 for the diversion channel footprint, biotic sample sites, and areas to be abandoned by the diversion channel. The results of this survey were published in January 2012. Mussel surveys would also be conducted after construction is complete on the Red River.

3.10.3.3 Prairie Species (Burrowing Owl and Garita Skipper)

Upland restoration is proposed, using a habitat-based approach, which would provide upland habitat in the project area that has historically converted its native prairie to agricultural land. This would provide new potential habitat for state listed species, such as the burrowing owl and garita skipper, where it currently does not exist. Additional wildlife habitat mitigation measures are present in Section 3.4 – Wetlands and Section 3.9 – Wildlife and Wildlife Habitat.

As part of this EIS process, the USACE and Diversion Authority have continued working with the MNDNR as well as other agencies and local governments on developing and revising approaches outlined in FFREIS Attachment 6 for pre- and post-Project construction and operation monitoring. The Draft AMMP, included as Appendix B, is an example of this collaborative effort. The Draft AMMP is built off of the Attachment 6, proposed survey monitoring plan, ongoing communications, and studies completed to date. Further evaluation of the FFREIS Attachment 6 Monitoring Plan and additional recommendations are discussed in Chapter 6 and within the EIS Draft AMMP included as Appendix B.

3.11 INVASIVE SPECIES

This section describes invasive species within the project area, potential environmental impacts related to construction and operation of the Project, and specific mitigation measures to avoid and minimize the introduction and spread of invasive species. The USACE FFREIS and Supplemental EA were reviewed for information on terrestrial and aquatic invasive species (AIS). Aquatic invasive species distribution information was obtained from the USGS, MNDNR, and NDGF. The Minnesota Department of Agriculture (MDA) and North Dakota Department of Agriculture (NDDA) data provided terrestrial invasive species that could occur within the project area.

Invasive species is a broad term used to define a species that is non-native to the ecosystem under consideration and whose introduction causes or is likely to cause economic or environmental harm or harm to human health (Executive Order 13112, Appendix 1, 1999). The definition of invasive species encompasses all species, including plants and animals, terrestrial or aquatic. A noxious weed is a specific regulatory definition applied to invasive plant species. Within this section, invasive species refers to non-native animal species and non-native aquatic plants that have been found to be invasive under the federal definition or are regulated under invasive species laws. Noxious weeds refer to invasive/non-native terrestrial plant species regulated by noxious weed laws.

Invasive species are problematic because they are able to spread rapidly, out-compete native species, and can result in adverse ecological or economic impacts (MDA, 2014a). Recent estimates show the economic impact of terrestrial and aquatic invasive species cost the United States economy billions of dollars each year (Lovell and Stone, 2005; MDA, 2014a).

The potential environmental and economic impact of invasive species led to regulation at the federal, state, and county level. Minnesota and North Dakota both have regulations for terrestrial and aquatic invasive species and noxious weeds. Noxious weed laws give the authority to counties in Minnesota and North Dakota to list additional noxious weeds that are of particular concern to that county. Table 3.47 provides a summary of the federal and state regulations for preventing and controlling the spread of invasive species. The counties within the project area do not have noxious weed regulations that differ from state and federal laws.

Table 3.47 State and Federal Regulations Pertaining to Invasive Species

Government Entity	Regulation	Description
Federal		
USDA Animal and Plant Health Inspection Service (APHIS)	7 United States Code (U.S.C.) 7701 *et. seq*, Plant Protection	Provides specific regulations for transport, control, and suppression of noxious weed species
Executive Branch	Executive Order 13112	Created a Council of Departments to prevent the introduction of invasive species, control their spread, and minimize economic, ecological, and human health impacts
U.S. Fish and Wildlife Service	18 U.S.C. 42-43, 16 U.S.C. 3371-3378 Lacey Act and the Alien Species Prevention Enforcement Act of 1992.	Prohibits the importation or shipment of invasive animal species, including the zebra mussel and other invasive mollusks
U.S. Fish and Wildlife Service	16 U.S.C. 4701 Aquatic Nuisance Prevention and Control Act, as amended by the National Invasive Species Act of 1996	"to prevent unintentional introduction and dispersal of nonindigenous species into waters of the United States"
State		
Minnesota	MN Statutes Chapter 18: Pest Control	Department of Agriculture rules to protect the state from "injurious effect of noxious weeds on public health, the environment, public roads, crops, livestock, and other property"
	MN Statutes Chapter 18G Plant Protection and Export Certification; MN Statutes Chapter18J Inspection and Enforcement	Department of Agriculture regulates the introduction or establishment of plant pests that "threaten Minnesota's agricultural, forest, or horticultural interests or the general ecological quality of the state"
	MN Statutes Chapter 84D: Invasive Species; MN Administrative Rules, part 6216, Invasive Species	Department of Natural Resources regulates the spread and control of aquatic invasive species and wild animals
North Dakota	ND Century Code Chapter 4.1-47-02, Noxious Weeds	"Requires every person to do all things necessary and proper to control the spread of noxious weeds and makes it illegal for any person to distribute, sell, or offer for sale within this state a noxious weed"

Government Entity	Regulation	Description
	ND Century Code 20.1-17, Aquatic Nuisance Species	Provides the Game and Fish Department with legal authority to prohibit the spread of aquatic invasive species

Source: USFWS 2012; MDA 2014b; NDDA 2013a

3.11.1 Affected Environment

3.11.1.1 Aquatic Invasive Species

There are several AIS of concern, including: zebra mussels (*Dreissena* spp.), bighead and silver carp (*Hypophthalmichthys* spp.), curly-leaf pondweed (*Potamogeton crispus*), Eurasian watermilfoil (*Myriphyllum spicatum*), flowering rush (*Butomus umbellatus*), and purple loosestrife (*Lythrum salicaria*), which is an emergent plant species. Of these species, zebra mussels, curly-leaf pondweed, and purple loosestrife are known to currently exist in the project area. However, Eurasian watermilfoil and flowering rush are currently found in several water bodies within the Red River drainage basin. The distribution of these species was identified by a query of the infested waters listing in Minnesota and North Dakota, and USGS Nonindigenous Aquatic Species database (MNDNR 2013b; NDGF 2012; USGS 2014 a-c).

In Minnesota, zebra mussels have been identified in Breckenridge Lake and the Otter Tail River from near the confluence of the Pelican River, downstream to the Bois De Sioux River (MNDNR 2013b). As of July 2012, zebra mussels had been identified in the Red River in Richland County, North Dakota (NDGF 2012; USGS 2013c). In July 2015, zebra mussel veligers (larvae) were found in the Red River in multiple sites. In Minnesota, the Red River in Clay, Kittson, Marshall, Norman, Polk, and Wilkin counties is designated as infested with zebra mussels. In North Dakota, the entire length of the Red River including tributaries upstream to the first vehicular bridge or crossing are listed as infested. Bighead and silver carp are not present within the Red River drainage basin at the time of this EIS (USGS 2014a, 2014b).

Although zebra mussels have recently been observed in the Red River, it is unlikely that infestations would maintain high densities in the river due to unfavorable habitat conditions. Impoundments or lentic (still water) environments with hard substrate are necessary to support settled adult colonies of zebra mussels at sufficient densities for successful reproduction. The Red River lacks impoundments with appropriate substrate for attachment.

Tributaries to the Red River have known populations of listed aquatic invasive plant species. However, the Red River itself does not have known populations of these species at the time of this EIS (NDGF 2012: MNDNR 2013b). In North Dakota, curly-leaf pondweed is present in the Wild Rice River in Richland County, and Eurasian watermilfoil is present in the Sheyenne River in Barnes and Ransom Counties (NDGF 2012). Aquatic invasive plants are also present within the Red River drainage basin of Minnesota (MNDNR 2013b). Union Lake in Polk County is listed as infested with Eurasian watermilfoil. Portions of the Pelican River are listed as infested with flowering rush (MNDNR 2013b). Curly-leaf pondweed is common in many water bodies within the drainage basin. Purple loosestrife, an emergent plant species, is also present within the project area, and is managed and regulated by terrestrial noxious weed laws (Table 3.48) and

MNDNR invasive species laws. The MNDNR does not list lakes and rivers that are infested with curly-leaf pondweed or purple loosestrife.

3.11.1.2 Terrestrial Invasive Species: Noxious Weeds

Minnesota and North Dakota maintain noxious weed lists to regulate activities that could cause spreading. Under these laws, counties have the authority to list additional noxious weeds that are problematic to that county. Noxious weeds that may occur within Minnesota and North Dakota, as well as specific weeds listed for Clay, Wilkin, Cass, and Richland Counties are presented in Table 3.48.

Table 3.48 Listed Noxious Weeds Potentially Present in the Project Area

Common Name	Scientific Name	State Listing
Absinthe wormwood	*Artemisia absinthium*	ND
Bull thistle	*Cirsium vulgare*	MN[1]
Canada thistle	*Cirsium arvense*	MN, ND
Common reed	*Phragmities australis* ssp. *australis*	MN
Common tansy	*Tanacetum vulgare*	MN
Dalmatian toadflax	*Linaria genistifolia* *Linaria dalmatica*	MN, ND
Houndstongue	*Cynoglossum officinale*	ND[2]
Japanese hops	*Humulus japonicas*	MN
Kochia	*Bassia scoparia*	MN[1]
Leafy spurge	*Euphorbia esula*	MN, ND
Musk thistle	*Carduus nutans*	ND
Plumeless thistle	*Carduus acanthoides*	MN
Purple loosestrife	*Lythrum salicaria*	MN, ND
Russian knapweed	*Centaurea repens*	ND
Saltcedar	*Tamarix ramosissima*	ND
Spotted knapweed	*Centaurea maculosa*	MN, ND
Yellow toadflax	*Linaria vulgaris*	ND
Wild parsnip	*Pastinaca sativa*	MN

Source: MNDA 2014, NDDA 2013a, NDDA 2013b, Early Detection and Distribution Mapping System 2014
[1]Listed in Clay County, MN
[2]Listed in Richland County, ND

3.11.1.3 Existing Management Programs

Noxious weeds and invasive species are currently managed in the project area under County and State authority. Cass and Clay County require eradication of noxious weeds through lawful methods. County Agricultural Inspectors ensure compliance with Minnesota noxious weed statutes. The MNDNR maintains the AIS program with seasonal staff at public accesses on water bodies to inspect for AIS on boat trailers and in boat water or bait buckets. Terrestrial invasive species are currently managed on MNDNR-owned lands using chemical, mechanical, and biological methods.

3.11.2 Environmental Consequences

Terrestrial and aquatic invasive species have the potential to adversely affect the project area and surrounding environment by spreading and establishing greater populations, potentially resulting in significant impacts to agriculture and natural plant and animal communities. These impacts could result in poor crop harvest, loss of native plant communities, and loss of wildlife habitat.

The focus of this section is on the construction and operation of the diversion channel due to the potential to affect the spread of invasive species. To a lesser degree, inundated areas have potential to affect the spread of invasive species and is also discussed.

3.11.2.1 Proposed Project

Construction has the potential to spread invasive species. Aquatic and terrestrial invasive species could be introduced to the project area by movement of equipment or materials from infested waters and lands. The diversion channel has the greatest potential for spreading invasive species. Terrestrial invasive species could spread by significant surface disturbance from construction. Aquatic invasive species could spread by creation of a new water pathway or from unclean construction equipment moving from infested areas into the project area. Most Project construction would occur on terrestrial land, and therefore, the use of marine construction equipment is not anticipated.

3.11.2.1.1 Aquatic Invasive Species Impacts

The potential introduction and spread of AIS during construction and operation could result in environmental consequences to aquatic communities. Zebra mussels and bighead and silver carp could cause harm through direct impacts to the aquatic food chain and displacement of native species (MNDNR 2014b, MNDNR 2014d). Zebra mussels are already located within the Red River Basin, and are anticipated to spread downstream regardless of the Project. Zebra mussels could also result in increased maintenance costs to Project control structures by direct attachment and encumbering structure function. Bighead and silver carp are not currently located within the Red River drainage basin.

<u>Construction</u>

Transport of construction equipment from outside the project area has the potential to introduce aquatic invasive species that may not be present. There is also potential for construction equipment to spread existing populations already present within the project area. This could potentially result in invasive species establishing new populations in currently unaffected areas.

<u>Operation</u>

Zebra mussels are not expected to colonize any of the structures within the project area because these structures would not create lake-like conditions, necessary for colonization and reproduction, for any substantial period of time. The Red River and Wild Rice River control structures would be similar to bridges, with constant water flow. The diversion inlet control structure would be dry unless the Project is in operation.

Project operation is not anticipated to affect the spread of zebra mussels nor bighead and silver carp. Current management of AIS in the project area and Red River drainage basin would continue. The diversion channel would provide a minor dispersal opportunity for zebra mussels during operation. Dispersal would occur from the upstream inundated areas on the Red River, through the diversion channel, and terminate downstream where the diversion channel re-enters the Red River. Essentially, the diversion channel would provide another route for the spread of AIS, but the destination on the Red River would remain the same. Therefore, operation of the Project would not provide a significant transportation opportunity into unaffected drainage systems, and is not anticipated to accelerate the spread of zebra mussels. Additionally, the upstream inundated area would not connect rivers or tributaries with known populations of bighead or silver carp to the Red River drainage basin, and therefore, is not anticipated to promote the spread of this species.

3.11.2.1.2 Terrestrial Invasive Species: Noxious Weed Impacts

Direct impacts to natural vegetation, such as clearing or excavating, could result in noxious weeds spreading into adjacent floodplain forest. Since most natural plant communities are limited to riparian areas in the project area, noxious weed spread into these areas is of particular concern for the Project.

The spread of noxious weeds during construction or operation could result in impacts to agricultural production. Noxious weed infestations have been shown to result in agricultural crop yield losses of 50 to 90 percent (MDA 2014a). A potential consequence of noxious weed spread could be increased herbicide use to control noxious weeds. Increased herbicide application can lead to more herbicide contained in runoff to nearby waterways. This results in water quality impacts, impacts to natural plant and wildlife communities, and could eventually lead to degradation of the quantity and quality of wildlife habitat in the project area.

<u>Construction</u>

Disturbance of soils in the footprint of the diversion channel and associated structures provide the potential for noxious weeds or invasive plants to spread and colonize the disturbed area. Most construction would occur in areas previously disturbed by agricultural activities, which comprise approximately 6,625 acres of the total approximately 8,725 acres in the Project footprint. The remaining undisturbed areas are primarily wetland (Section 3.6 – Cover Types). Spread of noxious weeds or invasive species could also occur if construction equipment is contaminated with soil containing noxious weed seeds or other plant material. Without mitigation and management, noxious weeds could spread into surrounding areas impacting agricultural operations and natural plant communities.

<u>Operation</u>

Water has long been recognized as a mechanism for the spread of invasive weeds (Zimdahl 1993; Pysek and Prach 1994). Floods provide an extreme example of the spread of plant species with water. During large flood events, as water velocities increase as a function of flow volumes, the erosive power of the water increases exponentially as a function of velocity, increasing sediment transport rates (Donaldson, 1997).

Periodic flooding provides disturbances and openings in vegetative cover (Pysek and Prach 1994). Species favored by disturbance and by newly mobilized dissolved nutrients would rapidly fill these niches. Flood flows likewise act to transport seeds and plant parts from existing infestations into previously weed-free areas (Donaldson 1997). Vegetative reproduction is a common trait of perennial weeds, and allows them to colonize readily in a wide range of disturbed habitats (Bhowmik, 1997). As flows recede, the plant matter is deposited on newly formed sandbars and in areas which have been stripped clear of riparian vegetation. For many weed species, invasion of riparian areas by seeds follows an exponential curve (Pysek and Prach, 1994).

Periodic inundation of the area upstream of the tieback embankment and floodplain benches of the diversion channel would likely result in deposition of sediment. Both the periodic inundation and depositions can cause soil disturbances, which could lead to the colonization of noxious weeds. Operation of the Project would occur when flow through Fargo is approximately 17,000 cfs, which is approximately the 10-percent chance flood (10-year flood). Without mitigation and management, aquatic and terrestrial invasive species that spread by water would likely colonize inundated areas or spread during diversion channel operation.

Mitigation Areas

Spread of noxious weeds is a concern to wetland mitigation areas along the diversion channel, as discussed in Section 3.4 – Wetlands. Noxious weeds likely out compete re-established native vegetation and become an established source of noxious weeds without mitigation through chemical and mechanical maintenance. Wetland mitigation areas are credited based on function and noxious weeds would reduce functionality of these mitigation wetlands.

3.11.2.2 Base No Action Alternative

Under the Base No Action Alternative, terrestrial and aquatic invasive species currently established in the project area are expected to spread. Existing populations provide a source for invasive species propagules (i.e., reproductive material) to spread into areas not yet colonized by invasive species. Periodic inundation of the floodplain would result in deposition of sediment, providing potential areas for noxious weed species to colonize. Existing aquatic invasive species, such as the zebra mussel, would be expected to increase in the Red River.

Existing management programs for AIS and terrestrial invasive species are assumed to continue. These efforts would help control the spread of invasive species as feasible. Program priorities would determine where funding and resources are targeted and implemented.

3.11.2.3 No Action Alternative (with Emergency Measures)

Under the No Action Alternative, the potential effects of invasive species in the project area would be the same as those anticipated for the Base No Action Alternative. However, it is feasible that materials used for emergency measures brought in from other locations may introduce invasive species to an area. It would be recommended that materials be cleaned prior to leaving a site (following use) to reduce the potential for spread.

3.11.2.4 Northern Alignment Alternative

Under the NAA, design, construction methods, and operation would be similar to those previously described for the Project. As is true for the Project, NAA construction would primarily occur in areas previously disturbed by agricultural activities. Invasive species are a regional issue, and therefore, potential impacts associated with the NAA would not change compared to the Project. Impacts from invasive species associated with construction and operation would also be similar to those previously discussed for the Project. Without mitigation and management for the NAA, aquatic and terrestrial invasive species that spread by water would likely colonize inundated areas or spread during diversion channel operation in the same manner described for the Project.

3.11.3 Proposed Mitigation and Monitoring Measures

The uncontrolled expansion of non-native, invasive species and noxious weeds would be reduced by the implementation of mitigation and the continued use of existing management methods for terrestrial and aquatic invasive species. Mitigation would reduce the potential introduction and spread of invasive species during Project construction and operation. A challenge to mitigation is that the management of invasive species through mechanical and chemical means can be expensive and ineffective once large populations are established.

An AMP has been proposed for the Project. This plan would be further refined by an AMT, composed of local, state, and federal agency personnel, once Project design is finalized and prior to construction. Pre-construction monitoring data previously collected by the USACE and post-construction monitoring of biota and physical habitat for both impact sites and mitigation sites would be included as part of AMP implementation. This would allow impacts to be verified and mitigation effectiveness to be evaluated. A key component of the AMP is a thorough monitoring program with performance measures. Monitoring to review effectiveness and follow through of proposed mitigation strategies would be overseen by the AMT. The Diversion Authority would be responsible for contingency mitigation. Additional detail on the AMP is provided in Attachment 6 of the FFREIS.

3.11.3.1 Construction

During construction, Best Management Practices (BMPs) would be followed to prevent the introduction and spread of aquatic or terrestrial invasive species (MNDNR 2013b). Prior to transporting equipment to the project area, all equipment would be cleaned and free of soil and vegetation to prevent the spread of invasive species, including removal of attached zebra mussels, plant material, and mud, which may contain plant seeds, propagating parts or other invasive species. When Project construction occurs in areas of known noxious weed infestations, equipment working in these areas would be cleaned prior to moving from the area. This would prevent migration of noxious weeds or invasive species within the project area during construction. The AMP would outline the inspection procedures and occurrences to ensure compliance with the proposed mitigation.

When construction activities are complete, disturbed areas would be seeded with native plant species or other plant species per Project plans and specifications. Native species are adapted to local climate and soil conditions, and after establishment, need little maintenance to thrive (MNDNR 2004). An established native plant community would reduce the amount of bare ground available for noxious weeds and invasive species to colonize, in addition to soil stabilization by deep spreading roots. Prior to planting, all source materials would be free of invasive plant seeds and other invasive species (e.g., emerald ash borer larvae, gypsy moth egg masses on woody plant material or zebra mussels on aquatic materials). After native species have been planted, the seeded areas would be monitored per the Project plans and specifications. The Diversion Authority would be responsible for noxious weed control on the whole Project perpetually as part of the OMRR&R.

3.11.3.2 Operation

According to USACE biologists and planners, zebra mussels are not anticipated to impact regular operations due to a lack of desirable habitat for colonization and reproduction. Additional maintenance requirements or costs due to zebra mussels are not proposed. The Diversion Authority would utilize the AMT to determine the correct course of action for potential operational impacts due to zebra mussels.

Operation of the diversion channel and upstream inundation has the potential to spread terrestrial invasive species into areas not previously exposed during 500-year or greater flood.

As part of the operation and maintenance of the Project, the Diversion Authority may provide assistance to clean -up and address impacts caused by Project operation.

The AMP would include measures to control invasive species, including mowing, burning, disking, mulching, biocontrol, and/or herbicide treatments. Monitoring for the spread of invasive and/or noxious weeds would be determined by the AMT.

As part of this EIS process, the USACE and Diversion Authority have continued working with the MNDNR as well as other agencies and local governments on developing and revising approaches outlined in FFREIS Attachment 6 for pre- and post-Project construction and operation monitoring. The Draft AMMP, included as Appendix B, is an example of this collaborative effort. The Draft AMMP is built off of the FFREIS Attachment 6, proposed survey monitoring plan, ongoing communications, and studies completed to date. Further evaluation of the FFREIS Attachment 6 Monitoring Plan and additional recommendations are discussed in Chapter 6 and within the Draft AMMP included as Appendix B.

3.12 CULTURAL RESOURCES

Cultural resources include a wide range of historic, archaeological and other resources related to past human activities, including sites with observable evidence of human activities, sites of religious or cultural significance that may have no observable evidence, historic structures and buildings, properties associated with the cultural practices or beliefs of a living community that are rooted in that community's history and are important in maintaining the community's cultural identity, as well as natural resources inexorably linked to cultural beliefs and practices.

Pertaining to cultural resource surveys, the USACE cultural resources studies include a Phase I survey and a Phase II evaluation. The purpose of a Phase I survey is to gain an understanding of what is present within the Area of Potential Effect (APE – defined further below) and whether any of the archaeological sites or historic buildings and structures may be potentially significant resources. For cultural resources, significant is defined as a cultural resource that is listed or eligible for listing in the National Register of Historic Places. A Phase I survey includes background research on what is already known and recorded about the historic properties in the project area. Research normally includes:

- examination of the state archaeological site and historic structure files at the State Historic Preservation Office (SHPO), which contain a list of previously recorded archaeological and historic sites;
- examination of prior Phase I survey reports on file at the SHPO to determine if any portion of the project area has been previously surveyed for cultural resources;
- general background research on the prehistory, history, and environment of the project area to provide a context within which to evaluate any newly discovered sites or buildings;
- informal interviews with other archaeologists and historians who may have worked near the project area; and
- the Phase I survey may also include interviews with local experts and inhabitants who may know the locations of any undocumented sites that should be evaluated for significance.

If potentially eligible cultural resources are found in the project area, a Phase II evaluation may be conducted. A Phase II evaluation further investigates a specific site or property in detail to determine its eligibility for inclusion on the National Register of Historic Places (NRHP), which is administered by the National Park Service. A property is eligible for listing based on its age (generally 50 years old or older), integrity (comparison of existing condition to original condition), and significance (associated with events, activities, or developments that were important in the past; associated with people who were important in the past; possesses significant architectural features, designed landscapes, and/or engineering achievements; and/or potential of the property to yield important information through archeological investigation about the past). Eligibility determinations are made by the federal agency conducting the undertaking and the appropriate SHPO. If a property is found to be eligible, effects on the property by the federal, federally licensed, or federally assisted project must then be considered and mitigated if they are adverse and cannot be avoided.

Cultural resource surveys are conducted within a defined Area of Potential Effect (APE). The APE is the area where historic properties may be impacted, directly or indirectly. Impacts in the APE are influenced by the size and type of the project (36 CFR Part 800.16(d)). For this Project, the APE for direct and indirect impacts has been defined in a programmatic agreement (Appendix G). A Programmatic Agreement for the Project was negotiated and signed per 36 CFR Part 800, Protection of Historic Properties, section 14(b), as a method for the St. Paul District, USACE to comply with Section 106 of the National Historic Preservation Act (NHPA), as amended. In the Programmatic Agreement, the APE is defined as consisting of the footprint of the selected diversion plan including the diversion channel alignment, its associated tieback levee(s), associated construction work areas, construction staging areas, borrow areas, and disposal areas, as well as associated upstream water storage and water staging areas, Project-related flood proofing locations, Project-related environmental mitigation areas, Project-related in-town (Fargo and Moorhead) levees, and the viewshed to one-half mile from the diversion channel's centerline and all other above-ground project features. In addition, cemeteries upstream of the staging area where the Project or NAA would cause additional depth of flood water above what is already experienced during a 100-year flood event would also be investigated.

Traditional Cultural Properties (TCPs) are cultural resource properties that are eligible for inclusion in the NRHP based on their associations with the cultural practices, traditions, beliefs, lifeways, arts, crafts, or social institutions of a living community. As discussed in the National Register Bulletin 38 – Guidelines for Evaluating and Documenting Traditional Cultural Properties (U.S. Department of the Interior, National Park Service, http://www.nps.gov/nr/publications/bulletins/nrb38/), a TCP can be hard to recognize as there are numerous kinds of TCPs. For example, a TCP could be a location associated with the traditional beliefs of a Native American group about its origins, history, or nature of the world; a rural community who reflect the cultural traditions by long-term residents; an urban neighborhood that is the traditional home of an ethnic group; and ceremonial sites. Investigations are most commonly identified through consultations with individuals or groups who may ascribe traditional culture significance to locations within the project area. The study includes background research and may involve varying levels of fieldwork. For Indian tribes, knowledge of TCP locations and the important qualities associated with them are considered to be sensitive information and information may be retained and considered confidential during any identification and documentation process.

This section discusses the cultural resources that have been identified in the APE for the project area, additional cultural resource survey needs within the APE, the Project's and the Project alternative's potential impacts on cultural resources, and proposed mitigation that may be required as a result of direct or indirect impacts to these resources. Note that the EIS does not include an appendix with the complete record of Minnesota or North Dakota SHPOs correspondence as some of the information contained in those documents is sensitive in nature. This information can be made available upon request from the SHPOs or from the USACE.

3.12.1 Affected Environment

Cultural resource surveys were conducted beginning in 2010 and are continuing (Figure 21). During that timeframe, survey areas included portions of the diversion channel and associated structures alignment presented in the FFREIS (FFREIS alignment) and portions of the currently proposed Project alignment presented in the Supplemental EA (Project alignment), as shown on Figure 1.

Those portions within the APE for direct and indirect impacts by the Project or NAA that were not included in previous surveys would need to be surveyed in order to document unidentified NRHP, NRHP-eligible, or NRHP-recommended sites that may be impacted. This additional information is also needed to determine appropriate mitigation for impacts. The USACE has indicated that the necessary additional cultural resource surveys are underway or would be completed prior to construction, which is further discussed in subsection 3.12.3. Based on the currently surveyed areas (Figure 21), additional surveys for the Project or the NAA would be needed in the following areas:

1. A portion of the Project alignment between the Maple River crossing and the Sheyenne River crossing;
2. Areas east of the Sheyenne River crossing for the Project alignment, including the part of the Red River control structure in Minnesota and the tieback embankment in Minnesota.
3. For the NAA alignment, the Wild Rice and Red River control structures, a portion of the connecting channel between the Red River and the diversion inlet control structure, and the tieback embankment in Minnesota.
4. The majority of the staging area for the Project and the NAA.
5. The APE for indirect effects for the diversion channel, connecting Channel, Wild Rice River control structure, Red River control structure, overflow embankment, and tieback embankment.

Results from completed cultural resource surveys are summarized below within their appropriate sections as feasible. Details from 2014 and 2015 surveys that are still under final report development are included based on preliminary information in their field reports. Where applicable, those surveys have been acknowledged in the text below. Information that is not able to be assessed and discussed within the EIS will be included and evaluated along with the additional surveys as discussed above.

In addition to cultural resource surveys, a TCP Inventory was conducted for the Project in Cass County, North Dakota and Clay County, Minnesota by the Turtle Mountain Band of Chippewa Indians Tribal Historic Preservation Office. Conclusions from this study are included in the discussion below as appropriate.

3.12.1.1 Existing Conditions

3.12.1.1.1 Diversion Channel

Phase I cultural resource surveys were conducted of the APE for direct effects for the northern portion of the diversion channel from the Maple River to the outlet and portions of the Project diversion channel overlapping the FFREIS alignment from the Maple River to the Sheyenne River crossing between 2010 and 2014 (Tucker et al. 2012 for 2010-2011 surveys; Meier et al. 2013 for 2012 surveys; McCarthy et al. 2014 for the 2013-2014 surveys). A Phase I cultural resources survey of the FFREIS alignment from the Sheyenne River crossing to the inlet at County Road 17 was conducted in 2010 to 2012 (Tucker et al. 2012; Meier et al. 2013). Most of the remaining Project diversion channel alignment from the Maple River to the diversion inlet at County Road

17 was surveyed in 2015 (Beaver Creek Archaeology and URS/AECOM 2015 field reports; final report pending).

A portion of the diversion channel between the Maple River and Drain No. 14 and just south of I-94, plus a few individual parcels remains to be surveyed.

As of January 1, 2016, the following cultural resources (includes archeological and architectural properties) were recorded in the diversion channel alignment:

- 10 prehistoric archeological sites,
- 20 prehistoric isolated find spots,
- 10 historic archeological sites,
- 5 historic isolated find spots,
- 2 combination prehistoric/ historic archeological sites,
- 1 lead to a reported grave site,
- 8 farmsteads,
- 2 bridges, and
- 12 built-environment linear resource sites, including;
    - 5 railroad segments,
    - 1 highway segment, and
    - 6 drains/ditches/channelized river segments

Of these cultural resources listed above, prehistoric occupation site 32CS201 in the outlet reach of the diversion channel alignment and prehistoric cultural material scatter sites 32CS5127 and 32CS5146 near the Maple River crossing were determined eligible to the NRHP as a result of Phase II testing in 2012 and 2013 (Jones et al. 2013; Jones et al. 2014). A farmstead site, 32CS5153, between the Sheyenne River and the diversion inlet at County Road 17, is recommended eligible for the NRHP under Criterion A (association with significant events) and under Criterion C (distinctive architecture) (Tucker et al. 2012).

Combination prehistoric and historic archeological site 32CS5139, near the Maple River crossing, would require additional testing to determine if there are significant archeological resources associated with the buried topsoil horizons at its location if it is determined that this site may not be avoided as Project designs are further refined, Prehistoric archeological site 32CS5135, near Drain No. 14 south of the Maple River and combination prehistoric and historic archaeological site 32CS5126 in Reach 1 west of site 32CS201 also are in need of Phase II testing to determine its eligibility to the NRHP.

Testing where local lore had a “chief’s grave” (site lead 32CSX362), located at the Sheyenne River crossing , was conducted in 2013 under North Dakota Administrative Code 40-02-03-06, Planned Disinterment—Notification, but no evidence of a burial was encountered (Jones and Shillinglaw 2013).

3.12.1.1.2 Project Connecting Channel, Wild Rice River Control Structure, Red River Control Structure, Overflow Embankment, and Tieback Embankment

A Phase I cultural resources survey was conducted of the APE for direct effects for portions of the connecting channel from the diversion inlet control structure to Interstate Highway 29 (I-29) in 2010, 2011, and 2012 as part of the former Storage Area #1 (Tucker et al. 2012; Meier et al.

2013). The overflow embankment along County Road 17 was completely surveyed for cultural resources in 2012 (Meier et al. 2013).

Most of the remainder of the connecting channel alignment in North Dakota was surveyed for cultural resources in October and November 2014 and October 2015. Details from those surveys are not currently available but preliminary site information from the field reports is included in the EIS as feasible. This information would include the connecting channel from the diversion inlet structure at County Road 17 eastward to the Red River and the control structures at the Wild Rice River and Red River in North Dakota. The Minnesota portion of the Red River control structure and the tieback embankment in Minnesota still need a Phase I survey. The tieback embankment in Minnesota crosses the reported route of the Red River Trail, a historic oxcart trail along the east side of the Red River. Physical evidence of that trail within the Project alignment still requires field verification.

As of January 1, 2016, the following cultural resources were recorded in these feature locations:

- 2 prehistoric isolated find spots
- 1 historic archeological site
- 1 historic isolated find spot
- 1 rural residence
- 4 farmsteads
- 1 bridge
- 2 built-environment linear resources sites, including
    - 1 railroad segment
    - 1 highway segment
- Site leads including:
    - 1 historic oxcart trail.

Buildings at farmstead site 32CS5168 are recommended as eligible to the NRHP under Criterion A (association with significant events) (Tucker et al. 2012). Farmstead FM2-59 is recommended as eligible to the NRHP under Criterion C (architecture) (URS/AECOM 2015 field report; final report pending). The County Road 16 bridge over the Wild Rice River (32CS4678) is also recommended as eligible to the National Register.

3.12.1.1.3 Northern Alignment Alternative Connecting Channel, Wild Rice River Control Structure, Red River Control Structure, Overflow Embankment, and Tieback Embankment

Approximately 80 percent of the NAA connecting channel from County Road 17 to I-29 was surveyed for cultural resources in 2010, 2011, and 2012, as part of the former Storage Area #1 (Tucker et al. 2012; Meier et al. 2013). The overflow embankment along County Road 17 was surveyed for cultural resources in 2012 (Meier et al. 2013).

The NAA tieback embankment in Minnesota crosses the reported route of the Red River Trail, a historic oxcart trail along the east side of the Red River. Physical evidence of that trail in the alignment requires field verification.

A Phase I cultural resources survey would need to be conducted for most of the connecting channel from just west of I-29 eastward to the Red River, the structures at the Wild Rice River and Red River, and the tieback embankment in Minnesota.

As of January 1, 2016, the following cultural resources were recorded in the NAA connecting channel, overflow embankment, and tieback embankment areas:

- 2 historic archaeological sites
- 2 prehistoric isolated find spots
- 1 historic isolated find spot
- 1 rural residence
- Site leads including:
    - 1 historic oxcart trail.

3.12.1.1.4 Project Staging Area

A Phase I cultural resources survey would need to be conducted for most of the staging area (OHB surveys have been completed, see discussion on OHB ring levee below). Previously surveyed portions of the staging area are limited to the former Storage Area #1, the overflow embankment in North Dakota, and the original tieback embankment alignment in Minnesota (Tucker et al. 2012; Meier et al. 2013), as well as along the I-29 road raise (URS/AECOM 2014 and 2015 field reports; final report pending).

The following cultural resources (includes archeological and architectural properties) were recorded in the staging area as of January 1, 2016:

- 5 prehistoric archeological sites,
- 5 prehistoric isolated find spots,
- 7 historic archeological sites,
- 3 historic archeological isolated find spots,
- 7 farmsteads,
- 3 rural residences,
- 1 log cabin,
- 1 bridge,
- 1 public school,
- 3 commercial buildings,
- 6 cemeteries (Lower Wild Rice and Red River Cemetery, North Pleasant Cemetery, Hemnes Cemetery, Hoff Cemetery, Clara Cemetery, Comstock Cemetery),
- 4 built-environment linear resource sites, including
    - 1 railroad segment,
    - 2 highway segments, and
    - 2 drains/ditches/channelized river segments
- Site leads, including
    - 2 prehistoric archeological sites,
    - 1 log cabin,
    - 1 rural residence,
    - 1 school,
    - 1 historic oxcart trail,
    - 1 cemetery (Roen Family Cemetery)

Two sites, CY-CSC-001 (Comstock Public School) and CY-HCR-001 (Bernard Bernhardson Log Cabin), were listed on the NRHP as of May 7, 1980. Three of the six cemeteries recorded (Lower

Wild Rice and Red River Cemetery, Hemnes Cemetery, and Clara Cemetery) have been determined eligible to the NRHP. Other sites recommended eligible include:

- 1 historic archeological site
- 2 farmsteads
- 1 railroad site
- 1 drain/ditch site.

Sites with undetermined eligibility include:

- 5 prehistoric archeological sites
- 1 rural residence
- 3 commercial buildings
- 1 cemetery site lead (Roen Family Cemetery)

All site leads, other than the cemetery, have unknown eligibility.

3.12.1.1.5 Northern Alignment Alternative Staging Area

Phase I cultural resource surveys have been completed for a portion of the NAA staging area. Previously surveyed portions of the staging area are limited to the former FFREIS Storage Area #1, the overflow embankment in North Dakota, and the original tieback embankment alignment in Minnesota (Tucker et al. 2012; Meier et al. 2013), and the Project connecting channel in North Dakota (URS/AECOM 2014 and 2015 field reports; final report pending).

The following cultural resources were recorded in the NAA staging area:

- 7 prehistoric archeological sites
- 6 prehistoric isolated find spots
- 16 historic archeological sites
- 4 historic isolated find spots
- 22 farmsteads
- 1 granary
- 5 rural residences
- 1 log cabin
- 2 bridges
- 1 public school
- 1 church (St. Benedict's)
- 5 commercial buildings
- 4 cemeteries (Lower Wild Rice and Red River Cemetery, Hoff Cemetery, Clara Cemetery, St. Benedicts Cemetery)
- 7 built-environment linear resource sites, including
    - 2 railroad segments,
    - 3 highway segments, and
    - 2 drains/ditches/channelized river segments
- Site leads, including
    - 2 prehistoric archeological sites
    - 2 historic archeological sites
    - 1 log cabin
    - 1 historic oxcart trail
    - 1 ghost town (Kurtz)

- o 1 rural residence
- o 1 school,
- o 1 cemetery (Roen Family Cemetery)

Two sites, CY-CSC-001 (Comstock Public School) and CY-HCR-001 (Bernard Bernhardson Log Cabin), were listed on the NRHP as of May 7, 1980. Three of the four cemeteries recorded (Lower Wild Rice and Red River Cemetery, Clara Cemetery, and St. Benedicts Cemetery) have been determined eligible to the NRHP. Other sites recommended eligible include:

- 2 historic archeological sites
- 6 farmsteads
- 1 bridge
- 1 railroad site
- 1 drain/ditch site.

Sites with undetermined eligibility include:

- 7 prehistoric archeological sites
- 3 rural residences
- 1 church (St. Benedict's)
- 5 commercial buildings
- 1 cemetery site lead (Roen Family Cemetery)

All site leads, other than the cemetery, have unknown eligibility.

There is a reported family cemetery located in Kurtz Township that may be impacted under the NAA. The information about this cemetery is unavailable at this time. The existence of and location of this cemetery would need to be verified if the NAA were chosen and a Phase I cultural resource survey completed.

3.12.1.1.6 Oxbow/Hickson/Bakke Ring Levee

A Phase I cultural resources survey of the entire ring levee footprint and associated project areas was conducted in October and November 2013 (Meier et al. 2014). Cultural resources sites recorded in the OHB ring levee area include:

- 2 historic archeological sites
- 6 historic isolated finds
- 1 prehistoric isolated find
- 12 residences
- 1 garage
- 1 granary site
- 1 barn
- 1 church (Hickson Lutheran Church)
- 1 dam (Hickson Dam)
- 1 highway segment
- 1 railroad segment
- 2 railroad station site leads

Of these 30 sites, the Hickson Dam (32CS5096) and the Hickson Lutheran Church (32CS113) are both recommended as eligible to the NRHP. The North Dakota SHPO concurred that the two historic archeological sites, the six historic isolated finds, and the one prehistoric isolated find are not eligible to the NRHP. All the other sites are recommended as not eligible to the NRHP.

In addition, no archeological evidence was found at the two site lead locations to former railroad stations at Hickson. The North Dakota SHPO has concurred that these two site leads are not eligible to the NRHP.

Six farmsteads (two in North Dakota and four in Minnesota), which may contain historic buildings, are located in the one-half mile indirect APE outside the OHB ring levee. These farmsteads would be checked for visual effects to historic buildings at their locations once rights-of-entry for these parcels have been acquired.

3.12.1.1.7 In-Town Levees and Floodwalls – 2nd Street, Fargo

A Phase I cultural resources survey was conducted of the APE for direct effects (i.e., construction footprint) for the proposed floodwall along 2nd Street North and for the proposed levee and floodwall along 2nd Street South in Fargo in 2013 (McCarthy et al. 2014). Three historic archeological sites were observed in the riverbank along 2nd Street North. All have been determined not eligible to the NRHP with North Dakota SHPO concurrence. Three historic buildings were recorded; the Fargo Public School Warehouse (32CS5234), the Howard Johnson Hotel (32CS5233), and the 4th Street levee pump station (32CS773). All three have been determined not eligible to the NRHP with North Dakota SHPO concurrence.

A survey of the area of indirect (visual) effects in both North Dakota and Minnesota recorded one NRHP-listed, 9 eligible, and one recommended eligible historic properties in North Dakota and one eligible and one recommended eligible historic properties in Minnesota, which are within the viewshed for the 2nd Street levee and floodwalls. One of these properties, the NP Avenue/Center Avenue Bridge over the Red River is shared by both states.

3.12.1.1.8 In-Town Levees and Floodwalls—El Zagal Golf Course, Fargo

The primary segment of the El Zagal Golf Course levee would replace an existing levee on the west side of the golf course in Fargo. The primary segment of the levee would not directly affect any cultural resources, but would have minor visual effects on some of the contributing properties in the adjacent North Side Fargo Builder's Residential Historic District. The second segment of the El Zagal levee would remove eight houses on Elm and Oak Streets, four of which are over 50 years old. A Phase I cultural resources survey of these four houses took place in September 2014 and March 2015. The Minnesota SHPO has concurred that none of the eight houses to be removed are eligible to the NRHP.

3.12.1.1.9 In-Town Levees and Floodwalls-Mickelson Levee Extension, Fargo

This segment of levee would fill the gap between the existing levee at the Mickelson ballfields to the north and an unnamed levee east of the Oak Grove neighborhood, which is north of downtown Fargo. Construction of the levee extension would directly affect five houses that are contributing properties to the Fargo Oak Grove Residential Historic District, which is listed on the NRHP. A Phase I survey of the levee extension area took place in 2015 (McCarthy 2015a). One of the houses (724 North River Road N.) has been relocated to another lot in the historic district. Four of the houses (16, 18, 24 and 26 North Terrace N.) would be demolished after mitigation documentation (drawings, photographs, and histories) has been completed and architectural elements salvaged from them, per the Memorandum of Agreement (MOA) covering the mitigation for this segment of the Project. A sixth house (12 North Terrace N.) would remain in place, though part of its lot would be used for levee construction. A historical marker about the Oak Grove neighborhood would also be prepared and installed in the neighborhood per the MOA.

A survey of the one-half mile area of APE for indirect effects was also conducted in 2015 (McCarthy 2015b). No historic properties would be affected in Minnesota. Five properties in the Fargo Oak Grove Residential Historic District in North Dakota would have minor visual effects; three would have moderate visual effects; and five would have major visual effects. The latter are located directly across North Terrace N. from where the houses would be removed and the levee extension constructed. The North Dakota SHPO and the Fargo Historic Preservation Commission would need to be consulted regarding mitigation of adverse visual effects.

3.12.1.1.10 Drayton Dam Fish Passage Mitigation Project

A Phase I cultural resources survey of the project area and Phase II evaluation of the eligibility of Drayton Dam to the NRHP was conducted in July 2012 (USACE, 2012a). An additional Phase I cultural resources survey on the Minnesota side of the project area was conducted in November 2012. No prehistoric or historic archeological sites were found in the project area during either survey. Drayton Dam was recommended as not eligible to the NRHP as it is less than 50 years old. The Minnesota SHPO concurred with the non-eligibility of the dam. The North Dakota SHPO has requested that the dam be reevaluated once it reaches 50 years of age in 2014.

3.12.1.1.11 Wild Rice Dam Fish Passage Mitigation Project

A Phase I cultural resources survey of the approximately four acre project area and Phase II evaluation of the eligibility of the Wild Rice Dam to the NRHP was conducted in May 2014. Two historic archeological sites, one prehistoric isolated find, and the Wild Rice Dam itself were recorded in the project area (Dolin et al., 2014). All four sites were determined not eligible to the NRHP, with North Dakota SHPO concurrence. The Black Duck Battlefield traditional cultural property (Ferris, 2011) is located within one mile of the dam but would not be affected by construction or dam removal related to this mitigation project.

3.12.1.1.12 Cemeteries Within the Project Area

The USACE conducted a separate Cemetery Study (Study) (http://www.fmdiversion.com/studies-technical-documents/), dated June 2014, for the project area. The Study identified 54 cemeteries within the project area, 28 located within the area enclosed by the Project, seven within the staging area, and 15 south of the staging area. These cemeteries are noted in the above discussions under their respective Project or NAA project features headings. The Study noted that although an extensive search was performed, additional cemeteries could be discovered during completion of the Phase I cultural resources surveys of the Project and NAA areas including their staging areas. Following identification of the cemeteries, interviews were conducted with points of contact for the majority of the cemeteries. The interviews focused on current impacts to the cemetery, the level of effort to clean up and/or repair flood impacts, and possible flood impact mitigation. Impacts to cemeteries from current flood conditions include:

- Access issues during flooding
- Erosion in the cemetery affecting gravesites, driveways, parking lots, and/or roadways
- Gravestone displacement

- Inaccessibility to crematorium during flooding.
- Sediment deposition
- Vegetation die-off
- Debris scatter from receding flood waters

Current cleanup efforts include:

- Sediment removal
- Erosion repair
- Road, driveway, parking lot repair
- Repair of gravesites and gravestones
- Replanting of vegetation, where needed.

Phase I cultural resources surveys documenting the Hemnes Cemetery in Richland County and the Lower Wild Rice and Red River Cemetery in Cass County were conducted in October and November 2014. Surveys documenting Wolverton/Salem Lutheran Cemetery, Clara Cemetery, and Comstock Cemetery took place in January 2015; Hoff Cemetery in March 2015; South Pleasant/Lium Cemetery in April 2015; and North Pleasant Cemetery in May 2015. The remaining affected cemeteries that are in and upstream of the staging area for the Proposed Project alignment (South Pleasant Church and Eagle Valley Evangelical in Cass County; and Roen Family in Clay County) are waiting on rights of entry. For the NAA alignment, in addition to the above cemeteries, St. Benedict's Cemetery in Cass County was documented in 2015.

3.12.1.2 Regulatory Framework

Cultural Resources Management within federal and state agencies seeks to identify and consider cultural resources with the goal of balancing development with protection of cultural resources. Section 106 of the NHPA of 1966, as amended (formerly 16 U.S.C. 470; now 54 U.S.C. 300101), is a key component for Cultural Resources Management by federal agencies. A historic property is defined as any prehistoric or historic district, site, building, structure, or object included in, or eligible for inclusion in the NRHP. Section 106 of the NHPA requires federal agencies to take into account the effects of their undertakings on historic properties and afford the Advisory Council on Historic Preservation (Advisory Council) a reasonable opportunity to comment on such undertakings. The Section 106 process is outlined in 36 CFR Part 800 – Protection of Historic Properties, subpart B.

3.12.2 Environmental Consequences

Potential impacts from the Project could occur to NRHP properties and NRHP-eligible properties. The Section 106 process includes the assessment of adverse effects to historic properties (36 CFR, subpart B § 800.5). Adverse effects on historic properties include, but are not limited to: physical destruction of or damage to all or part of a property; alteration of a property; removal of a property from its historical location; change of character of a property's use or physical features; introduction of visual or audible elements that diminish the integrity of a property's significant historic features; neglect of a property which causes its deterioration; and transfer, lease, or sale of property out of federal ownership or control without adequate restrictions or conditions to ensure long-term preservation.

3.12.2.1 Proposed Project

Construction and operation of the Project has the potential to directly and indirectly impact NRHP and NRHP-eligible properties. Direct impacts include damage, destruction or physical alteration of a property, as well as removal of a property. Indirect impacts include those associated with visual and noise impact from the Project. Cultural resources surveys have been completed for portions of the Project and its staging area (Figure 21) as described above. Table 3.49 provides a summary of properties that have been identified within the project area that may be affected by the Project. The table does not include those sites, buildings and structures in the Project APE that have been determined not eligible to the NRHP. Additional areas of the Project footprint and staging area remain to be surveyed, which means additional NRHP-eligible sites could be found. A programmatic agreement is in place to avoid and minimize impacts to these properties and any unknown cultural resources in the project area. The *Programmatic Agreement (Agreement) Among the U.S. Army Corps of Engineers, St. Paul District, the North Dakota State Historic Preservation Officer, and the Minnesota State Historic Preservation Officer Regarding the Fargo-Moorhead Metro Flood Risk Management Project, Cass County, North Dakota and Clay County, Minnesota* (Appendix G), was signed in June and July 2011 and was included in the FFREIS. Besides the primary signatory parties, the City of Fargo, the City of Moorhead, the Cass County Board of Commissioners, the Clay County Board of Commissioners, and the Tribal Historic Preservation Officer for the Leech Lake Band of Ojibwe signed the agreement as concurring parties. Fourteen other tribes were contacted and consulted with in preparing the agreement. The Agreement outlines avoidance, minimization, and consultation measures that would be taken during Project construction. This is discussed further in Section 3.12.3 – Proposed Mitigation and Monitoring Measures.

Table 3.49 Inventoried Cultural Resources within Proposed Project APE

Cultural Resource Numbers	Site Type	National Register of Historic Places Eligibility
	Diversion Channel	
32CS201	Prehistoric archeological site	Eligible
32CS5127	Prehistoric archeological site	Eligible
32CS5146	Prehistoric archeological site	Eligible
32CS5135	Prehistoric archeological site	Undetermined eligibility
32CS5138	Prehistoric archeological site	Recommended not eligible
32CS5141	Prehistoric archeological site	Recommended not eligible
32CS5247	Historic archeological site	Recommended not eligible
32CS5126	Combination prehistoric and historic archaeological site	Recommended not eligible
32CS5139	Combination prehistoric and historic archeological sites	Prehistoric -- undetermined eligibility; Historic -- not eligible
32CS5153	Farmstead	Recommended eligible
BCA15-1319-Site 2	Farmstead	Recommended not eligible
BCA15-1319-Site 1	Infrastructure: Bridge	Recommended not eligible
BCA15-1319-IF 1	Prehistoric isolated find	Recommended not eligible

Cultural Resource Numbers	Site Type	National Register of Historic Places Eligibility
Connecting Channel, Overflow Embankment, and Tieback Embankment		
32CS5168[1]	Farmstead	Recommended eligible
FM19-8[1]	Farmstead	Recommended not eligible
FM2-59[1]	Farmstead	Recommended eligible
32CS4678[1]	Bridge over Wild Rice River	Recommended eligible
FM10-66[1]	Historic archeological site	Recommended not eligible
FM2-58[1]	Infrastructure: Railroad segment	Recommended not eligible
FM2-57-PR[1]	Infrastructure: Highway segment	Recommended not eligible
21CYr	Historic oxcart trail – site lead	Unknown
Staging Area		
CY-CSC-001	Comstock Public School	Listed 5/7/1980
CY-HCR-001	Log Cabin: Bernhardson	Listed 5/7/1980
32CS5098	Historic archeological site	Recommended eligible
32CS5109	Farmstead	Recommended eligible
CY-HCR-003	Drains, ditches	Recommended eligible
CY-MHC-108	Farmstead	Recommended not eligible
CY-MHC-109	Farmstead	Recommended not eligible
CY-MHC-110	Farmstead	Recommended not eligible
CY-MHC-111	Farmstead	Recommended eligible
21CY43	Prehistoric archeological site	Undetermined eligibility
21CY44	Prehistoric archeological site	Undetermined eligibility
21CY45	Prehistoric archeological site	Undetermined eligibility
21CY46	Prehistoric archeological site	Undetermined eligibility
21CY47	Prehistoric archeological site	Undetermined eligibility
32CS2653	Lower Wild Rice and Red River Cemetery	Eligible
CY-CSC-002	Building	Undetermined eligibility
CY-CSC-003	Building	Undetermined eligibility
CY-CSC-004	Building	Undetermined eligibility
CY-HCR-002	Residence	Undetermined eligibility
32RI1877[2]	Hemnes Cemetery	Eligible
CY-HCR-007	Clara Cemetery	Eligible
Cemetery	Site lead: Roen Family Cemetery	Undetermined eligibility
2011 NWRR	Site Lead: Prehistoric archeological site	Unknown
2011 RRE	Site Lead: Prehistoric archeological site	Unknown

Cultural Resource Numbers	Site Type	National Register of Historic Places Eligibility
21CYr	Site lead: Historic trail	Unknown
32CSX248[2]	Site Lead: Residence	Unknown
32CSX5[2]	Site Lead: School	Unknown
Unknown	Site Lead: Log Cabin	Unknown
FM2-54	Historic archeological site	Recommended not eligible
FM2-55	Historic archeological site	Recommended not eligible
FG21-1	Historic archeological site	Recommended not eligible
FG21-2-IF	Prehistoric isolated find spot	Recommended not eligible
FG21-3-IF	Prehistoric isolated find spot	Recommended not eligible
FM19-6	Historic archeological isolated find spot	Recommended not eligible
FM10-65-IF	Historic archeological isolated find spot	Recommended not eligible
FM2-56-IF	Historic archeological isolated find spot	Recommended not eligible
FM19-7	Farmstead	Recommended not eligible
XX-RRD-004, segment 2	Infrastructure: Railroad segment	Recommended eligible
FM2-61	Infrastructure: Drain segment	Recommended not eligible
Oxbow/Hickson/Bakke Ring Levee		
32CS113	Hickson Lutheran Church	Recommended eligible under Criteria A and C
32CS5096	Infrastructure: Hickson Dam	Recommended eligible under Criterion A
32CS2655	Infrastructure: Railroad segment	Recommended not eligible
32CS2657	Infrastructure: Highway segment	Recommended not eligible
32CS5197	Residence	Recommended not eligible
32CS5198	Residence	Recommended not eligible
32CS5199	Residence	Recommended not eligible
32CS5200	Residence	Recommended not eligible
32CS5201	Residence	Recommended not eligible
32CS5202	Residence	Recommended not eligible
32CS5203	Residence	Recommended not eligible
32CS5204	Residence	Recommended not eligible
32CS5205	Garage	Recommended not eligible
32CS5206	Residence	Recommended not eligible
32CS5207	Residence	Recommended not eligible
32CS5208	Granaries	Recommended not eligible
32CS5209	Residence	Recommended not eligible

Cultural Resource Numbers	Site Type	National Register of Historic Places Eligibility
32CS5210	Residence	Recommended not eligible
32CS5211	Barn	Recommended not eligible
In-Town Levees and Floodwalls – 2nd Street, Fargo (Area of direct effects only)		
	No Eligible Sites	
In-town Levees and Floodwalls – 2nd Street, Fargo (Area of indirect effects—ND and MN)		
32CS1849	Case Plaza Building	Eligible – major visual effects
32CS179	Pontoppidan Lutheran Church	Eligible – moderate visual effects
32CS209	Donaldson Hotel	Eligible – minor/no visual effects
32CS4474 (ND) CY-MHC-61 (MN)	NP Ave/Center Ave Bridge	Eligible (ND)/Recommended eligible (MN) – minor/no visual effects
In-Town Levees and Floodwalls – Mickelson Levee Extension, Fargo (Area of direct effects only)		
32CS4278	Residence (724 North River Road N.)	Contributing property to NRHP listed Fargo Oak Grove Residential Historic District
32CS4294	Residence (16 North Terrace N.)	Contributing property to NRHP listed Fargo Oak Grove Residential Historic District
32CS4296	Residence (18 North Terrace N.)	Contributing property to NRHP listed Fargo Oak Grove Residential Historic District
32CS4298	Residence (24 North Terrace N.)	Contributing property to NRHP listed Fargo Oak Grove Residential Historic District
32CS4300	Residence (26 North Terrace N.)	Contributing property to NRHP listed Fargo Oak Grove Residential Historic District
In-Town Levees and Floodwalls – Mickelson Levee Extension, Fargo (Area of indirect effects – ND and MN)		
32CS4295	Residence (17 North Terrace N.)	Contributing property to NRHP listed historic district. Major visual effects.
32CS4297	Residence (21 North Terrace N.)	Contributing property to NRHP listed historic district. Major visual effects.
32CS4301	Residence (29 North Terrace N.)	Contributing property to NRHP listed historic district. Major visual effects.
32CS4302	Residence (33 North Terrace N.)	Contributing property to NRHP listed historic district. Major visual effects.
32CS4303	Residence (37 North Terrace N.)	Contributing property to NRHP listed historic district. Major visual effects.
32CS4289	Residence (3 North Terrace N.)	Contributing property to NRHP listed historic district. Moderate visual effects.
32CS4306	Residence (43 North Terrace N.)	Contributing property to NRHP listed historic district. Moderate visual effects.
32CS4309	Residence (47 North Terrace N.)	Contributing property to NRHP listed historic district. Moderate visual effects.

Cultural Resource Numbers	Site Type	National Register of Historic Places Eligibility
32CS4310	Residence (51 North Terrace N.)	Contributing property to NRHP listed historic district. Minor visual effects.
32CS4311	Residence (57 North Terrace N.)	Contributing property to NRHP listed historic district. Minor visual effects.
32CS4314	Residence (61 North Terrace N.)	Contributing property to NRHP listed historic district. Minor visual effects.
32CS4317	Residence (65 North Terrace N.)	Contributing property to NRHP listed historic district. Minor visual effects.
32CS4320	Residence (69 North Terrace N.)	Contributing property to NRHP listed historic district. Minor visual effects.

Source: USACE (Site data as of January 1, 2016)
[1] Along proposed Project connecting channel, but in NAA staging area.
[2] In proposed Project staging area but not in (south of) NAA staging area.

3.12.2.1.1 Diversion Channel

Potentially-impacted sites were determined based on their proximity to the construction footprint and work limits. The work limits include primary areas where construction activity from trucks and temporary equipment or materials staging would occur. Based on Phase I cultural resource surveys, Table 3.49 provides a list of sites located that would be within the construction footprint and work limits. These sites would be impacted by the Project. This includes the diversion channel and embankment areas. All construction footprint and work limit areas would have a Phase I cultural resources survey completed prior to Project construction, which may result in additional identification of historic or archaeological sites. Subsequent Phase II investigations would follow as needed.

Of the areas currently surveyed, the diversion channel would directly impact three NRHP-eligible properties and one site recommended eligible to the NRHP, which means part or all of the sites would be removed by the Project. Sites that are NRHP-listed or recommended eligible have concurrence between the USACE and SHPO, and would require avoidance, minimization, and mitigation for impacts. Mitigation, as further described in subsection 3.12.3, would be required for both archaeological and historic sites prior to construction. Archaeological sites would require Phase III mitigation, which means data recovery in the form of archaeological excavation of a portion of the site. Mitigation for architectural properties (buildings, structures) would include thorough documentation using text, photographs, and scaled drawings as needed.

There are two sites with undetermined NRHP-eligibility within the construction footprint and work limits of the Project. Sites listed as undetermined eligibility would require a Phase II investigation to further evaluate the NRHP eligibility of the site. This evaluation would be completed prior to Project construction. If a site is determined NRHP-eligible, mitigation would be required for impacts. Sites recommended as not eligible for the NRHP listing would not require mitigation under Section 106 of the NHPA.

3.12.2.1.2 Connecting Channel, Wild Rice River Control Structure, Red River Control Structure, Overflow Embankment, and Tieback Embankment

The overflow embankment along County Road 17 in North Dakota was surveyed in 2012. The connecting channel alignment in North Dakota from the diversion inlet east to the Red River, including the Wild Rice River and Red River control structure areas, was surveyed in 2014 and 2015, with only preliminary field reports available. The Minnesota tieback embankment and the Minnesota portion of the Red River control structure area have not been surveyed. As with the diversion channel, all construction footprint and work limit areas would have a Phase I cultural resources survey completed prior to Project construction, which may result in additional identification of historic or archaeological sites. Subsequent Phase II investigations would follow as needed.

Of the areas currently surveyed, the connecting channel would affect two farmsteads and one bridge, all recommended eligible to the NRHP. Phase II evaluation would be needed on these sites. If any of the sites are determined eligible, Phase III mitigation would be necessary at that site prior to construction.

3.12.2.1.3 Staging Area

Only a small portion of the staging area has had a Phase I cultural resources survey completed. Previously surveyed areas include the former Storage Area #1, the previous location of the Minnesota tieback embankment, the OHB ring levee, and the I-29 road raise. Of the areas surveyed in the staging area, including the OHB levee area, there are two NRHP-listed sites, three NRHP-eligible sites, seven recommended NRHP eligible sites, and ten with undetermined NRHP eligibility. As discussed for the diversion channel, NRHP-listed or eligible sites would require avoidance, minimization or mitigation for impacts. Impacts would be determined at a particular site, building or structure by comparing existing conditions to conditions during Project construction and operation. Sites recommended as not eligible for the NRHP listing would not require mitigation under Section 106 of the NHPA. Mitigation, as further described in subsection 3.12.3, would be required for both archaeological and historic sites prior to construction.

The staging area would be surveyed prior to Project construction completion. The USACE, North Dakota SHPO, and Minnesota SHPO have agreed on an approach to completing Phase I cultural resources surveys in the staging area as follows:

- All buildings and cemeteries within the staging area would have a Phase I cultural resources survey completed. This would identify NRHP-listed and NRHP-eligible sites that may be impacted by the Project.
- Phase I surveys for archaeological sites would be based on a ranking system of low, moderate, and high potential for landscape features to contain such sites. Phase I surveys would be completed for high and moderate site potential areas. This approach is based on the MN/Model Statewide Archaeological Predictive Model used by the Minnesota Department of Transportation. High site potential areas are likely to be used as habitation sites near rivers, water sources, and other areas deemed desirable by past cultures for home sites. Moderate site potential areas may include areas used for hunting and gathering or temporary home sites. Low site potential areas are located in the upland areas away from water sources and have likely been disturbed by existing land use practices, such as cultivation.

3.12.2.1.4 Oxbow/Hickson/Bakke Ring Levee

Sites 32CS5096 (Hickson Dam) and 32CS113 (Hickson Lutheran Church) would not be directly affected by the OHB ring levee and related construction. There should be no direct adverse effects to NRHP-eligible historic properties as a result of the proposed OHB ring levee construction. Additionally, six farmsteads (two in North Dakota and four in Minnesota) within one-half mile of the exterior of the ring levee would be checked for indirect (visual) effects to any historic buildings at their locations resulting from construction of the ring levee once rights-of-entry to these parcels have been acquired.

3.12.2.1.5 In-Town Levees and Floodwalls – 2nd Street, Fargo and El Zagal Golf Course, Fargo

No NRHP-eligible or listed historic properties would be directly affected by levee, floodwall, and pump station construction at 2nd Street and at the El Zagal golf course in Fargo. Indirect effects from the 2nd Street levee and floodwalls to historic properties includes major visual effects to the Case Plaza Building, moderate visual effects to the Pontoppidan Lutheran Church, minor to no visual effects to the Donaldson Hotel and the NP Avenue/Center Avenue Bridge over the Red River, and no visual effects to the eight other historic properties in the 2nd Street levee and floodwall viewshed.

3.12.2.1.6 In-Town Levees and Floodwalls – Mickelson Levee Extension, Fargo

Five contributing properties to the NRHP-listed Fargo Oak Grove Residential Historic District would be directly affected by levee construction. The house at 724 North River Road N. was moved by a private individual to another lot in the neighborhood. The houses at 16, 18, 24 and 26 North Terrace N. would be demolished after mitigation documentation consisting of photographs, drawings, and property histories is completed and architectural elements are salvaged. Part of the lot at 12 North Terrace N., another contributing property, would be acquired, but the house would remain in place. House removal and levee construction would have minor to major visual impacts on 13 of the 33 other contributing properties to the historic district. Mitigation also includes preparation of a historical marker on the Oak Grove neighborhood and its installation in the historic district. The North Dakota SHPO and the Fargo Historic Preservation Commission need to be consulted regarding mitigation for the indirect (visual) effects to the five residences with major visual effects and the three residences with moderate visual effects resulting from house removal and levee construction.

3.12.2.1.7 Cemeteries

With the Project in place, 28 of the 54 cemeteries identified are located within the protected area. In the staging area, seven cemeteries would be impacted with inundation depths estimated to rise between 0.3 to 8.3 feet and inundation time increasing by two to 7.5 days for the 100-year flood event. There are 15 cemeteries outside of the staging area boundary identified in the Cemetery Study. Of those 15, five would experience additional estimated inundation depths of between 0 to 0.5 feet (0 to six inches) and/or an additional flooding time between zero and three days for the 100-year flood event. Potentially affected cemeteries upstream of the Project staging area include Wolverton/Salem Lutheran Cemetery in Wilkin County, Minnesota and South Pleasant/Lium Cemetery, South Pleasant Church Cemetery, Richland Church Cemetery and Eagle Valley Evangelical Cemetery in Richland County, North Dakota. More information on project area cemeteries can be found in the June 2014 USACE Cemetery Study (http://www.fmdiversion.com/studies-technical-documents/).

3.12.2.2 Base No Action Alternative

Cultural resources surveys have been completed for portions of the project area. These surveys identified NRHP properties and NRHP-eligible properties. Additional surveys would be needed to fully evaluate the current affected environment. Under the Base No Action Alternative, cultural resources within the floodplain would continue to be affected during flood events. For example, 43 of the 54 known cemeteries in the project area are currently affected during a 100-year flood. Regulations governing cultural resources under the NHPA (formerly 16 U.S.C. 470; now 54 U.S.C. 300101), including Section 106, would apply under the Base No Action Alternative.

3.12.2.3 No Action Alternatives (with Emergency Measures)

Conditions for the No Action Alternative (with Emergency Measures) would be similar to the conditions described for the Base No Action Alternative, with slightly higher flood depths and slightly longer durations upstream of the F-M urban area. Emergency measures, such as sandbagging and temporary levees, primarily occur in the F-M urban area. These measures are used to reduce flooding in the urban area where cultural resources, such as historic properties, are located.

3.12.2.4 Northern Alignment Alternative

Cultural resources surveys have been completed for portions of the NAA and its staging area (Figure 21). Previously surveyed areas include the former Storage Area #1, the overflow embankment in North Dakota, the previous location of the Minnesota tieback embankment, the OHB ring levee, the Project connecting channel alignment in North Dakota, and the I-29 road raise. The surveys have identified cultural resource sites within the NAA project area that may potentially be impacted both directly and indirectly by the NAA. Direct impacts to cultural resources from construction of the diversion channel for the NAA are anticipated to be similar to those described for the Project. The NAA control structures, tieback embankment, and staging area would be located approximately 1.5 miles downstream when compared to the Project, and therefore, the identified NRHP eligible or recommended eligible sites would be different from the Project for these features. This could change the potential impact on these sites as some that were identified as located in the protected area under the Project, would be potentially impacted under the NAA.

It is important to note that as discussed above in subsections 3.12.1.1 and 3.12.2.1 for the Project, there are several areas within the NAA APE that have not had cultural resource surveys completed. The following discussion on potentially impacted sites should not be considered complete but rather includes the known cultural resource sites identified as of January 1, 2016. Future surveys would need to be conducted to fully consider NAA impacts to NRHP listed or eligible historic properties and determine avoidance, minimization or mitigation actions necessary. The NAA would be surveyed prior to the start of NAA construction as previously described for the Project. The USACE would follow the stipulations in the Project's Programmatic Agreement for completing a Phase I cultural resources survey for the NAA and would survey the NAA staging area using the same approach as described in subsection 3.12.2.1.3 Staging Area paragraphs above.

As mentioned above, the NAA includes potential impacts to cultural resource sites identified for the Project connecting channel and staging area as listed in Table 3.49. In addition to potentially impacting the sites identified in Table 3.49 for the Project, the NAA would also potentially impact cultural resource sites identified in Table 3.50. Table 3.50 does not include those sites, buildings and structures in the NAA APE that have been determined not eligible to the NRHP. As of January 1, 2016, the NAA, including the OHB levee area, would potentially impact two NRHP-listed sites, three NRHP-eligible sites, 13 NRHP-recommended eligible sites, and 17 sites listed as NRHP-undetermined eligibility. Table 3.50 provides a summary of the additional properties that have been identified within the surveyed area for the NAA that are not in the Project staging area.

Table 3.50 Additional Inventoried Cultural Resources within Northern Alignment Alternative APE

Cultural Resource Numbers	Site Type	National Register of Historic Places Eligibility
Connecting Channel		
32CS5074	Farmstead	Recommended not eligible
Staging Area		
32CS114	St. Benedicts Church	Undetermined eligibility
32CS5255	St. Benedicts Cemetery	Eligible
32CS5137	Historic archeological site	Recommended eligible
32CS32	Prehistoric archeological site	Undetermined eligibility
32CS37	Prehistoric archeological site	Undetermined eligibility
32CS5078	Historic archeological site	Recommended not eligible
32CS5128	Historic archeological site	Recommended not eligible
32CS5158	House/Farm	Recommended eligible
32CS5159	Farmstead	Recommended not eligible
32CS5160	Granary	Recommended not eligible
32CS5161	Farmstead	Recommended not eligible
32CS5162	Farmstead	Recommended not eligible
32CS5164	Farmstead	Recommended not eligible
32CS5165	Farmstead	Recommended not eligible
32CS5166	Farmstead	Recommended not eligible
32CS5169	House/Farm	Recommended eligible
32CSX34	Site lead: Historic archeological site	Unknown
32CSX337	Prehistoric isolated find	Recommended not eligible
21CYe	Site lead: Ghost town (Kurtz)	Unknown
CY-KUR-001	House	Undetermined eligibility
CY-KUR-002	House	Undetermined eligibility
CY-KUR-003	Kurtz Town Hall	Undetermined eligibility
CY-KUR-004	Grain Elevator	Undetermined eligibility
CY-KUR-010	Farmstead	Recommended not eligible
CY-MHC-107	Farmstead	Recommended not eligible

Source: USACE (Site data as of January 1, 2016)

3.12.2.4.1 Cemeteries

With the NAA in place, 27 of the 54 cemeteries identified are located within the protected area. Five cemeteries are located within the NAA staging area boundary, St. Benedict's Cemetery, Lower Wild Rice and Red River Cemetery, Hoff Cemetery, Clara Cemetery, and Roen Family Cemetery. There are 18 cemeteries outside of the staging area boundary identified in the Cemetery Study. Cemeteries upstream of the NAA staging area boundary that are anticipated to experience flooding greater than what is currently experienced would also be reviewed for potential impacts and include the North Pleasant Cemetery, Hemnes Cemetery, and Comstock Cemetery.

St. Benedict's Cemetery currently has no flooding during the 10-year event, but experiences flooding during the 50-year event to a depth of 2.5 feet for 11 days, during the 100-year event to a depth of 3.0 feet for 12 days, and during a 500-year event to a depth of 4.0 feet for 16.5 days. This cemetery is in the benefitted area for the Project, but would be subject to increased frequency, depth, and duration of flooding over current conditions under the NAA. Currently St. Benedict's Cemetery has undetermined eligibility for NRHP.

The actual inundation impacts (e.g., depth, frequency, duration) to St. Benedict's Cemetery and other cemeteries mentioned above within the inundation area of the NAA under various flood events has not been assessed yet but would be evaluated if the NAA was selected. However, impacts would be anticipated to be similar those described for the Project (see 2014 Cemetery Study for more details (http://www.fmdiversion.com/studies-technical-documents/).

As previously described for the Project, NRHP-listed or eligible sites would require avoidance, minimization or mitigation for NAA impacts. Impacts would be determined at a particular site, building or structure by comparing existing conditions to conditions during construction and operation. Sites recommended as not eligible for the NRHP listing would not require mitigation under Section 106 of the NHPA. Mitigation, as further described in subsection 3.12.3, would be required for both archaeological and historic sites prior to construction.

3.12.3 Proposed Mitigation and Monitoring Measures

Compliance with Section 106 of the NHPA requires federal agencies to avoid and minimize impacts to NRHP properties and NRHP-eligible properties. This is accomplished by first surveying and identifying potential properties, which has already been completed for part of the Project, including some additional investigations at specific properties for further evaluation. Not all portions of the Project have been surveyed, and therefore, additional Phase I cultural resource surveys and potential subsequent Phase II investigations would be needed prior to Project construction. Additional measures beyond Phase I and Phase II investigations may be identified. This would include Phase III mitigation to gather enough data from important sites or portions of the sites to mitigate for adverse effects from Project activities. Phase III mitigation would locate, define, and recover and record detailed data from areas impacted, including artifact concentrations and other important historical and cultural features. Phase III mitigation could include excavation and preservation of artifacts of an archaeological site or the creation of written site histories, photographs, and scaled drawings of architectural buildings and structures.

A Programmatic Agreement for the Project was negotiated and signed per 36 CFR Part 800, Protection of Historic Properties, section 14(b), as a method for the St. Paul District, USACE to comply with Section 106 of the NHPA, as amended (Appendix G). The Programmatic Agreement defines the Project APE and contains stipulations for cultural resources avoidance, minimization, and mitigation measures. The

Agreement covers the construction footprint, work limits, in-town levees, staging area, and environmental mitigation sites that are part of the Project, including the Drayton Dam and Wild Rice River Dam. The stipulations are listed below by responsible party:

USACE Cultural Resources Responsibilities:

- Ensure that archeologists, historians, and architectural historians, meeting the professional qualification standards given in the Secretary of the Interior's *Standards and Guidelines for Archeology and Historic Preservation*, conduct or supervise all Project-related cultural resources activities.
- Avoid or minimize Project-related adverse effects to historic properties to the extent practicable. If impacts are unavoidable, the USACE will coordinate and implement a Memorandum of Agreement with appropriate parties (Phase III Mitigation).
- Consult and coordinate with appropriate tribes to identify sites of traditional religious or cultural importance within the project area. Avoidance of impacts will be taken to the extent practicable and any remaining effects will be mitigated per a Memorandum of Agreement between the appropriate parties.
- Determine specific locations to be monitored by a qualified professional archeologist during Project construction.
- Cease all work in the vicinity, in the event of the discovery of an unidentified site or property that may be eligible for inclusion in the NRHP, until the site or property can be evaluated. Project activities not in the area of the discovery would be allowed to continue.
- Ensure that all draft and final reports resulting from actions related to the Agreement be provided to the appropriate parties.
- Consult with the appropriate parties if a dispute arises. If the USACE is unable to resolve the dispute with the parties, the USACE will provide the Advisory Council with the appropriate documents.

USACE, its contractors, or the City of Fargo, North Dakota, and the City of Moorhead, Minnesota, contractors Cultural Resources Responsibilities:

- Conduct a Phase I survey of all previously uninventoried project areas.
- Evaluate the NRHP eligibility of all cultural resources sites or structures over 50 years old located within the APE for Phase II Testing and Evaluation.
- Comply with Native American Graves Protection and Repatriation Act for federal or tribal lands, and with the appropriate state's burial laws for all other lands if any human burials are encountered during cultural resources field work or Project construction.
- Ensure that all materials and records resulting from cultural resource tasks related to the Project, be curated in accordance with 36 CFR Part 79, "Curation of Federally-Owned and Administered Archeological Collections" at an appropriate facility, or return the artifacts to the respective landowner after artifact analysis is completed.

Amendment No. 1 to the Programmatic Agreement was finalized in 2013 and was included with the Supplemental EA dated September 2013. The Amendment, which was signed by the primary and concurring parties to the Programmatic Agreement, added project-related environmental mitigation areas and project-related in-town levees to the APE and increased the indirect (visual) APE effects to a uniform one-half mile from all above-ground Project features. Visual effects to historic properties within the one-half mile viewshed are avoided or minimized by generally limiting the above ground height of the project feature to 20 feet or less, which would have little to no visual impact at more than oneeighth mile from the feature. Use of neighborhood-compatible formliner patterns on the in-town floodwalls is used to minimize visual impacts to historic buildings and structures.

3.12.3.1.1 Cemeteries

Potential mitigation measures were identified in the June 2015 USACE Draft Cemetery Mitigation Plan (see Appendix H and also http://www.fmdiversion.com/library.php). Potential mitigation measures for impacts to cemeteries could include:
Construction of earthen berms around entire cemeteries, along rivers, or in other strategic areas

- Armor areas of high potential erosion
- Anchor gravestones and/or coffins/vaults
- Use columbaria from which cinerary urns containing cremated remains could be removed prior to flooding
- Adaptive management
- Flowage easements
- Cemetery relocation

Mitigation measures for cemeteries have not been finalized. However, it is proposed that all cemeteries within the Project and NAA staging areas would be reviewed to determine potential impacts and mitigation. Additionally, it is proposed that cemeteries located upstream of the staging area boundaries that would experience additional flooding above flood depths that are currently experienced would also be reviewed to determine potential impacts and mitigation. Information provided in the study would be used as a tool to determine specific mitigation measures for impacted cemeteries once Project design is finalized.

The June 2015 USACE Draft Cemetery Mitigation Plan (see Appendix H to this EIS) proposed to require the Non-federal Sponsors to obtain flowage easements for the cemeteries within the staging area, as is required for other properties in the staging area for operation of the Project. Normal cemetery operations including burials and operation and maintenance activities would not be restricted by the flowage easement.

The draft plan states that no Federal mitigation is required for cemeteries located outside the staging area, because impacts at these cemeteries are minor and infrequent. The USACE believes that impacts to cemeteries either inside of or outside the staging area would not result in a taking under the Fifth Amendment of the U.S. Constitution.

The Non-federal Sponsors may choose to take additional steps to address concerns about induced impacts at cemeteries. The June 2015 USACE Draft Cemetery Mitigation Plan mentions assistance with clean-up of the staging area as one possibility. The details regarding potential options and the process to consider them are not currently available and would be developed as the design evolves. More information is included in Chapter 6 and Appendix O: Takings, Flowage Easements, and Acquisitions Processes on additional mitigation options that should be considered.

3.13 INFRASTRUCTURE AND PUBLIC SERVICES

Infrastructure and public services are the systems in place necessary for economic activity and development. Public infrastructure includes roads, power and water supplies, and other structures that provide utility, such as pipelines, bridges, and buildings. Public services include the United States Postal Service (USPS), emergency response, and public school districts.

This section describes the existing infrastructure and public services within the project area and the potential impacts to infrastructure and public services from construction and operation of the Project. The Base No Action, No Action Alternative (with Emergency Measures) and NAA are also discussed, along with proposed mitigation and monitoring.

The FFREIS (USACE 2011) and Supplemental EA (USACE 2013c) identified existing infrastructure and public services in the project area as well as evaluated potential infrastructure and public services impacts from the Project. Additional information was not available; however, details beyond those provided in these environmental review documents are included in this EIS.

Two transportation studies were developed after publication of the FFREIS and Supplemental EA that evaluated potential impacts to roads and bridges under the Project scenario for automobile traffic. These studies include:

- *North Diversion Master Transportation Plan – Fargo-Moorhead Metropolitan Area,* prepared by Kadrmas, Lee & Jackson and dated March 2012 (North Transportation Plan).

- *South Diversion Master Transportation Plan – Final Report,* prepared by Kadrmas, Lee & Jackson and dated October 2013 (South Transportation Plan).

The purpose of the North Transportation Plan was "to analyze the disruptions to roadway system continuity for the north section of the Red River diversion alignment (Maple River to the outfall), analyze the resulting impacts these disruptions have on roadway users and formulate recommendations intended to mitigate these impacts." The North Transportation Plan included all roadways within four miles of the proposed diversion channel alignment between the Maple River and the rock ramp diversion outlet structure into the Red River. The North Transportation Plan also briefly addresses public services in the study area, such as emergency response, postal services, and educational facilities.

The South Transportation Plan was "to analyze disruptions to roadway system connectivity, accessibility and mobility for the diversion channel and associated embankments, to analyze resulting impacts these disruptions have on roadway users and formulate recommendations intended to mitigate the impacts." The South Transportation Plan included all roadways within four miles of the proposed 23-mile section of diversion channel, including connecting channel, 4-mile overflow embankment and the 6-mile tieback embankment between the diversion channel origin south of the F-M urban area, north to the Maple River. The South Transportation Plan also briefly discusses railway infrastructure affected by the Project, which is further discussed in subsection 3.13.3 – Proposed Mitigation and Monitoring Measures.

Two utility plans were reviewed that were developed to be used by the USACE as utility relocation plans:

- *Fargo-Moorhead Metro Diversion Project: Utility Relocation Plans Reaches 1 through 3*, prepared by Houston-Moore Group and dated August 8, 2012 (Relocation Plans 1 through 3).

- *Fargo-Moorhead Metro Diversion Project: Utility Relocation Plans Reaches 4 through 7*, prepared by Houston-Moore Group and dated August 27, 2012 (Relocation Plans 4 through 7).

The purpose of the Utility Relocation Reaches 1 through 3 was to provide the USACE with preliminary utility relocation plans for the Project from the Red River outlet to the west side of I-29 or channel station 325+00. This section of the Project impacted 19 existing utility crossings.

Utility Relocation Reaches 4 through 7 includes preliminary utility relocation plans for the Project from the west side of I-29 or channel station 325+00 to the Maple River or channel station 725+00. This section of the Project impacted 16 existing utility crossings.

3.13.1 Affected Environment

3.13.1.1 Roads and Bridges

The project area has an established transportation system serving both rural and urban needs, and includes interstate highways, state highways, county roads, township roads and railways. Figure 22 provides an overview of the transportation system and outlines the extents of the North and South Transportation Plan; Figures 23 and 24 provide greater detail on each Transportation Plan; and Figures 5 and 6 provide details about road alternations proposed for the OHB and Comstock ring levees. The Transportation Plans identified a number of roads and bridges in the project area that would be affected by the Project and Project Alternatives. Specific impacts for the Project and Project Alternatives are discussed under subsection 3.13.2-Environmental Consequences.

3.13.1.2 Railroads

There are two rail lines in the project area that are within the affected environment. The Burlington Northern Santa Fe (BNSF) with its Dakota division headquartered in Fargo, and the Red River Valley & Western Railroad, a short-line regional railroad serving industrial parks and properties in rural communities throughout Cass County, North Dakota. The Red River Valley & Western interchanges with the BNSF Railroad in Casselton, North Dakota and with the Canadian Pacific Railroad just west of Cass County.

3.13.1.3 Utilities

There is an established network of utilities in the project area. These include electric, natural gas, water, sewer, stormwater, telephone, and internet. The utility system is operated and maintained by both public and private entities.

3.13.1.4 Public Services

Public services are provided by the local units of government, such as the counties, cities, and townships. These services include emergency response services, such as law enforcement, fire, and medical. Some of the local governments in the project area have city police departments, while others rely on the county sheriff's departments. These law enforcement agencies patrol both the rural and urban areas of the project area in Minnesota and North Dakota. Fire departments are located within the F-M urban area, while rural areas and smaller communities in the project area are typically served by volunteer departments. Both law enforcement agencies and fire departments respond to emergency calls that are coordinated through a 911 dispatch service. First responders and emergency medical technicians are dispatched to emergency calls as needed in the project area. Existing roadways are used to respond to calls and transport patients to local medical services. Air support is dispatched to an accident as needed for critical situations.

Several school districts and post-secondary educational facilities are located within the project area. In North Dakota, the Central Cass, Kindred, Mapleton, Northern Cass, Richland, and West Fargo School Districts are located in the project area. In Minnesota, the Barnesville, Breckenridge, and Moorhead School Districts are located in the project area. Each school district has bus routes that use the public road network which are travelled daily during the school year to transport students to and from school and school activities.

The project area crosses through several USPS zip codes with delivery service. In North Dakota, the following zip codes are located within the project area: 58005, 58015, 58021, 58042, 58047, 58051, 58059, 58075, 58077, and in Minnesota, 56525, 56560, 56580, and 56594. Each zip code has their own rural mail delivery routes and uses the public road network to deliver mail to both urban and rural homes.

3.13.2 Environmental Consequences

3.13.2.1 Proposed Project

The construction and operation of the Project would have impacts on existing infrastructure and require modification and/or relocation of existing roads, bridges, railroads, and utilities. Impacts to infrastructure include severed roadways, roadway alterations, reconstruction, and rerouting, and raised roadways to higher elevations to provide access during flooding, as well as potential detours and rerouting of existing service routes. Public services would also be affected by the construction and operation of the Project, such as detours and rerouting of existing service routes.

3.13.2.1.1 Roads and Bridges

The Project would result in the modification of traffic patterns for local residences and farmsteads that are close to the alignment, and would affect connectivity and accessibility to various locations and properties in the project area. Figures from the Transportation Plans and publicly available maps were used to provide the following list of roads that would be affected by the Project.

The Project also requires numerous infrastructure components. These include, for example, inlet structures, culverts, rock ramps, and control structures. A detailed Project description is provided in Chapter 2, Section 2.1 – Proposed Project Overview that describes the Project components and functionality.

<u>Diversion Channel</u>

Project construction and operation would cause numerous roadways to be severed or rerouted to other existing roadways due to termination at the diversion channel and associated embankments. The Transportation Plans indicate the Project would primarily impact township roads, county roads, state highways and interstates and their respective bridges. The proposed diversion channel and embankment locations would impact roads listed below (see Figures 23 and 24).

Cass County, North Dakota

- Interstate Highway 29 (I-29)/U.S. Highway 81
- Interstate Highway 94 (I-94)/State Highway 52
- County Road 4/25th Street Southeast
- County Road 6/76th Avenue South/44th Street Southeast
- County Road 8/40th Avenue West/41st Street Southeast
- County Road 10/12th Avenue Northwest/36th Street Northeast
- County Road 14/100th Avenue South/46th Street Southeast
- County Road 16/124th Avenue South/48th Street Southeast/
- County Road 17/170th Avenue Southeast
- County Road 18/52nd Street SE
- County Road 20/40th Avenue North/33rd Street Southeast
- County Road 21/173rd Avenue Southeast/38th Street South
- County Road 22/64th Avenue North/31st Street Southeast
- County Road 31/173rd Avenue Southeast
- County Road 32/28th Street Southeast
- County Road 81
- County Road 81/175th Avenue Southeast
- 13th Avenue West/38th Street Southeast
- 19th Avenue North/35th Street Southeast
- 21st Avenue West /39th Street, Southeast
- 32nd Avenue North/34th Street Southeast
- 32nd Avenue West/40th Street Southeast
- 52nd Avenue North/32nd Street Southeast
- 52nd Avenue West /42nd Street Southeast
- 64th Avenue South/43rd Street Southeast
- 76th Avenue North/30th Street Southeast
- 112th Avenue South/47th Street Southeast
- 167th Avenue Southeast/38th Street West
- 168th Avenue Southeast
- 169th Avenue Southeast
- 170th Avenue Southeast
- 171st Avenue Southeast
- 171st Avenue Southeast/57th Street South
- 172nd Avenue Southeast
- 172nd Avenue Southeast/45th Street South
- 174th Avenue Southeast
- Wall Avenue/45th Street Southeast
- 15th Street West
- 24th Street Southeast
- 27th Street Southeast
- 29th Street Southeast

- 37th Street Southeast
- 38th Street Southeast
- 38thStreet Northwest/105th Street North

North Dakota Overflow Embankment

The Project includes construction of an overflow embankment in North Dakota. Four roads would be impacted by the construction of the overflow embankment. Two of the four roads, 50th St SE and 51st St SE, would have crossings constructed. Utilities located in the overflow embankment area would be evaluated during the Project design phase. Known utilities in the overflow embankment area include, but are not limited to, electric power lines and rural water supply facilities.

Minnesota Tieback Embankment

The Project includes construction of a tieback embankment in Minnesota. Construction of the tieback embankment would impact five roads. Two roads, 28th Street South and Clay County Road 59, would end at the tieback embankment. U.S. Highway 75, Clay County State Aid Highway 7 and Clay County Road 61 would have crossings constructed. U.S. Highway 75 would also require a grade raise. Utilities located in the tieback embankment area would be evaluated during the Project design phase. Known utilities in the tieback embankment area include, but are not limited to, electric power lines and rural water supply facilities.

Staging and Inundation Areas

Traffic patterns, primarily within the staging area, would permanently change due to construction and alignment of the diversion channel and tieback embankment. This would alter the travel from locations where upstream inundation is greatest to Fargo and Moorhead. As a result, some of the severed roadways would be rerouted onto roadways with connectors across the diversion channel. These connecting roadways would then be used as a throughway for those commuting to and from the F-M urban area on I-29 or to and from locations to the east or west.

Project operation would temporarily store water, causing increased inundation, leading to changes in traffic patterns. Water in upstream inundation areas would prevent commuting along East –West routes due to inundation elevations overtopping some roadways. I-29 and U.S. Highway 75 would be elevated to maintain traffic routes during high flows. The BNSF Hillsboro Subdivision Rail Line and the BNSF Moorhead Subdivision Rail Line at these locations would also be raised to a higher elevation through the inundation area as necessary to accommodate flooding. Standard safety rules, laws and regulations would be applied to raise highways. All other roadways within the inundation areas would be allowed to flood when Project operations require staging of flood water. Local roads would remain the responsibility of local communities and additional bridges could be constructed at non-federal expense. Utilities located in the inundation area would be evaluated during the Project design phase. Known utilities in the inundation area include, but are not limited to, electric power lines and rural water supply facilities.

Oxbow/Hickson/Bakke Ring Levee

The OHB ring levee, shown on Figure 5, was evaluated for potential impacts in *Technical Memorandum Oxbow, Hickson, Bakke Ring Levee*, prepared by Houston-Moore Group, and dated March 12, 2013 (OHB Ring Levee Memorandum). OHB ring levee construction would impact transportation connections to the OHB area within the levee. These include impacts to Cass County Highway 81, Cass County Road 18, and Cass County Highway 25. The OHB ring levee Memorandum recommends several road improvements to avoid and minimize significant impacts, which are discussed in subsection 3.13.3 – Proposed Mitigation and Monitoring Measures.

Comstock Ring Levee

The Project includes construction of a levee surrounding the city of Comstock, similar in concept to the OHB ring levee, as shown on Figure 6. The levee would be built to FEMA certification requirements. The 100-year flood elevation at Comstock, based on unsteady modeling information, is an elevation of 922.3 feet, and the 500-year flood elevation is approximately 922.5 feet. The 100-year and 500-year elevations are similar since the city of Comstock is located in the staging area. The proposed levee elevations for Comstock would be set at approximately 926.5 feet on the north end of the city to provide four feet of freeboard. The elevation of the proposed levee on the south side of the city is 927.0 feet. The additional one foot of freeboard over the required amount was factored in based on the assumed level of settlement amount of six inches and six inches of topsoil.

Clay County Highway 2 would be raised at both places where it crosses the ring levee. The railroad on the north and south side would require protection measures above a 100-year flood or would need to have a closure that would stop railroad operations during large flood events.

The alignment on the north and east side of Comstock would have an internal ditch constructed along the levee. South of Clay County, Highway 2 and east of the Burlington Northern Santa Fe (BNSF) railroad. Existing flow from the southeast would be diverted by an external ditch installed around the outside of the levee. This ditch would carry the storm/flood water around town.

Connectivity

Connectivity refers to the frequency of crossings connecting both sides of the proposed diversion channel, connecting channel, and tieback embankment. The proposed diversion channel and tieback embankment would cut through the existing grid of township, county and state roads resulting in gaps in connectivity to roadways aligned both north and south, and east and west. This would sever roadways and cause a disconnect in that road and established traffic routes. The most recent Project design would cause disconnects on 15 east-west and 12 north-south county and township roadways. The Project includes bridges and road raises to maintain connectivity on county roads in addition to I-29 and I-94 and U.S. Highway 75 as discussed in subsection 3.13.3 – Proposed Mitigation and Monitoring Measures; connections would be available at an average spacing of approximately three miles along the diversion channel and tieback embankment.

Accessibility

Accessibility refers to the ability to access a property from an adjacent roadway. The construction of the proposed diversion channel may completely restrict access to sections of land/properties that currently have access. The Transportation Plans determined construction of the proposed diversion channel and tieback embankment would eliminate access to two parcels from existing roadways in the northern portion of the project area and eight parcels from existing roadways in the southern portion of the project area. Access would be provided to these parcels as further discussed in subsection 3.13.3 – Proposed Mitigation and Monitoring Measures.

Mobility

Mobility refers to the efficient movement of people and goods. Disruptions in existing roadways caused by the proposed diversion channel and tieback embankment may cause traffic to relocate to roads that are not designed for increased traffic loads. The majority of township and county roads affected by the proposed diversion channel are dirt or gravel roads with intermittent areas of paved roadway surfaces at higher volume locations. There would be a change in existing traffic patterns and may increase traffic on roads that were not constructed to handle higher levels of traffic. Increased traffic on roads that are not constructed to handle traffic, such as dirt or gravel roads, could result in deterioration of those roadways, requiring more frequent repair or reconstruction.

Construction Traffic

Diversion channel construction, which includes construction of associated bridges and roads, would result in an increase of traffic. In order to accommodate traffic impacts during construction, temporary construction bypass routes would be established for use until construction of a particular portion of the Project is complete. Construction may take several months or several years to complete. Traffic during construction would be routed onto existing infrastructure if available within a reasonable distance. Appropriate placement of construction and safety signage and use of road detours would help minimize impacts. Standard safety rules, laws, and regulations for highway travel with heavy equipment would have to be complied with. These impacts would be temporary, occurring only during Project construction.

Circuitous bypass routes would be established at County Roads 32 and 22, as they are lower volume county roads. On higher volume county roads, such as County Road 4, 20, 31, and 81, a new bypass road would be constructed with an offset 200 feet from the existing roadway during construction. In addition, construction contractors would be instructed to not impede any local traffic.

New temporary bypass routes directly adjacent to the existing roadways of Cass County Road 10, Cass County Road 14, and Cass County Road 81 would be provided to maintain traffic during bridge construction.

3.13.2.1.2 Railroads

There are two rail companies within lines in the project area that would potentially be affected by the construction of the Project (see Figures 23 and 24). These include:

North Dakota

- BNSF Hillsboro Subdivision Rail Line - near I-29/County Road 81 and 27th Street Southeast
- BNSF Prosper Subdivision Rail Line - near County Road 20
- BNSF KO Subdivision Rail Line - south of County Road 10
- Red River Valley and Western Line Railroad near County Road 14

Minnesota

- BNSF Moorhead Subdivision Rail Line - east of State Highway 75

Potential impacts could include the inability to deliver goods by railway in certain areas or delivery delays in other areas. Railways would require relocation, grade raises or other modifications. Proposed railway impacts would be further determined during the Project design phase. Considerations for railroad modifications are discussed in subsection 3.13.3 – Proposed Mitigation and Monitoring Measures.

3.13.2.1.3 Utilities

Project construction and operation would impact numerous public utilities such as electric, water, sewer, stormwater, gas, telephone, and internet. Impacts resulting from the construction and operation of the Project may include relocation of utilities and temporary disruption of services. Specific parcels would be identified during final design of the Project and arrangements made for utility relocation or modification. The Cass Rural Water District Phase I Water Plant is located in Pleasant Township (Township 137 N, Range 49 W, Section 3) on the south side of Cass County Road 16, approximately one mile west of I-29. Under current Project design, the Phase I Water Plant is located on the north side of the tieback embankment. Considerations for utility modifications are discussed in subsection 3.13.3 – Proposed Mitigation and Monitoring Measures.

Oxbow/Hickson/Bakke Ring Levee

Utilities impacted by the OHB ring levee include the existing sanitary sewer system, currently serving Oxbow Drive and Oxbow Circle, which generally flows west to east to a lift station outside of the OHB ring levee area. Removal of this lift station and installation of a new lift station within the protected area of the OHB ring levee would maintain sewer service to that portion of the Oxbow. Areas of Oxbow, Hickson, and Bakke are served by private septic systems. These septic systems are not anticipated to be impacted by the Project and these properties may be connected to the sanitary system in the future.

The existing stormwater system generally slopes from west to east and ultimately outfalls into the Red River. The stormwater system would be modified to reduce the number of pipes that would cross the levee. During times of flooding, the stormwater pump station would pump water out of a ponding area and into the Red River. In addition, stormwater lines would need to be installed to service the new proposed Oxbow Country Club and golf course.

The OHB ring levee would install a pipe parallel to the golf course, which would connect with the waterline at Riverbend Road and Oxbow Drive. In addition, new water service would be installed for the proposed Oxbow addition, which would tie into the existing water main located near the intersection of Sunset Drive and Riverbend Road. Water lines would also need to be installed to service the new Oxbow Country Club and golf course.

Overall, the proposed modifications to the sanitary sewer system, existing water main, and existing stormwater system would avoid significant impacts to this public infrastructure for those areas of Oxbow that would be affected. The OHB ring levee is not anticipated to cause impacts to the sanitary, water, or stormwater infrastructure in the Hickson or Bakke communities.

3.13.2.1.4 Public Services

During construction, disruptions to existing roadways caused by the proposed diversion channel and tieback embankment may cause temporary delays in public services, such as emergency response (police, fire, medical), postal deliveries, and school bus services. However, the Project has the potential to provide long-term benefits to public facilities and services by reducing the potential damage to facilities and disruption in delivery of services during future flood events.

The North Transportation Plan evaluated public services such as emergency response, postal service, and schools. Based on that evaluation, road configurations and bridge locations proposed for Project mitigation, as described in subsection 3.13.3, would not affect emergency response times as long as a bridge over the proposed diversion channel is provided for each county road and a combined bridge for County Road 4 and 31 is provided. School districts were consulted for the North Transportation Plan and also indicated the proposed road configurations and bridge locations would not impact bussing routes within the area.

The USPS indicated the proposed road configurations and bridge locations would not impact main service within the area (i.e., area evaluated for the North Transportation Plan). However, the USPS is concerned about phasing and timing of Project construction and the potential impact it would have on mail sorting prior to delivery. As roadways are closed, the USPS would need to reconfigure their mail delivery routes. However, before a route can be altered, the mail needs to be sorted at the post office and sequenced for each route. Each time the routes are reconfigured due to road closures, it would cost the USPS time and expense to reroute and re-sort the mail.

The South Transportation Plan did not evaluate public services, and therefore a detailed assessment of the potential impacts of the Project was not completed for that area. It is assumed potential impacts in the south area would be similar to those described for the north area, with the exception of the upstream inundation area, which would experience more significant impacts during Project operation due to flooding and road closures in many areas. It is anticipated the need for public services would be minimal for properties located within the staging area boundary, as there would be few residences remaining in that area. Access to the remaining residences may be maintained. An assessment would be completed prior to Project construction.

3.13.2.2 Base No Action Alternative

The Base No Action Alternative would result in numerous highway and railroad bridge closures and the airport closure during flooding events. The cities of Fargo and Moorhead each have ongoing and future FDR projects in the construction and planning phases. These projects provide benefit in reducing the potential for flooding in the cities of Fargo and Moorhead, and therefore, the potential impacts on infrastructure and public services. The magnitude of flooding under the Base No Action Alternative would likely be greater on infrastructure and public services, because emergency measures, such as sandbagging and temporary levee building would not be implemented, allowing more extensive flooding in some areas. Infrastructure could be damaged or destroyed and the delivery of public services could be inhibited in certain flood areas.

3.13.2.3 No Action Alternative (with Emergency Measures)

The No Action Alternative (with Emergency Measures) would result in numerous highway and railroad bridge closures and the airport closure during flood events. The cities of Fargo and Moorhead each have ongoing and future FDR projects. These projects provide benefit in reducing the potential for flooding in Fargo and Moorhead, and therefore also reduce the potential magnitude of impact on infrastructure and public services. Emergency measures, such as sandbagging and temporary levees, would be constructed where gaps in FDR project protection exist to tie into existing levees. A temporary levee may be constructed across a roadway, which would disrupt traffic flow in that area. Emergency measures could also be targeted toward specific infrastructure, such as a water treatment plant, as needed to reduce flood risk.

Predicting whether the emergency measures would be effective enough to avoid impacts to public infrastructure and public services is dependent on each flooding event. Emergency measures have been effective in the past when there has been enough lead time to prepare for flooding. However, there is a risk of the temporary structures failing, which would result in significant flooding in certain areas and potential significant impacts to infrastructure and delivery of public services.

3.13.2.4 Northern Alignment Alternative

Under the NAA, design, construction methods, and operation would be similar to those previously described for the Project but the tieback embankment and control structures would be located approximately 1.5 miles north from the Project alignment. As with the Project, the NAA would also require numerous infrastructure components, including, for example, inlets, culverts, spillways, and hydraulic control structures. The NAA components and functionality would be similar to what was previously described for the Project in Chapter 2, Section 2.1 – Proposed Project Overview and in the sections above.

A Transportation Plan has not been completed for the NAA. However, many of the impacts associated with the Project would be the same for the NAA with the exception of the location and construction of the tieback embankment and control structures as noted above. The Project and NAA have similar inundation footprints, so many of the same areas get impacted, only at varying depths. The NAA would cause new inundation impacts in the area between the Project embankment and NAA embankment, but would also remove impacts near Richland and Wilkin counties. The impacts identified specific to the NAA include new road crossings at Cass County Road 16 and 49th Street Southeast for the overflow embankment, road grade rises in the NAA inundation area, and impacts to the bridge at Cass County Road 16 and Clay County Road 8.

Utility impacts and necessary modifications and mitigations would be further determined during the NAA design phase. The Cass Rural Water District Phase I Water Plant would be located in the inundation area south of the NAA tieback embankment. Table 3.51 provides a summary of impacts specific to the NAA. Impacts from the NAA that would be the same as those previously described for the Project are not listed. Differences to infrastructure impacts between the NAA and the Project are due to the location of the NAA tieback embankment and inundation area. Specific infrastructure impacts occurring with the NAA would be mitigated in a similar manner to what is described in subsection 3.13.3 – Proposed Mitigation and Monitoring Measures for the Project.

Table 3.51 NAA Infrastructure Impacts[1]

Type	NAA	Notes
Road Crossing	New crossings at Cass County Road 16 and at 49th Street Southeast	New overflow embankment crossings relocated from 51st Street Southeast and 50th Street Southeast for the Project
Road grade raise	I-29 through NAA inundation area	Segment of I-29 north of the Project embankment would require road raise
Road grade raise	U.S. Highway 75 through NAA inundation area	Segment of U.S. Highway 75 north of the Project embankment would require road raise
Bridge impact	Cass County Road 16/Clay County Road 8	Bridge at Red River would likely be inaccessible during flood event operation
Water Plant	Cass Rural Water District Phase I Water Plant	Phase I Water Plant would be inundated and require mitigation

Source: KLJ and HMG 2012, KLJ and HMG 2013
[1]Infrastructure impacts listed are those that are specific to the NAA.

Similar to the Project, it is expected that operation of the NAA would cause increased upstream flooding, resulting in many road closures. The bridge at Cass County Road 16/Clay County Road 8 would not be accessible during operation. It is anticipated the need for public services would be minimal within the staging area boundary, because many of the impacted homes (those with greater than two feet of inundation would be mitigated through acquisition in that area. An assessment of structural impacts would be completed prior to NAA construction.

Construction of the NAA diversion channel and tieback embankment may cause disruptions to existing roadways similar to what was previously described for the Project. This may result in temporary delays for public services, such as emergency response (e.g., police, fire, medical), postal deliveries, and school bus services. The NAA would provide long-term flood risk reduction benefits to public facilities and services by reducing the potential damage to facilities and disruption in delivery of services during future flood events within the area downstream of the NAA.

Mitigation, similar to the Project, would be required for the NAA through reconstruction of roads, construction of new bridge crossings, and relocation of utilities as further described in subsection 3.13.3. A transportation study of the area upstream of the tieback embankment would need to be completed to identify impacts to infrastructure from inundation. The infrastructure impacts noted in Table 3.51 reflect impacts that would apply to the mitigation listed in subsection 3.13.3 – Proposed Mitigation and Monitoring Measures. These include the identified road raises and maintaining crossings at the tieback embankment at 50th Street South/ County Road 66 (MN), 40th Street South/ County Road 7 (MN), U.S. Highway 75, County Road 81, I-29, and 170th Street Southeast/ County Road 17 (ND). All other existing roads are anticipated to end at the at the NAA tieback embankment. When not in operation, crossings would be provided approximately three miles or less apart, similar to the Project. Bridge, surface upgrades, and new road development would be completed in the NAA upstream inundation area as needed, similar to the level of improvements proposed for the Project. Where utilities are impacted by the NAA, an evaluation, using the same criteria as described for the Project (subsection 3.13.3.3), would be made to determine if utility relocation or other mitigation is warranted.

3.13.3 Proposed Mitigation and Monitoring Measures

Mitigation measures for Project impacts were identified in the Transportation Plans and Utility Relocation Plans, which included constructing bridges, relocating roadways, terminating roadways, improving roadways, modifying railroads, and relocating utilities. These measures are necessary to avoid and minimize the potential impacts of the Project. Implementation of the proposed mitigation measures reduces potential Project impacts. Once final Project design is completed the Transportation Plans and preliminary Utility Relocation Plans would be updated to reflect the final design features and mitigation needed for the Project.

3.13.3.1 Roads and Bridges

Construction of road and rail bridges over the diversion channel would be completed to mitigate transportation connectivity impacts. Bridges would be constructed approximately every three miles to cross the diversion channel. These bridges would provide access for emergency vehicles, school bus routes, and general traffic. During construction, road and rail detours or bypasses would be provided to address impacts during construction.

3.13.3.1.1 Connectivity

Increased connectivity, through the use of bridges and grade raises, between both sides of the proposed diversion channel would help distribute traffic, reduce travel distances, and at times improve routing options for roadway users. The following roadways would require improvements to maintain connectivity across the diversion channel and tieback embankment:

Cass County, North Dakota

- I-29/State Highway 81 North Bound (crossed twice by Project)
- I-29/State Highway 81 South Bound (crossed twice by Project)
- I-94/State Highway 52 West Bound
- I-94/State Highway 52 East Bound
- Combination of Cass County Road 4/25th Street Southeast and Cass County Road 31/173rd Avenue Southeast
- Cass County Road 6/76th Avenue South/44th Street Southeast
- Cass County Road 8/40th Avenue West/41st Street Southeast
- Cass County Road 10/12th Avenue Northwest/36th Street Northeast
- Cass County Road 14/100th Avenue South/46th Street Southeast
- Combined Cass County Road 16/124th Avenue South/48th Street Southeast and County Road 17/170th Avenue Southeast
- Cass County Road 18/52nd Street Southeast
- Cass County Road 20/40th Avenue North/33rd Street Southeast
- Cass County Road 22/64th Avenue North/31st Street Southeast
- Cass County Road 81

- Cass County Road 81/175th Avenue Southeast
- Cass County Road 32/28th Street Southeast
- 13th Avenue West/38th Street Southeast and 167th Avenue Southeast/38th Street West (Cass County, North Dakota)
- BNSF Railway crossings
    - Hillsboro Subdivision Line, crosses near I-29/County Road 81 and 27th Street Southeast
    - Fargo-Nolan Line, crosses near County Road 20
    - KO Subdivision, crosses south of County Road 10
- Red River Valley and Western Railway crossing
    - Horace-Edgeley Line, crosses near County Road 14

Clay County, Minnesota
- Minnesota Highway 75 would be raised up to the 500-year staging area elevation
- Clay County State Aid Highway 7
- Clay County Road 61
- BNSF Moorhead Subdivision Rail Line crossing (including necessary rail line lengths for raising) near U.S. Highway 75 would be raised.

3.13.3.1.2 Accessibility

The North Transportation Plan recommends construction of two gravel roadway connections to County Road 4 and 169th Avenue Southeast to re-establish accessibility to two affected parcels. Accessibility to all other properties along the proposed diversion channel would be maintained by installing a connection between 27th Street and County Road 81.

To maintain farming accessibility, a box culvert would be installed where Drain 13 crosses 170th Avenue Southeast to provide access to the area south of Drain 30 between 170th Avenue Southeast and the diversion channel. The North Transportation Plan recommends that all existing roadways not identified as diversion channel crossings should either be terminated as dead-ends at the diversion channel or removed completely if the road is less than one-fifth of a mile.

The South Transportation Plan determined construction of the proposed diversion channel and tieback embankment would affect eight parcels from existing roadways, and therefore, prevent access to these parcels. A cost analysis completed for the South Transportation Plan recommends that parcels would either be purchased or new roadways constructed as mitigation for the Project. The cost/benefit of mitigation for these parcels would be evaluated on a case by case basis.

The South Transportation Plan also recommends that existing roadways that have not been identified as diversion channel crossings should terminate as dead-ends where they meet the connecting channel to allow for better accessibility to those properties. It is also recommended that the section of 26th Street West located between the diversion channel and 21st Avenue West be considered for removal as this roadway does not provide accessibility benefits.

3.13.3.1.3 Increased Use

Improvements to 167th Avenue Southeast would be completed to collect higher volumes of traffic due to township road terminations at the diversion channel. Recommended improvements include upgrading five miles of dirt roadways into gravel roadways and installing two new box culverts.

Additionally, 38th Street West from Cass County Road 8 to 43rd Street SE/64th Avenue South as well as 38th Street West from Cass County Road 14 to Cass County Road 16 would be upgraded from dirt roads to gravel roads. A "collector roadway", between crossings at 38th Street SW and Cass County Road 8 (40th Avenue West/41st Street SE), would be developed using existing infrastructure. This corridor would require the following mobility improvements:

- Improve 15th Street Southwest from Cass County Road 8 (40th Avenue South/41st Street Southeast) to 21st Avenue West/39th Street Southeast, including realignment of the intersection of 15th Street Southwest with 21st Avenue West/39th Street Southeast.
- Improve the curve that transitions 15th Street Southwest to 13th Avenue West to meet design standards for a 55 mile per hour curve.

3.13.3.1.4 Project Operation Impacts to Roadways

Roadways (as well as roadway features such as ditches and culverts) that are impacted from Project operation would be mitigated by the Diversion Authority as part of the Operation and Maintenance (O&M) plan for the Project. Prior to Project completion, the Diversion Authority would negotiate a flowage easement with the Local Government Units (LGUs). This flowage easement would identify how O&M would be performed and whether the LGU would perform the O&M and be compensated by the Diversion Authority, or whether the Diversion Authority would contract for the O&M.

Anticipated O&M activities for roads and ditches include removing debris and soil that may be deposited on roadways and culverts; repairing damages to roadways, ditches, and culverts; and re-establishing ditch inverts. If the Diversion Authority would contract for the O&M, they would work with the LGU to develop a schedule and priorities for cleanup following Project operation. The Diversion Authority member entities have multiple taxing authority options, including sales tax and a Project special assessment district, which could be used to fund long term O&M costs for the Project.

3.13.3.2 Railroads

Improvements and/or modifications to the rail lines were not evaluated in the Transportation Plans. The South Transportation Plan suggested future studies be conducted regarding rail lines. Any improvements and/or modifications to the railroads would need to be coordinated with BNSF and the Red River Valley & Western Railroad. Two modifications identified to address railroad transportation issues included raising the rail lines or relocating them. Specifically, the South Transportation Plan suggested the following:

- Evaluate an improvement plan for the rail line through Comstock (i.e., BNSF Moorhead Subdivision Rail Line). If the rail line was raised through Comstock, adjacent buildings would be impacted. If the rail line was relocated, the grain elevators would have to be relocated as well, which is not feasible. If no improvements were made, there would be rail line closures during each flood event.

- Evaluate whether the removal of the rail line through Horace is feasible. The rail line ends two miles past the diversion channel in Horace, and trains run once every two weeks, with most grain hauling occurring by truck.

3.13.3.3 Utilities

Utilities that cannot withstand occasional flooding in the inundation area would be abandoned, modified, or relocated, depending on the situation in accordance with applicable regulations. All utilities that would be severed by construction of the Project would be relocated prior to construction to reconnect affected parcels. If the in-town levees or ring levees are constructed, utilities affected by construction would also be modified or relocated. Specific improvements and/or modifications to the utility systems would be evaluated during final design of the Project. Parcels needing improvements, modifications, or relocations of utilities would be identified during that evaluation.

3.13.3.4 Public Services

The proposed road configurations and bridge locations were determined to not affect emergency response times, USPS delivery service, and school bussing routes. However, the USPS expressed concern about phasing and timing of Project construction and the impact it could have on mail delivery routes. The Diversion Authority should coordinate, as possible, with the USPS to provide sufficient notice for road closures.

3.14 LAND USE PLANS AND REGULATIONS

There are a number of LGUs within the project area that have planning and zoning authorities. Various zoning ordinances and comprehensive growth and development plans are in place for the counties, townships, municipalities, and watershed districts. Some municipalities and townships do not have their own planning and zoning, and rely on other LGU regulatory authorities, such as the county. This section describes relevant information from county and city land use plans, regulations, and flood damage reduction plans in the project area. Potential permits and zoning issues are identified for those LGUs who would be affected by the Project; either from Project operation or from Project construction activities. For those communities identified in Section 3.2 as participants in the NFIP program, floodplain development regulations would apply (see Section 3.2 for more information). These floodplain development regulations are intended to protect the floodplain's natural function for water conveyance and water storage against development that may alter this function.

3.14.1 Affected Environment

The Project is sponsored by a federal agency (USACE) and the Diversion Authority which is comprised of the following LGUs: Cass County (ND), Clay County (MN), City of Fargo (ND), City of Moorhead (MN), Cass County (ND) Joint Water Resources District, and the Buffalo-Red River Watershed District (MN). Coordination with all affected units of government is ongoing as part of Project development. There are a number of LGUs in the project area that implement planning, zoning or both. In general, communities within the project area have adopted measures through planning and zoning to reduce flood risk. These LGUs include counties, townships, municipalities, and watershed management organizations.

3.14.1.1 Counties in Project Area

There are four counties in the project area: Cass County and Richland County, North Dakota and Clay County and Wilkin County, Minnesota. These counties have established some form of land use management, which may include planning, zoning or both; the counties have also established development goals and objectives to alleviate the impacts of flooding.

Table 3.52 Summary of North Dakota County Land Use Management within the Project Area

North Dakota Counties	Land Use Management: Planning (P), Zoning (Z) or Both	
Cass County, ND[1]	Both	Zoning delegated to townships and municipalities. In areas without township or municipality jurisdiction, the County has Subdivision and Floodplain Ordinances and a Comprehensive Plan.
Richland County, ND	None	Delegated to townships and municipalities.

Source: Wenck, 2014/2015
[1]Project construction footprint is within LGU

In Cass County, most zoning is carried out by individual townships and municipalities (Table 3.52). However, Cass County currently administers three land use and zoning documents: the County's Comprehensive Plan, Ordinance #1998-2 (Flood Damage Prevention), and the Subdivision Ordinance. All of these documents are in effect where township or municipal zoning does not regulate these land uses.

Cass County's Comprehensive Plan was last adopted in 2005.There are six goals identified, each with established objectives and policy guidelines to base and establish the County's policies towards development and growth. The six goals include:

1. To achieve orderly, balanced, and sensible development.
2. To provide the citizens of Cass County with essential public facilities, services, and infrastructure.
3. To provide an efficient, safe, environmentally sensitive, and cost effective county transportation system.
4. To use and preserve natural resources in an environmentally sound manner.
5. To preserve and maintain Cass County's rural heritage.
6. To ensure and maintain public participation in the decision-making, influencing the future of Cass County and its citizens.

On February 2, 1998, Cass County implemented Ordinance #1998-2 (Flood Damage Prevention). This ordinance applies to all areas within the jurisdiction of Cass County, but outside of the boundaries of a city or township Flood Damage Prevention Ordinance, to "promote public health, safety, and general welfare and to minimize public and private losses due to flood conditions in specific areas." In order to accomplish this, the ordinance provides methods and provisions to reduce flood losses.

On March 6, 2006, Cass County implemented a subdivision ordinance, which was revised March 5, 2012. Section 612 of the Subdivision Ordinance regulates the floodplain. This section of the ordinance requires the 100-year floodplain (base flood elevation) and/or floodway be identified within a proposed subdivision. All proposed developments, except those in townships with adopted floodplain management regulations, shall be built pursuant to the Cass County Flood Damage Prevention Ordinance #1998-2.

Richland County does not manage planning or zoning at the county level, rather the responsibility lies within each city or township. The Richland County Water Resource Board requires permits for culverts, ditching, and drain tile.

Table 3.53 Summary of Minnesota County Land Use Management within the Project Area

Minnesota Counties	Land Use Management: Planning (P), Zoning (Z) or Both	
Clay County, MN[1]	Both	Cities and townships have their own planning and zoning authority.
Wilkin County, MN	Z	Wilkin County has zoning authority for townships in project area. County also has a Comprehensive Local Water Plan and Comprehensive Land Use Plan.

Source: Wenck, 2014/2015
[1]Project construction footprint is within LGU

In Clay County, Minnesota, most planning and zoning occurs at an individual township and municipality level (Table 3.53). Similar to Cass County, Clay County has county level ordinances that apply where the townships do not regulate a certain land use. Clay County Zoning Ordinance 2012-1, adopted March 13, 2012, replaces Chapter 8 of the Clay County Code and adopts all FEMA and MNDNR requirements resulting from the revised Clay County FIRM. The ordinance was adopted to identify and enforce regulations in Special Flood Hazard Areas, which are Zone AE and Zone A on the FIRM for Clay County. SFHAs are considered those subject to periodic inundation that results in potential loss of life, loss of property, health and safety hazards, disruption of commerce and governmental services, extraordinary public expenditures on flood protection and relief, and impairment of the tax base.

Chapter 5 of the Clay County Zoning Ordinance establishes Flood Hazard Zones and Districts: General Floodplain, Floodway, and Flood Fringe Districts. The County ordinance (Amended January 2011) identifies a levee, dike or floodwall built by a unit of government as a permitted use. A ring levee is considered a conditional use. Floodway District standards for conditional uses (Chapter 8-5A-6 subpart D1) may not cause any increase in the stage of the 100-year or regional flood or cause an increase in flood damages in the reach or reaches affected. Additionally, structural works for flood control (Chapter 8-5A-6 subpart D6) that would change the course, current, or cross section of protected wetlands or public waters would be subject to Minnesota Statute 2008, Chapter 103G. Levees, dikes, or floodwalls intended to remove areas from the regulatory floodplain shall not be allowed in the floodway, and structural works for flood control constructed in the floodway to protect individual structures or agricultural crops or farmsteads shall not cause an increase to the 100-year or regional flood.

Wilkin County currently administers countywide zoning in the project area (Table 3.53). The zoning ordinance (Amended June 2014) establishes six primary categories of zoning districts to meet the County's planning, development, and preservation needs: Floodplain, Shoreland, General Agriculture, General Residence, Airport, and Commercial/Industrial. The Floodplain District, Section 10 of the Wilkin County Zoning Ordinance, provides the permissible uses and procedures for projects proposed within the Floodplain District. These include Floodway, Flood Fringe, and General Flood Plain Districts.

3.14.1.2 Affected Townships in the Project Area

There are a number of townships in the project area that would be affected by the Project. Most of these townships, in both Minnesota and North Dakota, have some form of land use management, meaning they have the authority or requirement for permits and approvals for development through planning, zoning or both. The townships within the project area in North Dakota that administer zoning ordinances include: Harwood, Mapleton, Normanna, Pleasant, Stanley, and Warren. Pleasant Township also administers a floodplain ordinance (Table 3.54).

Table 3.54 Summary of North Dakota Township Land Use Management within the Project Area

North Dakota Townships[1]	Land Use Management: Planning (P), Zoning (Z) or Both	
Harwood Township, ND	Z	Zoning Ordinance
Mapleton Township, ND[2]	Z	Zoning Ordinance
Normanna Township, ND[2]	Z	Zoning Ordinance
Pleasant Township, ND[2]	Z	Floodplain Ordinance
Raymond Township, ND	None	Cass County planning and zoning applies.
Stanley Township, ND	Z	Zoning Ordinance
Warren Township, ND[2]	Both	Comprehensive Plan
Wiser Township, ND[2]	Z	Cass County planning and zoning applies.

Source: Wenck, 2014/2015

[1]Berlin Township, ND would be within the construction footprint, information to date of this EIS has been unable to be obtained regarding Land Use Management

[2]Project construction footprint is within LGU

Townships within the project area in Clay County that administer a zoning ordinance include: Georgetown, Glyndon, Kragnes, Kurtz, Moorhead, and Oakport Townships (Table 3.55). Holy Cross and Wolverton Townships do not administer a zoning ordinance, and therefore, fall under the jurisdiction of Clay County and Wilkin County, respectively. Moorhead and Oakport Townships are within the Moorhead urban area and work closely with the City as parts of these townships are planned for future annexation into the City.

Table 3.55 Summary of Minnesota Township Land Use Management within the Project Area

Minnesota Townships	Land Use Management: Planning (P), Zoning (Z) or Both
Georgetown Township, MN	Z
Glyndon Township, MN	Z
Holy Cross Township, MN	None, Clay County planning and zoning applies.
Kragnes Township, MN	Z
Kurtz Township, MN	Z
Moorhead Township, MN	Z
Oakport Township, MN	Z
Wolverton Township, MN	None, Wilkin County planning and zoning applies.

Source: Wenck, 2014/2015

3.14.1.3 Affected Cities in the Project Area

There are a number of cities in the project area that would be affected by the Project, including the large cities of Fargo and Moorhead, small communities outside of the immediate F-M urban area, and those located upstream of the tieback embankment. The Cities of Moorhead and Fargo have established development goals and objectives to alleviate the impacts of flooding. Plans and ordinances for the Cities of Moorhead and Fargo reference levees, flood walls, dikes, diversions, and property buyouts, as planned and regulated uses. These types of developments would typically require a permit from each of the Cities if the development occurs within city limits.

In North Dakota, the project area includes the cities of Argusville, Briarwood, Christine, Fargo, Frontier, Harwood, Horace, Kindred, Mapleton, Oxbow, North River, Prairie Rose, Reile's Acres, and West Fargo. All but two of these cities administer land use management through planning and zoning ordinances; Christine and North River's land use management is administered through their respective townships. Fargo has extensive planning and zoning related to floodplain management, including local flood risk reduction projects. Chapter 2 – Proposed Project and Alternatives provides information on local flood risk reduction projects in Fargo (Table 3.56).

Table 3.56 Summary of North Dakota City Land Use Management within the Project Area

North Dakota Cities	Land Use Management: Planning (P), Zoning (Z) or Both	
Argusville, ND[1]	Both	Planning and Zoning Ordinances
Briarwood, ND	Both	Planning and Zoning Ordinances
Christine, ND	None	Eagle Township zoning applies.
Fargo, ND[1]	Both	Land Development Code
Frontier, ND	Z	Zoning Ordinance
Harwood, ND	Z	City Ordinances
Horace, ND[1]	Z	Land Use Ordinance
Kindred, ND	Both	Planning and Zoning Ordinances
Mapleton, ND	Z	Zoning Ordinance
Oxbow, ND	Z	Zoning Ordinance
North River, ND	None	Reed Township zoning applies.
Prairie Rose, ND	Z	Zoning Ordinance
Reile's Acres, ND	Both	Planning and Zoning Ordinances
West Fargo, ND[1]	Both	Comprehensive Plan

Source: Wenck, 2014/2015
[1]Project construction footprint is within LGU

There are five cities in Minnesota within the project area that would be affected by the Project: Comstock, Dilworth, Georgetown, Moorhead, and Wolverton. All five administer land use management through planning, zoning or both. Moorhead has extensive planning and zoning related to floodplain management, including local flood risk reduction projects. Chapter 2 – Proposed Project and Alternatives provides information on local flood risk reduction projects in Moorhead (Table 3.57).

Table 3.57 Summary of Minnesota City Land Use Management within the Project Area

Minnesota Cities	Land Use Management: Planning (P), Zoning (Z) or Both	
Comstock, MN	Both	Planning and Zoning Ordinances
Dilworth, MN	Z	Zoning Ordinance
Georgetown, MN	Z	Floodplain Only
Moorhead, MN[1]	Both	Comprehensive Plan; Growth Plan
Wolverton, MN	Both	Planning and Zoning Ordinances

Source: Wenck, 2014/2015
[1]Project construction footprint is within LGU

3.14.1.4 Other Local Government Units in the Project Area

In addition to counties, townships, and municipalities, other types of LGUs also have planning and zoning in the project area. There are a number of watershed management organizations in the project area that are actively advocating for flood management through various flood risk reduction projects, and planning, and in some cases rules and permits in conjunction with other permits and approvals required by LGUs. Table 3.58 provides a summary of watershed management organizations within the project area.

Table 3.58 Summary of Other Local Government Units Land Use Management within the Project Area

Watershed Management Organizations	Land Use Planning
Cass County Joint Water Resource District, ND	Project review in the district
Red River Joint Water Resource District, ND	2007 – 2009 Water Management Strategy
Buffalo-Red River Watershed District[1], MN	Projects, rules, permits, and plans, such a watershed management plan
Red River Watershed Management Board, MN	Red River Watershed Management Board Policy Manual

Source: Wenck, 2014/2015
[1]Project construction footprint is within LGU

3.14.1.4.1 Cass County Joint Water Resource District

Cass County is divided into four water resource districts, each governed by a board of individuals: the Maple River, Rush River, North Cass, and Southeast Cass. Combined these districts form the Cass County Joint Water Resource District (CCJWRD). Each district is responsible for water management, drain and flood control issues. The Project would be located in the Maple River, Rush River, and Southeast Cass Watershed Districts. The CCJWRD does not have regulatory authority for planning and zoning, but are active in review of projects in the districts.

3.14.1.4.2 Red River Joint Water Resource District

The Red River Joint Water Resource District was formed in 1979 and stretches the length of the Red River from Richland County in the south to Pembina County in the north, encompassing 14 individual water resource districts in North Dakota. The goal of the District is to provide a coordinated and cooperative approach to water management in the North Dakota portion of the Red River Basin. The District does not have regulatory authority for planning and zoning, but is active in review of projects and providing coordination between the districts.

3.14.1.4.3 Buffalo-Red River Watershed District

The Buffalo-Red River Watershed District (BRRWD) is a LGU and drainage authority in Minnesota. Operation of the BRRWD is in accordance with their "Watershed Management Plan" which is required by the Minnesota Board of Water and Soil (BWSR). The BRRWD covers Clay and Wilkin Counties in the Minnesota portion of the project area and two other Minnesota counties which are outside of the project area. The BRRWD is divided into seven planning regions; the Project is in the Western Planning Region. The BRRWD Western Planning Region has two goals: improve existing hydrologic conditions in watercourses; and reduce erosion and resulting sedimentation in watercourses. The BRRWD implements its goals through planning, project implementation, and rules and permitting. A permit from the BRRWD, applications available on the BRRWD website, would be required for the Project. (http://www.brrwd.org/about-brrwd/rules/)

3.14.1.4.4 Red River Watershed Management Board

The Red River Watershed Management Board (RRWMB) is an organization with the mission "to institute, coordinate, and finance projects and programs to alleviate flooding and assure beneficial use of the water in the water of the Red River and its tributaries." The RRWMB, previously known as the Lower Red River Watershed Management Board, was created by an act of the Minnesota Legislature in 1976. As of 2004, the RRWMB had participated in over 40 flood water retention projects in the Red River Basin.

Under a joint powers agreement, eight watershed districts comprise the RRWMB: the Joe River, Two Rivers, Roseau River, Middle-Snake-Tamarac Rivers, Red Lake, Sand Hill River, Wild Rice, and Bois de Sioux. Each district manages its individual watershed and each district has a seat on the RRWMB. The jurisdiction and authority of the RRWMB covers the area of the eight districts. The northeastern edge of the project area is located in the Wild Rice district. RRWMB does not have regulatory authority for planning and zoning. Their activities generally focus on flood damage reduction projects.

3.14.1.5 Plans and Regulations in the Project Area

Plans and regulations for each LGU in the project area were identified in subsection 3.14.1 – Affected Environment. Table 3.59 provides additional details for potentially applicable zoning ordinances, comprehensive growth and development plans, and other relevant local plans that were reviewed for this EIS.

Table 3.59 Summary of Plans and Regulations

Jurisdiction	Document	Date	Summary	Affected Communities
North Dakota				
Counties				
Cass County, North Dakota	Cass County Comprehensive Plan	2005	This plan is a framework for Cass County's policies on development and growth. The document reviews current status of the county and creates a general work plan to establish how goals and objectives will be executed.	Cass County, Townships: Barnes, Berlin, Harwood, Mapleton, Pleasant, Raymond, Reed, Stanley, Warren Cities of: Argusville, Briarwood, Fargo, Frontier, Harwood, Horace, Kindred, Mapleton, North River, Oxbow, Prairie Rose, Reile's Acres, West Fargo
Cass County, North Dakota	Flood Damage Prevention: Ordinance #1998-2	Feb. 2, 1998	The purpose of this plan is to promote public health, safety, and general welfare, and to minimize public and private losses due to flood conditions in specific areas by provisions outlined in the ordinance.	Cass County: outside the boundaries of Flood Damage Prevention Ordinances of the following, if applicable Townships: Barnes, Berlin, Harwood, Mapleton, Pleasant, Raymond, Reed, Stanley, Warren Cities of: Argusville, Briarwood, Fargo, Frontier, Harwood, Horace, Kindred, Mapleton, North River, Oxbow, Prairie Rose, Reile's Acres, West Fargo
Townships[1]				
Harwood Township, Cass County, North Dakota	Harwood Township Zoning Ordinance	2005	The zoning ordinance details the specific definitions, laws, zoning, and ordinances for the township.	Harwood Township
Mapleton Township, Cass County, North Dakota	Mapleton Township Zoning Ordinance	May 2006, Amended June 23, 2008	The zoning code of Mapleton Township details the specific definitions, laws, zoning, and ordinances for the Township. The zoning code adopts the comprehensive plan of the Township as its basis.	Mapleton Township City of West Fargo

Jurisdiction	Document	Date	Summary	Affected Communities
Normanna Township, Cass County, North Dakota	Normanna Township Zoning Regulation	2004	The zoning code of Normanna Township details the specific definitions, laws, zoning, and ordinances for the Township. The zoning code adopts the comprehensive plan of the Township as its basis.	Normanna Township City of Kindred
Pleasant Township, Cass County, North Dakota	Pleasant Township Floodplain Ordinance	2004	The zoning code of Pleasant Township details the specific definitions, laws, zoning, and ordinances for the current Flood Hazard areas and plans to prevent creation of Flood Hazard areas within the Township.	Pleasant Township Cities of: Horace, Oxbow
Pleasant Township, Cass County, North Dakota	Pleasant Township Zoning Ordinance	2004	The zoning code of Pleasant Township details the specific definitions, laws, zoning, and ordinances for the Township. The zoning code adopts the comprehensive plan of the Township as its basis.	Pleasant Township Cities of: Horace, Oxbow
Stanley Township, Cass County, North Dakota	Stanley Township Zoning Ordinance	August 9, 2005	The zoning code of Stanley Township details the specific definitions, laws, zoning, and ordinances for the Township. The zoning code adopts the comprehensive plan of the Township as its basis.	Stanley Township Cities of: Briarwood, Fargo, Frontier, Horace
Warren Township, Cass County, North Dakota	Warren Township, Cass County ND, Zoning Regulations	Adopted Oct. 29, 2004; Amended Sept. 14, 2005; Amended Feb. 7, 2012	The zoning code of Warren Township details the specific definitions, laws, zoning, and ordinances for the Township. The zoning code adopts the comprehensive plan of the Township as its basis.	Warren Township City of Horace
Municipalities[2]				
Argusville, North Dakota	City Ordinance IV-Planning and Zoning	October 1, 2012	The objective of the document is to implement the plans and policies of the City of Argusville of the use and enjoyment of land resources.	City of Argusville

Jurisdiction	Document	Date	Summary	Affected Communities
Fargo, North Dakota	Fargo Growth Plan	2007	This document is an updated version of the City of Fargo's original growth plan. The essential intent is to plan land uses based on realistic controlled future growth throughout the community while addressing issues that hinder current growth. The plan touches on issues of residential, commercial and public property uses.	City of Fargo
Fargo, North Dakota	Fargo Comprehensive Plan – Go 2030	May 24, 2012	This plan is an update to the Fargo Growth Plan of 2007. The 2007 Plan is currently used to regulate, since this 2012 plan is in a draft phase.	City of Fargo
Fargo, North Dakota	City of Fargo Land Development Code – Chapter 20 – City Planning and Zoning Fargo Municipal Code	August 2009	This document presents the zoning for the City of Fargo and related ordinances.	City of Fargo
Fargo, North Dakota	Comprehensive Review of Potential Flood Mitigation Options	March 13, 2012	This map provides information on areas protected by existing and future flood risk reduction projects.	City of Fargo
Frontier, North Dakota	Zoning Ordinance for the City of Frontier, North Dakota	October 9, 2000	This document is intended to promote the public health, safety, and general welfare of the City of Frontier, and also secure orderly development and protection of the City's resources.	City of Frontier
Harwood, North Dakota	Harwood City Ordinances	October 1, 2006	This document is intended to implement the plans and policies of the City of Harwood for land uses within the City.	City of Harwood
Horace, North Dakota	The Revised Ordinances of 2003, City of Horace, North Dakota	February 3, 2003	This document is intended to implement the plans and policies of the City of Horace for land uses within the City.	City of Horace

Jurisdiction	Document	Date	Summary	Affected Communities
Reile's Acres, North Dakota	Ordinance Book of the City	June 14, 2011	This document is intended to implement the plans and policies of the City of Reile's Acres for land uses within the City.	City of Reile's Acres
West Fargo, North Dakota	City of West Fargo Comprehensive Plan	January 2008	The comprehensive plan for West Fargo outlines the City's current position on growth trends and the City's envisioned growth. The plan considers current and potential issues and associated policies. These range from school districts, infrastructure, community "feel", and land use. Additionally, this plan considers flood strategies as a necessity for devising new growth/development strategies.	City of West Fargo
West Fargo, North Dakota	West Fargo Zoning Code	2007	The zoning code of West Fargo details the specific definitions, laws, zoning, and ordinances for the City. The zoning code adopts the comprehensive plan as its basis.	City of West Fargo
Minnesota				
Counties				
Clay County, Minnesota	Clay County Comprehensive Plan	July 2, 2001	This plan is a framework to establish Clay County's policies toward development and growth. The document reviews current status of the county and creates a general work plan to establish how goals and objectives will be executed.	Clay County Townships: Alliance, Elmwood, Holy Cross, Georgetown, Glyndon, Kragnes, Kurtz, Moland, Morken, Oakport, Viding Cities of: Comstock, Dilworth, Georgetown, Moorhead, Sabin
Clay County, Minnesota	Clay County Ordinance 2012-1	March 13, 2012	This is the general ordinance to promote health and human safety, including safety from flood.	Clay County Townships: Alliance, Elmwood, Holy Cross, Georgetown, Glyndon, Kragnes, Kurtz, Moland, Morken, Oakport, Viding Cities of: Comstock, Dilworth, Georgetown, Moorhead, Sabin

Jurisdiction	Document	Date	Summary	Affected Communities
Clay County, Minnesota	Clay County Ordinance 2012-3	November 13, 2012	This document adds the definition of a retreat center to the nomenclature of the Clay County Development Code. Regarding flooding, retreat centers can have a conditional use in 0.1% chance floodplains.	Clay County Townships: Alliance, Elmwood, Holy Cross, Georgetown, Glyndon, Kragnes, Kurtz, Moland, Morken, Oakport, Viding Cities of: Comstock, Dilworth, Georgetown, Moorhead, Sabin
Clay County, Minnesota	Clay County Ordinance 2012-4	December 27, 2012	This document repeals and re-adopts various sections of Chapters 1, 3, 5, 7 and 8 of the Clay County Development Code.	Clay County Townships: Alliance, Elmwood, Holy Cross, Georgetown, Glyndon, Kragnes, Kurtz, Moland, Morken, Oakport, Viding Cities of: Comstock, Dilworth, Georgetown, Moorhead, Sabin
Clay County, Minnesota	Local Water Management Plan 2006 - 2015	December 20, 2005 Amended 2010	Administered by the Clay Soil and Water Conservation District. The purpose of the plan is to identify existing or potential problems and opportunities to protect, manage, or develop water resources and related land resources within the county; develop and implement plans of action to promote sound hydrologic management of water and related land resources within the county; and to work toward effective environmental protection and management within the county.	Clay County Townships: Alliance, Elmwood, Holy Cross, Georgetown, Glyndon, Kragnes, Kurtz, Moland, Morken, Oakport, Viding Cities of: Comstock, Dilworth, Georgetown, Moorhead, Sabin
Wilkin County, Minnesota	Zoning Ordinance	January 1, 2004 Amended June, 2014	This ordinance is intended to promote public health, safety, morals, and general welfare; provide for adequate light, air, and water; provide for safety from fire, flood, and other dangers, conserving the value of properties and encouraging the most appropriate use of land; and preserve and enhance the quality of surface and ground water.	Wilkin County Township: Eagle City of Wolverton

Jurisdiction	Document	Date	Summary	Affected Communities
Wilkin County, Minnesota	Local Water Management Plan 2008 – 2017	2008	The purpose of the Plan is to identify existing and potential problems, opportunities for protection, management, and development of water and land resources in the county; promote hydrologic management of water and related land resources in the county through action plans; and to work toward effective environmental protection and management of the water and land resources in the county.	Wilkin County Township: Eagle City of Wolverton
Wilkin County, Minnesota	Comprehensive Plan 2014-2024	2014	Wilkin County adopted a comprehensive plan for 2014-2024 in September 2014. The plan establishes goals and policies to enact land use controls and guide future development. .	Wilkin County Township: Eagle City of Wolverton
Townships				
Oakport Township, Minnesota	Alternative Urban Areawide Review and Mitigation Plan	April 9, 2009	An Alternative Urban Areawide Review was completed for a large development area near the border with the City of Moorhead in an area of the township that was annexed into the City of Moorhead on January 1, 2015. The City of Moorhead's Plans and Ordinances now apply to the annexed area.	Oakport Township
Holy Cross Township, Minnesota	Ordinance 1: Establishing a Planning Commission	Unknown	Ordinance 1 establishes a planning commission in Holy Cross Township.	Holy Cross Township
Municipalities				
Dilworth, Minnesota	City of Dilworth, Minnesota Zoning Ordinance	December 13, 2010	This document is intended to implement the Comprehensive Plan and promote the public health, safety, and general welfare of the people of Dilworth	City of Dilworth

Jurisdiction	Document	Date	Summary	Affected Communities
Moorhead, Minnesota	Comprehensive Plan for the City of Moorhead	July 19, 2004	This document is a comprehensive plan for guiding the growth and redevelopment of Moorhead. The plan includes general directions, policies, and strategies for reaching growth goals. Components of the plan include land use, infrastructure, and economic development.	City of Moorhead
Moorhead, Minnesota	Comprehensive Plan Addendum City of Moorhead	November 9, 2009	This addendum to the Moorhead's comprehensive growth plan primarily relies on information provided in the original plan with updating of relevant sections, policies, and plans. In general, it assesses the amount of household growth that Moorhead is expected to achieve in the next 25 years.	City of Moorhead
Moorhead, Minnesota	Moorhead Growth Plan Update	2009	This update to Moorhead's comprehensive growth plan divides the major growth areas of the city into sections and considers each individually. These zones are the East District, Southeast District, South Central District and the Southwest District. Some public amenities and public works projects are updated.	City of Moorhead
Moorhead, Minnesota	Zoning Ordinance of the City of Moorhead	January 1, 2005	This is the general ordinance to promote health and human safety, including flood control.	City of Moorhead
Moorhead, Minnesota	Moorhead Ordinance 2013-16, 2013-20, 2013-21, 204-01	Sept. 16 2013 – Feb. 10, 2014	This document considers various changes and additions to Moorhead's City Ordinance. Changes/additions include signage, private colleges, and off street parking regulations.	City of Moorhead

Jurisdiction	Document	Date	Summary	Affected Communities
Other Local Government Units				
Buffalo-Red River Watershed District, Minnesota	Western Planning Region Planning Summary	June 2010	The purpose of the Summary is to identify resource issues and problems, describe previous efforts to correct issues and problems and identify possible solutions for current issues. The document is a tool for gathering input and should be used alongside the Watershed Management Plan.	Counties: Clay, Wilkin Townships: Kurtz, Holy Cross City of Comstock
Buffalo-Red River Watershed District, Minnesota	Watershed Management Plan	June 2010	The purpose of this document is to identify problems, issues, goals, and short and long term strategies to address issues and attain the goals.	Counties: Clay, Wilkin Townships: Kurtz, Holy Cross City of Comstock
Red River Watershed Management Board, Minnesota	Policy Manual 3rd Revision	March 2004	This document outlines the history, authority, roles, and responsibilities of the Red River Watershed Management Board.	Counties: Clay, Wilkin, along with others outside the project area

Source: Diversion Authority Land Use Summary March 2014, and Wenck April and June 2014, updated 2015

3.14.2 Environmental Consequences

The current plans and zoning ordinances for each of the LGUs in the project area that could be affected by flooding and/or Project and Project alternatives were evaluated. This included evaluation of current and future plans for growth in a community and regulations in place to manage flood risk through land use and floodplain ordinances. Potential challenges with the plans and zoning ordinances are identified where applicable.

3.14.2.1 Proposed Project

The Project would affect a number of LGUs within the project area as previously discussed in subsection 3.14.1. Each of the planning and zoning ordinances were evaluated for potential issues. Summaries of these evaluations are included below. The intent of this section is to provide a general overview about the affected LGUs and any regulations or permits that may be applicable. Individual LGU plans and zoning ordinances referenced in this section should be reviewed for further detail for compatibility during Project design and prior to implementation.

Permits and other approvals from LGUs may apply to the Project, and are also discussed in subsection 3.14.3 – Proposed Mitigation and Monitoring Measures and in Section 1.5 – Government Approvals. Additionally, the Project would make it necessary to modify existing Flood Insurance Study mapping because of changes to regulatory floodways, BFEs or extent of SFHAs. The NFIP participating communities with FIRMs affected by the Project would require map revisions through the FEMA LOMR process and would occur in accordance with the Final FEMA/USACE Coordination Plan (April, 2015). This is further discussed in Chapter 1, Section 1.5 – Government Approvals and Section 3.2 – FEMA Regulations and the CLOMR Process.

3.14.2.1.1 Counties Affected by the Project

North Dakota

Cass County, North Dakota

Most zoning and permitting is administered at the township level in Cass County. The Project would likely be in-line with those aspects of Cass County's Comprehensive Plan that have goals around flood risk reduction. Flooding would discourage development in the inundated area south of the tieback embankment. The Project would also likely be in-line with the goals of the Flood Damage Prevention Ordinance, as flood risk would be reduced in large population areas.

Richland County, North Dakota

Richland County delegates land use management to the townships and municipalities. Where Project operation causes additional flooding, a zoning amendment may be required by the County or affected communities.

Minnesota

Clay County, Minnesota

Planning and zoning is administered at the township and municipal level in Clay County. Overall, most of the zoning in Clay County is considered Agricultural Preservation, which promotes agricultural land use and protects it from encroachment by non-agricultural development.

Project infrastructure located within Clay County would be the Red River control structure, Minnesota tieback embankment, Comstock ring levee, and levees and dikes that are planned to be built within Moorhead, Minnesota. This construction may be required to comply with the

Clay County ordinance (if located outside Moorhead City limits) and the City of Moorhead ordinance (if located inside Moorhead City limits). Where Project operation causes additional flooding, a zoning amendment may be required. LGU approvals are further discussed in subsection 3.14.3 and in Chapter 1, Section 1.5 – Government Approvals.

Wilkin County, Minnesota
The Wilkin County Local Water Management Plan 2008 – 2017 considers installing structures to reduce flood damages. These structures were not proposed as part of the Project, and therefore, were not evaluated for impacts in this EIS. No Project construction would occur within Wilkin County. However, Section 20.05 of the Wilkin County Zoning Ordinance, amended June 2014, requires a zoning amendment for any impoundment greater than 640 acres in size. Where Project operation causes additional flooding greater than 640 acres, approximately the 50-year flood or 2-percent chance flood, a zoning amendment may be required.

3.14.2.1.2 Townships Affected by the Project

<u>North Dakota</u>
Berlin Township, North Dakota
Berlin Township, North Dakota would be impacted by the diversion channel construction footprint. Any approvals needed for the Project would be managed by Cass County where township regulations do not cover certain land uses.

Harwood Township, North Dakota
Harwood Township, North Dakota would be impacted by the diversion channel construction footprint. Any approvals needed for the Project would be managed by Cass County where township regulations do not cover certain land uses.

Mapleton Township, North Dakota
Mapleton Township, North Dakota, would be bisected by the diversion channel. The Project would likely be in-line with the Mapleton Township Land Use Ordinance by assisting to conserve and enhance the value of the land within the Township by reducing flood risk in the area. The diversion channel may have challenges meeting compatibility with the Comprehensive Plan goal to facilitate traffic movement as some roads would be severed by the Project, as further discussed in Section 3.13 – Infrastructure and Public Services. Township approvals for Project construction may be required as discussed in subsection 3.14.3.

Pleasant Township, North Dakota
The diversion channel would be located on the northern boundary of Pleasant Township, North Dakota. The diversion channel may have challenges meeting compatibility with the Comprehensive Plan goal to facilitate traffic movement as some roads would be severed by the Project, as further discussed in Section 3.13 – Infrastructure and Public Services. Township approvals for Project construction may be required as discussed in subsection 3.14.3.

A large portion of the township would be included in the staging area. The Project may not be consistent with the Pleasant Township Zoning Ordinance purpose and intent to "protect public health, safety, morals, comfort, convenience, prosperity and general welfare of the Township of Pleasant" due to Project operation of the staging area that would flood land that is not part of the existing 100-year floodplain. A zoning amendment or floodplain permit may be required for the Project.

Raymond Township, North Dakota
Raymond Township, North Dakota would be bisected by the diversion channel. Raymond Township does not have its own zoning ordinance. Any approvals needed for the Project would be managed by Cass County.

Warren Township, North Dakota
The diversion channel would be located on the eastern edge of Warren Township, North Dakota. The Project is likely in-line those aspects of the Warren Township zoning regulations that assist to conserve and enhance the value of the land within the Township by reducing flooding in the area. The diversion channel may have challenges meeting with compatibility with the Comprehensive Plan goal to facilitate traffic movement as some roads would be severed by the Project, as further discussed in Section 3.13 – Infrastructure and Public Services. Township approvals for Project construction may be required as discussed in subsection 3.14.3.

Wiser Township, North Dakota
Wiser Township, North Dakota would be impacted by the diversion channel construction footprint. Any approvals needed for the Project would be managed by Cass County where township regulations do not cover certain land uses.

Other Townships
Barnes and Reed Townships, North Dakota are located within the protected area of the Project. Any approvals needed for the Project for the portions of these townships located outside of municipal boundaries, such as the Cities of Fargo and West Fargo, would be managed by Cass County where township regulations do not cover certain land uses.

<u>Minnesota</u>
Oakport Township
Oakport Township implemented an Alternative Urban Areawide Review (AUAR) and Mitigation Plan in April 2009. The AUAR is intended to review the cumulative impacts of development. Portions of Oakport Township were annexed into the City of Moorhead January 1, 2015, the City of Moorhead planning and zoning applies to this area, known as the Oakport area. This area is on the northeast side of the Red River between the city limits of Moorhead and U.S. Highway 75. The AUAR calls for development within the 100-year floodplain. The Project is likely not in conflict with the AUAR as flooding within the Oakport area would be reduced when the Project is in operation.

Other Townships
Georgetown, Glyndon, Kragnes, Kurtz, and Moorhead Townships have planning and zoning authority. Clay County regulations apply where township regulations do not cover certain land uses. Adverse impacts to these townships from the Project are not anticipated as they are located in areas north of the staging area and are intended to benefit from reduced flood risk. It is not anticipated that the Project would require approval by these townships. However, the local planning and zoning approval process for each of these townships may apply.

Holy Cross Township is located in the staging area and would have new flood inundation from the Project. Clay County administers planning and zoning in this township. Holy Cross Township is in the process of establishing a planning commission and interim ordinance which would establish a moratorium on water impoundment projects. Wolverton Township in Wilkin County is also located in the staging area where new flood inundation would occur. Wilkin County administers planning and zoning for this township, and some Wilkin County permits and approvals may apply.

3.14.2.1.3 Cities Affected by Project

<u>North Dakota</u>

Argusville, North Dakota

The City of Argusville, North Dakota, Title IV Planning and Zoning Ordinance 4-0401, states one of the goals of the City's Comprehensive Plan is to "encourage the most appropriate use of land in the city and its one mile planning area." The Project would be consistent with this goal and could reduce flooding in the City of Argusville and the one-mile planning area. The diversion channel would be located on the southeastern edge of the one-mile planning area of the City. To aid in planned development, Argusville has an Extra Territorial Area within one mile of the corporate city limits under the authority of the North Dakota Century Code. However, because the Project is within the one mile area, City approval may be required, as further discussed in subsection 3.14.3.

<u>North Dakota</u>

Argusville, North Dakota

The City of Argusville, North Dakota, Title IV Planning and Zoning Ordinance 4-0401, states one of the goals of the City's Comprehensive Plan is to "encourage the most appropriate use of land in the city and its one mile planning area." The Project is likely consistent with this goal and could reduce flooding in the City of Argusville and the one-mile planning area. The diversion channel would be located on the southeastern edge of the one-mile planning area of the City. To aid in planned development, Argusville has an Extra Territorial Area within one mile of the corporate city limits under the authority of the North Dakota Century Code. However, because the Project is within the one mile area, City approval may be required, as further discussed in subsection 3.14.3.

Fargo, North Dakota

The Project could be considered in-line with those aspects of the City of Fargo Growth Plan 2007 that have goals around flood risk reduction However, there are other aspects of Fargo's land use plans where the Project may have challenges meeting compatibility, such as development density, area needed for new development, and the ability to provide infrastructure at a reasonable cost for specific areas of concern.

The Project would provide flood risk reduction for a large, currently-undeveloped area south of Fargo. Protection of this area would likely encourage development in this area. Unplanned development (i.e., not considering goals of the City) within this area could very well be incompatible with Fargo's future growth plans and associated land use development ordinances as it relates to areas such as density, area and infrastructure at a reasonable cost. The City indicated that each proposed new development would be individually evaluated against City goals and ordinances. The City's Land Use Development Ordinances contain criteria (Sec.

20.0906 Part F) that would need to be considered to ensure compatibility with those aspects that would be challenged (density, area and infrastructure at a reasonable cost).
The diversion channel and the staging area of the Project would be located to the west and south of Fargo's city limits and outside of the City's planning and zoning authority. In-town levees, flood walls, and dikes would be constructed within the city limits of Fargo, and therefore, may require City approvals, as further discussed in subsection 3.14.3. In general, the Project would allow for development in areas that would otherwise be inundated by flooding during the 100-year or greater event.

Horace, North Dakota
The diversion channel would bisect both the southwestern and northwestern city limits of Horace, along with running through the western side of City's extra-territorial jurisdiction. One of the goals of the City of Horace Land Use Ordinance is "To protect the value of land and buildings and maintain harmony and consistency among land uses." The Project is anticipated to reduce flooding within this area as flood waters would be channeled into the diversion channel, which is intended to protect land and structures. The Project may allow for development in some areas of Horace that would otherwise be inundated by flooding during the 100-year or greater event. Protection of this area would likely encourage development in this area. Unplanned development (i.e., not considering goals of the City) within this area could very well be incompatible with the City's future growth plans and associated land use development ordinances as it relates to areas such as density, area and infrastructure at a reasonable cost.

City of Oxbow, Village of Hickson, Bakke Subdivision, North Dakota
The City of Oxbow, Village of Hickson, and Bakke Subdivision, located in Pleasant Township, Cass County, North Dakota would be affected by the Project. The OHB ring levee is designed at an elevation to protect the communities from Project operation. Some permits and approvals may apply. Chapter 2 provides additional details on the OHB ring levee.

West Fargo, North Dakota
A strategic issue of the 2008 West Fargo Comprehensive Plan is maximizing flood protected areas as a key aspect to reinvesting in the community. The Plan acknowledges that for growth of West Fargo to occur, additional flood protection is needed. The Project is likely in-line with those aspects of the Plan that call for reducing flood risk in West Fargo and allowing for development to extend into areas of existing floodplain with reduced risk of flooding. Under current municipal boundaries, the diversion channel is west of the city limits, but bisects, the extraterritorial area, and therefore, may require city approval.

<u>Minnesota</u>
Moorhead, Minnesota
A strategic initiative of the City of Moorhead Comprehensive Plan Addendum 2009 is Flood Risk Reduction. The Project is likely consistent with this initiative in that the diversion channel would work to reduce flooding within the Moorhead municipality and aid the planned growth of Moorhead by reducing flood risk in the existing floodplain. The diversion channel and the staging area of the Project would be located to the west and south of Moorhead, and therefore, are not under the City's jurisdiction. In-town levees, flood walls, and dikes would have direct impacts to the city of Moorhead, and therefore, may require City approvals, as further discussed in subsection 3.14.3. Information on the recently annexed Oakport area is provided in subsection 3.14.2.1.2.

Comstock, Minnesota
Comstock does not administer local planning or zoning. Clay County planning and zoning is followed as appropriate.

3.14.2.1.4 Other Local Government Units Affected by Project

North Dakota
There are two joint water resource districts in the project area in North Dakota, the Cass County Joint Water Resource District and the Red River Joint Water Resource District. Both of these districts review projects and provide comments to Diversion Authority, but neither has regulatory authority.

Cass County Joint Water Resource District
The Project would be located in the Maple River, Rush River, and Southeast Cass Watershed Districts. The CCJWRD does not have regulatory authority for planning and zoning, but are active in review of projects in the districts. The CCJWRD would be notified of the Project and provide review of the Project.

Red River Joint Water Resource District
The Project would be located with the Red River Joint Water Resource District (RRJWD) along the Red River in North Dakota. The RRJWD does not have regulatory authority for planning and zoning, but is active in review of projects and providing coordination between the districts. The RRJWD would be notified of the Project and provide review of the Project.

Minnesota
Two of the watershed management organizations in the project area are in Minnesota, the Buffalo-Red River Watershed District and the Red River Watershed Management Board. Both have been established planning in the respective areas and have stakeholder involvement with the Project.

Buffalo-Red River Watershed District
The BRRWD Western Planning Region has two goals: improve existing hydrologic conditions in watercourses; and reduce erosion and resulting sedimentation in watercourses. The Project would alter hydrologic conditions by regulating the flow in the Benefited Area during 10-year flood events and greater. Drainage system impairments and the Comstock levee would likely require a permit from the BRRWD to ensure that drainage systems provide landowners their assessed benefits. Permit approval would be subject to the conditions under Minnesota Drainage law 103E, which governs drainage systems (i.e., a system of ditch or tile, or both, to drain property, including laterals, improvements, and improvements of outlets, established and constructed by a drainage authority). "Drainage system" includes the improvement of a natural waterway used in the construction of a drainage system and any part of a flood control plan proposed by the United States or its agencies in the drainage system.

The BRRWD is also involved with the implementation of the MPCA Watershed Restoration and Protection Strategy (WRAPS). The WRAPS for the Buffalo River has been completed and is currently pending approval from the MPCA. The WRAPS for the Upper Red River is scheduled to be completed in December 2015. It is anticipated that concepts and strategies presented in the

WRAPS would be considered by the Diversion Authority during Project planning and construction, and would be considered during BRRWD's Project review and permitting process.

Red River Watershed Management Board
The Red River Watershed Management Board watershed districts would be involved with review and comment on the Project. Areas within the RRWMB area would experience altered hydrologic conditions from the Project regulating the flow in the Benefited Area during 10-year flood events and greater. The Red River Watershed Management Board has provided information and data about the watershed that has been used for planning and EIS development.

3.14.2.2 Base No Action Alternative

Under the Base No Action, land use plans and zoning ordinances would continue to be in place in the project area. These plans and regulations would be revised over time to reflect growth trends and future needs of each community, including regulation of floodplain development where required and appropriate. Watershed management organizations would also continue planning and implementing projects as feasible.

3.14.2.3 No Action Alternative (with Emergency Measures)

The No Action Alternative (with Emergency Measures) would be similar to that which was described for the Base No Action Alternative with the addition of emergency measures. Plans and regulations for emergency measures would be revised as needed over time and implemented during periods of flooding in the project area. Watershed management organizations would also continue planning and implementing projects as feasible.

3.14.2.4 Northern Alignment Alternative

Under the NAA, design, construction methods, and operation would be similar to those previously described for the Project, but portions of the NAA (control structures, embankment and connecting channel, overflow embankment, tieback embankment, and staging area) are moved approximately 1.5 miles north of their locations as proposed for the Project. The location of the NAA would not change the LGUs relevant to the Project. The connecting channel would be located in Stanley Township, Cass County instead of in Pleasant Township, Cass County. A portion of the connecting channel would be located in Stanley Township under the Project design, and therefore, the NAA would not result in additional permits from Stanley Township. The NAA tieback embankment would be located in Kurtz Township. Zoning ordinances, comprehensive growth and development plans, and other relevant local plans that were identified and reviewed for the Project are also relevant to the NAA.

Under the NAA, Comstock is not anticipated to have new flood inundation during NAA operation that would impact existing structures during the 1-percent chance flood (100-year flood), and therefore construction of a community ring levee is not included with this alternative. A permit may still be required for improvements needed to provide flood protection the sewage treatment lagoons as a result the NAA.

During NAA operation, the extent of new inundation in Richland and Wilkin Counties would be less than with the Project. This may affect the permits and approvals that may be needed in these counties. Section 20.05 of the Wilkin County Zoning Ordinance, amended June 2014, indicates a zoning amendment may be required for any impoundment greater than 640 acres in size. The NAA is not anticipated to cause additional flooding greater than 640 acres, and therefore, it is unlikely that a zoning amendment would be required by the County or affected communities.

Generally, the NAA is similar to the Project in regards to the applicable zoning ordinances, comprehensive growth and development plans, and other relevant local plans reviewed for this EIS. Permits and approvals from each of the LGUs, as described for the Project in subsection 3.14.3 and in Chapter 1, Section 1.5, may also be required for the NAA. Additionally, communities in which the NAA affects the existing Flood Insurance Study mapping would be required to go through the CLOMR process as described for the Project in Chapter 1, Section 1.5 and Section 3.2.

3.14.3 Proposed Mitigation and Monitoring Measures

Construction and operation of the Project would affect multiple LGUs. Project construction may require permits and LGU approval including conditional use permits (CUPs). Additionally, the impact of the Project on the existing floodplain may require LGU review of current floodplain ordinances and maps. Zoning amendments may be considered by the LGUs prior for Project operation and impacts may be monitored and quantified. Table 3.60 provides a summary of permits and possible approvals that may be needed for Project construction and operation. Although the following table does not list proposed mitigation and monitoring, these permits and approvals have the potential to include mitigation by requiring avoidance or minimization. Prior to Project implementation, the non-Federal sponsors are required to comply with all applicable federal and state laws and regulations (USACE 2011b). The USACE has indicated regulations would be followed as required by federal law, and that they would continue to work with state and local entities for Project implementation.

Table 3.60 Local Government Permitting and Approvals That May Be Needed for Project Construction or Operation

Project Construction Footprint		
Permitting Authority	**Potential Permits**	**Notes**
	North Dakota	
Cass County, North Dakota	Zoning amendment (potential)	A zoning amendment may be required due to possible changes to existing floodplain.
Harwood Township, North Dakota	Building permit	-
	Floodplain permit	-
Mapleton Township, North Dakota	Conditional Use permit and Site Approval	Conditional Use Permit (CUP) may be needed due to severed roads during Project construction.
Pleasant Township, North Dakota	Conditional Use permit and Site Approval	CUP may be needed due to severed roads during Project construction.
Warren Township, North Dakota	Site Approval for General Ground Excavation with Conditional Use Permit	CUP may be needed due to severed roads during Project construction.
City of Argusville, North Dakota	Conditional Use permit and Site Approval	-

Project Construction Footprint		
Permitting Authority	**Potential Permits**	**Notes**
City of Horace, North Dakota	Conditional Use permit and Site Approval	CUP may be needed due to severed roads during Project construction.
City of Fargo, North Dakota	Floodplain Permit	-
	Stormwater Permit	-
City of West Fargo, North Dakota	Conditional Use permit	CUP may be needed due to severed roads during Project construction.
Cass County Joint Water Resource District, North Dakota	Subsurface Drain/Application to Drain	-
	Application to Drain	-
Minnesota		
Clay County, Minnesota	Floodplain permit	-
City of Moorhead, Minnesota	Floodplain Permit	-
	Stormwater Permit	-
Buffalo-Red River Watershed District, Minnesota	Construction/Floodplain Approval	Permit may be needed per Rules Section 8
Two Rivers Water Resource District, Minnesota	Two Rivers Water Resource District Application	Drayton Dam mitigation project
Project Staging Area and FEMA Revision Reach		
Permitting Authority	**Permit Needed**	**Conditions, if applicable & Comments**
North Dakota		
Permits may be required depending on impacts observed during Project operation and depending on the applicability. At this time, some local governments are unsure whether or not certain permits would be required as the actual impact of Project operation is uncertain.		
Minnesota		
Buffalo-Red River Watershed District	Construction/Floodplain Approval	-
Permits may be required depending on impacts observed during Project operation and depending on the applicability. At this time, some local governments are unsure whether or not certain permits would be required as the actual impact of Project operation is uncertain.		

Source: Wenck, 2014/2015

3.15 MINNESOTA DAM SAFETY AND PUBLIC WATERS REGULATIONS AND PERMITTING

This section describes the regulatory framework for dam safety and the dam safety permit and work in public waters under Minnesota Statutes and Rules and the regulatory implications to the Project and Project Alternatives as applicable. A brief overview discussion regarding relevant studies and other available or required information as it relates to the dam safety and work in public waters permit are provided as well. The embankment system and control features together are considered a Class I dam under Minnesota Rules. Under the Minnesota Rules, parts 6115.0300 through 6115.0520 construction of a Class I dam require a dam safety permit from the MNDNR. The Diversion Authority or non-Federal sponsor would be the permit applicant and dam owner. The MNDNR received a permit application on February 18, 2016.

3.15.1 State Regulatory Framework and Process

The MNDNR Dam Safety Program (Program) was established in 1978 in response to the National Dam Safety Program Act. The purpose of the Program is to protect the health, safety, and welfare of the public by ensuring that dams are safe. Minnesota Statutes 2008, section 103G.515, authorize the MNDNR to inspect dams and issue orders directing dam owners to make necessary repairs. The same section directs the MNDNR to adopt rules governing dam safety. The specific rules governing the Program are defined in Minnesota Rules, parts 6115.0300 through 6115.0520.

The Program sets minimum standards for dams and regulates the design, construction, operation, repair and removal of dams. Both privately and publicly-owned dams are regulated. Although the embankment system and control features (referred to herein this section as the dam) would be designed to meet USACE dam safety standards (in accordance with Federal Guidelines for Dam Safety (Federal Emergency Management Agency Preprinted 2007) and *Engineering and Design – Safety of Dams: Policy and Procedures* (USACE, 2011c), dams regulated in Minnesota would also be required to meet Minnesota dam safety criteria regulated under Minnesota Rules.

Under the Minnesota Rules, parts 6115.0300 through 6115.0520 MNDNR dam safety permits are required to construct, alter, repair, remove or transfer ownership of a regulated dam. Regulated dams subject to existing dam safety rules are defined in Minnesota Rules, part 6115.0320, subpart 5.

Under Minnesota Rules, part 6115.0320, subpart 5, a dam is defined as any artificial barrier, together with appurtenant (i.e., belonging or necessary) works, which does or may impound water and/or waste materials containing water. Dams typically have a height greater than six feet and an impoundment volume greater than 15 acre-feet. Minnesota Rules, part 6115.0340 classifies dams into three hazard classifications; those dams where failure, misoperation, or other occurrences or conditions would probably result in:

- Class I: any loss of life or serious hazard, or damage to health, main highways, high-value industrial or commercial properties, major public utilities, or serious direct or indirect, economic loss to the public;
- Class II: possible health hazard or probable loss of high-value property, damage to secondary highways, railroads or other public utilities, or limited direct or indirect economic loss to the public other than that described in Class III; and
- Class III: property losses restricted mainly to rural buildings and local county and township roads which are an essential part of the rural transportation system serving the area involved.

Dams may also be classified as "no hazard," meaning there is no potential for loss of life or adverse impacts to health or safety.

It should be noted that Minnesota Rules, part 6115.0310 (Dams, Scope), identifies that dam safety rules "are supplementary and complimentary to the rules which establish standards and criteria for granting permits to change the course, current, or cross section of public waters (parts 6115.0150 to 6115.0210, 6115.0230, and 6115.0240 to 6115.0260). Where these parts conflict with other appropriate rules and requirements, the most restrictive provision shall apply. All provisions of part 6115.0220 are superseded by these parts as they relate to dams as defined herein, except the section relating to water level controls." Pursuant to Minnesota Statutes 2008, section 103G, and Minnesota Rules, part 6115, a work in public waters permit from the MNDNR would be required for Project construction. For this Project, the work in public waters permit including permit requirements and provisions; would likely be captured under permit combined with the dam safety permit requirements and provisions; herein referred to as the MNDNR combined permit when applicable. Denial or issuance of the MNDNR combined permit would extend to both. Minnesota Rules, part 6115.0240 identifies application requirements for work in public waters.

3.15.1.1 MNDNR Dam Safety and Work in Public Waters Permitting Process and Permit Decision Criteria

Minnesota Rules, part 6115.0410 details the documents necessary for the dam safety permit application process. The permitting process requires the submittal of a permit application including a preliminary report. The preliminary report would need to include:

a. A general statement setting forth the effect on the environment.
b. Maps showing project locations and adjacent governmental boundaries and local infrastructure.
c. A written report of surface conditions, i.e., geology, topography, which is based on a field examination by the applicant's engineer and other qualified personnel.
d. Typical cross-sections of the dam accurately showing elevations, proposed impoundment levels, and top width.
e. Logs of borings in the foundation and in the borrow areas, and results of seismic and resistivity subsurface investigations, when they are readily available.
f. Preliminary design assumptions, operational aspects, tentative conclusions, and references.
g. A preliminary cost estimate.
h. Where applicable, future plans on ultimate project size including dams and impoundments.
i. A general description of all other activities and elements related to and part of the total dam project, such as operational plans and details of smaller dams, dikes, diversions, reclaim water facilities, and other facility and utility lines including pipelines, roads, and railroads.

Following acceptance and agreement by the MNDNR of the preliminary report, a final design report along with plans and specifications must be submitted for approval. The final design report includes more detail than was required for the preliminary report. Typical information required includes, but is not limited to, geologic considerations, hydrologic studies, geotechnical information, considerations of construction materials and their properties, analytical determinations, analytical and design details of facilities, operations aspects, surveillance and inspection programs and a detailed cost estimate (see Minnesota Rules, part 6115.0410 for more details on required submittal documents).

The plans and specifications are required to include scaled drawings of the structure(s). Information provided with drawings includes general and technical provisions as well as any special conditions. State rules require that a professional engineer registered in the state of Minnesota (or engineers who are employees of the U.S. per Minnesota Statute 3.26.13) who is proficient in dam engineering, prepare the engineering documents, plans, and specifications; inspect the construction; and establish operation and maintenance procedures for the structure(s). Application materials provided by the Diversion Authority would be required to meet this requirement.

In evaluating work in public waters permit applications, it is the reviewer's job to ensure that all appropriate rules and statutes are considered. In the case of water level control related permit applications, the reviewer will also apply rules and statutes related to, but not limited to: filling, excavations, structures, bridges and culverts, drainage, and floodplain development. It should also be noted that Minnesota Rules, part 6115.0220, subpart 5 requires that proposed projects must be consistent with applicable floodplain management standards and ordinances. Minnesota Statute, section 103F.105 states that the policy of this state is to reduce flood damages through floodplain management, stressing nonstructural measures such as floodplain zoning and floodproofing, flood warning practices, and other indemnification programs that reduce public liability and expense for flood damages. Further, the MNDNR contends that a landowner is entitled to have the water or lack of water preserved in its natural state and at its accustomed level, or absence. If the Project would significantly change the water level on the land during Project operation, the owner of the Project should have acquired rights or flowage easements for all properties affected prior to construction of the project.

Many of these permit application requirements would fulfill the needs of the work in public waters permit application. During review of the application, the MNDNR would work with the applicant to identify missing or incomplete information in accordance with Minnesota Rules.

Minnesota Rules, part 4410.3100, subpart 2a. does allow for concurrent review of draft permits prior to completion of environmental review.

3.15.1.1.1 Permit Approval or Denial

The approval or denial of a permit would be based on the potential hazards to health, safety, and welfare of the public and the environment including probable future development of the area downstream or upstream of the dam. For a Class I dam, the MNDNR would need to determine the proposal is adequate and that it shows a “lack of other suitable feasible and practical alternative sites, and economic hardship which would have major adverse effect on population and socioeconomic base of the area affected” (Minnesota Rules, part 6115.0410 subpart 8). The proposal must adequately identify the need in terms of quantifiable benefits; the structural integrity of the dam and associated features under all conditions of construction and operation; discharge and storage capacity of handling the design flood; and compliance with prudent, current environmental practice throughout its existence. Minnesota Rules, part 6115.0220, subpart 5, lists some of the general criteria that must be met for a work in public waters permit to be granted; however it should be noted that other rules or requirements may apply.

Other considerations for permit approval or denial include Minnesota Statutes 2008, section 116D.04 subdivision 6 and Minnesota Statutes 2008, Section 103G.245. Minnesota Statute, Section 116D.04 subdivision 6 reads that a permit cannot be granted where the “…action or permit has caused or is likely to cause pollution, impairment, or destruction of the air, water, land or other natural resources located within the state, so long as there is a feasible and prudent alternative consistent with the reasonable requirements of the public health, safety, and welfare and the state's paramount concern for the protection of its air, water, land and other natural resources from pollution, impairment, or destruction. Economic considerations alone shall not justify such conduct.” In accordance with Minnesota Statutes 2008, section 103G.245, a permit may be issued only if it will involve minimum ecological impacts. However, “if a major change in the resource is justified, then the permit must include provisions to compensate for the detrimental aspects of the change." Examples of provisions, or conditions of the permit, may include construction and operational restrictions, inspection schedules, construction and operational reports, operation and maintenance plans, as well as required mitigation including adaptive management.

The information provided in this EIS and associated environmental review documents serve and must be used as a guide as part of decision-making in issuing, amending, and denying permits and carrying out other responsibilities of governmental units to avoid or minimize adverse environmental effects and to restore and enhance environmental quality (Minnesota Rules, parts 4410.0300 and 4410.7055). As such, in accordance with Minnesota Rule, part 4410.3100, the permit may not be granted (or a project started) until the EIS is determined adequate.

Minnesota Rules, part 4410.2900 states that final decisions on permits must be made within 30 days following the determination of adequacy of a final EIS, on those permits which were identified as permits required in the scoping process and for which information was developed concurrently with the preparation of the EIS. This is also in accordance with Minnesota Executive Order 11-04 which states that "Commissioners (of Natural Resources) shall establish a goal for each of their agencies to decide within 30 days after an environmental impact statement is finally approved, whether to issue the permit." Minnesota Rule, part 4410.2900 does allow the 30-day period to be extended with the consent of the permit applicant, where a longer period is required by federal law or state statute, or where a longer period is permitted by Minnesota Statutes 2008, section 15.99. Pertaining to the Project, the EIS presents the most current Project design; however, as noted within other chapters and sections within the EIS, the Project design has not been finalized. Several studies are underway or would need to be conducted that would be used in refining and further developing the Project design to avoid and minimize Project construction and operation impacts as well as to determine mitigation needs that have yet to be identified. Many of these studies would be required materials for the dam safety permit application that has yet to be submitted. Therefore, in accordance with Minnesota Rules, part 4410.2900 not all information required for permit decision-making has been developed concurrently with the preparation of the EIS. As such, it is an understanding between the Diversion Authority, USACE and MNDNR, as the permitting authority, that the permit decisions may be extended beyond the 30-day time period as allowed by Minnesota Rules, part 4410.2900 following an adequacy determination.

3.15.2 Affected Environment

Three large rivers converge in the project area, the Red River, the Wild Rice River, and the Sheyenne River. Tributaries that feed into these systems include the Maple River, Wolverton Creek, the Lower Rush River, and the Rush River. There are no Class I dams currently within or near the project area; however, there are smaller impoundments (dams and their reservoirs) located on other portions of these rivers, including the Drayton and Hickson dams on the Red River, three smaller dams within the F-M urban area on the Red River, and the Wild Rice Dam on the Wild Rice River.

Large portions of the project area are used for agricultural purposes and include systems related to agricultural activities such as drainage tiles and ditches. The F-M urban area includes the cities of Fargo and Moorhead, as well as neighboring suburbs, lies in the middle of the project area and downstream of the convergence of the Red and the Wild Rice Rivers. The proposed Class I dam would be located upstream of the F-M urban area. The Sheyenne River converges with the Red River further downstream of the F-M urban area (i.e., Benefited Area).

3.15.3 Environmental Consequences

The Project must be designed to provide the appropriate measures and factors of safety to meet the requirements of the MNDNR dam safety state rules (supplementary and complementary to requirements of the work in public waters state rules). Failure of the embankments, control structures or its components due to inadequate design, improper operation, inadequate maintenance, or unusually larger flood events that exceed the design capacity could allow flood water into the protected area, north of the dam. The effects of failure could be catastrophic, causing loss of life and significant property damages, depending on the magnitude and timing of the flood increases. The MNDNR combined permit application review and decision process helps provide assurances and safeguards from these types of impacts from occurring.

3.15.3.1 Proposed Project

The current alignment and design considerations for the Project are described in Chapter 2 and shown in Illustrations 2.1 and 2.2, and Figure 2. The embankment system and control features together are considered a Class I dam under Minnesota Rules and would require a dam safety permit from the MNDNR.

Much of the content reviewed and included in the EIS from the FFREIS (2011), the Supplement EA (USACE 2013), the Post Feasibility Southern Alignment Analysis (PFSAA)(HMG, 2012) and other Project studies would help fulfill the preliminary report submittal requirements for the dam safety permit application (combined with a work in public waters permit – i.e., MNDNR combined permit) (as detailed above). However, many of these studies were conducted to meet the intent of a feasibility-level study and provide preliminary design and cost estimates; and therefore, they were based on earlier design concepts that may not be applicable to current or future Project designs.

Additional and updated studies would be required to satisfy the necessary requirements for the MNDNR combined permit. This includes development of a complete OMRR&R Manual that would be completed once Project designs are finalized (note a Draft Operating Plan has been included with the EIS as Appendix A). The Diversion Authority has ongoing coordination with MNDNR permitting staff to determine what is needed in the permit application as well as discussions that would determine how the permit application process and permit decision would be applied to this Project.

The components evaluated to-date by the Diversion Authority and or the USACE includes the river control structures and some of the embankment system. The permit application received included the following information:

- Risk of Failure – Loss of Life (*Excerpts of:* FFREIS – Appendix D, Attachment 1 and 2, FFREIS 2011);
- Project component maps, plans, and illustrations (various resources);
- Maps of project area features (e.g., historical properties, transportation, utilities, and survey locations) (various resources);
- Geotechnical Assessments: physiography, topography, geology, structure, site hydrogeology, and seismic risk and earthquake history analysis (*Excerpts of:* FFREIS - Appendix I – Geotechnical Design and Geology, FFREIS 2011; PFSAA Report, HMG, 2012);

- Hydrology and hydraulic modeling (EIS);
- Preliminary Cost Estimate (PFSAA Report, HMG, 2012);
- Operation Plan (USACE, 2014c);
- Discussions on various mitigation, monitoring, and other Project plans);
- Socioeconomics information (*Excerpts of:* FFREIS 2011; HMG, 2015); and
- Environmental review documents (FFREIS 2011; Supplemental EA 2013; MNDNR EIS – in-progress)

3.15.3.1.1 Dam Safety Permit – Health, Safety, and Welfare

The most fundamental permit requirements focus on public safety. That is because the purpose of the Program is to safeguard against risk of failure and to ensure that dams are safe. It should be clarified that "risk" is the probability of failure times the consequences of failure.

Unlike environmental review, the dam safety permit application process does not typically include a public review component nor does it necessarily involve or include access to all decision makers. A public hearing on this permit application could occur, through the hearing is typically waived per Minnesota Statute, section 103G3.11, subdivision 4. For projects that require an environmental review, such as this one, the environmental review process offers an opportunity for the public and other interested parties to participate through public review and comment periods. Therefore, the focus of the remainder of this section will be on disclosing what is known in regard to public safety and the consequences of a dam failure.

The FFREIS discusses the risks associated with structure failure in Attachments 1 and 2 of Appendix D (USACE 2011). The results of these analyses provide an idea of what loss of life (LOL) consequences could occur as a result of structure (e.g., levee, dam) failure under existing conditions and Project conditions; but it is important to note that they were not based on current designs or hydrology models and that they should not necessarily be compared to each other as methods and flood scenarios differed between the analyses.

Attachment 1 estimates LOL under existing conditions due to levee overtopping or a levee breach in the F-M urban area under the anticipated and unanticipated scenarios for the 10-percent chance flood (10-year flood), 5-percent chance flood (20-year flood), 2-percent chance flood (50-year flood), 1-percent chance flood (100-year flood), 0.5-percent chance flood (200-year flood), and 0.2-percent chance flood (500-year flood). Anticipated scenarios mean that a potential failure is known and there is time to issue a public evacuation notice to 100 percent of the population. Unanticipated scenarios are ones in which there is no advance warning. The breach is assumed to occur at peak flood level. Existing conditions LOL estimates are included to provide a baseline for Project LOL estimates.

Table 3.61 shows the estimated LOL for each flood event under existing conditions with two assumptions. The first assumption is an anticipated failure in which an estimated 98 percent of the population would be evacuated, and the second assumption is an unanticipated failure with zero percent evacuation. Worst case results are presented (i.e., upper extremes). The LOL analysis for existing conditions estimates LOL for the 100-year flood with zero percent evacuation to be 200 lives. The 500-year LOL estimate for zero percent evacuation is 594 lives.

Table 3.61 Estimated Maximum Loss of Life in the Benefited Area - Existing Conditions Due to Levee Overtopping or a Levee Failure [1]

Flood Event	Population At Risk[1]	Existing Conditions (Base No Action Alt.)[2] Anticipated 98% Evacuated	Existing Conditions (Base No Action Alt.)[2] Unanticipated 0% Evacuated
10-year	858	1	32
20-year	1,501	1	54
50-year	2,177	2	90
100-year	18,050	4	200
200-year	64,670	8	394
500-year	133,403	12	594

Source: FFREIS – Appendix D, Attachment 1, USACE 2011

[1]Population was estimated by determining which structures would be impacted during an individual flood event (flood depth grids). Population associated with each structure was calculated as the total metro population (202,684 people) divided by the number of structures.

[2] "Existing conditions" for the purposes of the EIS is considered similar to the Base No Action Alternative.

Attachment 2 in Appendix D of the FFREIS is a draft report that provides preliminary results for a LOL analysis under Project conditions with a levee breach scenario. At the time of the draft report, the Locally Preferred Plan (LPP) was different than the plan presented in the Supplemental EA (USACE 2013c), but the results present an idea of the risk reduction as it relates to LOL. (Note: The LPP, as evaluated in the FFREIS, was later modified for evaluation in the Supplemental EA Federally Recommended Plan, the embankment use for this analysis was for Storage Area 1 – a feature that is not included in current Project plans). The results presented in the draft report evaluate LOL under a night scenario and a day scenario. Scenarios were run for the 10-, 100-, and 500 x 2-year flood events (a 500-year flood peak times two). The worst-case scenarios (i.e., upper extreme numbers during the day) are included in Table 3.62 below. The worst consequences of LOL occur during an Unanticipated Event in which it was estimated that the LOL for a 100-year flood event would result in 31 lives. As expected, a 500 x2-year flood has the highest LOL; however, that scenario is unlikely to occur and was included as a way to measure what an extreme worst-case scenario LOL would be. An existing conditions analysis using the same data and methods was being completed as part of this study; however, results were not finalized and published as Project design changes occurred.

Table 3.62 Estimated Maximum Loss of Life in the Benefited Area – Project Condition Due to a Levee Breach of the Storage Area

Flood Event	Population At Risk[2]	Project Conditions[1]
10-year Breach	863	0
100-year Breach	18,976	31
500x2 year (No Breach)	20,877	9
500x2 Breach	74,694	350

Source: FFREIS – Appendix D, Attachments 1 and 2, USACE 2011

[1] "Project conditions" for the purposes of the EIS is considered to be similar to the Project; however, this was based on a previous design and Project feature (Locally Preferred Plan / Storage Area 1) that has changed since the FFREIS.

[2] Population was estimated by determining which structures would be impacted during an individual flood event (flood depth grids). Population associated with each structure was calculated as the total metro population (202,684 people) divided by the number of structures.

These results provide valuable insight to what the consequences of a dam failure may be to human safety under existing and Project conditions. However, a dam breach analysis that considers current (or final design plans and flood scenarios/updated hydrology) would be necessary to meet permit requirements. The dam breach analysis would model a hypothetical breach of the tieback embankment or one of the gates during flooding conditions to find out how high the water would rise in the river downstream of the dam – similar to the LOL analysis completed and provided with the FFREIS. A map would need to be developed that would show the affected area and current and future projected populations that may be impacted by a dam breach which would be used in the development of an emergency action plan and for consideration in future land use development planning. Further details would be coordinated between the USACE, Diversion Authority, and MNDNR during the permitting process.

3.15.3.2 Base No Action Alternative

Under the Base No Action, flooding would continue in the project area. A Class I dam on the Red River and Wild Rice River would not be constructed. Potential flood risk reduction from the Project would not be realized. Loss of life under existing conditions for the 100-year flood with a 98 percent anticipated failure and evacuation would be four. Under a zero percent evacuation the loss of life is estimated to be 200 lives (FFREIS – Appendix D - Attachment 1, FFREIS 2011).

3.15.3.3 No Action Alternative (with Emergency Measures)

Conditions under the No Action Alternative (with Emergency Measures) would be similar to the Base No Action Alternative as no high-hazard dam would be constructed. Differences include sandbagging and temporary levees being installed along the Red River through the F-M urban area. Sandbagging and temporary levees, although providing some level of protection from flood waters, may increase the risk to human health and safety due to the increased likelihood of failure of emergency measures. These efforts would also result in higher flood stages through Fargo/Moorhead and in upstream areas and loss of life associated with an unanticipated failure would likely be higher than what was estimated for the Base No Action Alternative under unanticipated failure scenarios.

3.15.3.4 Northern Alignment Alternative

In general, the NAA design, construction, and operation would be similar to those proposed for the Project, including the construction of an embankment system and control structures. Therefore, the NAA would require a MNDNR dam safety permit.

NAA components and operation differences from the Project include the following:

- Tieback embankment and control structures locations. NAA structures would be located approximately 1.5 miles north of the Project tieback embankment and control structure locations (Figure 7). The Red and Wild Rice River control structures would be constructed adjacent to the Red River in Kurtz Township (Clay County, MN) and Wild Rice River in Stanley Township (Cass County, ND). The control structures would be constructed adjacent to the existing channels in order to keep the sites dry during construction.
- Upstream staging elevation operation. A maximum stage of 35.0 feet would be maintained at the Fargo gage until the upstream staging elevation would reach 919.3 feet, which is anticipated to occur with the 100-year flood.

NAA components would generally be designed the same as Project components (Chapter 2). Some of the submitted application materials, as described above under subsection 3.15.3.1, may still be applicable and used in part to meet permit requirements; however, a more thorough review would be necessary with a focus on the NAA and feature locations. As with the Project, it is likely that these studies would require updating or that additional studies may be necessary in order to meet the requirements for the MNDNR combined permit. The MNDNR has already received a permit application for the Project. However, if the Project were to change or become the NAA, the applicant would be required to either withdraw the application on file or would need to provide the MNDNR with the updated or additional information necessary for processing.

As the design, construction, and operation is generally the same for the NAA as it is for the Project, the LOL analysis discussed above under the Project provides an idea of what risk the NAA dam would have to human health and safety in the event of failure. However, the staging depth and the range of embankment heights are not identical for the Project and NAA. A dam breach analysis would need to be completed that would include detailed and current design plans to meet MNDNR combined permit requirements as discussed above under subsection 3.15.3.1.1.

3.15.4 Proposed Mitigation and Monitoring Measures

Proposed mitigation and monitoring recommendations are detailed within Chapters 3, 5, and 6; and Appendices B and O of this EIS. Appendix O – Takings, Flowage Easements, and Acquisition Processes provides additional details on proposed mitigation processes, and identifies opportunities and recommendations to support complete mitigation strategies. Mitigation and monitoring plans would need to be included as part of the dam safety permit application; specifically, those that are directly associated with the dam construction and operation, such as restoration activities or aquatic habitat improvements. The dam safety permit may also require – through permit conditions - additional mitigation above and beyond that which is proposed or may require plans already in place to address impacts that may occur, such as the Draft AMMP included with this EIS.

As stated above, a permit application was received by the MNDNR on February 18, 2016. Information presented within this EIS and associated environmental review documents was included with that submittal and will continue to be used as a guide as part of the decision process, along with any other addition documents or details necessary by MNDNR permitting staff. The permit application is currently undergoing a review, which includes a thorough review by MNDNR staff and other technical agencies, local government, or organization staff as deemed necessary. Additional discussions would occur between the USACE, Diversion Authority, their representatives, and MNDNR permitting staff to assess the dam safety permit requirements specific to this Project. As discussed above, a permit decision cannot be made until the EIS is deemed adequate (Minnesota Rules, part 4410.3100, subpart 1).

3.16 SOCIOECONOMICS

Socioeconomics is an evaluation of how economic activity can affect the social or human and community well-being and how those social or human aspects can also affect the economic or financial status and livelihood of a given area, such as a defined project area. There are many factors that can influence socioeconomics. Depending on which of those factors is affected, and to what extent, could result in various changes to the social and economic condition of the project area. Some of the factors potentially influencing socioeconomics as a result of the Project would include economic growth, health and safety, impacts to communities from relocation of its residents, and economic costs, including lost income or reduced property values.

The discussion provided within this section satisfies Minnesota Rules, part 4410.2300, item H that states that the EIS should include (for Project and each major alternative) "a thorough but succinct discussion of potentially significant adverse or beneficial effects generated in the areas of environmental, economic, employment, and socioeconomic impacts, whether they be direct, indirect, or cumulative." The rule further states that the "data and analyses shall be commensurate with the importance of the impact and the relevance of the information to a reasoned choice among alternatives and to the consideration of the need for mitigation measures."

This section also addresses public comments received during the SEAW and Draft EIS public comment period regarding the socioeconomic effects of the Project. This includes a quantitative and qualitative evaluation of the social and economic effects of reducing flood risk within the F-M urban area (i.e., the Benefited Area) while increasing flood impacts in the surrounding rural areas south of the tieback embankment (i.e., the Unbenefited Area); and reviews the flood damages/fighting, development, and social outputs of North Dakota and Minnesota.

The USACE completed an extensive economic and social analysis as part of the FFREIS in 2011 using a number of models, data inputs, observations and studies for the Project and its alternatives under consideration at that time (FFREIS Appendices C—"Economics" and D—"Other Social Effects"). Factors related to the human impacts of the Project and alternatives were considered by the USACE as Other Social Effects (OSE). The USACE study area extended along the Red River, between Abercrombie, North Dakota, and the Canadian border and included portions of 12 counties in North Dakota and Minnesota. Major socioeconomic characteristics and trends, including demographics and economics were evaluated in order to provide a context from which to assess impacts of the Project (referred to as the LPP in the FFREIS and associated documents) and alternatives. Cost-benefit ratios were included as part of that analysis due to the dual intent of that document (i.e., as a feasibility report as well as an EIS) as the USACE uses Residual Risk, benefit cost ratios, and net benefits for the purpose of selecting the most appropriate alternative. OSE were considered when determining which alternative provided the highest social benefit. With the exception of the Project, the alternatives included within those studies are not considered in this EIS.

The socioeconomic analysis completed for this EIS uses new and updated H and H modeling information; a different no action alternative (or baseline) for the analysis; updated Project designs and Project modifications; analysis of the NAA; additional supplemental resources (e.g., organic farms inventory and the MNDNR structure count analysis) as well as regional and local information. Most of the information presented and discussed within this section is focused on the F-M urban area and the rural areas located south of the tieback embankment within and adjacent to the staging area, as those are the areas that would be affected most by the Project. Because many of the models, data inputs, and studies used for the FFREIS are different from those used for the socioeconomic analysis in this EIS, a side-by-side comparison of the two analyses is not included in this discussion. However, these resources have been used to the extent that they are relevant and applicable to this discussion.

Primarily, the socioeconomic analysis completed for this EIS included review of:

- FFREIS, including Appendices C—“Economics”, D—“Other Social Effects”, G—“Real Estate”, and U—“Summarized Comments and Corps Responses” (2011),
- Supplemental EA (2013),
- Draft Ag Policy Group Mitigation Plan (2015) (Appendix J),
- *Final Technical Report: Fargo-Moorhead Area Diversion Project Socio Economics Technical Report In Support of Minnesota EIS* (HMG, 2015a) (SE Report) (Appendix I),
- *North Dakota State University (NDSU) Initial Assessment of the Agricultural Risk of Temporary Storage for FM Diversion (*NDSU, 2015),
- *Final Technical Memorandum: Opinion of Probable Construction Cost of Support MN/DNR Northern Alignment Evaluation* (HMG, 2015b) (SE Report-Appendix A), and
- *Technical Memorandum: Organic Farms Inventory* (Wenck, 2015) (Appendix K).

This subsection follows a similar format as other sections within Chapter 3. Current economic conditions are discussed to provide a base from which to consider potential Project and alternatives impacts. Details regarding the models and methodologies used for the quantitative and qualitative evaluations are included to provide context to the data and discussions provided within the tables and text. Estimated Project construction, operation and maintenance costs have been included to provide context for the overall Project and its potential economic impact on the project area. Potential socioeconomic impacts are discussed quantitatively where feasible, and qualitatively to evaluate the Project and its alternatives potential effects on public services, structures, structure function, flood insurance, effects of relocations, and agriculture.

3.16.1 Affected Environment

According to the Greater Fargo Moorhead Economic Development Corporation:

> *“Fargo Moorhead is a metropolitan area with a vibrant population of roughly 224,000 and almost 30,000 college students. The Fargo Moorhead community is known for steady growth, a highly- trained workforce, business friendly environment, outstanding quality of life and reasonable costs of living and doing business.”*[2]

Also according to the Greater Fargo Moorhead Economic Development Corporation website, the F-M urban area has been ranked as #1 in Forbes Best Small Places for Business and Careers, July 2014; as one of the “10 Best Cities for Finding a Job” by U.S. News & World Report, January 2012; ranked fifth as one of “America’s Best Places to Live” by Moving.com; and ranked third in the Eight Annual Farmers

[2] Greater Fargo Moorhead Economic Development Corporation, http://gfmedc.com/ accessed 2/3/2015

Insurance Study for the "Most Secure Places to Live in the U.S." (December, 2011). The F-M urban area serves as the regional center for healthcare, education, government, and commerce.

Flooding poses a considerable risk of damage to urban and rural infrastructure; disruptions to transportation corridors; and damages to businesses and homes. According to the OSE study completed by the USACE (FFREIS Appendix D), the threat of catastrophic flooding and the frequency and magnitude of recent floods results in high stress levels, which takes a toll on both mental and physical well-being of the residents and business owners within the F-M area. In recent history, the two flooding events that have had the greatest physical and emotional effect on the communities of Fargo and Moorhead are the 1997 and 2009 flood events.

3.16.1.1 Socioeconomic Conditions

The following presents an overview of the major socioeconomic trends for the four counties that comprise the project area: Cass and Richland County, North Dakota; and Clay and Wilkin County, Minnesota. Included in the analysis for context are the state and national averages. Major socioeconomic trends reviewed include: demographics, employment and income, housing, and fiscal resources. Information from a variety of references and sources were used in the socioeconomic analysis, including data through approximately 2012 as the most recent publicly available data. Primary data sources for the analysis include: 1980, 1990, 2000, and 2010 census data; American Community Survey; Bureau of Labor Statistics; Bureau of Economic Analysis. The Base No Action Alternative serves as the baseline for existing conditions for this socioeconomic conditions analysis. Data was compiled as part of the Socioeconomic (SE) Report completed for this EIS, which was reviewed by Michael Baker Jr., Incorporated for consistency with USACE and industry standards.

3.16.1.2 Population

The 2010 census reports the population of the four counties that consist of the project area at 231,674 (Table 3.63). Clay and Cass counties account for approximately 209,000 or about 90 percent of this population. Cass County has demonstrated historically high average growth from 1980 to 2010 with the average consistently above the state and national averages. Cass County growth has been centered on Fargo. County and Moorhead have not had the same high growth until the more recent period of 2000 to 2010. Conversely, Wilkin and Richland Counties have experienced consistent decline over the same periods.

Table 3.63 Historical Population Trends: National, State, County, and City

Location	1980	1990	Percent Change 1980-1990	2000	Percent Change 1990-2000	2010	Percent Change 2000-2010
United States	231,103,121	253,498,149	9.7%	281,421,906	11.0%	308,745,538	9.7%
Minnesota	4,075,970	4,375,099	7.3%	4,919,479	12.4%	5,303,925	7.8%
Clay County, MN	49,327	50,422	2.2%	51,229	1.6%	58,999	15.2%
Moorhead, MN	29,998	32,295	7.7%	32,177	-0.4%	38,065	18.3%
Wilkin County, MN	8,454	7,516	-11.1%	7,138	-5.0%	6,576	-7.9%
North Dakota	652,717	638,800	-2.1%	642,200	0.5%	672,591	4.7%
Cass County, ND	88,247	102,874	16.6%	123,138	19.7%	149,778	21.6%
Fargo, ND	61,383	74,111	20.7%	90,599	22.2%	105,549	16.5%
Richland County, ND	19,207	18,148	-5.5%	17,998	-0.8%	16,321	-9.3%
County Totals	165,235	178,960	8.3%	199,503	11.5%	231,674	16.1%

Source: U.S. Census Bureau, American Fact Finder.
Note: 1980 and 1990 data for each location obtained from Decennial Census, U.S. Census Bureau

The cities of Fargo and Moorhead account for approximately two-thirds of the population in the four-county study area. The remaining 88,000 persons reside outside of the two cities (44,000 in Cass County; 21,000 in Clay County; 16,000 Richland County; and 6,600 Wilkin County).

3.16.1.3 Educational Attainment

Approximately 43 percent of the population 18 years of age and over within the four counties have some college or an associate's degree according to the Census Bureau (Table 3.64). The F-M urban area and greater Cass and Clay counties have a lower incidence of population without a high school diploma or equivalent than the national and respective state averages (5-6 percent).

Table 3.64 Highest Educational Attainment 2010-2012

Location	Population 18 and Over	Less than High School graduate	High School graduate (includes equivalency)	Some college or associate's degree	Bachelor's degree or higher
United States	237,706,206	14%	28%	31%	26%
Minnesota	4,067,888	8%	27%	35%	30%
Clay County, MN	45,972	6%	29%	41%	25%
Moorhead, MN	30,818	6%	25%	44%	26%
Wilkin County, MN	4,985	11%	29%	44%	15%
North Dakota	534,217	9%	27%	40%	25%
Cass County, ND	119,948	5%	20%	42%	33%
Fargo, ND	87,205	6%	19%	42%	33%
Richland County, ND	12,813	10%	27%	46%	18%

Source: U.S. Census Bureau, American Fact Finder.

3.16.1.4 Housing

There are two measures of housing relevant to flood risk; first total housing provides an estimate of the stock of residential buildings in the four-county area. The second measure is the number of available housing units, which indicates the relative availability of housing for residents to use for temporary relocations during flooding or for permanent relocations due to project construction. As Table 3.65 shows, the majority of the total housing units are located in Cass and Clay counties within the F-M urban area.

Table 3.65 Total Housing Units

Location	2000	2010	2000-2010 Percent Change
Minnesota	2,065,946	2,347,201	14%
Clay County, MN	19,476	23,959	23%
Wilkin County, MN	3,105	3,078	-1%
Moorhead, MN	12,180	15,274	25%
North Dakota	289,677	317,498	10%
Cass County, ND	53,790	67,938	26%
Richland County, ND	7,575	7,503	-1%
Fargo, ND	41,200	49,956	21%

Source: U.S. Census Bureau, American Fact Finder

Available housing has been on the rise in both Cass and Clay counties, including the cities of Fargo and Moorhead, outpacing the national and state averages between 2000 and 2010, according to the Census American Fact Finder (Table 3.66).

Table 3.66 Available Housing Units

Location	2000	2010	2000-2010 Percent Change	2010 Median $ Value	2010 Median $ Monthly Rent
United States	10,424,540	14,988,438	44%	$187,500	$850
Minnesota	170,819	259,974	52%	$202,700	$762
Clay County, MN	1,076	1,680	56%	$154,900	$636
Moorhead, MN	520	970	87%	$153,500	$662
Wilkin County, MN	353	388	10%	$102,800	$496
North Dakota	32,525	36,306	12%	$117,200	$567
Cass County, ND	2,475	4,039	63%	$151,300	$611
Fargo, ND	1,932	3,165	64%	$149,400	$606
Richland County, ND	690	852	23%	$93,400	$454

Source: U.S. Census Bureau, American Fact Finder

3.16.1.5 Employment and Income

Employment trends in the four-county area are positive for Minnesota and North Dakota as indicated by the data presented below (Table 3.67). With the exception of Richland County, the counties and Fargo and Moorhead demonstrated positive growth in employment as well as declines in their respective unemployment rates. Additionally, all four counties have unemployment well below the national average.

Table 3.67 Civilian Labor Force Estimates – 2010-2012

Location	Labor Force		Employment		Unemployment		Unemployment Rate (%)	
	2010	2012	2010	2012	2010	2012	2010	2012
United States[1]	153,889	154,975	139,064	142,469	14,825	12,506	9.6	8.1
Minnesota	2,938,795	2,954,950	2,721,194	2,789,861	217,601	165,089	7.4	5.6
Clay County, MN	33,883	35,115	32,009	33,427	1,874	1,688	5.5	4.8
Moorhead, MN	21,967	22,880	20,871	21,906	1,096	974	5	4.3
Wilkin County, MN	3,815	3,783	3,606	3,605	209	178	5.5	4.7
North Dakota	378,342	397,892	364,053	385,718	14,289	12,174	3.8	3.1
Cass County, ND	89,319	89,968	86,177	87,344	3,142	2,624	3.5	2.9
Fargo, ND	62,742	63,019	60,528	61,183	2,215	1,836	3.5	2.9
Richland County, ND	9,068	8,554	8,720	8,242	348	312	3.8	3.6

Source: U.S. Bureau of Labor Statistics, Local Area Unemployment Statistics, http://www.bls.gov/lau, Downloaded April 27, 2015.
[1]Numbers in Thousands

In both Cass and Clay counties and the cities of Fargo and Moorhead, unemployment has remained well below the national average (Table 3.68). Unemployment rose slightly during the recession period from 2008-2010, but has been declining since.

Table 3.68 Unemployment Rate (%): National, State, County, and City (2002-2012)

Location	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
United States	5.8	6.0	5.5	5.1	4.6	4.6	5.8	9.3	9.6	8.9	8.1
Minnesota	4.5	4.9	4.6	4.2	4.1	4.7	5.4	8.0	7.4	6.5	5.6
Clay County, MN	3.6	3.6	3.6	3.5	3.3	3.5	3.7	5.0	4.8	5.1	4.2
Moorhead, MN	3.0	3.1	3.2	3.0	2.8	3.0	3.1	4.2	4.2	4.4	3.7
Wilkin County, MN	3.9	3.9	3.8	3.8	3.8	3.9	4.4	5.6	4.8	4.8	4.1
North Dakota	3.5	3.6	3.5	3.4	3.2	3.1	3.1	4.1	3.8	3.4	3.0
Cass County, ND	2.7	2.9	2.7	2.7	2.5	2.6	2.7	4.1	3.8	3.5	3.3
Fargo, ND	2.8	3.0	2.8	2.7	2.5	2.6	2.7	4.2	3.8	3.5	3.2
Richland County, ND	3.4	3.6	3.4	3.4	3.4	3.3	3.8	5.1	4.1	4.0	3.7

Source: U.S. Bureau of Labor Statistics, Local Area Unemployment Statistics, http://www.bls.gov/lau, Downloaded March 12, 2014.

Per capita income is a measure of income that is typically used to compare the prosperity of the population of an area. Table 3.69 presents an overview of per capita income for the four-county area, Minnesota, North Dakota, and the United States. With the exception of Clay County, per capita income in Cass, Wilkin, and Richland counties exceed the national average and are growing much faster than the nation. The per capita income in Richland and Wilkin counties is growing faster than Clay and Cass counties. In general, per capita income in North Dakota is growing at a faster rate than Minnesota.

Table 3.69 Per Capita Income

Location	2007	2008	2009	2010	2011	2012	2007-2012 Percent Change
United States	$39,804	$40,873	$39,357	$40,163	$42,298	$43,735	9.9%
Minnesota	$41,588	$43,068	$41,202	$42,616	$45,135	$46,925	12.8%
Clay County, MN	$31,842	$34,083	$33,219	$34,563	$36,595	$38,549	21.1%
Wilkin County, MN	$33,858	$41,661	$35,612	$41,699	$43,529	$52,343	54.6%
North Dakota	$36,127	$40,880	$40,005	$43,232	$47,218	$54,871	51.9%
Cass County, ND	$38,387	$42,336	$40,888	$42,805	$46,311	$49,402	28.7%
Richland County, ND	$32,321	$39,512	$34,369	$41,042	$43,727	$53,553	65.6%

Source: U.S. Bureau of Economic Analysis, National, State, and Regional Data
Note: Data for Fargo and Moorhead collected at the Metropolitan Statistical Area (MSA) level.

Another measure of wealth is median household income as reported by the Census Bureau (Table 3.70). The median household income in the four-county area is below the national average between 2000 and 2010. However, during the two periods the median household income demonstrated strong growth with increases between 19 and 34 percent (U.S. average 19 percent, Minnesota 18 percent, and North Dakota 41 percent).

Table 3.70 Median Household Income (2000 & 2010)

Location	Median Household Income	
	2000	2010
United States	$41,994	$50,046
Minnesota	$47,111	$55,422
Clay County, MN	$37,889	$48,395
Moorhead, MN	$34,781	$44,683
Wilkin County, MN	$38,093	$48,611
North Dakota	$34,604	$48,878
Cass County, ND	$38,147	$50,932
Fargo, ND	$35,510	$42,144
Richland County, ND	$36,098	$48,821

Source: U.S. Census Bureau, Small Area Estimates Branch, Internet
Release Date: November 2011

The industry breakdown for earnings by place of work is shown below in Table 3.71. Earnings by place of work indicate that in Clay County, Agriculture and Government Services are the largest sectors by income even though they are not the highest for number employed. In Cass County, Government is also a source of high earnings for the study area along with Health Care, Wholesale Trade, Manufacturing, and Construction. In Richland County, Agriculture, Manufacturing, and Government Services are the largest sectors by income. In Wilkin County, Agriculture is by far the largest sector of employment by income.

Table 3.71 Components of Personal Income, in Millions of Dollars (2012)[1 2]

2012 North American Industry Classification System Industry	United States	Minnesota	Clay County, MN	Wilkin County, MN	North Dakota	Cass County, ND	Richland County, MN	F-M urban area
Total earnings (by place of work)	9,821,404.0	190,045.9	1,121.4	204.9	31,093.4	6,918.1	656.5	8,039.5
Farming	99,786.0	7,143.3	149.2	93.2	4,306.6	338.4	254.2	487.6
Forestry, fishing, and related activities	27,819.0	457.3	(D)	(D)	120.8	(D)	(D)	(D)
Mining	168,326.0	901.4	(D)	(D)	2,790.9	(D)	(D)	(D)
Utilities	79,326.0	1,660.3	(D)	(D)	420.6	16.9	(D)	16.9 (E)
Construction	517,367.0	8,954.4	61.5	3.5	2,541.0	500.5	33.4	562.0
Manufacturing	972,055.0	24,415.6	66.9	0.5	1,504.9	570.9	112.4	637.8
Wholesale trade	502,780.0	12,163.5	72.4	15.9	2,053.5	583.7	28.9	656.1
Retail trade	586,086.0	9,902.9	79.6	5.4	1,709.4	470.8	23.5	550.4
Transportation and warehousing	332,747.0	5,824.0	(D)	(D)	1,835.8	251.1	(D)	(D)
Information	313,717.0	4,990.3	8.4	(D)	485.9	275.8	3.4	284.2
Finance and insurance	690,829.0	16,065.9	24.4	(D)	1,151.9	515.4	9.7	539.7
Real estate and rental and leasing	181,390.0	3,244.0	6.8	(D)	616.8	260.5	2.9	267.3
Professional, scientific, and technical services	974,178.0	14,915.3	34.3	1.3	1,226.9	445.8	13.7	480.1
Management of companies and enterprises	257,268.0	9,780.2	28.6	0.0	398.0	218.5	(D)	247.1
Administrative and waste management services	392,535.0	5,830.9	11.2	(D)	558.2	207.3	(D)	218.6
Educational services	164,466.0	2,752.9	(D)	0.9	119.6	24.5	(D)	(D)
Health care and social assistance	1,075,222.0	23,163.1	(D)	21.7	2,977.4	933.6	(D)	933.6 (E)
Arts, entertainment, and recreation	105,335.0	1927.7	4.1	0.1	89.6	31.7	0.8	35.8

2012 North American Industry Classification System Industry	United States	Minnesota	Clay County, MN	Wilkin County, MN	North Dakota	Cass County, ND	Richland County, MN	F-M urban area
Accommodation and food services	306,546.0	4,469.9	30.1	2.0	737.9	210.2	6.8	240.3
Other services, except public administration	355,6850.0	6,187.9	48.1	15.6	823.9	198.2	12.7	246.3
Government and government enterprises	1,717,941.0	25,166.7	244.2	20.3	4,623.8	850.4	93.8	1,094.6

Source: U.S. Bureau of Economic Analysis

[1](D) – Data subject to non-disclosure but the estimates for these items are included in total.

[2](E) – The estimate shown here constitutes the major portion of the true estimate.

3.16.2 Environmental Consequences

This subsection quantitatively evaluates the costs of the Project (including mitigation) as well as the flood damage reduction benefits arising from operation of the Project and mitigation actions. Quantitative analysis was also completed for the NAA and the Base No Action Alternative. Potential quantitative impacts for the No Action Alternative (with Emergency Measures) were extrapolated from the Base No Action Alternative as applicable.

The quantitative analysis was primarily summarized from the SE Report (Appendix I) prepared for the purposes of this EIS. The SE Report study area included four counties; Cass and Richland Counties; and Clay and Wilkin Counties; and focused primarily on the cities of Fargo and Moorhead, (i.e., the Benefited Area), the areas containing the Project features, and those which would be inundated by Project operation (i.e., part of the Unbenefited Area) (Figure 25).

To supplement the structure data presented in the SE Report, the MNDNR completed an ArcGIS structure count analysis that looked at impacts to residential and non-residential structures under the Project, Base No Action Alternative, and NAA conditions specifically within the Unbenefited Area south of the NAA tieback embankment. The area of analysis included the staging area as well as inundated areas outside of the staging area boundary, regardless of flood depth. The F-M urban area was not included as part of this analysis as the intent was to provide a more exact representation of the number and type of structures that would be impacted within the Unbenefited Area. The analysis also looked at the number of parcels that would be impacted (i.e., contained one or more impacted structures). Structure counts were completed by the MNDNR using geographic information system (GIS) data provided by the USACE. USACE data was derived by interpreting aerial photos to identify and classify structures as either residential or non-residential (2014). USACE data was not field-verified.

The Modeling and Evaluation Approach subsection below provides a summary of the modeling exercises and methodologies used to generate the data for both the SE Report and MNDNR analyses.

As mentioned above, this socioeconomic evaluation also considers social implications anticipated from the Project and alternatives that cannot be quantified by models or statistical analysis which require a qualitative approach to evaluate potential impacts. These social impacts include topics such as flood related-losses for agricultural producers, implications to transportation networks, and community and individual well-being. The primary resources for the qualitative evaluations were the FFREIS Appendix D—"Other Social Effects", the *Technical Memorandum: Organic Farms Inventory* (Wenck 2015), and supplemental discussions that occurred between the MNDNR, USACE, and Diversion Authority during the production of this EIS. A description of the USACE OSE study is included below under Modeling and Evaluation Approach. Organic farms are discussed in more detail under subsection 3.16.2.3.8 and in Appendix K.

3.16.2.1 Modeling and Evaluation Approach

Approaches to the SE Report Analysis, MNDNR structure count analysis, and qualitative discussions are provided in detail below.

3.16.2.2 Socioeconomics Report

Impacts of the Project and alternatives were evaluated using standard flood risk assessment methodologies. Flood risk is considered a function of flood impacts or consequences and the likelihood of those impacts occurring. The likelihood is measured by the return period of a flood. Flood impacts are divided into direct and indirect impacts. Direct impacts describe harm that results from the immediate physical contact of water to people, infrastructure, and the environment. Examples include damages to buildings, building contents and other assets. Indirect impacts are those caused by the disruption of the physical and economic links in the region as well as the costs associated with the emergency response to a flood. For example, businesses losses because of interruption of normal activities, or costs associated with traffic disruption when roads are impassable. Furthermore, the effect of a flood on the environment, human or community well-being, or the loss of life are difficult to quantify, and are therefore considered to be intangible impacts, whereas, the tangible dollar losses from a damaged building or ruined inventory in a warehouse are more easily calculated. The flood risk analysis was carried out using a combination of economic frameworks, including physical flood damage models and economic impact models.

The physical flood damage model provides measures of direct impacts, which are referred to as impacts to capital stock (buildings, contents, and vehicles). The results of the physical flood damage models were used to estimate indirect effects, which are referred to as the loss of building function. Impacts to loss of building function may include costs associated with relocating businesses and residents to temporary facilities; and losses of income earned from sales (economic output). The economic impacts associated with the flood damage modeling contain a degree of uncertainty which cannot be quantified. The models introduce uncertainty in both the engineering (H and H) and economic modeling. The key sources of uncertainty in the model include:

- Choice of distributions for stream flow and rainfall associated with future hydrologic events;
- Simplification of complex phenomena in hydraulic modeling;
- Estimation of relationships between flood depth and inundation damages; and
- Structural and geotechnical performance of flood measures when subjected to flooding.

Based on this, the flood damage modeling is assumed to provide a mid-point estimate of the impacts within the SE Report study area (Figure 25).

Cost estimates of actions are combined with economic impact models to evaluate the indirect regional benefits to employment and income patterns. Furthermore, the effect of a flood on the environment, human or community well-being, or the loss of life are difficult to quantify, and are therefore considered to be intangible impacts, whereas, the tangible dollar losses from a damaged building or ruined inventory in a warehouse are more easily calculated.

The combined sets of impacts and models used to evaluate the impacts are shown below in Table 3.72. Model frameworks are discussed in more detail in the following SE Report subsections.

Table 3.72 Model Frameworks for Fargo Moorhead SE Report Socioeconomic Analysis

Model	Model Framework	Impacts Evaluated	Model Outputs
Direct Impacts of Flood Risk			
HAZUS	GIS	Impacts to capital stock	Physical Flood Damages, ($'s)
Basement Flooding Model	MS Excel	Impacts to capital stock	Physical Flood Damages, ($'s)
Indirect Impacts of Flood Risk			
Business Loss Model	MS Excel	Direct effects of building function due to flooding	Relocations Costs ($'s) Output Impact ($'s)
Input-Output	Impact Analysis for PLANning Model (IMPLAN)	Secondary effects of building function due to flooding	Economic Output, Employment, Income, Tax Generation
Construction, and Operation and Maintenance Impacts			
Input-Output	IMPLAN	Direct and Secondary effects of project construction	Economic Output, Employment, Income, Tax Generation

Source: HMG, 2015a

3.16.2.2.1 FEMA HAZUS®- MH

The HAZUS model is designed to be a flexible model and comes with prepackaged default datasets. It also includes functionality for the user to add customized area-specific data (both engineering and economic). The model's flexibility allows the user to conduct analysis with multiple levels of detail depending on data format and availability as presented for this analysis in Table 3.73. However, the HAZUS model output is dependent on the detail of the input data. For this analysis, detailed engineering data was available for the entire project area; however, detailed economic data was available for only a portion of the project area. Therefore, two HAZUS analyses were conducted; one for the area which contained the more detailed economic data and the engineering data, and one for the area which contained only the engineering data.

Table 3.73 SE Report HAZUS Modeling Level of Effort

HAZUS Level of Analysis	Data Inputs	Application to the Project	H and H Inputs	Economic Inputs
1	Default hazard inventory and damage information	-	-	-
2	Combinations of local and default hazard, building, and damage data	Outside City Reach (Including inundation areas and diversion channel)	Depth Grids (10-, 25-, 50-, 100-, 500-year)	Used Default Data
3	Input detailed engineering and user supplied structure and damage information	In-Town Reach (Fargo and Moorhead)	Depth Grids (10-, 25-, 50-, 100-, 500-year)	COE Structure Inventory and Depth Damage Functions(DDFs)

Source: HMG, 2015a

Flood depth grids for the 10-percent chance flood (10-year flood), 4-percent chance flood (25-year flood), 2-percent chance flood (50-year flood), 1-percent chance flood (100-year flood), and 0.2 percent chance flood (500-year flood) were prepared for the HAZUS model.

The In-Town Reach of the study area (comprised primarily of Fargo and Moorhead cities as shown in Figure 25) is modeled as a Level 3 analysis. Before using USACE's structure inventory in the HAZUS model, the inventory information was updated from 2009 to 2013 dollars. To adjust to depreciated replacement value, necessary for the damage analysis, adjustment factors developed by the USACE FFREIS Appendix C –"Economics" (FFREIS 2011) for residential and non-residential properties were applied.[3]

The remaining areas, which include the inundation area upstream of the tieback embankment and diversion channel, were evaluated at a Level 2 analysis based on census tract with aggregation to the county level (Figure 25). Using a Level 2 analysis does not provide the same level of accuracy or detail as the Level 3 model. While Level 3 applied detailed inventory and hazard improvements, the Level 2 analysis uses locally produced depth grids with national default inventories. The results are still more exact than what would result from a Level 1 analysis, which uses only national default inventories; however, since some of the input utilizes default, prepackaged datasets, the output is not as exact as that the results presented for the F-M urban area and portions of Cass and Clay Counties and therefore, provides less detail to evaluate the Project and alternatives.

3.16.2.2.2 Microsoft® Excel

A characteristic of the SE Report study area is the potential for basement flooding through sewer backups of sanitary sewer lines. In this condition, homes that may not be flooded directly by flood waters may be indirectly flooded as a result of water backing up through sewer lines. HAZUS is not able to model this aspect due to its reliance on GIS depth grids and lack of inputs

[3] These factors were estimated by the USACE based on a comparison of a sample of assessed values from the structure inventory to estimates of depreciate replacement value from Marshal and Swift cost estimating.

for structure elevation information beyond foundation heights. Thus, a second flood damage model was developed to evaluate this set of damages.

This model was created in Excel with a subset of the structure inventory, the low entry elevations, and depth damage curves from the HAZUS model. To complete the basement flooding analysis, structures needed to be matched with a maximum water surface elevation for the sewer basin. To accomplish this:

1. Flooding depths were assigned at each structure location in ArcGIS. Structures were matched with sewer basins;
2. The maximum water surface elevations were determined for each sewer basin for the 10- to 500-year return periods based on the depth of flooding at each structure in the corresponding basin.
3. The maximum basin water surface elevation was then assigned back to each structure.

Depth damage curves were then applied in the basement flooding analysis following a similar process as HAZUS to estimate structure damages. The results were combined with the HAZUS estimates to give the full value of structure and content damage estimates.

3.16.2.2.3 IMPLAN®

IMPLAN (IMpact Analysis for PLANning) was used to estimate regional economic effects. IMPLAN is a computer-driven system of software and data commonly used to perform economic impact analysis. The data is annually updated using information collected at the national, state, county, and local level.

IMPLAN is based on the principles of input-output (I-O) analysis. I-O analysis represents a means of measuring the flow of commodities and services among industries, institutions, and final consumers within a study area. I-O models capture all monetary market transactions in an economy, accounting for inter-industry linkages and availability of regionally-produced goods and services. The resulting mathematical formulae allow I-O models to simulate or predict the economic impacts of a change in one, or several, economic activities on a study area.

I-O analyses use four main metrics to measure economic impacts – employment, labor income, value added, and industry output, defined as follows:

- Employment is measured by the number of full- and part-time jobs.
- Labor income represents the sum of employee compensation and proprietor income.
- Value added consists of four components –
  - employee compensation,
  - proprietor income,
  - other property income, and
  - indirect business tax.
- Industry output refers to the value of goods and services produced in a region.

3.16.2.2.4 MNDNR ArcGIS Structure and Developed Parcel Analysis

The MNDNR completed an ArcGIS analysis in order to obtain individual structure and/or structure parcel data specifically for the upstream inundation area (i.e., Unbenefited Area) as this is the area that would experience the majority of the negative effects resulting from the Project. The structure analysis was completed to provide a more detailed assessment of impacted structures within the Unbenefited Area. As noted above (Table 3.72), one of the weaknesses of a HAZUS Level 2 analysis is the inability to generate very accurate output as the input is based on census block-level data and supplemented by national default inventories where census block data is not available.

Structure data was obtained from the USACE and included point location and structure type (residential or non-residential) that was completed through a GIS desktop exercise in 2015. Residential structures were defined as structures that were used as living spaces (e.g., apartment complexes, townhomes, and single family homes). Non-residential structures are all other structure types including garages, barns, sheds, pole-sheds, and commercial structures. The inundation areas were modeled for three scenarios (i.e., the Project, the Base No Action Alternative, and the NAA) at five different flooding events—10-, 25-, 50-, 100-, and 500-year floods. Structures were "counted" where a flood impact was observed. Impact was defined for this analysis as a flood level greater than zero measured at the structure location. County parcel data obtained from the respective counties (Clay and Wilkin Counties, Minnesota; and Cass and Richland Counties, North Dakota) were then layered with the USACE structure inventory data and inundation areas modeled for scenario and flood events. The results (discussed in detail in subsection 3.16.2.3.3—Impacts to Structures and Structure Functions) are presented by county, parcel, structure type, flood event, and project scenario.

3.16.2.2.5 Qualitative Discussion Approach

The USACE OSE analysis evaluated alternative plan formulation, and informed the decision-making process for determining an alternative that maximized social benefits. Although the OSE study evaluated different or variations of alternatives not evaluated in this EIS, much of the information gathered for that study is applicable as it provides a basis for current social status as well as potential social outcomes under Project conditions. Relevant information and results from the OSE study have been used for discussion of the Project and alternatives as applicable. The LPP (in the FFREIS), further revised and referred to as the Federally Recommend Plan (FRP) in the Supplemental EA, is comparable to the Project as discussed in this EIS.

The baseline profile in the OSE study was framed around seven social factors used to describe the social structure of a community that included: Health and Safety, Economic Vitality, Social Connectedness, Identity, Social Vulnerability and Resiliency, Participation, and Leisure and Recreation. A set of metrics that were pertinent to each social factor were scored and evaluated to determine the potential impacts on a community as a result of implementing an alternative. The baseline profile in the OSE study represents existing conditions.

This EIS builds upon the OSE study and provides additional qualitative discussion as it relates to the Project and its alternatives. These discussions provide additional context and consideration for potential impacts in the project area, such as impacts to public services and agriculture, effects of relocations, and other social and economic effects. Where applicable and available, quantitative data was included with the qualitative discussion in order to provide a more complete context of the potential for socioeconomic impacts from the Project and its alternatives.

In addition, the social and economic impacts for particular areas of interest have also been discussed for the Project and Project alternatives that include the areas of:

- Minnesota;
- North Dakota;
- The Benefited Area: the F-M urban area and those areas north of the tieback embankment have been described as the area that would benefit most from the construction and operation of the Project; and
- The Unbenefited Area: the area upstream of the tieback embankment that includes the staging area and surrounding inundated areas and that would experience the majority of the negative effects from implementation of the Project.

These geographical extent discussions may include quantitative information as well when applicable.

3.16.2.3 Proposed Project

Economic impacts from the Project were evaluated based on potential to reduce flood damage and flood fighting costs using the previously described methodologies. Floodplains for the 10-, 25-, 50- 100-, and 500-year flood events with the Project in place were developed for analysis using HAZUS as described above. An example of these floodplains (100-year flood) is shown in Figure 25.

Evaluation of potential socioeconomic impacts included review of construction, operation and maintenance costs; impacts on infrastructure and public services; structures and structure function; flood insurance; the effects of relocations; and impacts on agriculture.

3.16.2.3.1 Construction, Operation and Maintenance

The Project is estimated to cost $1.789 billion (2010 price level)[4]. Construction is anticipated to occur over an eight and a half-year period with maintenance occurring every year following construction. Table 3.74 provides a summary of construction costs included for the Project. Note that proposed mitigation costs such as land acquisitions and road relocations are included as part of the construction costs.

Table 3.74 Estimated Project Construction Cost

Construction Component	Project Cost (2010 dollars) [1 2 3 4 5 6 7 8 9 10]
Land Acquisition and Damages (right-of-way and easements)	$283,000,000
Relocations (utility relocations, roadway improvements and construction)	$153,000,000
Fish and Wildlife Facilities	$61,000,000
Railroad Bridges	$59,000,000
Channels and Control Structures	$771,000,000
Levees, Floodwalls, and Embankments	$162,000,000
Recreation Facilities	$29,000,000
Planning, Engineering, and Design	$185,000,000

[4] Flood Diversion Authority, *Final Technical Memorandum, Opinion of Probable Construction Cost to Support MN/DNR EIS Northern Alignment Evaluation*, January 9, 2015.

Construction Component	Project Cost (2010 dollars) [1 2 3 4 5 6 7 8 9 10]
Construction Management[8]	$86,000,000
TOTAL	$1,789,000,000

Source: HMG, 2015b
[1] Costs are rounded to the nearest $1 million.
[2] 2010 U.S. Dollars ($) construction costs; escalation is not included (estimate is not fully funded).
[3] Methodology similar to *Post-Feasibility Southern Alignment Analysis* (USACE 2012) phase except where feature designs differ as stated in this report.
[4] Contingency included. Contingency is an allowance for costs that would be in the Project Cost and are not included in the Contract Cost. Does not account for changed conditions either in the final design or during construction.
[5] Changes to 2010 material, labor, equipment or fuel opinion of cost are not reflected in the project costs presented above.
[6] Limited design work completed (<5%). Based on screening-level project definition. This screening-level (Class 5, <5% design completion per ASTM E 2516-06 and USACE EI 01D010 [9/1/97]) cost estimate is based on screening-level designs, alignments, quantities and unit prices. Costs would change with completion of further design. A construction schedule is not available at this time. The estimated accuracy range for the total project cost as the project is defined is -50% to +100%.
[7] Quantities based on design work completed.
[8] Construction Management is estimated as 7% of construction costs.
[9] Land Acquisition and Damages includes Lands and Damages within the USACE-defined staging area; and Mitigation Area Easements
[10] Land Acquisition and Damages were based on both USACE detailed data and GIS data residential and non-residential data obtained through USACE 2014 desktop analysis.

Economic activity (e.g., employment and income) would increase during Project construction and following construction during annual maintenance activities and during Project operation (Table 3.75). The total impact from construction spending is estimated to be $3.0 billion for the Project and is anticipated to occur over an eight and half-year period.

Table 3.75 Proposed Project Economic Impacts from Construction, Operation and Maintenance ($Millions)

Description	Proposed Project Direct Impact	Proposed Project Total Impact[1]
Total Construction Impacts		
Output	$1,790	$3,021
Employment (in jobs)	11,333	20,744
Labor Income	$778	$1,219
Gross Regional Product	$820	$1,548
Total State and Local Tax	$106	$106
Annual Operations and Maintenance Impacts		
Output	$3	$5
Employment (in jobs)	20	37
Labor Income	$1	$2
Gross Regional Product	$1	$3
Total State and Local Tax	>$1	>$1

Source: HMG, 2015a
[1] Total impact includes the direct impact (i.e., direct economic effects (direct response of an industry)), the indirect effects (changes in output, income, and employment caused by direct impacts), and the induced economic effects (changes in output, income, and employment caused by expenditures associated with new household income generated by direct and indirect economic effects).

The estimated annual Operation and Maintenance (O&M) for the Project is $3 million. It is estimated that the O&M would support an additional $5 million in regional sales activity. The annual O&M output would continue for the life of the Project with the assumption that the estimated impacts would remain similar each year. O&M would generate approximately 20 jobs with average incomes of $70,000 per employee. It is estimated that annual spending, employment, and indirect and induced effects would generate approximately $190,000 in new tax revenues per year following construction.

3.16.2.3.2 Infrastructure and Public Services

The construction and operation of the Project, including ring levees, in-town levees, floodwalls, staging area, and surrounding inundation areas would have impacts on existing infrastructure and public services, such as emergency response services, potentially leading to impacts on socioeconomics in the project area. Section 3.13 provides greater detail on potential impacts to infrastructure and public services. The following provides a summary of impacts that could affect socioeconomics in the region as it relates to transportation, utilities, healthcare facilities, and emergency response.

Transportation Impacts

There would be a number of transportation impacts associated with construction of the Project. These include severed roadways by the diversion channel, roadway alterations, reconstruction, rerouting, and raised roadways to higher elevations to provide access during flooding. Detours and permanent changes of existing traffic patterns may also occur as a result of the Project. Bridges would be constructed approximately every three miles to cross the proposed diversion channel. These bridges would provide access for emergency vehicles, school bus routes, postal workers, and local traffic. Bridges would be constructed prior to excavation of the diversion channel to reduce impacts to traffic. This would limit detour routes created by Project construction to less than four miles with most detours less than two miles. Project construction activity could cause short-term negative impacts on existing community traffic patterns.

Compared to baseline conditions, the Project would decrease inundation in the F-M urban area, which would greatly reduce the need to close highway and railroad bridges and the airport in the Benefited Area. Increased and new inundation caused by Project operation within the Unbenefited Area would result in the modification of traffic patterns in the rural area for local residences and farmsteads. Altered traffic patterns may result in increased volumes on corridors not planned or designed to carry increased loads. However, a number of residences and farmsteads in the Unbenefited Area, specifically within the staging area, would be acquired which would reduce the need to have access to the area.

All existing roads within the staging area boundary would remain in place, allowing access to agricultural land in the staging area. In some locations, farm fields would be bisected by the connecting channel, which could result in “remnant” parcels that are separated from the associated farm operations. Owners of such parcels would be given a purchase offer in accordance with the Uniform Act[5] (additional information regarding acquisitions is located in Appendix O). In cases where ownership of the parcel remains intact, additional transportation time for farm equipment and modifications to parcel access could be necessary. These changes would result in minor impacts to daily traffic patterns.

[5] Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970, P.L. 91-646, as amended, 42 U.S.C §4601, et seq. Portions of this Act deal with the appraisal of real property.

During Project operation, flood inundation would prevent commuting along east-west routes across the inundation area. I-29 (ND), U.S. Highway 75 (MN), and the BNSF Moorhead Subdivision Rail Line running through Comstock, Minnesota, would be raised to provide access so that traffic could continue across the inundation area during Project operation. Egress and ingress from the OHB ring levee would be provided to I-29. The Comstock ring levee would provide egress and ingress via County Road 2 to U.S. Highway 75 or County Road 2 traveling to the east. The County Road 18 Bridge at the Red River would close during Project operation due to flooding, while the County Road 16 Bridge at the Red River would be located within the Benefited Area and experience reduced flooding than what is currently experienced. It is anticipated that transportation routes would temporarily change during Project operation, but that interstate commerce, emergency services, and commuting to the F-M urban area for work, shopping, and medical services would continue.

Rural residents living west and east of the inundation area and outside of the ring levees, normally using I-29 or U.S. Highway 75 to drive to the F-M urban area, Christine, North Dakota; Wolverton, Minnesota; or points south, may be required to use alternate routes. It is anticipated that the alternate routes would not increase travel distances.

Utilities

Project construction and operation would impact an established network of public utilities primarily located in the Unbenefited Areas, such as electric, water, sewer, stormwater, gas, telephone, and internet. Impacts resulting from the construction and operation of the Project may include relocation of utilities and temporary disruption of services. Specific parcels would be identified during final design of the Project and arrangements made for utility relocation or modification. Utilities that cannot withstand occasional flooding in the inundation areas would be abandoned, modified, or relocated, depending on the situation in accordance with applicable regulations. All utilities that would be severed by construction of the Project would be relocated prior to construction to reconnect affected parcels. Individual parcels may experience temporary disruptions in service during reconnection.

A utility relocation plan would be developed once the final Project design is completed, prior to Project construction. A summary of estimated utility relocations costs, based on preliminary design, is provided in Table 3.76.

Table 3.76 Summary of Utility Relocation Costs for the Proposed Project

Utility Relocation	Proposed Project
Electric Power	$9,921,400
Natural Gas Pipeline	$997,600
Petroleum Pipelines	$1,016,000
Fiber Optic Lines	$5,376,400
Water Utilities	$2,313,000
Sanitary Sewer	$369,400
Total Utility Relocation Cost	**$19,993,800**

Source: HMG, 2015a

Health Care Facilities

Major health care facilities in the project area are located in the F-M urban area, and serve local and regional healthcare needs. Facilities are located both in North Dakota and Minnesota.

Under the Project, health care facilities in the F-M urban area would be protected from major flooding. Hospitals would no longer be required to evacuate patients due to large flood events. Residents located within the F-M urban area would be able to readily access general and emergency healthcare.

Residents located in the Unbenefited Areas upstream of the Project may be required to travel further distances to access healthcare. Residents located within the Benefited Areas of the OHB ring levee and Comstock ring levee would have access maintained to I-29 and U.S. Highway 75, respectively, and therefore, the Project is not anticipated to be impact their access to healthcare facilities in the F-M urban area. Other residents located within or near the inundation area would access healthcare facilities in the urban area or other healthcare facilities outside of the project area by using designated detour routes or alternate routes outside of the inundation area. Table 3.77 provides a summary of potentially accessible healthcare facilities in Minnesota and North Dakota, and their estimated approximate distances from Comstock or Oxbow. These communities were chosen to provide a general representation of residences in the rural, inundation area. It is anticipated that the majority of rural residences in the staging area outside of the ring levees could be relocated through mitigation.

Table 3.77 Proposed Project Nearest Healthcare Facilities Outside of Inundation Area (Comstock/ Oxbow)

Healthcare Facility	Distance from Comstock, MN	Distance from Oxbow, ND
Good Samaritan Center Barnesville, MN	15 miles	20 miles
Various Healthcare Facilities F-M urban area	20 miles	20 miles
St. Francis Healthcare Campus Breckenridge, MN	30 miles	40 miles
Lisbon Medical Center Lisbon, ND	60 miles	60 miles

Source: Wenck, 2015

<u>Emergency Services</u>

Emergency response services include law enforcement, fire, and medical services. Law enforcement agencies patrol both the rural and urban areas of the project area in Minnesota and North Dakota. Emergency services are provided during significant flood events and dispatched to calls, as needed, 24 hours per day.

During construction, disruptions to existing roadways caused by the proposed diversion channel and tieback embankment may cause temporary delays in public services, such as emergency response (e.g., police, fire, medical), postal deliveries, and school bus services. However, the Project has the potential to provide long-term benefits to public facilities and services by reducing the potential damage to facilities and disruption in delivery of services during future flood events within the urban area.

The Unbenefited Areas would experience more substantial impacts during Project operation due to flooding and road closures in many rural areas. However, within the staging area boundary, it is anticipated the need for emergency services would be minimal, as there would be few residences remaining in that area. Egress and ingress would be provided and maintained for residents allowed to remain in the staging area (e.g., those within Comstock and OHB ring levees).

Local emergency flood plans may need to be revised based on the Project design. This includes revisions of existing evacuation routes and modification of flood fighting measures and locations. New emergency flood plans may be needed in areas that would potentially experience new inundation. If an evacuation is required, including for residents living within the ring levees, an evacuation notice would be issued. If residents do not evacuate after an evacuation notice, they are accepting some level of responsibility for this risk. However, if needed, emergency services would be provided to assist stranded persons affected by the flood, including those located in the staging area or within a ring levee.

3.16.2.3.3 Impacts to Structures and Structure Function

Impacts to structures considers direct impacts from flood inundation and indirect impacts, such as the cost associated with disruption from flooding, relocation, and business loss, and induced impacts related to income and employment, for example. This section is intended to provide a general estimate of impacted structures and estimate of the cost in damages and mitigation of those structures. Upon final Project design and prior to construction, a detailed analysis would be completed, including field verification where necessary, to determine what structures would be impacted and considered for acquisition, along with the cost of those structures. Acreage impacts would also be considered. The subsections that follow are for informational purposes and are not intended to provide exact structure impact totals. Additional information on mitigation, including the structure acquisition process, is provided in subsection 3.16.3.

The structure counts included in the following analysis originated from several sources. As depicted in Figure 25, the SE Report primarily used structure information that either used USACE detailed data collected during the FFREIS (HAZUS Level 3) or Census data (more generalized) (HAZUS Level 2) as previously described in the Models and Evaluation Approach subsection above. Structure impacts were determined by HAZUS for the 10-, 25-, 50-, 100-, and 500-year flood events. The MNDNR applied an ArcGIS structure count analysis to further refine the structure counts in the inundation area south of the tieback embankment as this area would require the majority of the mitigation for inundation impacts. The MNDNR used GIS data provided by the USACE that was obtained by the USACE through a GIS desktop exercise (2015) by interpreting aerial photographs to identify and classify structures as either residential or non-residential. The MNDNR ArcGIS analysis for the inundation area did not look at cost as this would be determined based on USACE mitigation criteria.

Cost associated with Project construction, including mitigation, was based on methodology used in the FFREIS and 2012 PFSAA. The structure GIS data obtained through the desktop exercise (same as those used in the MNDNR structure count analysis) were used in conjunction with the USACE detailed data for those analyses.

<u>Impacts to Structures</u>

Table 3.78 summarizes the SE Report’s estimated impacts to structures (protected and damaged) expected from Project implementation. The Base No Action Alternative was used as the baseline for the SE Report study and thus is included to represent flood impacts to structures under the existing conditions. Benefits from flood damage reduction to structures

from Project operation begin to occur around the 25-year flood event and incrementally thereafter. The Project is designed to provide protection up to the 100-year flood; however, it continues to provide benefit during greater than 100-year floods.

Approximately 17,486 structures within the SE Report study area under the Base No Action Alternative conditions are impacted by flooding during the 100-year flood. Under Project conditions, the number of structures subject to flooding during the 100-year flood would decrease to 921. Approximately 96 percent of the structures protected under Project conditions would be located within the F-M urban area, the Benefited Area. The majority of structures that would be protected within Cass and Clay Counties, outside of the F-M urban area, (approximately 700) are located north of the tieback embankment within the Benefited Area. Richland County would be expected to have an additional two structures impacted and Wilkin County impacted structures would remain the same at three. These estimates were calculated using the HAZUS Level 2 and Level 3 modeling, which was previously explained in subsection 3.16.2.2.1.

Table 3.78 Structures Impacted by the Proposed Project During the 10-year, 25-year, 50-year, 100-year, and 500-year Floods[1]

Location	10-year Flood	25-year Flood	50-year Flood	100-year Flood	500-year Flood
North Dakota					
Fargo Damaged Structures[2]					
Base No Action Alt.	502	3,473	11,673	15,767	26,060
Proposed Project	481	480	487	490	12,094
Protected Structures	**21**	**2,993**	**11,186**	**15,277**	**13,966**
Remaining Cass County Damaged Structures[3]					
Base No Action Alt.	236	549	723	947	1,368
Proposed Project	198	309	310	320	551
Protected Structures	**38**	**240**	**413**	**627**	**817**
Richland County Damaged Structures[4]					
Base No Action Alt.	0	0	4	18	53
Proposed Project	0	0	4	20	53
Protected Structures	**0**	**0**	**0**	**-2**	**0**
Total Protected (Proposed Project) – North Dakota	**59**	**3,233**	**11,599**	**15,902**	**14,783**
Total Damaged (Proposed Project) – North Dakota	**679**	**789**	**801**	**830**	**12,698**
Minnesota					
Moorhead Damaged Structures[2]					
Base No Action Alt.	9	23	210	616	1,382
Proposed Project	8	10	9	11	382
Protected Structures	**1**	**13**	**201**	**605**	**1,000**
Remaining Clay County Damaged Structures[3]					
Base No Action Alt.	12	66	104	135	230
Proposed Project	12	62	66	77	136
Protected Structures	**0**	**4**	**38**	**58**	**94**

Location	10-year Flood	25-year Flood	50-year Flood	100-year Flood	500-year Flood
Wilkin County Damaged Structures[4]					
Base No Action Alt.	0	1	1	3	37
Proposed Project	0	1	2	3	37
Protected Structures	**0**	**0**	**-1**	**0**	**0**
Total Protected (Proposed Project) – Minnesota	**1**	**17**	**238**	**663**	**1,094**
Total Damaged (Proposed Project) – Minnesota	**20**	**73**	**77**	**91**	**555**
Structures Protected (Proposed Project) within FM urban area[2]	**22**	**3,006**	**11,387**	**15,882**	**14,966**
TOTAL Protected Structures (Proposed Project)[4]	**60**	**3,250**	**11,837**	**16,565**	**15,877**
TOTAL Damaged Structures (Base No Action Alt.)[5]	**759**	**4,112**	**12,715**	**17,486**	**29,130**
TOTAL Damaged Structures (Proposed Project)	**699**	**862**	**878**	**921**	**13,253**

Source: HMG, 2015a

[1]Structure numbers should not be compared to those represented in Table 3.82. Methods and data sources applied were different.

[2]Based on HAZUS level 3 evaluation using COE Hydrologic Engineering Center Flood Damage Reduction Analysis (HEC-FDA) structure inventory

[3]Based on HAZUS level 2 evaluations with HAZUS default county data for remaining portions of Clay and C ass counties not covered by the structure inventory

[4]Based on HAZUS level 2 evaluations with HAZUS default county data for Richland and Wilkin counties

[5]Includes both the level 3 and level 2 analysis results

The following table displays the estimated cost of damages under Project conditions. Costs were estimated for structures, but, also included are estimates for structure content and vehicle damages. The computed average annual damages for the SE Report study area are approximately $9 million (Table 3.79). The majority (78%) of those damages would be to buildings (such as residential, commercial, and industrial properties) and their contents.

Table 3.79 Proposed Project Estimated Residual Damages to Buildings and Contents; and Vehicles ($ Millions)

Return Period	10-year Flood	25-year Flood	50-year Flood	100-year Flood	500-year Flood	Average Annual Damage[1]
Damages - North Dakota						
Fargo						
Buildings and Contents	$25	$41	$44	$48	$801	$7
Vehicles	$9	$11	$11	$11	$46	$1
Total Fargo	$35	$51	$54	$59	$847	$8
Remaining Cass County						
Buildings and Contents	$0	$1	$1	$1	$2	$0
Vehicles	$1	$1	$2	$2	$3	$0
Total Remaining Cass County	$1	$2	$3	$3	$5	$0
Richland County						
Buildings and Contents	$0	$0	$0	$0	$0	$0
Vehicles	$0	$0	$0	$1	$1	$0
Total Richland County	$0	$0	$0	$1	$1	$0
Total North Dakota	$36	$53	$57	$63	$853	$8
Damages – Minnesota						
Moorhead						
Buildings and Contents	$0	$3	$4	$4	$24	$0
Vehicles	$6	$7	$7	$7	$10	$1
Total Moorhead	$7	$10	$11	$12	$34	$1
Remaining Clay County						
Buildings and Contents	$2	$2	$2	$2	$3	$0
Vehicles	$1	$1	$1	$1	$2	$0
Total Remaining Clay County	$3	$3	$3	$3	$5	$0
Wilkin County						
Buildings and Contents	$0	$0	$0	$0	$0	$0
Vehicles	$0	$0	$0	$0	$1	$0
Total Wilkin County	$0	$0	$0	$0	$1	$0
Total Minnesota	$10	$13	$14	$15	$40	$1
Total Damages						
Buildings and Contents	$29	$47	$52	$57	$830	$7
Vehicles	$18	$21	$22	$22	$63	$2
Total	$47	$68	$74	$79	$893	$9

Source: HMG, 2015a

[1] Average Annual Damage represents the average damage that would occur in any given year, spread over the 50 year life cycle of the Project (FFREIS Appendix C “Economics”).

It should be noted that when interpreting the cost of damages provided in Table 3.79, costs are rounded off the nearest $1 million and were calculated using HAZUS Level 2 and 3 analyses as detailed above (Figure 25). Therefore, estimates provided for those within the HAZUS Level 2 areas are, 1) not as precisely represented in terms of building and contents model inputs as those from HAZUS Level 3 areas; and, 2) as those areas have less buildings, contents, and vehicles; rounding to the nearest million may inadvertently misrepresent estimated flood damage costs and average annual damage costs, particularly from a cumulative cost perspective.

Project operation would result in the impoundment of flood waters upstream of the tieback embankment for flood events greater than the 10-year flood and would begin to cause damages to structures within that area if mitigation did not occur. Mitigation would be required for those structures/properties that would be impacted by the impoundment in the form of a property buyout, flowage easement, structure relocation, or other non-structural measure (includes both those structures/properties that are currently flooded and those that would be newly inundated by Project operation) (see subsection 3.16.3 Proposed Mitigation and Monitoring Measures and Appendix O for more details).

The majority of property buyouts that include structures would occur in the staging area and would be for those properties that are impacted by two feet of flooding or greater (those with up to two feet of flooding may be purchased as well depending on site conditions). Property buyouts would also occur for those properties affected directly by the construction of the diversion channel and embankments. Buyouts associated with diversion channel construction are anticipated to be primarily land acquisition using right-of-way and easements. Flowage easements (easements that legally allow temporary flooding of property for Project operation) would be acquired for all inundated land within the staging area. Farmsteads would be given additional consideration (see subsection 3.16.2.3.8 - Agricultural Impacts). Additional information regarding these buyouts and flowage easements are included in Appendix O.

Table 3.80 provides a summary of the estimated cost for land acquisition and damages. As the majority of the land acquisition and damages mitigation would occur within the defined staging area and as this was a defined USACE boundary for which the flood water storage was necessary, the USACE used the staging area as a boundary for determining costs. As discussed in other subsection topics, there are other properties, undeveloped land and residential/ commercial properties, which would require mitigation outside of the staging area. Those costs would be included in a final cost for land acquisition and damages that would be determined once design plans were finalized.

Table 3.80 Proposed Project Summary of Estimated Cost of Land Acquisition and Damages

Item Description	Proposed Project
Right-of-Way and Easements – Construction Footprint[1]	$ 41,464,402
Right-of-Way and Easements – Staging Area	$ 223,588,278
TOTAL: Lands and Damages[2 3]	$ 265,152,680

Source: HMG, 2015b

[1]Project construction footprint includes areas associated with the construction of the diversion channel, embankment systems, levees, and other flood control features.

[2]With 25% Contingency

[3]Costs are associated with a 100-year flood event.

The cost of acquisition, including right-of-way and easements, is the second largest Project cost behind construction of channels and control structures. Table 3.81 provides a breakdown of property acquisition and easements for the Project for the Sheyenne structure site to the inlet weir, the diversion and embankment footprints, and staging area. Note that numbers presented are for the construction footprint and staging area only as with Table 3.80 above. Other property acquisitions and easements would occur outside of these locations as well, such as in-town levee and floodwall acquisitions and other easements and potential acquisitions that would be necessary within the inundation area and mitigation areas; however, these are not anticipated to have a large impact on the estimates provided below.

Table 3.81 Proposed Project Property Acquisitions, Easements, and Costs

Type of Property[1]	Proposed Project Fee Title	Proposed Project Easement
Sheyenne Structure Site to Inlet Weir		
Acres	170	5
Non-Residential	0	-
Residential	0	-
Total Cost[1]	$1,756,000	$8,000
Diversion and Embankment Footprints		
Acres	717	60
Non-Residential	11	-
Residential	3	-
Total Cost[1]	$10,548,000	$100,000
Staging Area		
Acres	25,842	6,400
Non-Residential	434	160
Residential	71	20
Total Cost[2]	$210,504,000	$13,085,000

Source: HMG, 2015b

[1]Land Acquisition and Damages were based on both USACE detailed data and GIS residential and non-residential structure data obtained through USACE 2014 desktop analysis.

[2] Reflects cost as rounded estimates to the nearest thousand. Includes administrative costs and 25% contingency.

Using the HAZUS Level 2 analysis reduces the ability to get detailed structure count information, particularly the Level 2 analysis that was applied to the Unbenefited, rural areas. In order to gain a more exact impacted structure count for the Unbenefited Area, MNDNR completed an ArcGIS structure count analysis using structure GIS data obtained through a desktop analysis (USACE 2015). As depicted in Figure 26, the MNDNR analysis focused on the inundated area south of the tieback embankment that includes both the staging area and the inundated area outside of the staging area (i.e., the Unbenefited Area). Because data and methodologies applied differ from the SE Report analysis completed, the numbers presented in Table 3.78 above and Table 3.82 below should not be compared. The Base No Action Alternative was used in this analysis to provide a baseline with which to gage Project-impacted structures. The Base No Action Alternative study area focuses on the same Unbenefited Area as was used for the Project for the analysis.

The proposed ring levees to OHB and Comstock were considered in this structure count analysis. The Comstock ring levee would surround 46 existing residential structures, of which 26 would be impacted up to one foot without the levee. The Comstock ring levee would also include areas for future growth and possible relocation from other areas affected by the Project. In OHB, the ring levee would surround 103 existing residential structures, of which 13 would be impacted under existing conditions in a 100-year flood. An additional 60 home lots would be created within the ring levee to accommodate relocations within OHB and from other areas affected by the Project.

The results of the MNDNR analysis indicated in Table 3.82 below that within the Unbenefited Area residential structure impacts are the same as those experienced under existing conditions during the 10-year flood. This is expected as the Project would not operate until it exceeds the threshold of the 10-year flood. However, during the 25-year flood, when the Project is in operation, the number of structures impacted increases substantially from 221 to 506 total structures; about 18 percent of those impacts would be to residential structures (15 in Minnesota and 75 in North Dakota).

Impacts to both structure types continue to increase beyond the 25-year flood; however, not as drastically. Impacts to non-residential structures are much greater for all events. This is expected as many of these rural properties, whether residential, farm, or commercial, contains more than one structure in addition to a home. For the 100-year flood, 702 of the 828 structures impacted are to non-residential structures. The remaining 15 percent is to residential structures, of which 28 would be impacted in Minnesota and 98 within North Dakota.

Table 3.82 Proposed Project Number and Type of Structures Impacted under 10-year, 25-year, 50-year, 100-year, and 500-year Floods within the Upstream Inundation Area[1 2 3 4 5 6]

Return Period Scenario	10-year Flood Base No Action Alt.[7]	10-year Flood Project	25-year Flood Base No Action Alt.	25-year Flood Project	50-year Flood Base No Action Alt.	50-year Flood Project	100-year Flood Base No Action Alt.	100-year Flood Project	500-year Flood Base No Action Alt.	500-year Flood Project
North Dakota										
Cass County **Non-Residential**[5]	27	23	177	249	313	301	404	319	556	351
Cass County Residential	0	0	10	75	29	88	64	93	191	96
Richland County **Non-Residential**	3	3	13	19	33	52	74	94	273	276
Richland County Residential	0	0	0	0	0	2	2	5	43	45
Total Non-Residential - North Dakota	**30**	**26**	**190**	**268**	**346**	**353**	**478**	**413**	**829**	**627**
Total Residential – North Dakota	**0**	**0**	**10**	**75**	**29**	**90**	**66**	**98**	**234**	**141**

Return Period Scenario	10-year Flood Base No Action Alt.[7]	10-year Flood Project	25-year Flood Base No Action Alt.	25-year Flood Project	50-year Flood Base No Action Alt.	50-year Flood Project	100-year Flood Base No Action Alt.	100-year Flood Project	500-year Flood Base No Action Alt.	500-year Flood Project
Minnesota										
Clay County **Non-Residential**	3	2	16	133	71	211	98	241	174	250
Clay County **Residential**	0	0	0	15	1	20	2	22	11	23
Wilkin County **Non-Residential**	2	2	5	15	21	29	36	48	149	151
Wilkin County Residential	0	0	0	0	1	2	4	6	47	49
Total Non-Residential - Minnesota	**5**	**4**	**21**	**148**	**92**	**240**	**134**	**289**	**323**	**401**
Total Residential - Minnesota	**0**	**0**	**0**	**15**	**2**	**22**	**6**	**28**	**58**	**72**
Total Non-Residential Structures	**35**	**30**	**211**	**416**	**438**	**593**	**612**	**702**	**1,152**	**1,028**
Total Residential Structures	**0**	**0**	**10**	**90**	**31**	**112**	**72**	**126**	**292**	**213**
Total Structures	**35**	**30**	**221**	**506**	**469**	**705**	**684**	**828**	**1,444**	**1,241**

Source: MNDNR, 2015

[1]Structures included within the analysis are those found within the counties identified and limited to the upstream inundation area.

[2]Impact is not defined by a set flood depth. If a structure is impacted by water by any extent, it is considered an impact.

[3]Structures impacted are not differentiated by currently inundated and newly inundated structures.

[4]GIS structure data was obtained and provided by the USACE through a desktop analysis, 2014 and has not been field-verified

[5]Non-residential includes all other structures that are not used for residential purposes, including commercial structures.

[6]Structure numbers should not be compared to those represented in Table 3.78. Methods and data sources applied were different.

[7]Base No Action Alternative numbers were included as this Alternative was used to present current conditions.

As mentioned above, properties typically contain more than one structure. In the case of a farm or commercial property, several structures could be present. Only looking at the number of structures makes it difficult to assess the number of properties/property owners that would be affected by the Project. The MNDNR used the structure data presented in Table 3.82 above and overlaid it with parcel boundaries. A property that had one or more impacted structure(s) was included in the analysis and was given a count of one. Table 3.83 provides a breakdown of the number and type of parcels that would be impacted by the Project within the Unbenefited Area. It would be expected that overall, the results below would follow a similar trend as those observed in Table 3.82 above. It should be noted that the analysis did not sort through individual property owners, only by parcels; so if a property owner owned more than one parcel, each parcel would be represented in the Table 3.83 count below.

Similar to Table 3.82 above, the number of impacted parcels between the baseline and the Project remains relatively the same, 16 impacted parcels under the Project and 18 impacted parcels under the Base No Action Alternative, during the 10-year flood. Impacts within the inundation area are greater than the Base No Action Alternative (baseline) under the 25-, 50-, and 100-year floods, when the Project is in operation; the 25-year flood experiencing the greatest increase in parcels impacted from 44 parcels to 149 parcels (Table 3.83).

Table 3.83 Proposed Project Number of Parcels Impacted under 10-year, 25-year, 50-year, 100-year, and 500-year Floods within the Upstream Inundation Area[1 2 3 4 5 6]

Return Period: Scenario	10-year Flood: Base No Action Alt.[6]	10-year Flood: Project	25-year Flood: Base No Action Alt.	25-year Flood: Project	50-year Flood: Base No Action Alt.	50-year Flood: Project	100-year Flood: Base No Action Alt.	100-year Flood: Project	500-year Flood: Base No Action Alt.	500-year Flood: Project
North Dakota										
Cass County	12	12	28	101	61	119	91	122	218	131
Richland County	3	3	10	13	19	31	32	41	102	109
Total Parcels - North Dakota	**15**	**15**	**38**	**114**	**80**	**150**	**123**	**163**	**320**	**240**
Minnesota										
Clay County	1	1	3	27	10	36	12	42	19	43
Wilkin County	2	2	3	8	9	15	21	25	91	94
Total Parcels - Minnesota	**3**	**3**	**6**	**35**	**19**	**51**	**33**	**67**	**110**	**137**
Total Parcels	**18**	**18**	**44**	**149**	**99**	**201**	**156**	**230**	**430**	**377**

Source: MNDNR, 2015

[1]Structures used for determining parcel inclusion are those found within the counties identified and limited to the upstream inundation area.
[2]Impact is not defined by a set flood depth. If a structure is impacted by water by any extent, it is considered an impact.
[3]Parcels impacted are not differentiated by currently inundated and newly inundated parcels.
[4]Parcels included in counts were those found to contain impacted structures. Undeveloped land was not included in this analysis.
[5]Structures used in analysis were identified and provided by the USACE through a GIS desktop analysis, 2014 and has not been field-verified
[6]Base No Action Alternative numbers were included as this Alternative was used to present current conditions.

Loss of Structure Function

Damages to structures can result in regional economic losses through the loss of functionality. This includes costs associated with business or resident relocations to temporary facilities, losses of income earned from sales (economic output) and the effects on local and state taxes, for example. The SE Report provided an estimate of “loss of structure function” costs for the Project as summarized in Table 3.84 below. Similar to other analysis completed in the SE Report, the Base No Action Alternative was used as a baseline for representing existing conditions and thus is included below for that purpose. Costs have been rounded off to the nearest $1 million.

Average annual relocation and disruption costs are $8 and $1 million, respectively. Those costs are all estimated to be from North Dakota; however, it is important to consider that rounding off to the nearest million could omit costs for Minnesota as Minnesota does experience losses that may not be completed captured in this representation. Project losses for jobs would total

1,448; 10 percent of those impacts would be to Minnesotans. More detailed information is summarized in Table 3.84, below.

Table 3.84 Proposed Project Annual Impacts from Loss of Building Function ($ Millions)

Description	Proposed Project: **Direct Impact**[1]	Proposed Project: **Total Impact**[2]	Base No Action Alternative: **Total Impact**
North Dakota Losses			
Business Losses			
Output	$119	$183	$1,512
Employment (in jobs)	825	1,298	15,782
Labor Income	$41	$65	$548
Gross Regional Product	$65	$103	$866
Total State and Local Tax	$12	$12	$110
Disruption Costs	$1	$1	$3
Relocation Costs	$8	$8	$53
Minnesota Losses			
Business Losses			
Output	$14	$18	$43
Employment (in jobs)	117	149	380
Labor Income	$5	$6	$14
Gross Regional Product	$7	$10	$23
Total State and Local Tax	$2	$2	$4
Disruption Costs	$0	$0	$1
Relocation Costs	$0	$0	$2
Total Losses			
Business Losses			
Output	$133	$200	$1,555
Employment (in jobs)	942	1,448	16,162
Labor Income	$46	$71	$562
Gross Regional Product	$72	$113	$889
Total State and Local Tax	$14	$14	$113
Disruption Costs	$1	$1	$4
Relocation Costs	$8	$8	$55

Source: HMG, 2015a

[1]Direct Impacts are those that direct to the industry.

[2]Total impact includes the direct impact i.e., direct economic effects (direct response of an industry), the indirect effects (changes in output, income, and employment caused by direct impacts), and the induced economic effects (changes in output, income, and employment cause by expenditures associated with new household income generated by direct and indirect economic effects).

3.16.2.3.4 Flood Insurance

With the Project, it is anticipated that substantial cost savings could be realized to numerous property owners within the project area due to the reduced numbers of impacted structures expected to occur during a 100-year flood event, as noted in Table 3.78 and Table 3.82 above. The cost savings would apply both to those within the Benefited and Unbenefited Areas as the properties would be removed from the floodplain, either from Project operation protection north of the tieback embankment, or through mitigation actions within the staging area and within the FEMA revision reach (or the area defined by the Red River profile and limited to where the Project would alter the river profile flood elevation by more than 0.5 feet) (see subsection 3.16.3 Proposed Mitigation and Monitoring or Section 3.2 FEMA Regulations and the CLOMR Process for more details).

The NFIP indicates the average flood insurance policy costs about $650 per year. These costs are higher for properties in high risk areas and higher for properties with basements below the base flood elevation. For example, a policy that includes $250,000 in coverage for the structure and $150,000 in coverage for contents has a premium of $1,958 per year ($1,191 for structure only) and this cost is expected to increase 10 percent-18 percent per year as the Homeowner Flood Insurance Affordability Act is implemented and as the Biggert Waters Flood Insurance Reform Act of 2012 and subsequent 2014 Homeowner Flood Insurance Affordability Act are implemented.

Newly inundated properties located outside the FEMA revision reach are anticipated to have less than six inches of flooding. For newly inundated insurable structures located within Minnesota, State law (Minnesota Rules, part 6120.5700, subpart 4a) requires mitigation. Minor site modifications, such as landscaping, could be used as mitigation to exceed the 100-year flood elevation. If the mitigation (e.g., landscaping) is done before the LOMR at the end of the Project, mandatory flood insurance would not be required. However, if mitigation was not completed, flood insurance would be required. For newly inundated insurable structures located within North Dakota, communities and property owners would have to work with the North Dakota State Engineer and USACE to determine what mitigation would be necessary.

3.16.2.3.5 Effects of Relocations and Flowage Easements

The Project would result in substantial social disruptions for the communities and residents within the upstream inundation area, with the potential for a large number of residents to be displaced. The relocations would disrupt community activities such as school and church functions, as well as the social networks among residents.

Relocations may also result in social and economic effects, such as loss of tax revenue for local municipalities and local government, and a reduction of student populations and property tax base for local school districts (however, the larger tax-base communities such as OHB and Comstock would persist as they would be protected by ring levees). Land values and future land development would be impacted by restrictions imposed by flowage easements and increased flood risk. Business owners may also be required to relocate which may affect the economic vitality of the community.

Below provides a qualitative discussion on potential social and economic effects of relocation and flowage easements or considerations for those who may be impacted, drawing from the concerns and potential impacts noted above.

Property Owners
Mitigation in the inundation area, specifically the staging area and remaining areas within the FEMA revision reach, would include a number of property buyouts (relocations), non-structural measures (flood risk reductions), elevating structures, and flowage easements (see Chapter 2, subsection 3.16.3 Proposed Mitigation and Monitoring below, and Appendix O for further discussion). Depending on the anticipated depth of flooding, current property owners within the staging area who would be impacted by Project operation may be required or offered the option to relocate to areas outside the staging area or within the protected communities of OHB and Comstock. Implementation of these buyouts, relocations, and non-structural measures may cause stress and disruption for those residents. Property owners who would be required to leave could experience stress related to the inconvenience of relocating and the disruption of established personal routines and connections.

The USACE would evaluate Project inundation impacts to undeveloped and developed land outside the FEMA revision reach through an analysis to determine, a case-by-case basis, if a taking had occurred. This would be used to define appropriate mitigation measures (see Section 3.16.3 Proposed Mitigation and Monitoring, and Appendix O for more details). Proposed mitigation measures would likely be similar to those proposed for the staging and FEMA revision reach areas. Implementation of mitigation would likely cause stress and disruption to residents and properties owners similar to as those within the staging area and FEMA revision reach as discussed above.

Property owners may also be affected through loss of income from renters; either residential or business (including agricultural lands – see subsection 3.16.2.3.8 Agricultural Impacts below). Renters of residential and commercial structures or agricultural properties may be required to relocate or find that new restrictions are less desirable and choose to find other arrangements.

Considerations for relocation and flowage easement effects on property owners:

- Impacts to property values are difficult to assess as property values are based on many market factors including location, proximity to jobs, goods and services, weather and climate, quality of soil, natural amenities, such as a river, lake, or golf course, national, regional, and local economies. Due to these factors, it is unknown how property values might be affected following Project construction and after mitigation is complete. However, it could be expected that long-term land value/demand would likely be expected to decrease for land in the inundation due to risk of impacts associated with staging of water and encumbered by flowage easements.
- Pertaining to property compensation, landowners are proposed to be compensated per federal law[6]. Compensation would be based on the degree of impact, the assessed value of land, and the type of real estate acquired (fee or easement).
- As noted above, a portion of the farmsteads and residences that would be impacted in the inundation area are currently at flood risk. In those scenarios, the residents may

[6] The 5th Amendment of the U.S. Constitution requires just compensation when private property is taken for public use. CFR 49 Part 24 - Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970, PL 91-646, as amended, details benefits to the property owner and/or displaced residential renters for Federal and Federally Assisted Programs.

benefit from Project mitigation as their property would be protected by the OHB and Comstock ring levees, purchased and/or relocated, compensated through flowage easements, or mitigated by some other means.

Community Ring Levees

The Project includes the construction of ring levees that would provide flood protection for the communities of OHB, as well as one for the community of Comstock. While the ring levees do reduce flood risk to those who would reside and work within the levee, they would result in social impacts, including disruptions during construction, as well as the perception of living behind a levee.

The OHB ring levee design was coordinated with the affected communities. Pertaining to Comstock, the conceptual ring levee includes areas for stormwater retention as well as years of future growth. As design for the ring levee moves forward, additional coordination with the community of Comstock would take place to better define the design of the ring levee. This would include coordination on alignment, location and size of future growth areas, and other features associated with the ring levee. Consideration would also be given to the potential for other impacted residents in the staging area to relocate within the Comstock ring levee.

Due to the additional flood risk of the Project, the residents of Comstock would be expected to experience higher levels of stress and anxiety than they do under the baseline condition. Comstock is currently located outside of the existing 100-year floodplain; however, during large flood events it has been necessary to employ emergency measures to reduce impacts from ditch and drainage way backups resulting from Wolverton Creek flood waters. It is expected that flooding would reduce the economic vitality of the area as businesses might relocate to other areas not prone to flooding. The ring levee may restrict future development due to the increased flood risk in and around the area.

Century, Centennial and Sesquicentennial Farms

The area has a long history of farming dating back to settlement activities in the mid-1800s (USACE, FFREIS 2011). Although the number of farms is in decline, there are some that are still active that have been established for over a century. If the farm has been owned or lived on by the same family for 100 years or more, the farm may be designated or would be eligible for "Centennial Farm" status (North Dakota Centennial Farm Program). In Minnesota, a farm must be owned by the same family for at least 100 years and be at least 50 acres in size, to be designated or eligible to be listed as a "Century Farm;" or if you meet the same requirements but have owned your farm for 150 years or more you would be considered a "Sesquicentennial Farm" (Minnesota Farm Bureau). An inventory of Century Farms or Centennial or Sesquicentennial Farms was not included as part of this discussion. To be listed, a landowner or family must complete and submit an application to their respective state programs. A complete list of designated Centennial/Century Farms in North Dakota can be accessed by visiting the Lewis and Clark Interpretive Center located in Washburn, North Dakota, or in Minnesota a complete listing of these farms can be found on the Minnesota Farm Bureau Webpage at http://www.fbmn.org/farm-recognition.

The USACE cultural investigations completed so far for the Project have found that some farmsteads are recommended eligible for listing on the NRHP (see Section 3.12 Cultural Resources). Presumably, some of these might be Century Farms. While farming of the land may continue, people would not be allowed to reside in large parts of the staging area and possibly within other newly inundated areas. Potential mitigation for these properties would be similar as discussed above and if found to be eligible for the NRHP would also follow mitigation procedures as laid out in the Programmatic Agreement (FFREIS Attachment 3, USACE, 2011).

Given the historical context of these farms in addition to the family heritage these families would have to a particular farm, social impacts to those families who claim family heritage ties to the land would likely be emotionally taxing if required to relocate due to increased inundation or new inundation impacts.

<u>School Districts</u>
The fiscal requirements and resources of the school districts would both be positively and negatively affected by the Project. Local school district officials have concerns the student population and future development of local school districts within the upstream inundation area could be affected by the Project due to relocations or flowage easements, resulting in reduced property tax base. Implementation of the Project may result in school districts within the upstream inundation area to experience changes in student population; however, the extent of these changes and resulting impacts are not definitively known. Area residents who are relocated may choose to keep children enrolled in the same school, resulting in very minimal impacts to school districts; however, some students may enroll in a different school. If the tax valuation of properties in the school districts is affected, this would need to be addressed at the local level and could be discussed further with the Diversion Authority.

The OHB and Comstock ring levees are not anticipated to negatively impact the tax base or the population within the Kindred and Barnesville school districts because the levees would allow people to remain in their school districts. Forty-two (42) homes in Oxbow would be impacted by the OHB ring levee construction and would be replaced in Oxbow as part of the Project. The Diversion Authority has, however, proposed to compensate the City of Oxbow and the Kindred school district for the loss of tax base that would be caused by property (42 homes) being taken out of service for construction of the OHB ring levee project for a period of up to four years. In addition, the OHB ring levee would provide approximately 60 additional residential development lots for other displaced residents within the upstream inundation area, if they choose, to move to Oxbow and the Kindred school district. If this occurs, this would positively impact the school district. The Comstock ring levee concept would preserve all existing community development and allow for future growth which would positively impact the Barnesville school district.

It is possible that school district boundaries may be adjusted to offset shifts in student population or for loss of tax revenue; however, this is not expected to occur. Such proposals and decisions would be under the authority of the Minnesota Department of Education and the North Dakota Department of Public Instruction and their respective state agencies.

<u>Municipal and Local Governments -Tax Bases</u>
Municipalities and other local governments within the upstream inundation area may experience impacts from the Project from a decreased tax base due to relocations. However, while that may occur, the property tax base for many of these impacted districts within the inundated area is largely agricultural in nature. Agricultural property value is influenced by the market value of crops and the soil quality of the land. Inundated agricultural land would be

considered for flowage easements, and would still be capable of being farmed for crops. The flowage easements may depreciate the real estate value and demand for the land, but may not affect agricultural property value as much as inundation of land zoned for residential or commercial.

3.16.2.3.6 Effects on Property Improvements

Flood waters have the potential to cause impacts and damages to not only structures on a property but to improvements on the property such as wells and septic systems. These types of site improvements are primarily associated with rural properties or small towns and developments. Flood waters could contain of chemical or biological hazards that could contaminate drinking wells. Flood waters could also become contaminated through septic system failures.

<u>Drinking Water and Well Contamination</u>

There are a number of existing private wells in the project area that currently supply drinking water to residents, agricultural operations, and other activities. Project construction may impact existing wells near the diversion channel and the associated embankment systems. Wells and structures within the Project construction footprint would be removed or abandoned in accordance with applicable local, state, and federal regulations, including Minnesota Rules, part 4725 – Wells and Borings and North Dakota Century Code. Wells immediately adjacent to the Project construction footprint would be identified and monitored to quantify any impacts.

Where wells that may be affected by operation of the Project would remain, appropriate modifications would be made to prevent contamination of groundwater/drinking water. The number and locations of affected wells would be determined during the design phase of the Project. Any impacts to drinking water supplies would be mitigated as appropriate, including proper abandonment or modification for flood protection. Any actions needed to prevent contamination of wells would be part of the Project and the responsibility of the USACE and the Diversion Authority.

Minnesota Rules, part 4725 regulates wells for groundwater and drinking water sources. The requirements regarding flood protection for water-supply wells are outlined in Minnesota Rules, part 4350, subpart 2. The requirements do not apply to areas protected by FEMA accredited flood control structures. Some of these requirements include construction of a water-supply well to prevent the entry of flood water into the well.

The MDH advises well owners that flood water has the potential to contaminate water-supply wells and provides guidance on how to take precautions prior to flood events to protect water-supply wells. MDH guidance also outlines procedures for taking proper measures, such as disinfecting, if a water-supply well becomes contaminated by a flood event (<u>http://www.health.state.mn.us/divs/eh/wells/natural/index.html</u>).

<u>Septic System Compliance</u>

In areas that would be newly inundated, existing septic systems and other Subsurface Sewage Treatment Systems (SSTS) that serve commercial, industrial, and residential properties could be deemed non-compliant with state and local rules/ordinances. SSTS components that are discharging effluent to subsurface soils compromised by rising flood waters can pollute ground and surface water with pathogens, viruses, and nutrients such as nitrogen and phosphorus.

In Minnesota, Minnesota Rules, part 7080.2270 indicates that placement of SSTS components are not allowed in a floodway and should be avoided within the 100-year floodplain. An elevated drain field, known as a mound system, is allowed in a floodplain when no other option is available provided the bottom of the mound is at least 0.5 feet above the 10-year flood elevation. During flood events and inundation of the SSTS, the structure must cease producing wastewater and have an adequate backflow prevention to prevent flood waters into the structure. Once a septic tank has been inundated, the solids and liquids must be removed by a licensed company and disposed at an approved facility once flood waters recede and prior to being put back into use. The pumping and hauling costs on a one time basis could be approximately $250 to $500.

Residential homes with SSTS that would be located in newly inundated areas could realize an investment of approximately $15,000 to $20,000 to either flood proof their existing system and/or relocate a system to another location on their property above the 100-year floodplain where flood proofing or other restrictions are not required. Commercial and industrial facility SSTS upgrade costs would depend on the size of the facility but tend to be equal to or greater than that of a residential home. Improvements to SSTS require design or engineered plans that are submitted to the local jurisdictional agency for permitting. For larger SSTS, permitting is completed through the state agency; in Minnesota it is the MPCA, in North Dakota it is the NDDH.

3.16.2.3.7 Effects on Cemeteries

A Cemetery Study completed by the USACE in June 2014 (http://www.fmdiversion.com/studies-technical-documents/) identified that there were 54 cemeteries located within a defined study area (see Figure 1 of Cemetery Study) that could potentially be impacted by the Project (note that the Cemetery Study did not include areas downstream of Georgetown as the staging area would be used to minimize impacts downstream). The study evaluated the existing flood conditions for the 10-year, 50-year, 100-year, and 500-year floods as well as what the water elevations would be at each cemetery under Project conditions.

The results of that study determined that of the 54 identified cemeteries studied, 28 would be located within the Benefitted Area and 11 were considered potentially impacted by Project operation (under a 100-year flood scenario). The potentially impacted cemeteries are the Lower Wild Rice and Red River Cemetery; Hoff Cemetery; Clara Cemetery; Roen Family Cemetery; Comstock Family Cemetery; North Pleasant Cemetery; Hemnes Cemetery; South Pleasant Church Cemetery; South Pleasant/Lium Cemetery; Eagle Valley Evangelical Cemetery; and Wolverton Cemetery. Potential impacts identified in the study include damage from ice or debris; sediment or debris deposition; erosion; gravestone toppling or movement; delays for burials and burial preparations; vegetation die-off, and the inability to access the cemetery.

Potential Impacts not included within the study but associated with social and economic effects could include emotional effects due to damage to a gravesite of a person of significance to an individual(s), burial delays, stress caused by concern to cemeteries or cemetery sites for impacts under flood conditions (during Project operation), concern and stress pertaining to costs for repairs from flood damage. Potential economic impacts include those caused by additional cemetery operation costs due to impacts from new or increased flood depths or durations under Project operation. These may include damage to cemetery markers, such as headstones and signs; and post-Project operation cleanup.

Cemeteries are considered for inclusion to the National Register of Historic Places (NRHP) if they are considered integral parts of historic districts or fall within the purview of National Register eligibility. Once eligibility of each cemetery has been determined, the USACE would work with the respective state Historic Preservation Offices to determine avoidance or minimization efforts. This is discussed in more detail in Section 3.12 Cultural Resources. As of the date of this report, 3 of the 11 cemeteries are considered eligible; 5 are not eligible; and 3 are undetermined eligibility.

The USACE completed a Draft Cemetery Mitigation Plan for the 11 potentially impacted cemeteries in June 2015 that more fully evaluated potential Project impacts, proposed mitigation, and potential mitigation impacts. Those cemeteries which are determined eligible under Section 106 of the National Historic Preservation Act are discussed in detail in Section 3.12 Cultural Resources. For the cemeteries which would be impacted by Project operation and which fall within the staging area, federal mitigation would be in the form of flowage easements. The USACE has stated that impacts to cemeteries are not considered a taking (see 3.16.3.2.4 for definition of a "taking" as defined in the Fifth Amendment of the U.S. Constitution). Additional mitigation may be considered by the non-Federal Sponsors that include clean-up assistance after Project operation. See also Appendix O for additional discussion on cemetery proposed and recommended mitigation measures.

3.16.2.3.8 Agricultural Impacts

Potential agricultural impacts were evaluated for traditional agricultural activities and organic farms, including property value, crop loss, grain and feed spoilage, and loss of organic certification. Traditional and organic farms were evaluated separately due to the requirements for organic certification, which may influence the value of the property and the potential loss of income from flood inundation. Flowage easements would be the proposed federal mitigation for land within the staging area and possibly for property outside the staging area that would be inundated during Project operation. Landowners would be compensated for flowage easements acquired.

<u>Agricultural Property Value</u>

Agricultural property value is influenced by the location of the land and the production quality of the soil on the land. New flooding or increased depth and duration of flooding of agricultural landscapes introduce several concerns for agricultural producers as flood impacts could affect agricultural production beyond the Project operation timeframe.

Soil health

Good soil health is vital to successful agricultural production. Project operation waters could negatively impact soil health by:

- Moving nutrients and minerals into areas where they have never been or increasing the duration and frequency of flooding to a particular area that result in a negative change to local soil conditions (See Appendix B--Draft AMMP –Geomorphology Monitoring Plan).
- Causing sedimentation to occur in undesirable locations. This would be particularly true for low-lying areas which could experience sedimentation gradually over decades or

major impacts as a result of a single flood event. Sedimentation could result in deposits of undesirable, inorganic material such as silt that lowers the nutrient value of the soil and could result in a decrease of crop yields (see also Section 3.3 Stream Stability).

- Erosion of healthy, productive soil (or certified soil in the case of a certified organic farmer) (See also Section 3.3 Stream Stability and Section 3.4 Wetlands).
- Transportation of plant pathogens and undesirables such as invasive plants or weeds and weed seeds (see also Section 3.11 Invasive Species).
- Movement of hazardous materials (recognized environmental hazards) or materials that are considered detrimental to a particular farming practice such as organic (see also Section 3.7 Potential Environmental Hazards).

The location of the impacted site relative to the dam, other agricultural producers, current land use practices, and whether a landowner or renter has experienced flooding factor into how Project operation could impact soil health.

Farm Building Limitations

Due to the increased level of flood risk, construction of farm buildings to support agricultural activities would be limited due to restrictions imposed from flowage easements. Existing agricultural structures, especially livestock-related structures, would not be compatible with flooding in the staging area and within the FEMA revision reach, and therefore, would likely be relocated. The USACE and Diversion Authority have not made final determinations about whether any existing non-residential structures would be allowed in the staging area or FEMA revision reach. This could impact farm activities with farm equipment and other supplies that need to be brought into the area rather than being able to store them for use in the immediate vicinity.

It is anticipated that agricultural land in the inundation area could continue to be farmed with the Project and would be allowable under the terms of the proposed flowage easements. However, this land may experience increased flood depths and duration or may be more susceptible to new flood inundation with the operation of the Project. The extent of flood impacts on agricultural productions would vary depending on when the flood event occurs. If flooding occurs prior to the growing season there may not be any impact to agricultural production. The Project is designed to pass 17,000 cfs through the Benefited Area before the Project would be operated. Based on a review of historic flood events, the Project would not likely operate during the summer.

Planting Delays - NDSU Initial Ag Impact Study

Due to growing season restrictions, final planting dates for crops range between the end of May for corn, to early June for soybeans and flax. Farmers would have until this time for stored water to clear and for land to dry enough for planting to occur. If stored water is still present and/or the land has not dried prior to these timeframes, crop plantings would not be feasible resulting in agricultural losses and/or limited production.

In a first attempt to address potential impacts Project operation would have on agricultural production within the staging area, NDSU completed the Initial Assessment of the Agricultural Risk of Temporary Water Storage for FM Diversion (NDSU Initial Ag Impact Study) (NDSU 2015). The NDSU Initial Ag Impact Study can be found on the Diversion Authority's website at: http://www.fmdiversion.com/wp-content/uploads/2015/02/AAE745.pdf).

The goals of the NDSU Initial Ag Impact Study were to gain insights on flooding duration, variability of effects based on land elevation and flood size, expected timeline for the effects of flooding to be gone, quantify the risk of delayed planting and its potential financial impact on producers. The NDSU Initial Ag Impact Study was to be a step in the process towards identifying with more accuracy, potential Project impacts to agricultural producers that could be used to identify what else is necessary to know to determine impacts and adequate mitigation.

The study focused on two things: 1) the additional time the Project added to the number of days for the effects of flooding to be gone, and 2) how often those additional days would result in planting delays. These two factors when combined would determine whether a particular storage area (geographical unit within the staging area that is delineated by man-made and/or natural features – for hydrology purposes, the storage areas are treated as one homogenous tract) would or would not have delayed planting.

Four of the main agricultural crops within the project area were assessed as part of this study. Those included were corn, sugarbeets, wheat, and soybeans. All four of these situations represented traditional agricultural practices (e.g., as opposed to organic farms). Hydrology used for modeling was the same hydrology that was used for this EIS. Storage areas considered in the NDSU Initial Ag Impact Study are presented in Figure 1 of that study.

NDSU Initial Ag Impact Study findings indicated that:

- For 25-year and 50-year floods, many storage areas were not adversely affected by Project operation and that a majority of these (lying at lower elevations) would experience flooding under current conditions from 1 to 7 days. For those lands that would be newly inundated under the Project, 25 days would be required for the effects of flooding to be gone (it should be noted that doesn't directly translate into planting delay days as there are other factors to be considered).
- Impacts for corn, wheat, and sugarbeets would likely be substantially different than soybeans which had the lowest relative yield decline of the four crops considered in the analysis.
- Project operation was likely to result in planting delays and subsequent revenue loss (about 50 to 65 percent likelihood); however, the probability of revenue loss generally low (less than $25/acre average for storage area). The probability of revenue loss of $25 to $75/acre average within a storage area is about 10 percent for flood events larger than the 10-year flood.

The NDSU Initial Ag Impact Study was not intended to present a final conclusion of what Project impacts would be to agricultural production/producers. Many assumptions were used in the development of this study. In addition, the study needed to use and define available information that would enable a conclusion. For example, organic farming presents a unique set of circumstances to agricultural production (discussed below) and represents a small percentage of agricultural producers in the area; as such they were not included in the study as they were not representative of the "average" agricultural producer in the project area. Other example considerations not included in the study include future prices and yields, how does this affect a renter of agricultural land, travel costs to parcel, actual elevations (e.g., 60 percent of a farmed land could be low-lying, the other 40 percent could be at a higher elevation – farmer may need to delay planting for the whole field if equipment mobility and availability is a factor). Authors of the study noted that:

"…Due to the complexity of the hydrology, which varies by storage area for the flood events evaluated, generalized statements about how producers will be individually affected are difficult. Revenue losses across all acres and crops within a storage area and by hydrology group measures the potential cumulative losses in the staging area and identifies general risk. However, care should be exercised that generalities and averages mask substantial differences for individual crops and storage areas. The economic impacts on some agricultural producers are likely to be considerably different from the average values within the hydrology groups."

Several recommendations were made to further the study that would go towards more accurately identifying Project impacts and adequate mitigation options. Some of these include:

- Evaluating the potential loss of crop insurance as a result of man-induced flood impacts.
- Including all inundated land in the study (this is proposed to be undertaken the fall of 2016 utilizing the same methodologies and assumptions).
- Improving key assumptions; e.g., are dry-down periods linked to weather or planting rates or refining data by obtaining local information for crop yields, planting periods, planting rates, and other agricultural factors (state- and county-level data was used in the analysis).
- Variability of effects highlights the needs for fair, flexible, and comprehensive compensation policy.

It is anticipated that long-term land values would not be impacted by the Project as farming activities could continue within the Unbenefited Area. However, there is a potential for land values to decrease as the land may be less desirable to purchase or rent following implementation of the Project. Crop insurance to impacted parcels remains a concern and could affect the agricultural production in the inundation area.

<u>Grain and Livestock Feed Spoilage</u>

Grain and livestock production are common in the project area and typically involve storage of grain and other feed for consumption at a later date by livestock or to sell as a commodity at market rate. Significant quantities of bulk grain are typically stored in large grain bins, silos or other storage structures throughout the project area. Bulk grain usually has low moisture content prior to storage in order to prevent decomposition during storage. Other livestock feed may also include silage that is transferred as wet feed material to silos or other storage structures. Grain and feed materials are an integral part of a farm operator's income. Both result either directly or indirectly through the consumption and growth of the livestock in variable levels of income for the farm.

Grain and feed storage structures located in the flood inundation areas would like become contaminated by flood water and/or take on excessive moisture, which can lead to unusable materials, thus spoiling the grain and feedstock. During flood events it is not feasible to move large quantities of stored grain and feed. Without grain or feedstock, the income to the individual farm operations could be impacted.

Based on review of aerial photographs and available property information, a majority of the non-residential structures are located within the existing 100-year floodplain. Based on the active agricultural operations in the area, it is likely that some of these non-residential structures are used for storage, and, likely flood under the Base No Action Alternative.

The Project would increase the risk of flood inundation, especially in areas upstream of the dam, where inundation may be deeper than existing conditions and new inundation may occur to areas not previously impacted by flooding. Livestock production would not be compatible with flooding in the staging area, and therefore, livestock operations would be relocated. This would minimize impacts to storage of livestock feed. USACE and the non-Federal sponsor have not made final determinations about whether any existing non-residential structures would be allowed in the staging area. However, it is unlikely that vulnerable grain storage facilities would be allowed to remain below the 100-year flood elevation. Mitigation of structures is proposed and described in subsection 3.16.3 below.

Organic Farms Certification

Organic certification applies to the farm operation and the products produced by the operation. The farmer receives organic certification for the land on which the crops are grown; however, certification is non-transferable and does not stay with the land if the land is sold. The technical memorandum prepared for this EIS includes a more detailed discussion on the organic certification process. This technical memorandum is included as Appendix K of the EIS.

Table 3.85 provides a summary of the four known organic farms within the vicinity of the Project inundation areas. Each organic farm includes several parcels of land associated with the organic certification. These parcels of land are not typically contiguous. Appendix K, Fargo-Moorhead Flood Risk Management Project EIS – Organic Farms Inventory –Figure 1 shows the location of the parcels that contain organic acreage relative to the Project staging area boundary. The total parcel-based land acreage calculated was 4,370 acres. All of this land, except two parcels in Farm 4, is located in Minnesota.

Table 3.85 Organic Farms Located Within the Vicinity of the Proposed Project Inundation Areas During the 100-year Flood[1]

Farm	Crops/ Forages	Farmer Reported Organic Acres	Parcel Acres	Acres within Project Staging Area Boundary
Farm 1	Soybeans, Spring Wheat, Corn, Flaxseed	889 Acres	998 Acres	843 Acres
Farm 2	Alfalfa, Corn, Soybeans, Pasture	1,256 Acres	1,330 Acres	606 Acres
Farm 3	Soybeans, Wheat, Corn, Alfalfa	767 Acres	835 Acres	241 Acres
Farm 4	Corn, Soybeans, Wheat	715 Acres	1,208 Acres	1,208 Acres

Source: Wenck, 2015

[1]This table provides a summary for organic farms located within the vicinity of inundation areas and identifies parcel acres located within the staging area boundaries. It does not reflect acreages of inundation. Estimated acres of inundation are presented in Table 3.86 below.

The potential for contamination of an organic farm could result from contact with flood water containing prohibited substances per the USDA National Organic Program List. A third-party certifying agency would determine whether flood water on a parcel of land would affect a particular farm's organic certification.

According to USDA National Organic Program (7 CFR 205), a farm would not necessarily lose their organic certification due to potential contamination from natural disasters such as floods. In the instance of a flood, a temporary variance may be issued to farms that experience negative effects. If the crops are found to have a certain level of contamination of prohibited substances, the USDA would allow them to continue growing and harvesting crops in that field as organic, but require them to sell them as traditional for three years in an effort to transition their field back to certified organic. The USDA National Organic Program (7 CFR 205.290) does not differentiate between natural and man-induced flooding as it relates to granting temporary variances for damages caused by flood.

Organic farms would have unique susceptibilities to flood waters. All of the agricultural impacts as described above would apply; however, if the impacts are considered severe enough, an agricultural producer's certification could be affected. The University of Minnesota has published an article, Impact of Flooding on Organic Food and Fields (Riddle 2013) (http://www.iatp.org/files/102_2_99846.pdf) that identifies some immediate and long term impacts of flooding on organic farms, foods, and fields. As discussed above and in Appendix K, determination regarding the future status of affected land would be determined by the certification agency.

The 100-year flood event under Project conditions was evaluated to determine where a particular parcel of identified organic farm land was located relative to existing and new flood inundation. Table 3.86 provides a summary of total acres for the identified organic farm parcels along with percentages of flooded acres. Approximately 2,200 acres of new inundation, approximately half of the overall identified organic farm acreage, would occur as a result of Project operation. This would have an effect on all four farms. Appendix K—Figure 2 shows the areas of flood inundation for flooded and non-flooded acreage associated with operation of the Project during the 100-year flood. As presented in Table 3.86, the Project would flood significant portions of Farm 1 (over 900 acres) and Farm 4 (approximately 850 acres). The Project would also flood 369 acres of Farm 2 and 80 acres of Farm 3.

Table 3.86 Organic Farm Acreage By 100-Year Flood for Proposed Project [1 2 3 4]

Farm	Proposed Project	Area (acres)	Proposed Project: Percent of the Total Parcel Acreage (%)
Farm 1: 998 acres	*Flooded*	*913*	*90%*
	Non-flooded	*85*	*9%*
Farm 2: 1,330 acres	*Flooded*	*369*	*28%*
	Non-flooded	*961*	*72%*
Farm 3: 835 acres	*Flooded*	*80*	*10%*
	Non-flooded	*755*	*90%*
Farm 4: 1,208 acres	*Flooded*	*848*	*70%*
	Non-flooded	*360*	*30%*
TOTAL: 4,370 acres	*Flooded*	*2,210*	*51%*
	Non-flooded	*2,160*	*49%*

Source: Wenck, 2015

[1]Total acres for each farm are based on the total acreage in the parcel, not the total acres that are actually farmed. Acreages were rounded to the near acre. Totals and percentages provided are rough estimates based on rounded acreage.

[2]Flooded and Non-flooded conditions are based on the USACE elevations modeled for the 100-year flood. Flood indicates the estimated acreage that is anticipated to be inundated during the 100-year. Non-flood indicates the estimated acreage that is anticipated to not be inundated during the 100-year flood.
[3]Proposed Project 100-year flood refers to the additional area that would flood for the 100-year flood during Project operation.
[4]Total farm acreage is based on total parcel acreage for the Parcel Identification Numbers provided by the farmers, which includes their reported organic farm acreage. In all cases the organic farm acreage reported by the farmer is less than the total parcel acreage associated with the farmed Parcel Identification Numbers. ArcGIS was used to map and evaluate the organic farm acreage using the available Parcel Identification Numbers data. Surveys and delineations of actual organic farm acreage were not available, and therefore, the Parcel Identification Number information was the best available information at the time of EIS publication.

The potential financial impact of crop loss or loss of organic certification is dependent on a number of variables, including market rate for organic versus traditional crops, and buyer perceptions associated with purchasing organic products grown under flooded conditions. As discussed, many factors influence the significance of the potential impact on agricultural land and organic farms from the Project. Mitigation has been proposed for agricultural and organic farm impacts, including flowage easements and land acquisition. A variation of crop insurance could also be a potential mitigation; however, since it is unknown the extent of impacts and how certification would be affected for any one agricultural producer it would have risk. Estimated costs for land acquisition, including right-of-way and easements were previously discussed above. Mitigation is further described in subsection 3.16.3 Proposed Mitigation and Monitoring Methods below.

3.16.2.3.9 Flood Fighting

The stress associated with the continued threat of flooding and the flood fight efforts is currently a significant issue in the F-M area (FFREIS, Appendix D, 2011). Project construction and operation would reduce the stress experienced by communities and individual property owners/renters in the Benefited Areas by reducing the threat of flooding and flood fighting efforts. Historically, constructing the emergency levees has taken significant financial and human resources, has caused business and traffic disruptions, and was wearing on the social fabric of the communities. Although constructing emergency levees have been successful in the past, they are at high risk of catastrophic failure, which would result in significant damage in the surrounding area and potential loss of life. The Project is expected to reduce the need for flood fighting in the F-M urban area, and therefore, reduce disruption to normal community activities that have typically occurred during past flood events. The Project would also reduce threats to life/safety associated with flood fighting and emergency personnel both in the Benefited Area and mitigated Unbenefited Area.

Although the risk, depth, and duration of flooding may increase under Project conditions within the Unbenefited Area, many of these property owners already experience the social and financial burdens associated with flooding. Many of these residents would be relocated to areas outside of the floodplain or to the protected ring levee communities. Other residents and property owners would be mitigated for impacts through nonstructural measures or by flowage easements. Therefore, it is expected that Project mitigation would overall reduce the social and economic costs to those within the Unbenefited Areas as well. Overall risk, stress and economic burdens associated with flood fighting would be reduced up to a 500-year event.

3.16.2.3.10 Geographical Extent Social and Economic Impacts: Minnesota and North Dakota; Benefited and Unbenefited Areas

Minnesota and North Dakota

Some comments received during the federal process and again during the SEAW and Draft EIS public comment periods pertained specifically to Minnesota's involvement in the Project. Some Minnesotans expressed concern for the burden that would be placed on Minnesotans when Minnesota did not face the same flood threats and flood damages that Fargo experienced (see USACE FFREIS Appendices R and S, 2011; USACE Supplemental EA, Appendices E and F; MNDNR FSDD, Public Comments and Agency Responses to Public Comments Received, 2014; and Final EIS Appendix L).

The Red River floodplain extends to both the North Dakota and Minnesota side of the Red River; both states have been impacted by flooding on the Red River at similar ground elevations (however, a large portion of Moorhead is at a higher ground elevation than Fargo) (Figure 30). Both cities have completed, funded, and proposed FDR projects (Moorhead $137,281,000; and Fargo $187,274,000 (see Chapter 2)), so overall flood reduction benefits would be experienced by both Minnesota and North Dakota. For example, the number of structures impacted during a 25-year flood through a 500-year flood would be reduced under Project conditions for both states.

The average annual damage under the Project for the study area is approximately $10 million. Damages in North Dakota and Minnesota are estimated to be reduced by 84 percent and 38 percent, respectively, from the existing conditions. Using the information from Table 3.78 and Table 3.79, the Project would provide direct protection primarily to North Dakota. The damage reduction benefits in North Dakota would be focused primarily on the Fargo urban area (Fargo and West Fargo). The Project would begin to provide benefit in Fargo at the 10-year flood with increasing performance up to the 500-year flood, with maximized benefits experienced up to the 100-year flood. The Project would begin to provide measurable protection to Minnesota between the 50-, 100-, and 500-year floods; the benefited area being the Moorhead urban area.

It is important to note that when considering the quantitative information presented above regarding costs and damages, for example, that social conditions of the area be considered as well. Focusing on the F-M urban area, Moorhead, in the last four decades, has experienced a slower growth rate than Fargo, North Dakota and is smaller in population than Fargo, making up about 27 percent of the overall population between the two cities. Due to the urban size differences, it would be expected that numbers presented such as number of jobs, damages and costs would be less for Minnesota.

Regardless of these differences, the two cities do share economic vitality. If Moorhead were to be protected from a large-scale flood event such as a 100-year flood, and Fargo was not protected, it is likely that Minnesota would still be affected both socially and economically. Socially, stress from the fear of flood damage and human safety would be reduced. However, the stress of a neighboring community experiencing flood damage that shares in social and economic vitality would occur. Many Minnesota damages and losses quantitatively described above would still occur, albeit reduced. Minnesota would, for example, experience loss of employment or income as many residents reside in one state but, work in the other. According to the Greater Fargo Moorhead Economic Development Corporation, 13,377 persons, or about

39 percent of Clay County residents, work in Cass County. Alternately, 4,646 Cass County residents are employed in Clay County, or about five percent. Local businesses depend on customers from both cities/states. Impacts to shared public infrastructure and services, such as utilities or emergency services, could also affect those in Minnesota.

Both states would experience social and economic impacts from implementation of the Project. Residences and businesses may directly be impacted by construction or operation of the Project, resulting in property buyouts or other measures (see subsection 3.16.2.3.5 Effects of Relocations and Flowage Easements). The local governments would be expected to cover some of the Project construction, operation and maintenance costs (see FFREIS Section 3.14 Implementation Requirements); however, the Project is anticipated to provide employment opportunities and income (both direct and indirect) from the operation and maintenance of the Project.

Of the total benefits from the project approximately 10,229 acres, or about 14 percent, are within Minnesota. The total newly inundated acres in Minnesota are 12,317; an addition of 2,088 acres of inundation over existing conditions. This is largely due to higher ground in Minnesota and efforts of the City of Moorhead to manage flood risk. Minnesota would have more acres impacted than benefited in total (considering new and removed floodplain). North Dakota would see 62,694 acres benefited, or about 86 percent of the Project benefits. The total newly inundated acres in North Dakota is 8,145; a reduction of 54,549. The area upstream of the tieback embankment, referred to as the Unbenefited Area, would experience the majority of negative impacts from the Project and would affect both states.

Under the same 100-year flood event 317 total structures would be impacted in Minnesota while 511 total structures would be impacted in North Dakota. Structures that occur within the FEMA revision reach would be mitigated by the USACE and Diversion Authority as described throughout this section. Mitigation for structures outside the FEMA revision reach would be determined on a case-by-case basis. Both states would have communities that would benefit from the protection of a ring levee within the staging area; OHB and Comstock.

Benefited and Unbenefited Areas

Conclusions from the USACE's OSE study indicate that while the Project would reduce the stress, anxiety, and related psychological effects of flood and flood potential to those in the F-M urban area, the Project would cause considerable social disruptions for the communities and residents within the inundated areas, particularly those within the upstream inundation area south of the tieback embankment. Similar concerns were communicated in comments received during the federal process and again during the SEAW and Draft EIS public comment periods. Some communities and individuals expressed that the Project would unfairly place the burden of social and economic losses to those who reside and or work outside of the F-M urban area; and that the stress and economic hardship the Project would place on these communities and individuals was great (see USACE FFREIS Appendices R and S, 2011; USACE Supplemental EA, Appendices E and F; MNDNR FSDD, Public Comments and Agency Responses to Public Comments Received, 2014; and Final EIS Appendix L).

The Benefited Area would gain from the Project from a reduced flood risk perspective. The stress associated with the continued threat of flooding and the flood fight efforts is currently a significant issue to these communities (FFREIS, Appendix D, 2011). Project construction and operation would reduce the stress experienced by communities and individual property owners/renters by reducing the threat of flooding and flood fighting efforts (see above discussion under subsection 3.16.2.3.9 Flood Fighting).

Although many communities and rural properties located within the Unbenefited Area experience flooding under existing conditions; Project operation would increase flood water depth in many areas and would also result in new inundation to areas that currently are not within the floodplain. Currently, this area is at risk of local levees overtopping; however, the increased frequency of flood events and increased water levels resulting from Project operation would increase this risk, and thereby stress, for potential property damages and loss of life for residents, local business owners, and or farmers. It should be noted; however, that it is anticipated that relocated residents from within the Unbenefited Area would settle in areas not prone to flooding, or within the communities of OHB and or Comstock, which would be protected by ring levees. This would reduce flood-related stress and reducing overall social impacts from a flood-risk reduction project.

Health and safety and economic vitality were two factors identified to be most important to all residents within the USACE's OSE study area. Implementation of the Project would considerably improve both of these factors for residents within the Benefited Area. Protection of medical infrastructure and economic activities within the F-M urban area would also indirectly benefit the entire study area. However, many of those within the Unbenefited Area would not receive any direct benefits and would be negatively affected due to increased flood risk and Project-associated actions (e.g., buyouts, relocations). Residents within the Unbenefited Area (identified generally as Area 1 for the OSE study) were likely to experience considerable negative impacts from Social Connectedness and Economic Vitality social factors due to the number of relocations associated with mitigation measures.

Pertaining to economic vitality, the F-M urban area, as part of the Benefited Area, serves as a regional center for employment, commerce, and educational and training opportunities. Implementation of the Project would reduce the flood risk and damages that would otherwise result in business losses, potentially higher unemployment, and add to the economic vitality of the F-M urban area. However, the Unbenefited Area would experience negative effects to economic vitality. Induced flooding and acquisitions of structures would require businesses to relocate to other areas and may result in associated loss of employment. Future land development would be limited due to restrictions imposed by flowage easements and increased flood risk. Relocations would likely result in a loss of tax revenue and may impact local municipalities and local governments to provide services to the remaining residents and businesses within their jurisdictions; however, the effect of loss of tax revenue is less of an impact considering the inclusion of the OHB ring levee as Project component (see above discussions under subsection 3.16.2.3.5 Effects of Relocations).

The USACE's OSE study concluded that regarding the negative impacts that would be experienced by those within the Unbenefited Areas, reducing flood risk and flood costs from a long-term perspective would benefit not only those residents, business owners, workers, and public servants within the Benefited Area; but to all within the study area and region. Therefore, implementation of a flood-risk reduction project was regarded as providing the greatest social benefit to the area.

It is important to note when considering the conclusions of the OSE study that the OHB ring levee was not a Project component at the time of the OSE study. Conclusions of the OSE study assumed that the communities of Oxbow, Hickson, and Bakke would be impacted by the Project. This would have increased the number of residents and businesses that would be affected by the Project as well as tax base revenues as the communities of Oxbow, Hickson, and Bakke combined represent one of the larger population bases within the Unbenefited Area.

3.16.2.4 Base No Action Alternative

The Base No Action Alternative includes the potential flood risk reduction impact of existing and currently funded permanent projects such as levee construction (i.e., structural measures) and property buyouts (i.e., non-structural measures). This alternative does not include emergency measures currently pursued in the project area as necessary due to flooding, and therefore, the Base No Action Alternative would have flooding where the water level exceeds the tie-in of levees to natural ground. Figure 11 illustrates the current areas of flooding in the F-M area during the 100-year flood. Additional information on the Base No Action Alternative is presented in Chapter 2, Section 2.2 – No Action Alternatives.

The Base No Action Alternative for this EIS includes all of the permanent levee segments identified in the FFREIS; however, credit given to existing levees varied (FFREIS Appendix H – “Credit to Existing Levees” as no credit was given for emergency measures that were necessary to fill gaps between the existing permanent level segments). The FFREIS No Action Alternative also did not include the in-town levees that are currently proposed or under construction as part of the Base No Action Alternative.

3.16.2.4.1 Construction, Operation and Maintenance

The Base No Action Alternative would include construction and maintenance of FDR projects, but would not include construction, operation and maintenance of a large-scale flood control project. It should be noted that the economic impacts of smaller FDR projects were not evaluated for any of the alternatives in the SE Report (HMG, 2015a).

3.16.2.4.2 Infrastructure and Public Services

The existing network of infrastructure and public services would continue to be operated and maintained, including during flood events as feasible. During flood events under the Base No Action Alternative, many roads and utilities in the urban and rural areas are impacted with inundation. This results in potential impacts of loss of water and sewage services, contamination of public water supplies, compromised natural gas systems, and other utility damages, as well as potential impacts to travel and emergency services response times.

The USACE provided an evaluation of impacts to transportation systems in the FFREIS Appendix D (transportation study). The transportation study evaluated impacts to vehicle traffic, rail systems, and air travel from the historic flood in 2009. The evaluation found significant impacts to transportation networks with the 2009 event (which equates to approximately a 50-year flood). In particular, roadway impacts included:

- Submerging of roadways from overland and riverine flooding from the Red, Wild Rice, Sheyenne, Maple, Rush, and Lower Rush Rivers;
- Roadway used for temporary levees;
- Central travel corridors repurposed to sand bag distribution routes; and
- Congestion increased with emergency responders.

USACE found that transportation impacts increase for flood fighting activities with a 50-year event and greater due to increased flood fighting activities. Furthermore, transportation impacts increase from local detours with the 100-year and 500-year floods as flood inundation limits and duration increase.

The transportation study found that air and rail traffic are unaffected until a 100-year event. Under current conditions the railroads crossing the Red River at Fargo must be shut down to build dikes across the rail embankment during the 100-year event and above, which shuts down the rail traffic through the Fargo-Moorhead area and impacts the operation of the rail yard in Fargo and rail yard in Dilworth. According to the May 2014 North Dakota State Freight Plan, produced by North Dakota Department of Transportation (NDDOT), 127 trains per day passed through Fargo-Moorhead in 2012. The USACE estimated equivalent expected annual damages to transportation for the FFREIS No Action Alternative condition to be of $3.7 million (October 2011 dollars).

3.16.2.4.3 Impacts to Structures and Structure Function

Under the Base No Action Alternative, structures and structure functions would continue to be impacted. Although flood risk is reduced by existing and currently funded projects, the F-M area would experience substantial losses during flood events. During large scale flood events, these losses would expect to increase dramatically when flood waters begin to flow around the levees where the water level exceeds the tie-in elevations to natural ground. Considerations for interpretation of information presented in Table 3.87 and Table 3.88 below are similar to those described for the Project.

<u>Impacts to Structures</u>

Table 3.87 summarizes the SE Report's estimated impacts to structures (damages) that occur under the Base No Action Alternative condition. Over 17,400 structures in the study area under current conditions are subject to flooding during the 100-yr flood. Ninety-four percent of structure impacts occur within the F-M urban area; however, only four percent of those occur within Minnesota.

Table 3.87 Structures Impacted under the Base No Action Alternative During the 10-year, 25-year, 50-year, 100-year, and 500-year Floods

Location	10-year Flood	25-year Flood	50-year Flood	100-year Flood	500-year Flood
North Dakota					
Fargo Damaged Structures[1]	502	3,473	11,673	15,767	26,060
Remaining Cass County Damaged Structures[2]	236	549	723	947	1,368
Richland County Damaged Structures[3]	0	0	4	18	53
Total Damaged – North Dakota	**738**	**4,022**	**12,400**	**16,732**	**27,481**
Minnesota					
Moorhead Damaged Structures[1]	9	23	210	616	1,382
Remaining Clay County Damaged Structures[2]	12	66	104	135	230
Wilkin County Damaged Structures[3]	0	1	1	3	37
Total Damaged – Minnesota	**21**	**90**	**315**	**754**	**1,650**
Structures Damaged within FM urban area[1]	**511**	**3,496**	**11,883**	**16,383**	**27,442**
TOTAL Damaged Structures (Base No Action Alt.)[4]	**759**	**4,112**	**12,715**	**17,486**	**29,131**

Source: HMG, 2015a

[1]Based on HAZUS level 3 evaluation using COE HEC-FDA structure inventory

[2]Based on HAZUS level 2 evaluations with HAZUS default county data for remaining portions of Clay and C ass counties not covered by the structure inventory

[3]Based on HAZUS level 2 evaluations with HAZUS default county data for Richland and Wilkin counties

[4]Includes both the level 3 and level 2 analysis results

The SE Report’s estimated damages for the Base No Action Alternative, average annual damages, are approximately $51 million (Table 3.88). This includes damages not only to the structures identified in Table 3.87 above but also damage costs associated with structure contents and vehicles. The majority (92%) of those damages are to residential, commercial, and industrial properties and their contents.

Under the Base No Action Alternative, nearly all of the flood damages (99%) are located in the F-M urban area. The largest damages (96%) are in the Fargo ($48 million) and four percent of the total damages ($2 million) are in Moorhead (Table 3.88).

Table 3.88 Base No Action Alternative Estimated Damages to Buildings and Contents; and Vehicles ($ Millions)

Return Period	10-year	25-year	50-year	100-year	500-year	Average Annual Damage[1]
Damages - North Dakota						
Fargo						
Buildings and Contents	$28	$156	$720	$1,322	$3,952	$46
Vehicles	$10	$15	$43	$64	$188	$3
Total Fargo	$38	$170	$763	$1,386	$4,140	$48
Remaining Cass County						
Buildings and Contents	$0	$1	$1	$1	$2	$0
Vehicles	$1	$1	$2	$2	$3	$0
Total Remaining Cass County	$1	$2	$3	$3	$5	$0
Richland County						
Buildings and Contents	$0	$0	$0	$0	$0	$0
Vehicles	$0	$0	$0	$1	$1	$0
Total Richland County	$0	$0	$0	$1	$1	$0
Total North Dakota	$39	$172	$766	$1,390	$4,146	$48
Damages - Minnesota						
Moorhead						
Buildings and Contents	$0	$2	$14	$29	$66	$1
Vehicles	$6	$7	$9	$11	$15	$1
Total Moorhead	$7	$10	$24	$40	$81	$2
Remaining Clay County						
Buildings and Contents	$2	$2	$2	$2	$3	$0
Vehicles	$1	$1	$1	$1	$2	$0
Total Remaining Clay County	$3	$3	$3	$3	$5	$0
Wilkin County						
Buildings and Contents	$0	$0	$0	$0	$0	$0
Vehicles	$0	$0	$0	$0	$1	$0
Total Wilkin County	$0	$0	$0	$0	$1	$0
Total Minnesota	$10	$13	$27	$43	$87	$2
Total Damages						
Buildings and Contents	$31	$161	$739	$1,355	$4,024	$47
Vehicles	$18	$25	$55	$79	$208	$4
Total	$50	$187	$794	$1,434	$4,232	$51

Source: HMG, 2015a

[1] Average Annual Damage represent the average damage that would occur in any given year, spread over the 50-year life cycle of the Base No Action Alternative (FFREIS Appendix C "Economics").

The $51 million in average annual damages estimated varies from the USACE 2011 study, which computed existing conditions damages of $194 million with USACE Hydrologic Engineering

Center's Flood Damage Reduction Analysis (HEC-FDA).[7] Differences between the models make a comparison of results inappropriate. Notable reasons for the difference in damage estimates are:

- Inclusion of funded and recently constructed levees in the Base No Action Alternative
- Updated hydraulics
- Conversion of model frameworks from HEC-FDA to HAZUS.

Proprietary information about commercial damages is protected by non-disclosure agreements; therefore the data was removed from the HEC-FDA inventory by the USACE prior to releasing the model to the MNDNR. These commercial properties accounted for approximately $20 million in damages in the USACE damage estimate and are not accounted for in this analysis.

The MNDNR completed a more detailed structure count analysis for the area encompassing the staging areas and the additional upstream inundated areas associated with the Project and NAA alternatives. The number of structures and parcels impacted within the same geographic area under the Base No Action Alternative were also counted for comparison with the action alternatives. The numbers are included in Table 3.87 and Table 3.88 above.

Loss of Structure Function

Average annual direct and indirect impacts from loss of building function are summarized below in Table 3.89. The Base No Action Alternative would maintain the flood related relocation costs. The estimated average annual existing relocation costs are approximately $55 million.

Impacts to business losses were estimated with the direct impacts to output run through the IMPLAN model, resulting in average annual impacts. The IMPLAN model provided average annual estimated indirect impacts to output; average annual direct and indirect impacts to employment, labor income, and value added; and average annual impacts to taxes. Existing conditions flooding generated an average annual direct loss of $1,013 million in business output. During flooding approximately 9,500 jobs are impacted with average income losses of $48,000 per employee. When combined with the indirect and induced impacts, flooding generates over $1.6 billion in business output losses and affects nearly 16,000 jobs. Additionally, business activity losses (economic output and employment) reduce overall tax collections by approximately $114 million.

[7] "The socioeconomic analysis incorporates new and updated economic and hydraulic information in addition to what was incorporated into economic models developed for the FFREIS. Therefore, the EIS model outputs are not a side-by-side comparison of economic model outputs developed for the FFREIS and will not be comparable to model outputs that were presented in the FFREIS or model outputs that would result from applying the model platform used for the FFREIS."

Table 3.89 Base No Action Alternative Summary of Average Annual Impacts from Loss of Building Function ($ Millions)

Description	Direct Impact	Indirect Impact	Induced Impact	Total Impact
North Dakota				
Business Losses				
Output	$980	$266	$266	$1,512
Employment	9,202	3,018	3,562	15,782
Labor Income	$350	$101	$96	$548
Gross Regional Product	$547	$157	$163	$866
Total State and Local Tax	$110	-	-	$110
Disruption Costs	$3	-	-	$3
Relocation Costs	$53	-	-	$53
Minnesota				
Business Losses				
Output	$33	$6	$4	$43
Employment	299	46	35	380
Labor Income	$11	$2	$1	$14
Gross Regional Product	$17	$3	$2	$23
Total State and Local Tax	$4	-	-	$4
Disruption Costs	$1	-	-	$1
Relocation Costs	$2	-	-	$2
Total				
Business Losses				
Output	$1,013	$272	$270	$1,555
Employment	9501	3064	3597	16162
Labor Income	$361	$103	$97	$562
Gross Regional Product	$564	$160	$165	$889
Total State and Local Tax	$114	-	-	114
Disruption Costs	$4	-	-	$4
Relocation Costs	$55	-	-	$55

Source: HMG, 2015a

3.16.2.4.4 Flood Insurance

It is assumed that the Base No Action Alternative would not reduce flood insurance requirements beyond those potentially impacted by the already completed and currently funded permanent projects.

3.16.2.4.5 Effects of Relocations and Flowage Easements

Under the Base No Action Alternative, some portions of the F-M urban area would continue to flood. FDR projects (e.g., in-town levees and floodwalls) and plans for additional property buyouts in these areas would continue as funding and feasibility allows. This would result in relocation of residences and businesses, including the Park East apartments with 122 apartment units. Over 400 residential buyouts have already occurred since 2009, and property owners in the F-M urban area have relocated out of the floodplain or to locations protected by in-town levees and floodwalls. These relocations have affected individual neighborhoods. This level of relocation causes a significant socioeconomic impact to affected residents, businesses, and neighborhoods.

3.16.2.4.6 Effects on Property Improvements

Flood waters have the potential to cause impacts and damages to not only structures on a property but to improvements on the property such as wells and septic systems. The potential impact of flood inundation on wells and septic systems under the Base No Action Alternative would be similar to those described for the Project. Where there is potential for flood inundation under the Base No Action Alternative, Minnesota Rules, part 4725, which regulates wells for groundwater and drinking water sources, would be followed for requirements regarding flood protection for water-supply wells. In Minnesota, septic systems are regulated by Minnesota Rules, part 7080.2270, which require placement of SSTS components outside of a floodway and avoidance of the 100-year floodplain.

3.16.2.4.7 Effects on Cemeteries

The Cemetery Study completed by the USACE in June 2014 (http://www.fmdiversion.com/studies-technical-documents/) identified that there were 54 cemeteries located within a defined study area (see Figure 1 of Cemetery Study). The purpose of the study was to determine whether or not a cemetery may be impacted by the Project; the Base No Action Alternative served as the comparison for this study. The study evaluated the existing flood conditions for the 10-year, 50-year, 100-year, and 500-year floods as well as what the water elevations would be at each cemetery under Project conditions.

The results of that study determined that of the 54 identified cemeteries studied, 20 did not flood under current conditions (under a 100-year scenario). Thirty cemeteries currently experience flooding from a 100-year event with depths of between 0.4 (Clara Cemetery, Clay County) and 17.2 feet (Hector Memorial Cemetery, Cass County) and durations ranging from 1.5 (Roen Family Cemetery, Clay County) to 32.5 days (Hector Memorial Cemetery, Cass County). Four cemeteries where found to be located outside of model extent.

During development of the Cemetery Study, the USACE met with cemetery points of contact (POCs) to inquire about existing conditions. The POC interviewees were asked to document previous cleanup efforts required after floodwaters receded. Clean up efforts after flooding included:

- Removal of sediment that has been deposited
- Stabilizing banks where erosion has occurred
- Repairing eroded areas
- Removal of temporary measures that prevent flooding (flood walls)
- Road, driveway, and parking lot repairs
- Returning gravestones to grave sites
- Leveling gravestones
- Repairing gravestones
- Replanting of vegetation that has died.

Patrons of the cemeteries that already flood under current conditions experience the social and economic effects as described under subsection 3.16.2.3.7.

Cemeteries are considered for inclusion to the NRHP if they are considered integral parts of historic districts or fall within the purview of National Register eligibility. Clara Cemetery, St. Benedicts Cemetery, and Lower Wild Rice and Red River Cemetery both have been deemed eligible. Hoff Cemetery, South Pleasant/Lium Cemetery, and Wolverton Cemetery (aka Salem

Lutheran Cemetery) have been deemed ineligible. The remaining cemeteries within the study area are considered to be undetermined; meaning that site survey work hasn't been completed at these sites that would go towards determining eligibility. See Section 3.12 Cultural Resources for more discussion on cemeteries.

3.16.2.4.8 Agricultural Impacts

The majority of the project area is rural and currently used for agriculture. Under the Base No Action Alternative, agricultural land currently subject to flooding during the 100-year flood would continue to be inundated by flood water. Results of the NDSU Initial Ag Impact Study revealed that a majority of the acres within the staging area (see Figure 1 of the NDSU Initial Ag Impact Study) flood under most large flood events under current conditions. It should be noted that an assumption of the model was that all land within a given storage area was equally affected (i.e., elevation was averaged over a storage area so results should be considered in context). In addition, Federal crop insurance indemnities were not included in this study. This is important as natural flood events are covered under Federal crop insurance.

As previously described above, there are four organic farms located within the vicinity of the inundation area in addition to the traditional agricultural operations. Of the four organic farms, as summarized in Table 3.90, Farm 1 and Farm 2 each have over 100 acres that is inundated during the Base No Action 100-year flood. Farm 3 has approximately 10 acres of inundation, while Farm 4 does not flood during the 100-year flood. Approximately 310 acres of organic farm land, or approximately seven percent, flood during the existing 100-year flood. The MNDNR was unable to verify whether flooding has in the past affected the organic certifications for Farm 1 and 2.

Table 3.90 Organic Farm Acreage By 100-Year Flood for Base No Action Alternative[1 2 3 4]

Farm		Area (acres)	Percent of the Total Acreage (%)
Farm 1: 997 acres	*Flooded*	*131*	*13%*
	Non-flooded	*867*	*87%*
Farm 2: 1,330 acres	*Flooded*	*168*	*13%*
	Non-flooded	*1,162*	*87%*
Farm 3: 835 acres	*Flooded*	*10*	*1%*
	Non-flood	*824*	*99%*
Farm 4: 1,208 acres	*Flooded*	*0*	*0%*
	Non-flooded	*1,208*	*100%*
TOTAL: 4,370 acres	*Flooded*	*309*	*7%*
	Non-flooded	*4,061*	*93%*

Source; Wenck, 2015

[1]Total acres for each farm are based on the total acreage in the parcel, not the total acres that are actually farmed. Acreages were rounded to the near acre. Totals and percentages provided are rough estimates based on rounded acreage.

[2]Flood and Non-flood conditions are based on the USACE elevations modeled for the 100-year flood. Flood indicates the estimated acreage that is anticipated to be inundated during the 100-year. Non-flood indicates the estimated acreage that is anticipated to not be inundated during the 100-year flood.

[3]Base No Action Alternative 100-year flood refers to the area that would flood under the existing 100-year flood. This flood inundation would occur whether or not the Project or NAA were constructed and operated.

[4]Total farm acreage is based on total parcel acreage for the PIDs provided by the farmers, which includes their reported organic farm acreage. In all cases the organic farm acreage reported by the farmer is less than the total parcel acreage associated with the farmed PIDs. ArcGIS was used to map and evaluate the organic farm acreage using the available PIDs data. Surveys and delineations of actual organic farm acreage were not available, and therefore, the PID information was the best available information at the time of EIS publication.

The Base No Action Alternative would pose potential financial impacts from crop loss or loss of organic certification where flooding occurs. The magnitude of these impacts would be dependent on a number of factors, such as timing and extent of flooding and type of crop. Effects of flooding to organic farm certification would be determined on a case-by-case basis (Appendix K).

3.16.2.4.9 Flood Fighting

Under the Base No Action Alternative, flood fighting and other emergency measures would not be implemented. Where levees and other permanent structures cannot hold back the flood water due to elevation, areas behind the structures would be inundated with flooding.

3.16.2.4.10 Geographic Extent Social and Economic Impacts: Minnesota and North Dakota, Benefited and Unbenefited Areas

Minnesota and North Dakota

Under the Base No Action Alternative, the flooding conditions in Minnesota and North Dakota would remain the same and would not be influenced by a large-scale flood control project. Flood damages and the social and economic effects resulting from large flood events would continue under the Base No Action Alternative. The estimated average annual damages for the F-M area are approximately $51 million (HMG, 2015a). The majority (92%) of the damages are to residential, commercial, and industrial properties and their contents. Appreciable damage begins with the 10-year flood and increases at the 50-year flood and above. Nearly all of the flood damages (99%) are located in the F-M urban area. The largest damages (96%) are in Fargo ($48 million) and four percent of the total damages ($2 million) are in Moorhead.

Benefited and Unbenefited Areas

Under the Base No Action Alternative, communities, residents, and businesses would continue to experience flooding resulting in social and economic impacts, including emotional, physical, and financial loss. Completed and planned permanent levees and floodwalls reduce some of the risk and extent of flooding within the F-M urban area. Section 2.2 provides greater detail on the levee locations, elevations, and level of protection. The remaining areas, primarily rural areas and some of the F-M urban area, depending on the magnitude of the flood, would be impacted by flood inundation and considered Unbenefited.

3.16.2.5 No Action Alternative (with Emergency Measures)

The No Action Alternative (with Emergency Measures) includes the potential flood risk reduction impact of existing and currently funded permanent projects such as levee construction and property buyouts. This alternative also assumes that emergency measures similar to those that have been historically implemented in the project area would continue to be implemented as necessary due to flooding. Additional information on the Base No Action Alternative (with Emergency Measures) is presented in Section 2.2 – No Action Alternatives.

3.16.2.5.1 Construction, Operation, and Maintenance

The No Action Alternative (with Emergency Measures) would include construction and maintenance of FDR projects, but would not include construction, operation and maintenance of a large-scale flood control project.

3.16.2.5.2 Infrastructure and Public Services

The existing network of infrastructure and public services would continue to be operated and maintained, including during flood events as feasible. During the 100-year flood under the No Action Alternative (with Emergency Measures) impacts to infrastructure and public services would be similar to what was previously discussed for the Base No Action Alternative. Under the No Action Alternative (with Emergency Measures), flood inundation of infrastructure in the urban area may be less, as temporary flood protection measures could be implemented to protect specific infrastructure as needed and feasible.

3.16.2.5.3 Impacts to Structures and Structure Function

The uncertainty of the effectiveness of emergency measures in fighting floods is beyond the capabilities of HAZUS modeling; therefore, this alternative was not quantifiably analyzed. However, it is estimated that impacts to structures would be somewhat similar, but not the same as those presented above in Table 3.87, Table 3.88, and Table 3.89 under the Base No Action Alternative discussions.

3.16.2.5.4 Flood Insurance

It is assumed that the No Action Alternative (with Emergency Measures) would not reduce flood insurance requirements beyond those potentially impacted by the already completed and currently funded permanent projects.

3.16.2.5.5 Effects of Relocations and Flowage Easements

Under the No Action Alternative (with Emergency Measures), effects of relocations would be similar to those described for the Base No Action Alternative. Implementing emergency measures has reduced flood risk in the past, but would have uncertainty in having consistent success in implementing these measures in the future. Uncertainty may result in individual property owners deciding to relocate out of the flood-prone areas. This level of relocation is not anticipated to cause significant socioeconomic impacts.

3.16.2.5.6 Effects on Property Improvements

Flood waters have the potential to cause impacts and damages to not only structures on a property but to improvements on the property such as wells and septic systems. The potential impact of flood inundation on wells and septic systems under the No Action Alternative (with Emergency Measures) would be similar to those described for the Project. Where there is potential for flood inundation under the No Action Alternative (with Emergency Measures), Minnesota Rules, part 4725, which regulates wells for groundwater and drinking water sources, would be followed for requirements regarding flood protection for water-supply wells. In Minnesota, septic systems are regulated by Minnesota Rules, part 7080.2270, which require placement of SSTS components outside of a floodway and avoidance of the 100-year floodplain.

3.16.2.5.7 Effects on Cemeteries

The Cemetery Study completed by the USACE in June 2014 (http://www.fmdiversion.com/studies-technical-documents/) identified that there were 54 cemeteries located within a defined study area (see Figure 1 of Cemetery Study). The purpose of the study was to determine whether or not a cemetery may be impacted by the Project; the Base No Action Alternative served as the comparison for this study. The study did not account for emergency measures in the modeling. However, the discussion under subsection 3.16.2.4.7 above would apply for the No Action Alternative (with Emergency Measures) as emergency measures are representative of those actions that are currently employed during large events under current conditions. See Section 3.12 for more information on cemeteries.

3.16.2.5.8 Agricultural Impacts

Under the No Action Alternative (with Emergency Measures), impacts to agriculture would be similar to those described for the Base No Action Alternative. However, additional acres of agricultural land may be impacted under the No Action Alternative (with Emergency Measures) due to increased inundation upstream in the rural areas from implementation of emergency measures in the urban area.

3.16.2.5.9 Flood Fighting

Emergency measures are intended to temporarily protect specific areas from flooding that do not have permanent flood damage reduction projects in place or enhance existing flood damage reduction projects, where there are gaps in levee protection between each of the individual projects, for example. Where gaps in protection exist, a temporary levee may be constructed to tie into existing levees to reduce flood risk from occurring behind the levee or overtopping an existing levee. Implementation of emergency measures could result in upstream stage increases larger than those under full levee protection for the Base No Action Alternative. This alternative could reduce flood risk in some areas not protected under the Base No Action Alternative, while increasing flooding in other areas upstream.

Flood forecasting, through modeling and other methods, is used to predict the flood crest and its timing as a specific gage. This allows the F-M area to prepare and implement emergency measures as needed. However, flooding is a natural occurrence that is complex and uncertain. This means that communities are required to plan for a wide range of flood stages, especially when probabilistic forecasts are made. Uncertainties with flood forecasting along with several other factors have made the probability of having consistently successful emergency efforts in the future low, especially for flooding events larger than the 100-year flood. These factors include variable and extreme temperatures and weather conditions during March and April when flooding typically occurs. These conditions also complicate flood crest predictions and emergency measures implementation. Winter snowfall and precipitation can be monitored to predict potential levels of spring runoff that influence flooding and flood levels. Flood crest elevations are predicted in the project area by the National Weather Service in order to provide as much time as possible to implement emergency measures. The flood crest is the highest level of a flood as it passes a particular location. The higher the flood’s crest elevation, the more time and effort are needed to construct emergency measures increasing the probability of failure as the time available to implement is more likely to be insufficient.

Local governments in the project area have flood emergency plans in place outlining the implementation steps, emergency measures, and the locations for each of the measures. These emergency measures may include temporarily raising permanent levees, constructing temporary levees and other temporary flood barriers in various areas, and sandbagging. The locations of each type of emergency measure are mapped with instructions for implementation at various times and stages of flooding. Emergency measures, primarily implemented in the F-M urban area, require significant financial and human resources. During past large flood events, such as the 2009 flood, 80 miles of temporary emergency levees were constructed, requiring more than 7.3 million sandbags and thousands of volunteers. Construction of emergency measures typically occurs on frozen ground, which adds to greater difficulty and risk to implementation. Additionally, due to successful emergency measures in the past, there is a perceived sense of security that may not reflect the true flood risk in the area. This has led to people staying to fight the flood rather than evacuate, which puts a greater number of people at risk if the emergency measures suddenly fail, during large flood events.

3.16.2.5.10 Geographic Extent Social and Economic Impacts: Minnesota and North Dakota, Benefited and Unbenefited Areas

Minnesota and North Dakota
Under the No Action Alternative (with Emergency Measures), the flooding conditions in Minnesota and North Dakota would remain the same and would not be influenced by a large-scale flood control project. Flood damages and the social and economic effects resulting from large flood events would continue as would flood fighting efforts. Under the No Action Alternative (with Emergency Measures) the estimated average annual damages for the F-M area are anticipated to be slightly less than those presented for the Base No Action Alternative; however, there is an additional cost of implementation of emergency measures, which varies depending on the magnitude of the flood.

Benefited and Unbenefited Areas
Under the No Action Alternative (with Emergency Measures), there are areas within the F-M urban area that are protected by permanent levees and floodwalls, plus implementation of temporary levees and floodwalls, and sandbagging, which would reduce the flood inundation in the F-M urban area. Section 2.2 provides greater detail on the levee elevations and level of protection. In general, implementation of emergency measures could protect the F-M urban area to at least a 50-year flood. However, there is high risk involved with relying on temporary measures for protection, which could result in catastrophic failure.

Areas outside of the F-M urban area are considered Unbenefited. These areas are primarily rural where permanent and emergency measures have limited use. Small communities may implement flood fighting measures depending on the flood, as well as some individual property owners to protect their homes or other property. Depending on the magnitude of the flood, the Unbenefited Areas would be impacted by flood inundation, which would cause damage to property, potential income loss, and effects on the emotional and physical well-being of individuals, families, and communities. During flood events, many communities and rural properties located within the Unbenefited Area would be flooded by the Red River and its tributaries.

3.16.2.6 Northern Alignment Alternative

The NAA was analyzed for its impacts on flood damage reduction and other social and economic factors using the previously described models, approaches, and considerations. Floodplains for the 10-, 25-, 50-, 100-, and 500-year floods with the NAA in place were developed for analysis under HAZUS. The extent of inundation from the 100-year flood under the Northern Alignment Alternative is shown in Figure 13.

3.16.2.6.1 Construction and Operations & Maintenance

The NAA is estimated to cost $1.87 billion (2010 price level)[8]. Construction is anticipated to occur over an eight and a half year period with maintenance occurring every year following construction. Table 3.91 provides a summary of construction costs included for the NAA. Note that proposed mitigation costs such as land acquisitions and road relocations are included as part of construction costs.

Table 3.91 Estimated Northern Alignment Alternative Construction Cost

Construction Component	NAA Cost (2010 dollars) [1 2 3 4 5 6 7 8 9 10]
Land Acquisition and Damages (right-of-way and easements)	$351,000,000
Relocations (utility relocations, roadway improvements and construction)	$149,000,000
Fish and Wildlife Facilities	$61,000,000
Railroad Bridges	$59,000,000
Channels and Control Structures	$784,000,000
Levees, Floodwalls, and Embankments	$163,000,000
Recreation Facilities	$29,000,000
Planning, Engineering, and Design	$187,000,000
Construction Management[8]	$87,000,000
TOTAL	$1,870,000,000

Source: HMG, 2015b

[1] Costs are rounded to the nearest $1 million.
[2] 2010 U.S. Dollars ($) construction costs; escalation is not included (estimate is not fully funded).
[3] Methodology similar to PFSAA phase except where feature designs differ as stated in this report.
[4] Contingency included. Contingency is an allowance for costs that would be in the Project Cost and are not included in the Contract Cost. Does not account for changed conditions either in the final design or during construction.
[5] Changes to 2010 material, labor, equipment or fuel opinion of cost are not reflected in the project costs presented above.
[6] Limited design work completed (<5%). Based on screening-level project definition. This screening-level (Class 5, <5% design completion per ASTM E 2516-06 and USACE EI 01D010 [9/1/97]) cost estimate is based on screening-level designs, alignments, quantities, and unit prices. Costs would change with completion of further design. A construction schedule is not available at this time. The estimated accuracy range for the total project cost as the project is defined is -50% to +100%.
[7] Quantities based on design work completed.
[8] Construction Management is estimated as 7% of construction costs.
[9] Land Acquisition and Damages includes Lands and Damages within the USACE-defined staging area; and Mitigation Area Easements
[10] Land Acquisition and Damages were based on both USACE detailed data and GIS residential and non-residential GIS data obtained through USACE 2014 desktop analysis.

The NAA would have similar impacts on economic activity (e.g., employment and income) during construction and annual O&M as previously described for the Project (Table 3.92). Total impact from construction spending is $3.1 billion for the NAA. Construction impacts would be spread over eight and one half years. Annual spending, employment, and indirect and induced effects would generate $190,000 in new tax revenues per year following construction. Tax revenues would be used by local governments to fund public services and infrastructure.

[8] Flood Diversion Authority, *Final Technical Memorandum, Opinion of Probable Construction Cost to Support MN/DNR EIS Northern Alignment Evaluation*, January 9, 2015.

Table 3.92 Northern Alignment Alternative Economic Impacts from Construction, Operation and Maintenance ($ Millions)

Description	Northern Alignment Alternative: Direct Impact	Northern Alignment Alternative: Total Impact[1]
Total Construction Impacts		
Output	$1,791	$3,100
Employment (in jobs)	12,045	22,049
Labor Income	$827	$1,295
Gross Regional Product	$872	$1,645
Total State and Local Tax	$113	$113
Annual Operations and Maintenance Impacts		
Output	$3	$5
Employment (in jobs)	20	37
Labor Income	$1	$2
Gross Regional Product	$1	$3
Total State and Local Tax	>$1	>$1

Source: HMG, 2015b

[1]Total impact includes the direct impact i.e., direct economic effects (direct response of an industry), the indirect effects (changes in output, income, and employment caused by direct impacts), and the induced economic effects (changes in output, income, and employment cause by expenditures associated with new household income generated by direct and indirect economic effects).

3.16.2.6.2 Infrastructure and Public Services

The NAA is anticipated to result in traffic impacts similar to those previously described for the Project with the exception that the NAA would close the County Road 16 bridge in North Dakota over the Red River during Project operation, and similar to the Base No Action, may impact the County Road 18 bridge during large flood events. Section 3.13 provides greater detail on potential impacts to infrastructure and public services.

Transportation impacts under the NAA are anticipated to be similar to those previously described for the Project. The NAA would reduce impacts to transportation networks within the urban area. Impacts to air and rail would also be reduced. Road closures noted under the Base No Action Alternative would be reduced in the urban area. The NAA would generate transportation impacts from closures to roadways and bridges in the rural areas where the inundation area or diversion channel occur. Under the NAA, flooding would create approximately $333,000 (2009 dollars) in average annual transportation impacts.

Based on preliminary design, impacts to utilities from the NAA would be similar to those described for the Project. Table 3.93 provides a summary of utility relocation costs for the NAA.

Table 3.93 Summary of Utility Relocation Costs for the Northern Alignment Alternative

Utility Relocation	Northern Alignment Alternative
Electric Power	$9,921,400
Natural Gas Pipeline	$997,600
Petroleum Pipelines	$1,016,000
Fiber Optic Lines	$5,376,400
Water Utilities	$2,313,000
Sanitary Sewer	$369,400
Total Utility Relocation Cost	**$19,993,800**

Source: HMG, 2015b

Under the NAA, access to healthcare facilities and emergency services would be similar to those previously described for the Project.

3.16.2.6.3 Impacts to Structures and Structure Function

The NAA would impact structures and structure function similar to what is described above under the Project. Section 3.16.2.3.3 includes a brief discussion on structure and structure function analyses completed and discussed herein as well as considerations in interpreting the information presented. Costs associated with NAA construction, including mitigation, were based on methodology used in the FFREIS and PFSAA (HMG, 2012).

Impacts to Structures

Similar to the Project, the SE Report results indicated that benefits from flood damage reduction to structures would begin to occur around the 25-year flood and incrementally thereafter, maximizing under the 100-year flood (Table 3.94). Out of the number of structures protected under the NAA during the 100-year flood, 91 percent of those would be within the F-M urban area. Two additional structures would be impacted in Richland County under the NAA. Wilkin County structure impacts would be expected to remain the same as the Base No Action Alternative (baseline conditions for study).

North Dakota would experience the greatest number of structure impacts under all flood scenarios. Under the 100-year flood, the number of structures impacted is 829 (about 90 percent); for Minnesota, the number of structures impacted is 91 (or 10 percent).

Table 3.94 Structures Impacted by the Northern Alignment Alternative During the 10-year, 25-year, 50-year, 100-year, and 500-year Floods [1]

Location	10-year Flood	25-year Flood	50-year Flood	100-year Flood	500-year Flood
North Dakota					
Fargo Damaged Structures[2]					
Base No Action Alternative	502	3,473	11,673	15,767	26,060
Northern Alignment Alternative	474	473	479	489	12,108
Protected Structures	**28**	**3,000**	**11,194**	**15,278**	**13,952**
Remaining Cass County Damaged Structures[3]					
Base No Action Alternative	236	549	723	947	1,368
Northern Alignment Alternative	198	309	310	320	551
Protected Structures	**38**	**240**	**413**	**627**	**817**

Location	10-year Flood	25-year Flood	50-year Flood	100-year Flood	500-year Flood
Richland County Damaged Structures[4]					
Base No Action Alternative	0	0	4	18	53
Northern Alignment Alternative	0	0	4	20	53
Protected Structures	**0**	**0**	**0**	**-2**	**0**
Total Protected – North Dakota	**66**	**3,240**	**11,607**	**15,903**	**14,769**
Total Damaged (NAA) – North Dakota	**672**	**782**	**793**	**829**	**12,712**
Minnesota					
Moorhead Damaged Structures[2]					
Base No Action Alternative	9	23	210	616	1,382
Northern Alignment Alternative	8	10	9	11	382
Protected Structures	**1**	**13**	**201**	**605**	**1,000**
Remaining Clay County Damaged Structures[3]					
Base No Action Alternative	12	66	104	135	230
Northern Alignment Alternative	12	62	66	77	136
Protected Structures	**0**	**4**	**38**	**58**	**94**
Wilkin County Damaged Structures[4]					
Base No Action Alternative	0	1	1	3	37
Northern Alignment Alternative	0	1	2	3	37
Protected Structures	**0**	**0**	**-1**	**0**	**0**
Total Protected – Minnesota	**1**	**17**	**238**	**663**	**1,094**
Total Damaged (NAA) – Minnesota	**20**	**73**	**77**	**91**	**555**
Structures Protected within FM urban area[1]	29	3,013	11,395	15,883	14,952
TOTAL Protected Structures (NAA)[5]	**2**	**3,257**	**11,845**	**16,566**	**15,863**
TOTAL Damage Structures (Base No Action Alternative)[4]	**759**	**4,112**	**12,715**	**17,486**	**15,178**
TOTAL Damaged Structures (NAA)	**692**	**855**	**870**	**920**	**13,267**

Source: HMG, 2015b

[1]Structure numbers and type should not be compared to those represented in Table 3.98. Methods and data sources applied were different.

[2]Based on HAZUS level 3 evaluation using COE HEC-FDA structure inventory

[3]Based on HAZUS level 2 evaluations with HAZUS default county data for remaining portions of Clay and C ass counties not covered by the structure inventory

[4]Based on HAZUS level 2 evaluations with HAZUS default county data for Richland and Wilkin counties

[5]Includes both the level 3 and level 2 analysis results

Table 3.95 below presents the residual damages under NAA that includes not only damages to the structures identified in Table 3.94 above, but also costs associated with structure contents and vehicles (SE Report). The average annual damages within the SE Report study area are approximately $10 million. Under NAA conditions, damages in Fargo and Moorhead are reduced by 50 percent and 38 percent, respectively, from the Base No Action Alternative (baseline conditions). Damages in the surrounding areas increase by approximately four percent (increase of $40,000 in average annual damages); however the damages in the surrounding areas remain less than one percent of the overall total damage estimate.

A review of the SE Report results indicates that increased flood depths result in an increase in expected damages to properties already at risk. The overall net impact to Richland and Wilkin counties is $187 and $532 in average annual damages respectively. It should be noted that when interpreting the cost of damages provided in Table 3.95, costs are rounded off the nearest $1 million and were calculated using HAZUS Level 2 and 3 analyses as detailed above (Figure 25). Therefore, estimates provided for those within the HAZUS Level 2 areas are, 1) not as precisely represented in terms of building and contents model inputs as those from HAZUS Level 3 areas; and, 2) as those areas have less buildings, contents, and vehicles; rounding to the nearest million may inadvertently misrepresent estimated flood damage costs and average annual damage costs, particularly from a cumulative cost perspective.

Table 3.95 Northern Alignment Alternative Estimated Residual Damages ($ Millions)

Return Period	10-year	25-year	50-year	100-year	500-year	Average Annual Damage[1]
Damages - North Dakota						
Fargo						
Buildings and Contents	$25	$41	$44	$48	$802	$7
Vehicles	$9	$11	$11	$11	$46	$1
Total Fargo	$35	$51	$54	$59	$848	$8
Remaining Cass County						
Buildings and Contents	$0	$1	$1	$1	$2	$0
Vehicles	$1	$1	$2	$2	$3	$0
Total Remaining Cass County	$1	$2	$3	$3	$5	$0
Richland County						
Buildings and Contents	$0	$0	$0	$0	$0	$0
Vehicles	$0	$0	$0	$1	$1	$0
Total Richland County	$0	$0	$0	$1	$1	$0
Total North Dakota	$36	$53	$57	$63	$854	$8
Damages – Minnesota						
Moorhead						
Buildings and Contents	$0	$3	$4	$4	$24	$0
Vehicles	$6	$7	$7	$7	$10	$1
Total Moorhead	$7	$10	$11	$12	$34	$1
Remaining Clay County						
Buildings and Contents	$2	$2	$2	$2	$3	$0
Vehicles	$1	$1	$1	$1	$2	$0
Total Remaining Clay County	$3	$3	$3	$3	$5	$0
Wilkin County						
Buildings and Contents	$0	$0	$0	$0	$0	$0
Vehicles	$0	$0	$0	$0	$1	$0
Total Wilkin County	$0	$0	$0	$0	$1	$0
Total Minnesota	$10	$13	$14	$15	$40	$1
Total Damages						
Buildings and Contents	$29	$47	$52	$57	$831	$7
Vehicles	$18	$21	$22	$22	$63	$2
Total	$47	$68	$74	$79	$894	$9

Source: HMG, 2015b

[1] Average Annual Damage represents the average damage that would occur in any given year, spread over the 50 year life cycle of the NAA (FFREIS Appendix C "Economics").

Table 3.96 provides a summary of the estimated cost for land acquisition and damages for the NAA. As the majority of the land acquisition and damages mitigation would occur within the defined staging area and as this was a defined USACE boundary for which the flood water storage was necessary, the USACE used the staging area as a boundary for determining costs. As discussed throughout this document, there are other properties, undeveloped land and residential/commercial properties, which would require mitigation outside of the staging area. Those costs would be included in a final cost for land acquisition and damages that would be determined once design plans were finalized.

Table 3.96 Northern Alignment Alternative Summary of Estimated Cost of Land Acquisition and Damages

Item Description	Northern Alignment Alternative
Right-of-Way (ROW) and Easements – Construction Footprint[1]	$ 38,838,912
ROW and Easements – Staging Area	$ 294,942,383
TOTAL: Lands and Damages[2 3]	$333,781,295

Source: HMG, 2015b
[1]Project construction footprint includes areas associated with the construction of the diversion channel, embankment systems, levees, and other flood control features.
[2]With 25% Contingency
[3]Costs are associated with a 100-year flood event.

The cost of acquisition, including right-of-way and easements, is the second largest NAA cost behind construction of channels and control structures. Table 3.97 provides a breakdown of property acquisition and easements for the NAA. Note that numbers presented are for the construction footprint and staging area only. Other property acquisitions and easements would occur outside of these locations as well, such as in-town levee and floodwall acquisitions and other easements and potential acquisitions that would be necessary within the inundation area and mitigation areas; however, these are not anticipated to have a large impact on the estimates provided below.

Table 3.97 Northern Alignment Alternative Property Acquisitions, Easements, and Costs

Type of Property[1]	Northern Alignment Alternative: Fee Title	Northern Alignment Alternative: Easement
Sheyenne Structure Site to Inlet Weir		
Acres	196	8
Non-Residential	0	-
Residential	0	-
Total Cost[1]	$2,025,000	$13,000
Diversion and Embankment Footprints		
Acres	453	44
Non-Residential	7	-
Residential	5	-
Total Cost[1]	$7,678,000	$71,000
Upstream Staging Area		
Acres	28,356	4,997
Non-Residential	677	94
Residential	132	20
Total Cost[2]	$285,202,000	$9,741,000

Source: HMG, 2015b
[1]Land Acquisition and Damages were based on both USACE detailed data and structure count information obtained through USACE 2015 desktop analysis.
[2] Reflects cost as rounded estimates to nearest thousand, includes administrative costs and 25% contingency.

The MNDNR's ArcGIS structure count analysis results are included below in Table 3.98. Under the 10-year flood, impacts to structures are increased only slightly over the Base No Action Alternative (baseline used for analysis) from 35 to 40. All impacts would be to non-residential structures. Impacts to structures increase substantially during the 25-year flood, impacting 817 structures under Project operation; 596 more than the Base No Action Alternative of which 139 are to residential structures. The majority of those impacts to residential structures would be to those residing in North Dakota (76 percent, or 106 out of the 139 residential structures impacted). Under the 100-year flood, impacts to structures would increase approximately 38 percent (from 684 to 1,102 structures impacted). Residential structures impacts make up 17 percent of those impacts (or 186 out of 1,102 total structures impacted). Non-residential structures make up the majority of structures impacted under all floods with the largest percentage of impacts occurring in Cass County. Note that Table 3.98 numbers should not be compared to Table 3.94 above as detailed in subsection 3.16.2.1, data and methods applied differ.

Table 3.98 Northern Alignment Alternative: Number and Type of Structures Impacted under 10-year, 25-year, 50-year, 100-year, and 500-year Floods within the Upstream Inundation Area[1 2 3 4 5 6]

Return Period: Scenario	10-year Flood: Base No Action Alt.[7]	10-year Flood: NAA	25-year Flood: Base No Action Alt.	25-year Flood: NAA	50-year Flood: Base No Action Alt.	50-year Flood: NAA	100-year Flood: Base No Action Alt.	100-year Flood: NAA	500-year Flood: Base No Action Alt.	500-year Flood: NAA
North Dakota										
Cass County **Non-Residential[5]**	27	32	177	454	313	491	404	510	556	561
Cass County Residential	0	0	10	106	29	127	64	133	191	143
Richland County **Non-Residential**	3	3	13	14	33	37	74	79	273	275
Richland County Residential	0	0	0	0	0	0	2	3	43	44
Total Non-Residential -North Dakota	**30**	**35**	**190**	**468**	**346**	**528**	**478**	**589**	**829**	**836**
Total Residential – North Dakota	**0**	**0**	**10**	**106**	**29**	**127**	**66**	**136**	**234**	**187**
Minnesota										
Clay County **Non-Residential**	3	3	16	201	71	282	98	291	174	340
Clay County **Residential**	0	0	0	33	1	44	2	45	11	47
Wilkin County **Non-Residential**	2	2	5	9	21	23	36	36	149	150
Wilkin County Residential	0	0	0	0	1	1	4	5	47	47
Total Non-Residential -Minnesota	**5**	**5**	**21**	**210**	**92**	**305**	**134**	**327**	**323**	**490**
Total Residential - Minnesota	**0**	**0**	**0**	**33**	**2**	**45**	**6**	**50**	**58**	**94**
Total Non-	**35**	**40**	**211**	**678**	**438**	**833**	**612**	**916**	**1,152**	**1,326**

Return Period: Scenario	10-year Flood: Base No Action Alt.[7]	10-year Flood: NAA	25-year Flood: Base No Action Alt.	25-year Flood: NAA	50-year Flood: Base No Action Alt.	50-year Flood: NAA	100-year Flood: Base No Action Alt.	100-year Flood: NAA	500-year Flood: Base No Action Alt.	500-year Flood: NAA
Residential Structures										
Total Residential Structures	**0**	**0**	**10**	**139**	**31**	**172**	**72**	**186**	**292**	**281**
Total Structures	**35**	**40**	**221**	**817**	**469**	**1,005**	**684**	**1,102**	**1,444**	**1,607**

Source: MNDNR, 2015

[1]Structures included within the analysis are those found within the counties identified and limited to the upstream inundation area.

[2]Impact is not defined by a set flood depth. If a structure is impacted by water by any extent, it is considered an impact.

[3]Structures impacted are not differentiated by currently inundated and newly inundated structures.

[4]GIS structure data obtained and provided by the USACE through a GIS desktop analysis, 2014 and has not been field-verified

[5]Non-residential includes all other structures that are not used for residential purposes, including commercial structures.

[6]Structure numbers and type should not be compared to those represented in Table 3.94. Methods and data sources applied were different.

[7]Base No Action Alternative numbers were included as this Alternative was used to present current conditions.

Similar to Table 3.98 above, the number of impacted parcels between the baseline and the NAA remains relatively the same during the 10-year flood (from 19 to 20 parcels impacted) (Table 3.99 and Figure 28). Impacts within the inundation area are greater than the Base No Action Alternative (baseline) under the 25-, 50-, and 100-year floods, when the NAA is in operation; the 25-year flood experiencing the greatest increase in parcels impacted from 80 parcels to 226 parcels; 157 of which would be to those within Cass County.

Table 3.99 Northern Alignment Alternative Number of Parcels Impacted under 10-year, 25-year, 50-year, 100-year, and 500-year Floods within the Upstream Inundation Area[1 2 3 4 5]

Return Period: Scenario	10-year Flood: Base No Action Alt.[6]	10-year Flood: NAA	25-year Flood: Base No Action Alt.	25-year Flood: NAA	50-year Flood: Base No Action Alt.	50-year Flood: NAA	100-year Flood: Base No Action Alt.	100-year Flood: NAA	500-year Flood: Base No Action Alt.	500-year Flood: NAA
North Dakota										
Cass County	11	13	57	157	109	177	147	184	292	201
Richland County	3	3	10	11	19	21	32	36	107	108
Total Parcels - North Dakota	**14**	**16**	**67**	**168**	**128**	**198**	**179**	**220**	**399**	**309**
Minnesota										
Clay County	2	2	10	53	17	62	19	64	29	69
Wilkin County	2	2	3	5	9	10	21	21	94	94
Total Parcels - Minnesota	**4**	**4**	**13**	**58**	**26**	**72**	**40**	**85**	**123**	**163**
Total Parcels	**18**	**20**	**80**	**226**	**154**	**270**	**219**	**305**	**522**	**472**

Source: MNDNR, 2015

[1]Structures used for determining parcel inclusion are those found within the counties identified and limited to the upstream inundation area.

[2]Impact is not defined by a set flood depth. If a structure is impacted by water by any extent, it is considered an impact.

[3]Parcels impacted are not differentiated by currently inundated and newly inundated parcels.

[4]Parcels included in counts were those found to contain impacted structures. Undeveloped land was not included in this analysis.

[5]Structures used in analysis were identified and provided by the USACE through a GIS desktop analysis, 2014 and has not been field-verified.

[6]Base No Action Alternative numbers were included as this Alternative was used to present current conditions.

Loss of Structure Function

Under the NAA, average annual relocation and disruption costs are $9 and $1 million, respectively Table 3.100). These costs are all estimated to be from North Dakota; however, Minnesota does experience relocation and disruption costs resulting from floods. The figures presented in Table 3.100 are rounded up to the nearest million; therefore, Minnesota's average annual relocation and disruption costs when totaled do not add up to an amount that when rounding to the nearest millionth would be captured. Business losses in general would be greatest in North Dakota. Loss of structure function would result in 2,081 employment losses during floods; of which 84 percent would be to North Dakotans and 16 percent to Minnesotans.

Table 3.100 Northern Alignment Alternative Summary of Annual Impacts from Loss of Building Function ($ Millions)

Description	Northern Alignment Alternative: Direct Impact[1]	Northern Alignment Alternative: Total Impact[2]	Base No Action Alternative: Total Impact[3]
North Dakota Losses			
Business Losses			
Output	$154	$239	$1,512
Employment (in jobs)	1,121	1,756	15,782
Labor Income	$56	$88	$548
Gross Regional Product	$84	$136	$866
Total State and Local Tax	$15	$15	$110
Disruption Costs	$1	$1	$3
Relocation Costs	$9	$9	$53
Minnesota Losses			
Business Losses			
Output	$24	$32	$43
Employment (in jobs)	260	325	380
Labor Income	$9	$11	$14
Gross Regional Product	$13	$17	$23
Total State and Local Tax	$2	$2	$4
Disruption Costs	$0	$0	$1
Relocation Costs	$0	$0	$2
Total Losses			
Business Losses			
Output	$178	$271	$1,555
Employment (in jobs)	1,381	2,081	16,162
Labor Income	$65	$99	$562
Gross Regional Product	$97	$153	$889
Total State and Local Tax	$17	$17	$113
Disruption Costs	$1	$1	$4
Relocation Costs	$9	$9	$55

Source: HMG, 2015a

[1]Direct Impacts are those that direct to the industry.

[2]Total Impacts include direct impacts[1]Total impact includes the direct impact i.e., direct economic effects (direct response of an industry), the indirect effects (changes in output, income, and employment caused by direct impacts), and the induced economic effects (changes in output, income, and employment cause by expenditures associated with new household income generated by direct and indirect economic effects).

[3]Base No Action Total Impact was used to represent a baseline for current costs and losses.

3.16.2.6.4 Flood Insurance

The NAA would result in similar impacts to flood insurance as those previously described for the Project as detailed in subsection 3.16.2.3.4. with the exception of those who, with the Project, were located within the Benefited Area that would now be located in the Unbenefited Area, i.e., the approximately 1.5 mile area (north of Project tieback embankment and connecting channel) that under the NAA would now be included as part of the staging area. These property owners would not realize cost savings.

3.16.2.6.5 Effects of Relocations and Flowage Easements

A detailed discussion is provided above under Effects of Relocations and Flowage Easements for the Project and provides information regarding potential impacts related to property owners, ring levees, century, centennial and sesquicentennial farms, school districts, and municipal and local government tax bases. It is anticipated that potential effects of relocations and flowage easements would generally be similar to those described for the Project. An exception would be regarding the number of structures and parcels impacted under this alternative (Table 3.98 and Table 3.99 above) and who would be impacted. The NAA tieback embankment is located approximately 1.5 miles north of the Project tieback embankment. That would shift the boundaries of the Benefited versus Unbenefited Area north impacting structures within the approximate 1.5 mile in between area that would have been protected and reducing or removing impacted properties on the southern end of the staging area within Richland and Wilkin Counties.

3.16.2.6.6 Effects on Property Improvements

The potential impact of flood inundation on wells and septic systems under the Northern Alignment Alternative would be similar to those described for the Project. Where there is potential for flood inundation under the Northern Alignment Alternative, Minnesota Rules, part 4725, which regulates wells for groundwater and drinking water sources, would be followed for requirements regarding flood protection for water-supply wells. In Minnesota, septic systems are regulated by Minnesota Rules, part 7080.2270, which require placement of SSTS components outside of a floodway and avoidance of the 100-year floodplain.

3.16.2.6.7 Effects on Cemeteries

The Cemetery Study completed by the USACE in June 2014 (http://www.fmdiversion.com/studies-technical-documents/) identified that there were 54 cemeteries located within a defined study area (see Figure 1 of Cemetery Study) (note that the Cemetery Study did not include areas downstream of Georgetown as the staging area is would be used to minimize impacts downstream). The study evaluated the existing flood conditions for the 10-year, 50-year, 100-year, and 500-year floods as well as what the water elevations would be at each cemetery under Project conditions.

The study was focused on comparing the current conditions (Base No Action Alternative) to conditions under the Project. NAA hydrology was not evaluated; however the study provides conclusions that can be used to determine which cemeteries may be impacted or protected under the NAA.

The extrapolated results indicate that 54 identified cemeteries studied, 27 would be located within the Benefitted Area. Five cemeteries would be located within the NAA staging area, and 8 would be located upstream of the NAA staging area. The potentially impacted cemeteries are St.

Benedict's Cemetery, Lower Wild Rice and Red River Cemetery; Hoff Cemetery; Clara Cemetery; Roen Family Cemetery; South Pleasant Church Cemetery; South Pleasant/Lium Cemetery; Eagle Valley Evangelical Cemetery; and Wolverton Cemetery. St. Benedict's Cemetery would likely experience the greatest negative impact from the NAA through increased frequency, depth, and duration. St. Benedict's Cemetery is considered eligible for NRHP (See Section 3.12 Cultural Resources).

The actual impacts to St. Benedict's and other cemeteries anticipated to be impacted by the NAA would need to be fully assessed through a modeling exercise similar to the one completed for the Cemetery Study. Patrons of the cemeteries that already flood under current conditions experience the social and economic effects as described under subsection 3.16.2.4.6. Potential economic impacts include those caused by additional cemetery operation costs due to impacts from new or increased flood depths or durations under Project operation. These may include damage to cemetery markers, such as headstones and signs; and post-Project operation clean-up.

The Draft Cemetery Mitigation Plan (USACE 2015) includes all potentially NAA impacted cemeteries with the exception of St. Benedicts; however, potential mitigation for St. Benedict's would be assumed to be similar to that proposed (or considered) for the other NHRP eligible cemeteries. For the cemeteries which would be impacted by NAA operation and which fall within the staging area, federal mitigation is proposed in the form of flowage easements. The USACE has stated that impacts to cemeteries are not considered a taking (see subsection 3.16.3.2.4 for definition of a "taking"). Additional mitigation may be considered by the non-Federal Sponsors that include clean-up assistance after Project operation. Section 3.16.3 and Appendix O – Takings, Flowage Easements, and Acquisition Processes provide additional details on proposed mitigation processes, and identifies opportunities and recommendations to support complete mitigation strategies.

3.16.2.6.8 Agricultural Impacts

General agricultural impacts resulting from the NAA are anticipated to be similar to those described for the Project. Impacts to agricultural production would be considered to be less under the NAA as the NAA would have approximately 26 percent fewer newly inundated acres during NAA operation. The NDSU Initial Ag Impact Study did not look at the NAA; however, it could be assumed that results could loosely be applied to what would occur under NAA conditions.

NAA impacts related to organic farms would result in different impacts compared to the Project. Under the NAA, four farms would be potentially impacted by new flood inundation (Table 3.101). Of the four farms impacted by the NAA, two of the farms would not be impacted, based upon the percentage of their overall acreage, compared to existing conditions. Two of the four organic farms have parcels located within the NAA staging area boundary (Appendix K—Figure 3).

Table 3.101 Organic Farm Acres Located Within the Vicinity of the Northern Alignment Alternative Inundation Areas During the 100-year Flood[1]

Farm	Farmer Reported Organic Acres	Farm Total Acres	Acres within NAA Staging Area Boundary
Farm 1	889	995	706
Farm 2	1,256.1	1,330	None
Farm 3	767.16	835	None
Farm 4	714.6	1,208	474

Source: Wenck, 2015

[1]This table provides a summary for organic farms located within the vicinity of inundation areas and identifies acres located within the staging area boundary. It does not reflect acreages of inundation. Estimated acres of inundation are presented in Table 3.102 below.

Table 3.102 provides a summary of total acres for the identified organic farm parcels along with percentages of flooded acres. This table implies a rough estimate and percentage for how much of the identified organic farm acreage would be flooded under the NAA during a 100-year flood. Within the NAA flood inundation area, approximately 1,265 acres would flood (Table 3.102). Appendix K - Figure 3 depicts the areas of flood inundation associated with the operation of the NAA during the 100-year flood. Flood inundation from operation of the NAA would most impact Farm 1 (610 acres of inundation) and Farm 4 (approximately 440 acres of inundation). During the 100-year flood, Farm 2 and Farm 3 would experience a similar acreage of flooded area under NAA as they experience under the Base No Action Alternative (Table 3.90).

Table 3.102 Organic Farm Acreage By 100-Year Flood Event for the Northern Alignment Alternative[1 2 3 4 5]

Farm		Area (acres)	Percent of the Total Acreage (%)
Farm 1: 998 acres	*Flooded*	*610*	*61%*
	Non-flooded	*388*	*39%*
Farm 2: 1,330 acres	*Flooded*	*187*	*14%*
	Non-flooded	*1,143*	*86%*
Farm 3: 835 acres	*Flooded*	*24*	*3%*
	Non-flooded	*811*	*97%*
Farm 4: 1,208 acres	*Flooded*	*443*	*37%*
	Non-flooded	*765*	*63%*
TOTAL: 4,370 acres	*Flooded*	*1,265*	*29%*
	Non-flooded	*3,105*	*71%*

Source: Wenck, 2015

1 Total acres for each farm are based on the total acreage in the parcel, not the total acres that are actually farmed. Acreages were rounded to the near acre. Totals and percentages provided are rough estimates based on rounded acreage.

[2]Flooded and Non-flooded conditions are based on the USACE elevations modeled for the 100-year flood. Flood indicates the estimated acreage that is anticipated to be inundated during the 100-year. Non-flood indicates the estimated acreage that is anticipated to not be inundated during the 100-year flood.

[3]NAA 100-year flood refers to the additional area that would flood for the 100-year flood during Project or NAA operation.

[4]Total farm acreage is based on total parcel acreage for the PIDs provided by the farmers, which includes their reported organic farm acreage.

[5]In all cases the organic farm acreage reported by the farmer is less than the total parcel acreage associated with the farmed PIDs. ArcGIS was used to map and evaluate the organic farm acreage using the available PIDs data. Surveys and delineations of actual organic farm acreage were not available, and therefore, the PID information was the best available information at the time of EIS publication.

Mitigation for potential impacts to agriculture and organic farms would be similar to that proposed for the Project and is further discussed in subsection 3.16.3.

3.16.2.6.9 Flood Fighting

The social and economic effects from flood fighting for the NAA would be similar to those previously described for the Project. The stress, disruption, and financial burdens associated with the continued threat of flooding and the flood fight efforts would be reduced in the F-M urban area with construction and operation of the NAA. Many residents in the Unbenefited, rural areas are currently at risk of flooding under the Base No Action Alternative. Where the NAA would cause increased flood inundation, mitigation through relocation or flowage easements would be considered for property owners. Additional information on mitigation is provided in subsection 3.16.3.

3.16.2.6.10 Geographic Extent Social and Economic Impacts: Minnesota and North Dakota, Benefited and Unbenefited Areas

<u>Minnesota and North Dakota</u>

The NAA is estimated to result in similar flood damages as those described for the Project. The NAA flood reduction benefits in Minnesota and North Dakota are also estimated to be similar to those described for the Project with flood reduction benefits primarily occurring in North Dakota in the Fargo and West Fargo urban areas. Measurable protection benefits from the NAA would occur in Minnesota, primarily in the Moorhead urban area between the 50-, 100-, and 500-year floods. Under the NAA, both Minnesota and North Dakota would experience some negative effects from operation of the NAA, particularly if they are located within the upstream inundation area.

<u>Benefited and Unbenefited Areas</u>

The NAA would reduce emotional, physical, and financial impacts in the Benefited Area similar to those described for the Project. This would be accomplished by reducing flood risk, primarily in the F-M urban area through construction and operation of the NAA. Implementation of the NAA would improve health and safety, and economic vitality (e.g., employment, public services, education) in the Benefited Area.

Areas south of the tieback embankment are considered the Unbenefited Areas and would experience increased flood inundation and associated social and economic impacts to those described for the Project, including relocations, potential loss of income, and potential effects on property values. The geographic extent of the NAA would be slightly different from the Project as it would be moved north, which would result in a slightly smaller upstream flood inundation area and a smaller Benefited Area. A ring levee would be constructed for Oxbow, Hickson and Bakke, but would not be necessary for Comstock. However, protection would be necessary for the Comstock sewage lagoons. The OHB ring levee would provide permanent protection for Oxbow, Hickson, and Bakke. Comstock may still require the use of emergency measures for large flood events to protect against floodwater impacts from Wolverton Creek to drainage ways and ditches within and adjacent to the community.

3.16.3 Proposed Mitigation and Monitoring Measures

The discussion below provides an overview of mitigation required by the FEMA CLOMR process (agreed to by the USACE) (details on the FEMA CLOMR process can be found in Section 3.2—FEMA Regulations and the CLOMR Process) and proposed mitigation by the USACE and Diversion Authority outside of the FEMA CLOMR process relating to social and economic impacts resulting from construction and operation of the Project. Details regarding proposed mitigation and monitoring for topics included in the discussion above, such as Infrastructure and Public Services, are included within their respective EIS sections.

3.16.3.1 FEMA/USACE Coordination Plan Mitigation

The USACE and FEMA have developed a Coordination Plan (Appendix F) (April 2015) that outlines floodplain management requirements for the Project, including CLOMR requirements for floodplain map revisions and Project mitigation. This plan would be used to implement mitigation as it relates to FEMA CLOMR requirements in the project area.

3.16.3.1.1 FEMA Revision Reach

The mitigation discussed within the April 2015 FEMA/USACE Coordination Plan (Coordination Plan) is defined primarily by the FEMA revision reach. The FEMA revision reach is defined by the Red River profile and limited to where the Project would alter the river profile flood elevation by more than 0.5 feet. The actual revised reach would be determined once the Project design is finalized and updated H and H modeling (Phase 8) becomes available. Section 3.2 – FEMA and the CLOMR Process provides additional discussion on the FEMA map revision process.

The staging area is located entirely within the FEMA revision reach; portions of the FEMA revision reach are upstream of the staging area.

3.16.3.1.2 Mitigation for Impacts to Structures

According to the Coordination Plan, all impacted insurable structures within the FEMA revision reach would be mitigated. Impacts resulting from the Project would be mitigated through agreed methods consistent with those specified by the NFIP based on the depth of flooding at each structure. For residential structures, proposed measures include elevating structures, relocation, buy-outs, and accredited ring levees. For non-residential structures these include dry flood proofing, elevation, relocation, buy outs, and accredited ring levees. Proposed non-structural mitigation measures were developed based upon the actual risk to properties within the project area. The NRCS information, farmstead ring levee programs, and USACE experience was used to determine that farmstead ring levees greater than five feet were not practicable. The use of farmstead ring levees was not yet determined at the time of the EIS production.

3.16.3.1.3 Changes to Flood Hazard Mapping Designations

The Coordination Plan requires that the areal extent of flood inundation required for operation of the Project within the staging area be mapped as floodway in order to ensure that the required volume is available for the Project during the 100-year flood. Flowage easements are proposed to be obtained for all floodway designated areas (further discussion on flowage easements is included below). Any additional flood inundation within the FEMA revision reach that is outside of the staging area would be mapped as floodplain in order to portray the elevated flood risk outside of the required staging area.

3.16.3.1.4 FEMA/USACE Coordination Plan Mitigation Summary

Proposed mitigation measures for residential and non-residential structures and lands, including agricultural lands, are summarized below in Table 3.103. Mitigation measures for residential structures (including homes, structures, and businesses) are primarily dependent upon the depth of flooding under a 100-year flood and location within the project area (e.g., whether it is located within the FEMA revision reach or staging area). To provide an idea of where mitigation approaches would be applied with respect to impact magnitude, Figures 26 and 27 depict locations of impacted residential and non-residential structures and parcels located within the Unbenefited Area, Figure 31 depicts the Coordination Plan areas of interest (e.g., FEMA revision reach, newly designated floodway, newly designated floodplain) and Figure 32 depicts the anticipated 100-year flood inundation depths.

Table 3.103 FEMA/USACE Coordination Plan Structure and Land Proposed Mitigation Categories and Descriptions

Project Area Location	Resource Impacted[1]	Impact Magnitude	Mitigation Requirement or Approach and Description
FEMA Revision Reach	Residential and Non-residential Insurable Structures	More than 2 feet, 100-Year Flood Depth	Acquisition or relocation of structures in manner consistent with applicable federal and state law.
FEMA Revision Reach	Residential and Non-residential Insurable Structures (*including* Farmsteads)	Up to 2 feet, 100-Year Flood Depth	Evaluate for non-structural measures, such as ring levees, relocation, or elevating structures. Acquisition may be considered in areas where risk and safety analysis indicated remaining in place may be inappropriate.
Staging Area	All Land	100-Year Flood Inundation	Areal extent required for Project operation would be mapped as FEMA floodway; other inundated areas would be mapped as FEMA floodplain. Flowage easements would be obtained.
Outside Staging Area/Within the FEMA Revision Reach	All Land	100-Year Flood Inundation	Mapped as FEMA floodplain – an analysis to determine if a taking has occurred would be performed and flowage easements would be obtained only where impacts rise to the level of a taking.[2]

Source: FEMA/USACE Coordination Plan, April 2015; Diversion Authority, USACE, and Project Consultants Communications, April 2015
[1]All structures discussed are those that are "existing" structures.
[2]See subsection 3.16.3.2.4 "What is a taking?" and Appendix O for more information.

3.16.3.2 USACE and Diversion Authority – Other Proposed and Required Mitigation

In addition to FEMA CLOMR requirements, the USACE and or Diversion Authority have proposed specific agricultural lands mitigation, including organic farm considerations, as well as mitigation of structures for those areas located outside of the FEMA revision reach and additional considerations for undeveloped land located outside the staging area (within or outside of the FEMA revision reach).

3.16.3.2.1 Cemetery Mitigation

The USACE completed a Draft Cemetery Mitigation Plan for the 11 potentially impacted cemeteries in June 2015 that more fully evaluated potential Project impacts, proposed mitigation, and potential mitigation impacts. Those cemeteries which are determined eligible under Section 106 of the National Historic Preservation Act are discussed in detail in Section

3.12 Cultural Resources. For the cemeteries which would be impacted by Project operation and which fall within the staging area, federal mitigation would be in the form of flowage easements. The USACE has stated that impacts to cemeteries are not considered a taking (see subsection 3.16.3.2.4 for definition of a "taking"). Additional mitigation may be considered by the non-Federal Sponsors that include clean-up assistance after Project operation. See Cultural Resources subsection 3.12.3.1.1, Chapter 6, Appendix G, Appendix H, and Appendix O for more information pertaining to proposed and recommended mitigation for Project impacts to cemeteries.

3.16.3.2.2 Agricultural Mitigation

The Diversion Authority has developed a Draft Ag Impacts Mitigation Plan (January 2015) (Appendix J) to address impacts to agricultural lands, including organic farms. This mitigation may include flowage easements, voluntary acquisitions, supplemental crop insurance or other compensation for impacted agricultural land.

Flowage easements are proposed to be acquired on agricultural land within the staging area. As described above, flowage easements would provide the legal ability to inundate the property as part of the operation of the Project. Easements would include a one-time payment to the property owner at the time the easement is obtained. The value of the payment would be determined on an individual property basis by independent appraisal. The value may consider factors such as depth, duration, frequency of additional flooding, and highest and best use of property. It may also consider future impacts from delayed planting, yield loss, debris, and limitations to future land use. There is uncertainty of whether organic certification would influence the value of the property, and therefore, the value of the flowage easement required by USACE. Organic certification is associated with the farmer and the land that the farmer uses for organic crops. Landownership may also be a factor for implementation of mitigation.

In addition to the proposed flowage easement, the Diversion Authority is working on an additional mitigation alternative--voluntary relocation for organic producers. The Diversion Authority would work with interested organic farmers to appraise, purchase, and temporarily rent back their property prior to Project construction in order to establish organic certification on land outside of potential flood inundation impacts purchased by the farmer with proceeds of the sale. Organic certification may take up to five years depending on the land.

According to the FFREIS, USDA Risk Management Agency has indicated the purchase of crop insurance in the staging areas could still be obtained; however, flood impacts resulting from the Project may not be covered. Federal crop insurance would apply to crops which can be planted prior to the established late planting dates. The NDSU Initial Ag Impact Study completed in October 2015 would be updated this fall to include all storage areas within the staging area not included in the 2015 study. No additional studies are planned for at this time. The Diversion Authority has indicated that those findings would be used to guide supplemental crop insurance risk policies, which are currently under study and consideration. Such supplemental risk policies could include provisions for "prevented planting" in the event that water is present past the final planting dates for a growing season. The risk policy could also provide coverage for damages caused by Project operations on planted crops (summer impacts). The Diversion Authority risk policy would be based on federal crop insurance programs and would be funded through the O&M for the Project.

Additional potential mitigation options are under consideration by the Diversion Authority. The Evaluation of Agricultural Risk Management Options for the FM Area Diversion Project (Watts and Associates 2014) (located on the Diversion Authority website at http://www.fmdiversion.com/pdf/Ag%20Risk%20Options%20FM%20Diversion%2003052014.pdf) was completed to help develop available options for mitigating risk or providing specified approaches for compensation to agricultural producers. The report included a brief discussion on a number of approaches, pros and cons, expected timeframe for implementation, and anticipated costs. Mitigation approaches included private insurance products, federal insurance products, flowage easements, land purchases, subsidized installation of tile drain systems, self-insurance, and a combination of approaches. The report concluded that likely a combination of various approaches integrated into a comprehensive risk management plan should be considered. Steps towards resolving agriculture mitigation has been included in the Diversion Authority Goals for 2016 (http://www.fmdiversion.com/diversion-authority-goals-for-2016/).

For additional discussions on proposed and recommended mitigation as well as a more information on flowage easements and acquisition process refer to Chapter 6 and Appendix O, respectively.

3.16.3.2.3 Outside Staging Area and/or FEMA Revision Reach

In addition to Coordination Plan requirements, the USACE has proposed performing an analysis to determine if a taking has occurred on a case-by-case-basis for all inundated undeveloped land outside of the staging area. This would be used to define mitigation needs within this area. Flowage easements would be obtained only where this analysis determines that an impact rises to the level of a taking under the Fifth Amendment of the U.S. Constitution[9] and applicable state laws (see Appendix O). The USACE has also proposed performing an analysis to determine if there is a taking for all structures and lands impacted by the Project that are located outside of the FEMA revision reach. The USACE would determine mitigation needs on a case-by-case basis through the takings process.

State laws (Minnesota Rules, part 6120.5700, subpart 4a) pertaining to floodplain allowances would need to be considered as well. The state of Minnesota has laws regarding mitigation requirements necessary to avoid mandatory flood insurance for those properties in which insurable structures may be impacted greater than 0.00 feet for areas newly inundated on the FIRM. Minor site modifications, such as landscaping, could be used as mitigation to exceed the 100-year flood elevation. If the mitigation (e.g., landscaping) is done before the LOMR at the end of the Project, mandatory flood insurance would not be required. However, if mitigation was not completed, flood insurance would be required. Otherwise more traditional mitigation such as relocation, flood proofing, or elevating structures would be necessary. For newly inundated insurable structures located within North Dakota, communities and property owners would have to work with the North Dakota State Engineer and USACE to determine what mitigation would be necessary.

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[9] The 5th Amendment of the US Constitution requires just compensation when private property is taken for public use. CFR 49 Part 24 - Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970, PL 91-646, as amended, details benefits to the property owner and/or displaced residential renters for Federal and Federally Assisted Programs.

3.16.3.2.4 What is a Taking?

The Fifth Amendment of the U.S. Constitution prohibits the federal government from taking property for a public purpose without first paying the landowner just compensation for the taking of his or her property. The Fourteenth Amendment of the U.S. Constitution makes the Fifth Amendment takings requirement applicable to the individual states. In addition, Article I § 13 of the Minnesota Constitution expressly provides: “*Private property shall not be taken, destroyed or damaged for public use without just compensation therefor, first paid or secured.”* The North Dakota Constitution also contains a taking provision which provides in part that “private property shall not be taken or damaged for public use without just compensation having been first made. . .” *North Dakota Constitution,* Art. I § 16. Thus neither a Minnesota governmental unit nor a governmental unit in North Dakota can acquire property for the project without meeting the takings requirements of both the U.S. Constitution and their individual state constitutions. A more detailed description of “taking” is included in Appendix O.

3.16.3.2.5 Oxbow/Hickson/Bakke and Comstock Ring Levees

Ring levees for the communities of OHB and Comstock are included as Project components. The ring levees would serve to provide protection to these communities when the Project is in operation. Forty-two homes in Oxbow would be directly impacted by the OHB ring levee construction. These homes would be replaced within the ring levee at different site locations. In addition, 60 residential developmental lots would be added within the ring levee, which would be available for other displaced residents within the Unbenefited Area. The Diversion Authority has proposed to compensate the City of Oxbow and the Kindred School District for the loss of tax base caused by the temporary loss of the 42 homes for a period of up to four years. The Comstock ring levee concept currently does not impact homes and allows for future community development within the ring levee. The Diversion Authority would retain the responsibility for the operation and maintenance of the OHB and Comstock ring levees.

3.16.3.3 Property Acquisition and Estimated Costs

Property acquisitions would primarily be governed under Public Law 91-646, the “Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970” (Uniform Act) which grants protections and assistance for those affected by federally-funded projects. The Uniform Act was enacted to assure that those whose real property is acquired or who are forced to move as the result of a federally-funded project are treated fairly, equitably, and receive assistance in moving. The Surface Transportation and Uniform Relocation Assistance Act of 1987 designated the U.S. Department of Transportation as the federal Lead Agency for the Uniform Act and the Federal Highway Administration, Office of Real Estate Services has been delegated to carry out the duties including the development, issuance, and maintenance of the government-wide regulation; assisting other federal agencies, and reporting to Congress.

The majority of the property buyouts involving structures would occur in the FEMA revision reach. Property buyouts would also occur for construction of the diversion channel and associated embankment systems. Buyouts associated with diversion channel construction are anticipated to be primarily land acquisition using right-of-way and easements. Table 3.104 provides a summary of the estimated cost for land acquisition and damages. Additional information regarding takings, flowage easements and acquisitions is included in Appendix O.

Table 3.104 Summary of Estimated Cost of Land Acquisition and Damages

Item Description	Proposed Project	Northern Alignment Alternative
ROW and Easements – Construction Footprint[1]	$ 41,464,402	$ 38,838,912
ROW and Easements – Upstream Staging Area	$ 223,558,278	$ 294,942,383
TOTAL: Lands and Damages[2]	$ 265,022,680	$ 333,781,295

Source: HMG, 2015b

[1]Project construction footprint includes areas associated with the construction of the diversion channel, embankment systems, levees, and other flood control features.

[2]With 25% Contingency

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4.0 Cumulative Potential Effects

4.1 CUMULATIVE POTENTIAL EFFECTS SCREENING SUMMARY

Cumulative potential effects (CPE) are environmental or social effects that result from the proposed project in conjunction with other projects in a given area. The effects from any one project may be small; however, the aggregated effects from all the projects together may be significant. This chapter discusses the State CPE definitions, differences between the State and Federal CPE analysis, CPE methodology, results of methods, and individual discussions on applicable projects.

4.1.1 State and Federal Cumulative Potential Effects Definitions and Differences

Although similar, there are differences between the State and Federal CPE definitions, criteria and analysis methods.

4.1.1.1 Minnesota Cumulative Potential Effects Definition

Minnesota Rules require that cumulative potential effects are considered as part of environmental review of a project because the incremental effects of individual projects evaluated together may result in a significant environmental effect.

Minnesota Rules, part 4410.0200, subpart 11a defines cumulative potential effects as follows:

> *"The effect on the environment that results from the incremental effects of a project in addition to other projects in the environmentally relevant area that might reasonably be expected to affect the same environmental resources, including future projects actually planned or for which a basis of expectation has been laid, regardless of what person undertakes the other projects or what jurisdictions have authority over the projects. Significant cumulative potential effects can result from individually minor projects taking place over a period of time. In analyzing the contributions of past projects to cumulative potential effects, it is sufficient to consider the current aggregate effects of past actions. It is not required to list or analyze the impacts of individual past actions, unless such information is necessary to describe the cumulative potential effects. In determining if a basis of expectation has been laid for a project, an Responsible Government Unit (RGU) must determine whether a project is reasonably likely to occur and, if so, whether sufficiently detailed information is available about the project to contribute to the understanding of cumulative potential effects. In making these determinations, the RGU must consider: whether any applications for permits have been filed with any units of government; whether detailed plans and specifications have been prepared for the project; whether future development is indicated by adopted comprehensive plans or zoning or other ordinances; whether future development is indicated by historic or forecasted trends; and any other factors determined to be relevant by the RGU."*

The Environmental Quality Board (EQB) provides guidance to Minnesota Rules (*May 2010 Guide to Minnesota Environmental Review Rules*, EQB 2010) when evaluating cumulative potential effects. Three main points of the guidance are as follows:

1. Individual projects (past and future) must be located within the environmentally relevant area and be reasonably expected to affect the same environmental resources as the project under review. The area of impact can vary based on the project and type of impact so it is not uncommon to have multiple environmentally relevant areas under review.

2. To account for past projects, current aggregate effects are used in place of an inventory of effects from individual projects. The existing conditions with respect to an environmental resource would be equal to the current aggregate effects from past projects.

3. Consideration of future projects includes only projects that have been actually planned or for which a basis of expectation has been laid. The RGU must identify other projects that are reasonably likely to occur. Examples of documentation which would confirm that likeliness to occur include: permit records, detailed plans and specifications, adopted comprehensive plan, forecasted development trends, etc.

4.1.1.2 Federal Cumulative Effects Analysis

Federal environmental review is based on Council on Environmental Quality (CEQ) regulations (40 CFR §§ 1500-1508). The federal regulations implement the procedural provisions of the National Environmental Policy Act (NEPA) of 1969, as amended (42 United States Code (U.S.C.) § 4321 et seq.). CEQ identifies the following principles to be included in a cumulative effects analysis, and define cumulative impact as:

> *"the impact on the environment which results from the incremental impacts of the action when added to another past, present, and reasonably foreseeable future actions regardless of what agency (federal or non-federal) or person undertakes such other actions." (40 CFR § 1508.7)*

The USACE conducted a cumulative effects analysis (CEA) in the Final Feasibility Report and Environmental Impact Statement (FFREIS). The Supplemental Environmental Assessment (Supplemental EA) did not identify any new cumulative effects or conduct new analyses of cumulative effects already identified in the FFREIS. The FFREIS defined the geographical extent broadly to include the Red River of the North Drainage Basin (Red River basin). It determined the pertinent time scale for assessing cumulative impacts spans approximately 160 years, and dates from 1901, the beginning of the existing discharge records for the United States Geological Survey (USGS) gage at Fargo, through 2060, the end of the project planning horizon.

The FFREIS generalized past environmental impacts in addition to aggregate effects of the Project. The FFREIS identified significant cumulative ecological impacts which were organized into several resource categories. These resource categories are identified below in Table 4.1. The FFREIS did not identify specific projects for evaluation and determination of cumulative effects. This resulted in a general evaluation of the potential aggregate cumulative impacts of the Project.

More detailed information regarding the CEA can be found in the FFREIS.

4.1.1.3 Primary Differences Between Federal (CEQ) and State (EQB) Cumulative Potential Effects

While federal CEQ guidance focuses more on the aggregate effects of past, present and future projects; Minnesota EQB guidance indicates that past and present effects may be presented in aggregate, but an additional focus of the analysis is on specific known projects and planned future projects. Therefore, since individual projects were not identified in the FFREIS, assumptions were made during this analysis that the potential cumulative effects evaluated in the federal processes existed within the environmentally relevant area. Although the requirements between the NEPA and Minnesota Environmental Policy Act (MEPA) processes are different, the information presented within the FFREIS has merit and was utilized (see subsection 4.1.2, below).

4.1.2 Minnesota State Cumulative Potential Effects Analysis Methodology

4.1.2.1 Selecting the Cumulative Potential Effects Categories

In compliance with Minnesota Rules, the FFREIS CEA was compared to the State Environmental Impact Statement (EIS) requirements to identify how to best utilize the existing analysis. The first step in this process was to align environmental resource categories from the FFREIS CEA with the equivalent EIS environmental impact categories. Categories which were included in one analysis but did not have an equivalent in the other were noted. Then, conclusions of whether an impact category could contribute to the potential for cumulative effects were documented with “yes/no”. Finally, categories were carried forward in the CPE analysis if the EIS reached the conclusion that an impact category could contribute to the potential for cumulative effects.

4.1.2.2 Defining the Environmentally Relevant Areas

The environmentally relevant area was examined for each environmental impact category included in this analysis. Generally, the initial environmentally relevant area included the entire project area, watersheds immediately upstream of the Project, and watersheds immediately downstream of the Project, to an estimated distance of twenty miles from the Project location. This general area was defined in an effort to conservatively capture an area which would receive any direct impacts from the Project which could contribute to cumulative potential effects. Within this general area, the environmentally relevant area for each environmental impact category was refined to the area of potential impact for the Project. Specific discussion of this area is specific to each environmental impact category and is included in each of the category analyses carried forward, in the Affected Environment/Environmentally Relevant Area section.

4.1.2.3 Identifying the Reasonably Foreseeable Projects

Once defined for an environmental impact category, the environmentally relevant area was reviewed for known projects that may have the potential to contribute to cumulative potential effects when combined with the construction and operation of the Project. The identified projects have a range of available information; from very little to detailed plans created about potential outcomes and concepts for projects. Numerous plans and studies have been completed in the Red River basin and adjoining watersheds that examine flood control, hydrology, geomorphology, water quality, and socioeconomics related to large-scale flooding events. Many of these studies do not identify specific project plans and have not resulted in specific permitted projects. In accordance with Minnesota Rules, part 4410.0200, subpart 11a , projects identified that were not fully planned, or those where a basis of expectation had not been laid, were not included in this analysis. The analysis does include projects that have been sufficiently planned and at a minimum, a permit application has been submitted. In some cases, project construction may have started or been recently completed.

Proposed mitigation and monitoring measures for the Project and alternatives carried forward, in combination with the past and reasonably foreseeable projects, were then reviewed holistically regarding the impacts to the environmental impact categories. A summary of all proposed Project mitigation and monitoring is discussed in Chapter 6.

4.1.2.4 Cumulative Potential Effects Screening Analysis

Once the environmental impact categories were identified (from subsection 4.1.2.1, above), a screening analysis (Wenck, 2014) was completed to refine the full list of projects identified in subsection 4.1.2.3, above, and define the total list of future projects that could contribute to cumulative environmental effects. Minnesota Rules and EQB guidance were used in the screening analysis to define the environmentally relevant areas and the list of relevant reasonably expected projects for inclusion in this evaluation.

4.1.3 Results of the Cumulative Potential Effects Methodology

4.1.3.1 Cumulative Potential Effects Categories

Table 4.1, below, provides a summary of the cumulative potential effects categories identified for the FFREIS and the EIS, indicating which categories were identified in the FFREIS to have the potential to contribute to cumulative impacts, and which resource categories were carried forward in this CPE analysis.

In compliance with Minnesota Rules, environmental resource categories from the FFREIS CEA (see Table 4.1, Column A, below) were aligned with the equivalent EIS environmental impact category in Column B. Categories which were included in one analysis but did not have an equivalent in the other are noted as Not Applicable (N/A) in Table 4.1. For each environmental impact category, Column C indicates whether the FFREIS determined the Project could contribute to the potential for cumulative impacts. Third, Column D indicates if, based on information presented in this EIS, the Project has the potential to contribute to cumulative effects. Where the EIS identified the potential for environmental or social effects to a resource category, (i.e., a “yes” in column D), the resource category was carried forward for further evaluation (a “yes” in Column E). If the resource category was identified in the FFREIS, but was not part of the scope of the EIS, or was scoped into the EIS but was found to not have the potential to contribute to cumulative impacts, then the resource category was not carried forward for further evaluation.

Table 4.1 Summary of Potential Cumulative Effects Categories

A: FFREIS Environmental Resource Category	B:MN EIS Equivalent Environmental Impact Category	C: Significant Potential Cumulative Effects Identified in the FFREIS	D: Significant Effects Identified in MN EIS	E: Category Included in Cumulative Potential Effects in MN EIS
Air Quality	Not a scoped category	No	No	No
Aquatic Habitat	Fish Passage and Biological Connectivity	Yes	Yes	Yes
Climate	N/A	No	N/A	No
Cultural Resources	Cultural Resources	Yes	Yes	Yes
Social Effects	Socioeconomics	Yes	Yes	Yes
Fish Passage	Fish Passage and Biological Connectivity	Yes	Yes	Yes
Geomorphology	Stream Stability	No	Yes	Yes
Prime and Unique Farmland	Cover Types	No	No	No
Recreational Opportunities	Not a scoped category	Yes	N/A	No
Shallow Groundwater	Not a scoped category	No	N/A	No
Endangered Species	State Listed Species and Special Status Species	No	No	No
N/A	Potential Hazards due to Past Land Uses	N/A	No	No
Upland Habitat/Riparian Habitat	Wildlife Resources	Yes	Yes	Yes
Water Quality	Not a scoped category	No	N/A	No
N/A (similar to Water Quantity)	Hydrology & Hydraulics	N/A	Yes	Yes
Wetlands	Wetlands	No	Yes	Yes
N/A	Cold Weather Impacts on Aqueduct Function	N/A	No	No
N/A	Invasive Species	N/A	No	No
N/A	Infrastructure and Public Services	N/A	No	No
N/A	Land Use Plans and Regulations	N/A	No	No

A: FFREIS Environmental Resource Category	B:MN EIS Equivalent Environmental Impact Category	C: Significant Potential Cumulative Effects Identified in the FFREIS	D: Significant Effects Identified in MN EIS	E: Category Included in Cumulative Potential Effects in MN EIS
N/A	Dam Safety	N/A	No	No
Water Quantity	Not a scope category (similar to Hydrology and Hydraulics)	No	No	No
Economic Issues	Socioeconomics	No	Yes	Yes
Environmental Justice	N/A	No	N/A	No

[1]N/A=Not traditional category in federal or state environment review

The following environmental impact categories were identified for inclusion in the evaluation of cumulative potential effects in the EIS:

- hydrology,
- stream stability (geomorphology),
- wetlands,
- fish passage and biological connectivity (includes aquatic habitat),
- wildlife resources,
- cultural resources, and
- socioeconomics.

4.1.3.2 Cumulative Potential Effects Reasonably Foreseeable Projects

Future projects that were determined to be in the environmentally relevant area, would have an impact on one of the resource categories, and had a reasonable expectation of occurring are listed in Table 4.2, below, and shown on Figure 33.

Table 4.2 Reasonably Foreseeable Projects

Reasonably Foreseeable Project	Project Location	Applicable Environmental Impact Category
Wolverton Creek Restoration and Sediment Reduction Project	Holy Cross Township, Clay County; and Wolverton Township, Roberts Township, and Mitchell Township, Wilkin County	Hydrology Stream Stability Wetlands Fish Passage Wildlife Resources Cultural Resources
Manston Slough Wildlife Pool Management	Buffalo Watershed, South Branch Buffalo River	Hydrology Stream Stability Wetlands Fish Passage Wildlife Resources

Reasonably Foreseeable Project	Project Location	Applicable Environmental Impact Category
Cass County Drain 21 Improvements	West Fargo, North Dakota	Hydrology Stream Stability Socioeconomics
Cass County Drain 45 Improvements	West Fargo, North Dakota	Hydrology Stream Stability Socioeconomics
Cass County Drain 30 Channel Improvements	Argusville, North Dakota Township 141 North, Range 49 West, Sections 8,9,16,17	Hydrology Stream Stability Wetlands Socioeconomics

Source: Diversion Authority and Wenck 2014

4.1.3.2.1 Wolverton Creek Restoration and Sediment Reduction Project

Wolverton Creek is the outlet for numerous ditch systems and drainages with significant erosion that contributes high sediment loading and increased turbidity to the Red River. The Buffalo-Red River Watershed District (BRRWD), along with cooperation from Clay and Wilkin County Soil and Water Conservation Districts and Minnesota Board of Water and Soil Resources (BWSR), has been planning and developing the Wolverton Creek Restoration and Sediment Reduction project (Wolverton project) over the past several years.

The intent of the Wolverton project to is to reduce erosion and sedimentation along the portions of the restored stream channel and areas downstream. The Wolverton project would be a restoration of Wolverton Creek from United States (U.S.) Highway 75 upstream to the east boundary of Section 17, Township 135 North, Range 47 West (Mitchell Township), Wilkin County. The Wolverton project includes: channel restoration to stabilize slopes and establish vegetation, side inlet sediment controls on gullies and ditches, buffer strips, channel grade control, and instituting conservation tillage programs, all to reduce erosion and sedimentation. The BRRWD received the work in public waters permit from the Minnesota Department of Natural Resources (MNDNR) early in 2015 and expects to start construction in 2015.

4.1.3.2.2 Manston Slough Wildlife Pool Management

For over 140 years, excessive water has been a problem for Mitchell, Manston, and Meadows Townships in Wilkin County, Minnesota. A drainage ditch was constructed in 1897 to try to control water in the area which resulted in some success. In 2005, the BRRWD began working with local partners to develop a larger flood damage reduction (FDR) and natural resources enhancement project for the area. In 2013, these efforts resulted in the BRRWD and BWSR working together to design and construct the Manston Slough Wildlife Pool Management project (Manston project), which was completed in 2014.

The Manston project consisted of installing a water control structure at the outlet and improving a number of roadways with additional clay embankment. The purpose of the water control structure was to fix the run-out elevation of Manston Slough at its pre-drainage level and allow for periodic drawdowns. The wetland pool would be managed with some level of permanent pool water during most times when flooding or drawdowns are not occurring. The storage area has a temporary capacity of approximately 5,500 acre-feet at the emergency spillway crest. The size of the flood pool ranges from approximately 1,080 acres (normal pool) to 4,110 acres (emergency spillway crest) in the Buffalo River watershed.

The Natural Resources Conservation Service (NRCS) secured numerous easements for the Manston project. State and local funds were secured including assessments to benefited landowners. This resulted in restoration of over 2,000 acres of wetland and over 3,000 acres of upland. The Manston project provides flood storage and retention for flood reduction in adjacent and downstream areas. Additional project components include: waterfowl and wildlife habitat creation through restored wetland, recreational opportunities are created, enhanced quality of water flowing from the project, and groundwater recharge to the Buffalo aquifer.

4.1.3.2.3 Cass County Drain 21 and Drain 45 Channel Improvements

The Southeast Cass Water Resource District previously constructed drainage channels within their jurisdiction and purview to provide drainage for sections of land in Cass County, North Dakota. To accommodate future growth and continued adequate flow in the channels for adjacent benefiting properties, the Southeast Cass Water Resource District is proposing two improvement projects to Cass County Drains 21 and 45 (Drain 21 and Drain 45). The channel improvements are located within the City of West Fargo. Both projects involve: excavation in the drainage channels to remove sediment, inverts re-graded to reduce erosion and sedimentation in the channel, and deepening of the channels to accommodate future growth of the City of West Fargo storm sewer infrastructure. The Drain 21 and 45 projects are being reviewed by the Southeast Cass Water Resource District and are expected to be constructed in 2015.

4.1.3.2.4 Cass County Drain 30 Channel Improvements

The Rush River Water Resource District previously constructed drainage channels within their jurisdiction to provide drainage for land in Cass County, North Dakota. To ensure adequate flow through the channel and drainage system, the Rush River Water Resource District improved Cass County Drain 30 in Harwood Township.

The Channel Improvements project (Cass Drain 30 project) involved reconstruction of two miles of existing legal drain, which flows east to the Sheyenne River from a point near County Road 81. Cass Drain 30 has a drainage area of approximately 10 square miles. Approximately 30 percent of Drain 30's design flow is overflow from Cass County Drain 13, which flows from west of Interstate Highway 29 (I-29). The project involved excavation of the drainage channel, re-grading of the drain invert to reduce sedimentation in the upstream reach and erosion in the downstream reach, and flattening of the side slopes to reduce future slope failures. The Cass Drain 30 project was constructed in 2014.

4.2 DISCUSSION OF REASONABLE FORESEEABLE PROJECTS

This section of the CPE analysis discusses how each of the five reasonable and foreseeable projects could contribute to CPE for each of the seven resource categories.

4.2.1 Hydrology and Hydraulics

4.2.1.1 Affected Environment/Environmentally Relevant Area

Since 1902, the Red River has exceeded the National Weather Service flood stage of 18 feet at the USGS gage in Fargo (the Fargo gage) in 49 of the past 114 years (1902 through 2015), and recently every year from 1993 through 2015. The hydrologic record of the Red River shows a trend of increasing magnitude and frequency of flooding in recent decades. This increase in flood frequency and magnitude is likely due to many factors, including, but not limited to, effect of past and current land use that has resulted in tiling and drainage of watersheds, modification of streams, urbanization in the watershed, naturally-occurring wet/dry periods, and increases in impervious surface.

To reduce flooding from the Sheyenne River in West Fargo and Horace, the Federal Sheyenne River Project was authorized in 1986. The project includes modifications to Baldhill Dam, the Horace to West Fargo Diversion, and the West Fargo Diversion. The diversion projects were completed in 1994, and the modifications to Baldhill Dam were completed in 2004. There are also numerous drainage ditches and drain tiling systems in the project area that have altered the hydrology. These drainage systems are located throughout the project area with flow into tributaries to the Red River.

4.2.1.2 Environmental Consequences

Several projects have been completed or are planned to be completed, with the goal to reduce area flooding by adding flood water storage or retention. Additional drainage improvement projects, stream restorations, and development (not currently planned) would continue into the foreseeable future further altering hydrology of the watershed.

4.2.1.2.1 Proposed Project

The Project is intended to reduce flood risk in portions of the Fargo-Moorhead (F-M) urban area by controlling water flow and temporarily storing and diverting flow through a diversion channel. This would result in impacts to the hydrology and hydraulics of flood events. For the Project's proposed Benefited Area (i.e., the area located north of the tieback embankment, generally the F-M urban area) there would be a reduction of flood stage through the main stem of the Red River, as well as a reduction of the extent, depth and duration of flooding. For the Project's proposed inundation area (i.e., all land within the project area that would be inundated when the project is operated, which includes areas that flood under existing conditions and areas where flooding is caused by Project operation), there would be an increase in the extent, depth and duration of flooding, and specific hydrologic impacts would vary based on location within the inundation area. Additionally, there would be a diversion of high flows from the Sheyenne and Maple Rivers into the diversion channel and lower portions of the Rush and Lower Rush Rivers would be abandoned and rerouted into the diversion channel.

The Wolverton project includes installing side inlets and buffer strips, which are not anticipated to have a significant effect on hydrology or hydraulics. However, portions of the Wolverton Creek near the confluence with the Red River may experience greater flood depth and duration during Project operation compared to current conditions.

The Manston Slough Wildlife Pool Management would provide 4,430 acre-feet of water storage in the Buffalo River watershed by installing an outlet structure and improving a number of roadways. This would alter the hydrology and hydraulics in the Buffalo River watershed during flood events by providing flood water storage and retention. This would provide some flood control in that area of the watershed.

Hydrologic impacts could occur from the Cass Drain 21 and Cass Drain 45 projects as flows would likely be increased with re-grading and deepening of the channels through West Fargo. Additionally, both drains are intended to convey flood water to reduce localized flooding in West Fargo. The City of West Fargo requires retention of stormwater to offset any increase in peak flow due to development. Drain 21 currently drains to the Sheyenne River, while Drain 45 eventually drains to the Red River.

The Cass Drain 30 project is intended to re-grade and deepen the drainage channel. Cass Drain 30 would be altered by the Project as Cass Drain 30 would no longer flow into the Sheyenne River, but instead would flow into the diversion channel. Runoff from breakout flows from the local rivers results in a 100-year flood flow entering the Project that is larger than the 100-year flood flow from the local drainage area, and therefore, the inlet structure into the diversion channel would be sized to accommodate this larger, regional 100-year flood flow. The overall design of the drainage channel would be modified to accommodate operation and maintenance with the diversion channel. This includes considerations for flow capacity, flap gates to control water from backing out of the diversion channel during large flood events, and inlet structure design. The Cass Drain 30 project is anticipated to improve flows and drainage in the local area.

Of the reasonably foreseeable projects expected to have impacts to hydraulics and hydrology, only the Manston Project has the purpose of restoring pre-drainage conditions in the watershed and restoring wetlands. The purpose of the other projects included in this analysis, including the Project, is to improve hydrology and hydraulics. The cumulative effect on hydrology and hydraulics in the project area since settlement has been and continues to be significant.

4.2.1.2.2 Base No Action Alternative

Water flows between the Base No Action in-town levees constructed throughout the F-M urban area would be constricted, causing higher water surface elevations upstream of the levees and increasing flood extents. The Base No Action Alternative, reviewed along with the current environment and construction of the Manston project, the Wolverton project, Drain 21 and Drain 45, and Cass Drain 30 project, is anticipated to have hydrologic or hydraulic impacts, such as minor changes in flow or localized flood water storage, with the intent of reducing flood risk through the F-M urban area. The aggregate of these projects also are intended to reduce erosion and sedimentation, and enhance wildlife habitat, although these benefits would primarily be realized within a localized area of each respective project and are not likely or proposed to provide basin wide flood risk reduction. The Base No Action Alternative is not anticipated to have a measureable CPE when combined with the reasonably foreseeable projects.

4.2.1.2.3 No Action Alternative (with Emergency Measures)

Considerations discussed under the Base No Action Alternative also apply to the No Action Alternative (with Emergency Measures). Compared to the current conditions, the No Action Alternative (with Emergency Measures) increases the flood depth and flood extent immediately upstream of the F-M urban area. Water flows between the levees and emergency measures constructed throughout the F-M urban area would be constricted, causing higher water surface elevations upstream of the levees and increasing flood extents. This shift in water flows provides storage upstream of the levee, which impacts upstream structures and land, and decreases peak flow rates through the F-M urban area.

Similar to the Base No Action Alternative, each of the reasonably foreseeable projects is anticipated to have a beneficial effect to reducing flood risk in localized areas. The No Action Alternative (with Emergency Measures) does not have the potential to contribute to cumulative potential effects on overall hydrology.

4.2.1.2.4 Northern Alignment Alternative

Since the environmentally relevant area would be the same as the Project, cumulative potential effects from the Northern Alignment Alternative (NAA) are anticipated to be similar to those described for the Project. However, flood evaluations, flood depths, and the duration of flood events would differ depending on the specific location within the project area.

4.2.2 Stream Stability

4.2.2.1 Affected Environment/Environmentally Relevant Area

The Red River drainage basin currently experiences flooding associated with spring snowmelt and summer runoff events. Flood flows from these events are prone to exceed the natural banks of the reaches for extended durations, as the flood levels rise much faster than they recede. This results in extended durations of saturated bank conditions, inundation of riparian vegetation, and sediment deposition along the banks of the reaches that contribute to bank failure. In general, cohesive clay in the channel substrate of the streams in the project area provides some resistance against significant channel migration. However, in some areas, these same clays are also particularly vulnerable to slumping when they consist of an upper, relatively competent layer of sediment resting on more easily deformable clays. Within the project area, the reaches of the Red River, Wild Rice River and Wolverton Creek are currently susceptible to and commonly exhibit bank slumping especially on outside bends of these reaches.

Comparison of historic to current aerial photographs of streams in the project area indicated that overall there has been little channel movement horizontally or laterally over time, indicating relatively stable streams. However, in the recent past, the Red River has seen a higher frequency of large flood events which could lead to accelerated bank failures and channel migration.

4.2.2.2 Environmental Consequences

4.2.2.2.1 Proposed Project

The Project has the potential to cause significant geomorphic changes upstream or downstream of the project area. Project design and mitigation and monitoring measures through an adaptive management process have been proposed to minimize potential impacts to project area-affected geomorphology. Within the Project's Benefited Area, the magnitude of flood events would be limited to a 10-year flood (500-year floods or larger events would be allowed through the Benefited Area), altering the natural hydrology of the area. Riparian vegetation would no longer experience the magnitude of flood inundation, (i.e., the depths and duration of inundation or significant sediment burial as compared to current flood conditions). Riparian vegetation may begin to take root in areas that are currently lacking or have minimal vegetation present which would help stabilize stream banks and result in less bank slumping. Within the Project's inundation area located south of the tieback embankment, there would be a direct impact due to increased depths and duration of flooding during Project operation. Longer flood durations could reduce soil bank strength and result in an increase of bank failures. Depending on the magnitude of the flood and the duration, sediment deposition on banks may add to bank failures. The effects of sedimentation within the floodway/floodplain would occur incrementally over decades and would likely occur in areas that do not currently experience sediment deposition. This could result in indirect impacts, such as area vegetation becoming increasingly stressed, making it more susceptible to disease and insect infestations, invasive or other undesirable species establishment; or may result in vegetation type community changes.

The portions of the Rush and Lower Rush Rivers between the Project diversion channel and the Sheyenne River would experience direct geomorphological impacts due to potential aggradation from sediment. Regarding the Project control structures, there would be an increased potential for bed and channel scour. Specific mitigation and monitoring measures, such as pre- and post-construction and operation monitoring, and modified Project operation, are discussed in detail in Chapter 3, subsection 3.3.3.

The Wolverton project includes the installation of side inlets and buffer strips which are intended to reduce erosion and sedimentation along Wolverton Creek within a large portion of the project area. However, portions of the creek within the staging area would experience increased flood depth and duration during Project operation potentially impacting stream stability. In addition, stream reaches in the Wolverton project area typically consist of clay material that have compacted over time to form a stable stream bottom, and are not anticipated to contribute to sediment loads.

The Manston project is designed to provide flood storage and maintain a stable flood pool elevation. This would have localized benefits by reducing the potential for sudden flow downstream, and therefore, the potential for downstream erosion, sedimentation, and flooding would be reduced, minimizing the impact on geomorphology in the Buffalo River watershed.

Re-grading and deepening the drain channels as proposed for the Cass Drain 21 and 45 projects are anticipated to manage water flows more effectively, supporting better flood control, (i.e., moving water out of the flooded areas quicker), which would continue to protect West Fargo and associated streams. However, increases in water flow and volume could potentially affect stream stability downstream of the projects.

Localized impacts to the drainage way are anticipated with the Cass Drain 30 project as the channel is re-graded and deepened. This project is intended to reduce sedimentation in the upstream reach and erosion in the downstream reach, while flattening side slopes to reduce future slope failures. These measures are anticipated to help improve water quality downstream of this project.

Impacts from reasonably foreseeable projects are anticipated to be beneficial to the rivers and floodplains within and near the project area, due to reduction in erosion and sedimentation, stabilization of stream channels, increased control of water flow, and reduced flooding in localized areas. The Project has the potential to contribute to cumulative potential effects on stream stability in the project area or its vicinity.

4.2.2.2.2 Base No Action Alternative

The Base No Action Alternative, including the current conditions and the effects to the area as a result of the Manston project, the Wolverton project, Drain 21 and Drain 45, and Cass Drain 30 project, would contribute to the continuation of sedimentation and deposition due to recurring flood damage, consistent with current geomorphic processes. Urbanization and additional development of the watershed creates impervious surface that can increase flow rates and sedimentation during rain events affecting the overall stream system. Although stormwater management regulatory requirements have limited or reduced peak flow rates for new urban developments, over time, the flow rates of streams during rain events have increased leading to greater potential for changes in geomorphology through increased erosion and sedimentation.

The aggregate effects of the reasonably foreseeable projects are anticipated to contribute to the stabilization of the local rivers by providing localized flood storage, reducing erosion and sedimentation, and directing main water flow in specific channels. The Wolverton project is intended to restore portions of Wolverton Creek, resulting in a more stable stream. The Manston project is designed to provide flood storage and maintain a stable flood pool elevation, which would have localized benefits of reducing the potential for sudden flow downstream, reducing associated erosion, sedimentation, and flooding, and minimizing the impacts in the Buffalo River watershed. Cass Drain 21 and 45 projects may potentially impact stream stability downstream of the projects due to increased flow volume during flood or higher runoff rain events but would provide local benefits as channel deepening and regarding would move flood water out of the area better.

4.2.2.2.3 No Action Alternative (with Emergency Measures)

Considerations discussed under the Base No Action Alternative also apply to the No Action Alternative (with Emergency Measures). The No Action Alternative (with Emergency Measures) would require sandbagging and temporary levees to protect adjacent floodplain areas, which would result in some stage increases upstream. Localized effects of emergency measures/levees have the potential to change the stream stability dynamics, incrementally increasing velocities and sedimentation; banks nearest these measures would experience greater stressors and likely have more potential for slumping and/or failure. Emergency measures are not anticipated to significantly change the depth, rate or duration of flow in the project area, and therefore, are not anticipated to cause significant changes to current geomorphology. The reasonably foreseeable projects are anticipated to contribute to the stabilization of geomorphology in specific areas where these projects are located.

4.2.2.2.4 Northern Alignment Alternative

Since the environmentally relevant area would be the same as the Project, cumulative potential effects from the NAA are anticipated to be similar to those previously described for the Project. However, impacts from the NAA would be shifted approximately 1.5 to 3 miles downstream compared to impacts at the Project location.

4.2.3 Wetlands

4.2.3.1 Affected Environment/Environmentally Relevant Area

Glacial Lake Agassiz lakebed contains fertile silty and clayey soils, which when drained, provide land suitable for agriculture. Historically, prior to settlement, this area was comprised of tall grass and wet prairies. According to the 1997 Minnesota Wetlands Conservation Plan (MNDNR 1997) less than 20 percent of the native wetlands in the Moorhead area and upstream sub-basins remain. Factors influencing the alteration and decline of wetlands primarily include urban development, such as housing developments, road construction, and construction-related activities; and agricultural activities, such as tiling, ditching and drainage for crop production, and plowing activities that have exposed loose, fine-textured soils, contributing sediment transport into nearby wetlands.

The vast majority of wetlands in the project area are seasonally flooded basins (potholes) located on agricultural land. Wetlands found within the active agricultural lands, such as row-cropped fields, provide limited levels of function due to extensive drainage by agricultural drain tiling and overall alteration that has taken place since pre-settlement. Seasonally flooded wetlands generally provide low function for the Minnesota Routine Assessment Methodology for Evaluation of Wetland Functions (MNRAM) categories of Maintenance of Hydrologic Regime and Maintenance of Wetland Water Quality in the agricultural land due to the extensive drainage systems in these areas.

Depressional wetlands within agricultural fields can, however, generally provide moderate to high function for the MNRAM categories of Flood/Storm Water Attenuation and also for Downstream Water Quality. Those wetlands that have been shaped into shallow field ditches provide a moderate level of temporary flood water or stormwater storage. Field wetlands provide a moderate level of function for protection of downstream water quality because they are able to filter some of the nutrients in the agricultural runoff before it enters nearby waterways. Wetlands present in the project area, and associated impacts, are discussed in detail in Chapter 3, Section 3.4 - Wetlands.

4.2.3.2 Environmental Consequences

4.2.3.2.1 Proposed Project

The Project would result in direct and indirect impacts to wetlands from construction and operation. Greater than 80 percent of pre-settlement wetlands in the project area have been drained or filled. The Project proposes to directly impact over 1,800 acres of wetland from the diversion channel, connecting channel, excavated material berms, shallow drainage ditches outside berms, overflow and tieback embankments, roads, control structures, and the City of Oxbow, Village of Hickson, Bakke Subdivision (OHB) ring levee with the potential for additional indirect impacts during Project operation. Most of the impacts occur in shallow open water wetland types, but the impacts also include 62 acres of floodplain forest. The Project would also result in direct impacts to wetlands from the Comstock ring levee (estimated to be less than five acres) and from the Drayton Dam Mitigation Project (0.5 acres). Indirect and temporary wetland impacts to 151 (estimated) acres would occur in the Project's proposed inundated areas. Additional indirect impacts to wetlands would occur by changing wetland function and type from Rush and Lower Rush River bisect.

The Project would use adaptive management for mitigation and monitoring of wetland impacts. A final adaptive management plan would include the diversion channel conceptual wetland mitigation plan (i.e., wetland mitigation plan) that would be used during the federal and state permitting/approval processes to assess wetland impacts and determine appropriate replacement of those impacts. The wetland mitigation plan is habitat-based with a goal of replacing impacted wetland habitat and certain functions rather than designing the plan purely on wetland design criteria. An adaptive management plan would also be in place for mitigation and monitoring of floodplain forest impacts (see Appendix B - Draft AMMP). MNRAM would be used to evaluate the mitigation wetlands at the end of the monitoring period. Wetland mitigation for the Project would replace lost wetland and convert thousands of acres of agricultural land into wetland within the diversion channel. This would result in greater wetland acreage within the Red River basin. Additional detail describing mitigation and monitoring measures is provided in Chapter 3, Section 3.4.

4.2.3.2.2 Base No Action Alternative

Under the Base No Action Alternative, wetland impacts from flood events would remain largely the same as under the current conditions. Flooding that could occur would be temporary, and impacts to wetlands would occur slowly over a long period of time as part of flood dynamics and from other system influences. The Cities of Fargo and Moorhead have planned flood risk reduction projects that reduce flooding potential for properties along the Red River within the F-M urban area. Direct and indirect impacts to wetlands could occur with the natural expansion of the F-M urban area, as wetlands are converted to urban development.

The Wolverton project is intended to result in creating a low flow channel, and establishing vegetated buffers along the corridor, potentially encouraging the establishment of wetlands along the stream corridor, although there may be temporary impacts to wetlands during project construction.

The Manston project is anticipated to establish approximately 2,000 acres of wetland in the Buffalo River watershed within the Red River basin by constructing a control structure. Temporary impacts to wetlands during the construction of the control structure may occur. The project would be managed to control the water pool elevation to pre-drainage conditions and also allow for periodic drawdowns to further restore and maintain wetlands.

Cass Drains 21 and 45 are not managed for wetlands, but may contain wetlands that have become established over time. Cass Drain 21 and 45 projects would deepen channels in order to continue to provide effective drainage in the West Fargo area. The drainage channels may have established wetlands, which would be removed as part of excavation. Additionally, drainage typically results in altered hydrology that can impact wetland areas. Cass Drains 21 and 45 are primarily in the urbanized area of West Fargo, and therefore, impacts to wetlands due to drainage channel improvements are not anticipated.

Cass Drain 30 provides drainage to a 10 square mile area, which includes areas that may have historically been or currently are wetland. The improvement project would excavate wetlands that have become established within the drainage channel. Improvements to this drainage would deepen channels in order to continue to provide effective drainage, water flow, and supply water to the Sheyenne River. The Sheyenne River has wetland areas within its corridor. The drainage area for Cass Drain 30 is primarily agricultural land; however, effective drainage in the area may impact any remaining wetland, which could result in less water storage areas in the Red River basin.

4.2.3.2.3 No Action Alternative (with Emergency Measures)

Considerations discussed under the Base No Action Alternative also apply to the No Action Alternative (with Emergency Measures). Emergency measures would be used to reduce flooding in the F-M urban area, which could displace the flow causing flooding in other areas. Flooding that could occur would be temporary, and wetland impacts would occur slowly over a long period of time as part of flood dynamics and from other system influences.

The Cities of Fargo and Moorhead have planned flood risk reduction projects that reduce flooding potential for properties along the Red River within the F-M urban area, and would use emergency measures, such as sandbagging and temporary levees, to protect certain areas that may require additional protection. These actions could reduce impacts to the protected areas, but potentially increase impacts to other areas, such as increased flooding upstream with the potential to impact upstream wetlands. Direct and indirect impacts to wetlands could occur with the natural expansion of the F-M area as wetlands become developed, resulting in required mitigation within the Red River basin.

4.2.3.2.4 Northern Alignment Alternative

Since the environmentally relevant area is the same as the Project, CPEs to wetlands from the NAA and reasonably foreseeable projects would be similar to those described for the Project. However, the NAA has the potential to eliminate the need for the Comstock ring levee, eliminating the direct wetland impacts, (about five acres), and reducing indirect wetland impacts in inundated areas by an estimated three acres fewer in the NAA as compared to the Project.

4.2.4 Fish Passage and Biological Connectivity

4.2.4.1 Affected Environment/Environmentally Relevant Area

There are a number of species found in the Red River and its tributaries (roughly 80 native fish species) that are believed to use the Red River main stem seasonally for habitat and as a migration route. These fish and aquatic biota species have experienced decline of fish passage and aquatic habitat quality in the Red River watershed since settlement. This is for a variety of reasons, including dam construction limiting migration, siltation, channel modifications, and loss of necessary in-stream habitat. Habitat quality on the Red River and its tributaries is considered to be greatly reduced compared to pre-settlement conditions. Aquatic habitat on the Red River main stem has been affected by stream channelization, damming, land cover type changes, artificial drainage, and agricultural drain tiling. Area development has also altered the ability of fish to migrate within the Red River basin, due to construction of eight dams on the main stem and hundreds of dams on tributaries within the Red River basin. In the last 15 to 20 years, projects have been implemented to improve fish passage.

An Environmental Assessment (EA) examining fish passage in the Red River basin in Minnesota was completed by the United States Fish and Wildlife Service (USFWS) in 2005. This assessment identified over 400 dams and control structures that have been constructed throughout the watershed on the Red River and its tributaries. Additionally there have been thousands of culverts installed at road crossings on ditches and streams, which in some cases have become barriers to fish movement. These collective land use changes have impacted the habitat within and adjacent to rivers and streams in the Red River basin. Efforts have been made over the last decade by the MNDNR, USACE and City of Fargo, as well as other groups, to remove or bypass migration barriers (such as low-head dams) on the Red River as well as tributaries throughout the watershed, resulting in improved fish passage at several dams in the watershed.

4.2.4.2 Environmental Consequences

4.2.4.2.1 Proposed Project

The Project has the potential to continue the degradation of aquatic habitat in the project area. Project construction would directly impact aquatic habitat on the Red (one mile, 17 acres), Wild Rice (0.9 miles, 12 acres), Sheyenne (0.9 miles, 8.4 acres), Maple (1.1 miles, 11 acres), and would result in the loss of river channel to the Lower Rush and Rush Rivers, 2.7 and 2.3 miles, respectively. Potential aquatic habitat impacts include direct mortality to macroinvertebrates and fish from crushing and excavation; temporary fish relocation would occur during project construction. Indirectly, aquatic habitat may be impacted from construction and operation of the Project that may result in altered hydrology, stream stability, sedimentation, and wetland impacts.

Impacts to fish passage and migration include the creation of impassable conditions due to flow velocities on the Red and Wild Rice Rivers for fish during operation; potentially impacting migrations of walleye, northern pike, and redhorse/white sucker; and access to Wolverton Creek. Abandonment of Rush/Lower Rush Rivers could impact fish migration from Red and Sheyenne Rivers. In addition, if water recedes too quickly, fish may become stranded in the pools resulting in mortality.

Project mitigation proposed for aquatic habitat/fish passage includes stream channel restoration projects, fish migration and connectivity projects, construction avoidance periods, and future studies to identify possible additional projects. Additional detail regarding proposed mitigation and monitoring measures for fish passage and biological connectivity can be found in Chapter 3, subsection 3.8.3.

4.2.4.2.2 Base No Action Alternative

The construction of the reasonably foreseeable projects would cause some localized impacts to aquatic habitat. However, these flood control projects are not anticipated to create barriers to fish passage in the watershed or contribute to fish stranding and mortality in adjacent floodplain areas in the watershed. Habitat within these rivers would continue to be influenced by the flooding patterns that currently occur and potentially contribute to channel scouring and/or siltation of aquatic habitat. Fish mortality in the form of fish stranding within floodplain areas adjacent to rivers would be expected to continue in a similar magnitude as currently occurs. This process is dependent on the frequency of current flood patterns on the Red River and its tributaries.

The Wolverton project is anticipated to restore potential habitat and reduce sedimentation in the stream, which would result in potential benefits to aquatic habitat. During the stream restoration process, there would be temporary impacts to aquatic habitat, fish and aquatic biota from construction. Once the stream is restored and re-established, the Wolverton project is anticipated to be beneficial for aquatic habitat and biota. The Manston project is anticipated to provide aquatic habitat for smaller fish and aquatic biota that is typical of small pools and deep wetland habitat. This would maintain water surface elevations and result in an overall beneficial impact within the Buffalo River watershed. The Cass Drain 21, 45, and 30 projects are not anticipated to have significant impacts on aquatic habitat or fish passage. Some aquatic habitat may exist in the drainages, but the quality of that habitat has not been assessed. It is anticipated that over the long term, the projects could provide some indirect improvements to aquatic habitat by providing more consistent water flow, reducing sedimentation, deepening the channels for fish that may enter the drainage system, and therefore, aquatic habitat or fish passage may be provided to a limited degree. However, these drain projects are man-made drainage ways that are not managed or intended for fish or aquatic biota.

4.2.4.2.3 No Action Alternative (with Emergency Measures)

The No Action Alternative (with Emergency Measures) would not add or remove barriers to fish passage within the Red River and its tributaries, and therefore, fish passage and migration within the watershed is not anticipated to change under current conditions.

4.2.4.2.4 Northern Alignment Alternative

Impacts and cumulative potential effects from the NAA are anticipated to be similar to those previously described for the Project. The location of the control structures on the Red and Wild Rice Rivers, and the tieback embankment would be located further downstream, and therefore, would impact a different location but with similar habitat.

4.2.5 Wildlife and Wildlife Habitat

4.2.5.1 Affected Environment/Environmentally Relevant Area

The majority of the project area is comprised of agricultural land and urban development. Due to settlement of the area, wildlife habitat has been limited to floodplain forests along stream corridors, remnant grasslands, shelterbelts around homesteads, and other areas that may not be developed. Both Minnesota and North Dakota have Comprehensive Wildlife Conservation Plans, State Wildlife Action Plans in Minnesota (SWAPs), developed and funded through federal grants and programs. These plans identify Species of Greatest Conservation Need (SGCN) and key habitats for conservation actions (MNDNR 2006). Key habitats are areas that historically supported SGCN. In Minnesota, the project area is in the Red River Prairie subsection. Key habitats include: prairie, wetland-nonforest, river-headwater to large, river-very large, and forest-lowland deciduous. Equivalent areas in North Dakota are: Tallgrass Prairie (Red River Valley); Rivers, Streams, and Riparian; and Wetlands and Lakes. The following provides a summary of key habitats in the project area and past land use changes. Additional details are provided in Chapter 3, Section 3.9 – Wildlife Resources.

<u>Prairie</u>

Land use practices over the last century, including urban development and widespread agriculture, have significantly reduced the amount of native prairie habitat across Minnesota and North Dakota. While the prevalence of prairies has been reduced compared to pre-settlement levels, grassland and surrogate upland habitats are present in the project area. These include hayland, pasture, and planted shelterbelts (FFREIS, 2011). Shelterbelts, planted near farmsteads and homes or along field edges, are composed mostly of small shrubs and fast growing tree species, but can also include some coniferous trees, as well as grassy understory. These habitats support wildlife species at varying levels depending on the size of habitat tracts and their proximity to existing human developments or activities. Pasture and hayland also support a variety of migratory birds for foraging and nesting.

Wetland-Nonforest

Nonforested wetlands have declined in many subsections of Minnesota's ecological classification system, especially in the Prairie Parkland province, which includes the Red River Prairie subsection (MNDNR, 2006). Due to the decline of nonforested wetlands, several species of birds are considered SGCNs in Minnesota (MNDNR, 2006). In North Dakota, the majority of nonforested wetland habitat is found outside the Red River Valley.

River Habitat

Historically, the Red River, its backwaters, and upland areas supported several species of wildlife. Rivers and streams within the Red River Valley ecological section have been significantly altered since the time of settlement through intensive agriculture, wetland drainage, channelization of streams, and addition of dams (Aadland et al., 2005). Historically the pre-settlement vegetation of the Red River Prairie subsection was dominated by tall grass prairies and wet prairies but has been replaced by wide-spread agriculture (MNDNR, 2006). Many SGCNs therefore have been extirpated from the Red River (MNDNR, 2006), but some species may persist.

In order to facilitate crop production, the land has been extensively drained through tiling of wetlands, creation of ditches, and channelization of streams, including streams such as the Rush and Lower Rush Rivers. These land use alterations lead to changes in river habitat such as nutrients and pollutants into the Red River and its tributaries, and alteration of flow regimes and increased sedimentation that reduces pool depth or covers hard substrates.

One of the other most significant changes to river habitats in the Red River basin is the creation of dams and flow control structures. The addition of these structures has altered the ability of fish to migrate within individual rivers and also through multiple rivers and streams across the overall watershed. This limitation of fish movement throughout the Red River watershed limits the access of fish to certain important habitat types such as native spawning areas or wetlands located in the upstream portions of the watershed. Reduced fish migrations can also impact other aquatic organisms, such as mussels, which depend on fish hosts for reproduction and dispersal (Aadland, 2010). Despite past alterations, river habitats within the Red River Prairie subsection support several significant fish and wildlife resources such as catfish and the reintroduction of lake sturgeon.

Forest-Lowland Deciduous

Large areas of floodplain forests have been lost since settlement within the project area (MNDNR, 2006). Floodplain forests were formerly dominant in the wide floodplains surrounding streams and rivers. However, conversion to agriculture and urbanization has reduced the floodplain forests to narrow margins along rivers and streams. Within the project area, floodplain forest is less prevalent than in other parts of Minnesota, such as along the Mississippi River. The remnant margins are essentially the only floodplain forest habitat remaining. Past habitat distribution shows that five to seven percent of the Red River Prairie subsection consisted of floodplain forest, but its occurrence is now less than one percent (MNDNR, 2006; Hagen et. al 2005). Since the project area was historically prairie, forest was uncommon but served as important nesting, breeding, and overwintering habitat for a variety of terrestrial wildlife species (FFREIS, 2011).

4.2.5.2 Environmental Consequences

4.2.5.2.1 Proposed Project

The primary concerns for potential impacts to wildlife habitat would occur from construction and operation of the Project. Construction would impact floodplain forest and aquatic habitat, and would also convert agricultural land into upland and wetland through mitigation. Direct impacts to wildlife resources during construction include potential for direct mortality, displacement or increased exposure of less mobile species (i.e., small mammals, amphibians, reptiles, ground-nesting birds, including some migratory birds) to predators. Temporary impacts to wildlife resources from construction would primarily include displacement due to human presence, increased noise and visual disturbances. Impacts to riparian vegetation during construction may also cause stream bank destabilization.

Project operation has the potential to temporarily displace wildlife due to flooding in areas that would not be inundated under existing conditions. Project operation would cause potential impacts to forested areas that would not otherwise be affected and may not have species adapted to these flooding events. The direct impacts to floodplain forest habitat during project operation would have the longest potential temporal loss of habitat function as the loss of habitat would be immediate. Wildlife species migrate between habitat areas for foraging and cover in the region, meaning impacts to wildlife species and populations can occur indirectly due to impacts to habitat. Direct impacts to aquatic wildlife resources include 8-25 acres of stream channel habitat impacts, including the direct loss of stream channel aquatic habitat from abandonment of Rush/Lower Rush Rivers. During operation of the project, displacement and mortality may also occur to wildlife using the diversion channel due to a sudden flow of water.

Construction-related impacts would be mitigated by replacement of habitat in disturbed areas or at mitigation locations near the project area. All direct impacts to the floodplain forest would be mitigated at a two-to-one ratio in farmed wetlands along the Red River. There would likely be some temporal loss of habitat function during the period after habitats are impacted by the Project but before created mitigation habitats have matured and replaced the lost habitat function. All non-cropped upland habitat would be replanted with native species, particularly native grasses that are anticipated to have positive impacts on overall habitat value (FFREIS, 2011). The degree of impacts would be dependent on the timing and duration of flood events and operation of the Project.

4.2.5.2.2 Base No Action Alternative

Flooding would continue resulting in temporary displacement of wildlife. Natural habitat would generally remain fairly similar to existing conditions, with changes in vegetation communities occurring over time after flooding or other disturbance events. Development is expected to continue in the project area that has the potential to further turn natural habitat into urbanized area or agricultural land.

The Wolverton project would result in a more stabilized stream corridor that could result in additional wildlife habitat following completion of the project. This corridor would be susceptible to current flood dynamics and, during flood events, result in temporary displacement of wildlife. During the construction of the stream restoration project, wildlife may be negatively impacted due to displacement. Once vegetation is re-established along the corridor, wildlife is anticipated to return.

The Manston project would provide a consistent wetland pool, which would allow wetlands and wildlife habitat to establish. This would result in approximately 2,000 acres of wetland habitat and approximately 3,000 acres of upland habitat in the Buffalo River watershed within the Red River basin.

4.2.5.2.3 No Action Alternative (with Emergency Measures)

The No Action Alternative (with Emergency Measures) could result in minor, temporary impacts to wildlife habitat along the Red River within the cities of Moorhead and Fargo where levees and sandbags are used to control flooding. Wildlife may be temporarily displaced. These impacts would be minor as most emergency measures would occur in urban areas, where wildlife habitat is already disturbed by human activities. Natural habitat would generally remain fairly similar to existing conditions, with natural changes in vegetation communities occurring over time after flooding or other natural disturbance events.

4.2.5.2.4 Northern Alignment Alternative

Since the environmentally relevant area is the same as the Project, impacts and cumulative potential effects from the NAA are anticipated to be similar to those previously described for the Project. However, specific habitat acreages could vary, floodplain forest, wetlands, aquatic habitat and other cover types specific to the NAA embankment and control structure areas have not been surveyed, and therefore, exact acreages are unknown.

4.2.6 Cultural Resources

4.2.6.1 Affected Environmental/Environmentally Relevant Area

Cultural resources include a wide range of historic, archaeological and other resources related to past human activities. Prior to European settlement, the project area, as part of the Red River valley, was inhabited by Native American tribes. As settlers moved in, tribes relocated, leaving artifacts and evidence of their use of the area. The project area experienced significant settlement during the late 1800s. Settlement to this area was influenced by the United States Congress Homestead Act and development of the railroad, which brought homesteaders to the area, many of whom established farms. As time has passed, development has continued, while leaving archaeological and historic resources, such as Native American artifacts, structures, and historically significant places. Some of these cultural resources have been destroyed, while others have remained or are yet to be identified.

For the Project, cultural resource surveys are conducted within a defined Area of Potential Effect (APE). The APE is the area where historic properties may be impacted, directly or indirectly, which has been defined in a programmatic agreement. A Programmatic Agreement for the Project was negotiated and signed per 36 CFR Part 800, as a method for the St. Paul District USACE to comply with Section 106 of the National Historic Preservation Act (NHPA), as amended. The Programmatic Agreement identified the APE, within which potential impacts to cultural resources were surveyed. The APE is defined as consisting of the footprint of the selected diversion plan including the diversion channel alignment, its associated tieback levee(s), associated construction work areas, construction staging areas, borrow areas, and disposal areas, as well as associated upstream water storage and water staging areas, Project-related flood proofing locations, Project-related environmental mitigation areas, Project-related in-town (Fargo and Moorhead) levees, and the viewshed to one-half mile from the diversion channel's centerline and all other above-ground project features.

Phase I cultural resource surveys have been conducted for a majority of the current Project construction footprint, and portions of the staging area. A number of historic structures were found and evaluated for eligibility for the National Register for Historic Places (NRHP) listing. Additional surveys would be required following final Project design, prior to Project construction, to determine if there are additional NRHP eligible properties that should be evaluated and handled appropriately. Additional detail is provided in Chapter 3, Section 3.12 – Cultural Resources.

4.2.6.2 Environmental Consequences

4.2.6.2.1 Proposed Project

Potential impacts from the Project could occur to NRHP properties and NRHP-eligible properties. The Section 106 process includes the assessment of adverse effects to historic properties (36 CFR, subpart B § 800.5). Construction and operation of the Project has the potential to directly and indirectly impact NRHP and NRHP-eligible properties. Within the diversion channel construction footprint, there are three NRHP-eligible sites, one NRHP-recommended eligible site, and two NRHP-undetermined eligibility sites. Within the Project connecting channel and staging area, including the OHB levee, there are two NRHP-listed sites, three NRHP-eligible sites, ten NRHP-recommended eligible sites, and ten sites listed as NRHP-undetermined eligibility. Direct impacts include damage, destruction or physical alteration of a property, as well as removal of a property. Within the Protected Area there are 20 cemeteries which would be removed from current flooding risk. Within the inundation areas upstream of the tieback embankment, there are 12 cemeteries with varying level of impacts.

Indirect impacts include those associated with visual and noise impact from the Project. Cultural resources surveys have been completed for portions of the Project and its staging area.

Compliance with Section 106 of the NHPA requires federal agencies to avoid and minimize impacts to NRHP properties and NRHP-eligible properties. Some portions of the Project have been surveyed, but additional surveys would be needed for Project construction. A Programmatic Agreement for the Project was negotiated and signed per 36 CFR Part 800 to ensure the USACE complies with Section 106 of the NHPA. The Programmatic Agreement defines the Project APE and contains stipulations for cultural resources avoidance, minimization, and mitigation measures. The Programmatic Agreement covers the construction footprint, work limits, in-town levees, staging area, and environmental mitigation sites that are part of the Project, including the Drayton Dam and Wild Rice River Dam.

It is unknown what surveys or mitigation measures, if any, are associated with the Wolverton project. However, the Project, in combination with the Wolverton project, is not anticipated to contribute to cumulative potential effects.

4.2.6.2.2 Base No Action Alternative

Cultural resources would continue to be affected during flood events consistent with current conditions. Forty-three of the total 54 known cemeteries in the Project area are currently affected during 100-year floods. Cultural surveys have not been conducted on the reasonably foreseeable projects, therefore, cultural resources cumulative effects, although applicable, cannot be fully assessed.

The Wolverton project would disturb the stream corridor. If cultural resources are present where ground disturbance occurs, it is anticipated that appropriate actions would be taken to avoid, minimize and mitigate any impacts to cultural resources.

4.2.6.2.3 No Action Alternative (with Emergency Measures)

Activities associated with the Base No Action Alternative (with Emergency Measures) are planned to occur primarily within existing urban areas which are not known to have impacts to cultural resources.

4.2.6.2.4 Northern Alignment Alternative

Impacts and cumulative potential effects from the NAA are anticipated to be similar to those previously described for the Project, with a few exceptions. The NAA connecting channel and staging area, including the OHB levee, would include two NRHP-listed sites, three NRHP-eligible sites, 13 NRHP-recommended eligible sites, and 17 sites listed as NRHP-undetermined eligibility. Within the Benefited Area of the Project, 19 cemeteries would be removed from currently flooded areas. Within the inundation areas upstream of the tieback embankment, ten cemeteries would have flooding at varying levels of impact.

4.2.7 Socioeconomics

4.2.7.1 Affected Environment/Environmentally Relevant Area

The F-M urban area serves as a regional center for healthcare, government, employment, commerce, educational and training opportunities. Flooding in the Red River basin threatens the F-M urban area with risks of damage to urban and rural infrastructure; disruptions to transportation corridors; and damages to businesses and homes. Flooding also affects an individual’s employment, income, and potentially their access to public services. The FFREIS identified the threat of catastrophic flooding and the frequency and magnitude of recent floods causes high stress levels, resulting in mental and physical effects on the well-being of residents and business owners. In the recent past, the floods of 1997 and 2009 have had the greatest physical and emotional effect on the communities of Fargo and Moorhead. Completed FDR projects have had beneficial social and economic impacts in the F-M area by reducing flood risk and flood damage to homes and businesses, and protecting critical infrastructure within the F-M urban area. The FDR projects provide some flood protection, but do not provide full flood protection for some areas. During significant flood events, emergency response plans are implemented, which include evacuations, installation of temporary levees, sandbagging, and other measures. This requires considerable effort, financial resources, and coordination. The threat of flooding also causes significant stress (e.g., emotional, physical, and financial) on many individuals, families, and businesses located within the floodplain in both rural and urban areas. Further discussion on the social and economic implications of all alternatives is provided in Chapter 3, Section 3.16.

4.2.7.2 Environmental Consequences

4.2.7.2.1 Proposed Project

The Project would cause new flood inundation in areas outside of the existing 100-year floodplain. The Project would also buy out properties within a designated staging area, which would potentially remove them from the tax base and school district of a particular local government area. The Project would also impact more agricultural land than the current 100-year flood, which would economically impact individual farmers and landowners. There are also social implications to relocation of families and potentially generations of farmers within the staging area.

The Project would also significantly reduce the flood risk for some areas in the current 100-year floodplain. These areas near the F-M urban area may experience development at a greater rate. The rate of development would be determined based on market conditions, land use plans, local zoning regulations, and permitting approval.

Past projects appear to have resulted in potentially beneficial impacts on socioeconomics in the project area by providing some flood risk reduction in the F-M urban area through the construction of levees and removing properties from the floodplain. The Project is anticipated to provide additional flood risk reduction to the socioeconomics in the F-M urban area, but would also impact individual property owners and communities located outside of the Benefited Area. This could have a potentially significant impact on certain individuals and possibly on communities in the F-M rural areas. Proposed mitigation for the social and economic impacts of this Project includes property acquisition and easements. The identified projects in the environmentally relevant area did not have significant social and economic impacts, and therefore, no mitigation was proposed. Proposed mitigation and monitoring may result in social and economic cumulative potential effects as property owners are relocated or property values are affected by easements. Proposed mitigation is further described in Chapter 3, Section 3.16 - Socioeconomics. The overall social and economic impacts of the Project are positive. Negative social and economic impacts are primarily located within and adjacent to the footprint of constructed features or in the inundation areas upstream of the tieback embankment.

The Cass Drain 21 and 45 projects would improve water flow and drainage in West Fargo. Social or economic impacts for primarily private landowners could occur from the Cass Drain 30 project, which are anticipated to be beneficial. The Project would provide flood damage reduction to drainage areas similar to those served by the Cass Drain 21, 45, and 30 projects.

4.2.7.2.2 Base No Action Alternative

The Base No Action Alternative would continue the current flood risk in the F-M urban area. Federal Emergency Management Agency (FEMA) plans to update the National Flood Insurance Program (NFIP) maps in the future to reflect the current understanding of flood risk. Continuation of current conditions would not result in certifiable flood protection to the 100-year flood needed for FEMA accreditation, so thousands of existing structures would be mapped into the regulatory floodplain. This could increase the need for flood insurance to these structures as part of obtaining financing for real estate transactions.

Cass Drain 21, 45, and 30 projects are anticipated to provide drainage and some flood risk benefits, but these benefits would mostly be contained within in localized areas and would not qualify to receive FEMA accreditation.

4.2.7.2.3 No Action Alternative (with Emergency Measures)

The No Action Alternative (with Emergency Measures) provides some flood risk reduction through the implementation of planned emergency measures in the F-M urban area. Some current and planned FDR projects do or would have FEMA accreditation; however, not all current conditions and emergency measures would provide a certifiable 100-year level of protection needed for FEMA accreditation in the future. This alternative would be similar to the Base No Action Alternative with respect to the need for flood insurance to support financing for real estate transactions. The locations of each type of emergency measure are mapped with instructions for implementation at various times and stages of flooding. In general, the social and economic effects of the No Action Alternative (with Emergency Measures) are anticipated to be beneficial to the F-M urban area by reducing flood risk. However, emergency measures in the F-M urban area require significant financial and human resources, including thousands of volunteers.

Cass Drain 21, 45, and 30 projects are also anticipated to provide drainage and some flood risk benefits in localized areas.

4.2.7.2.4 Northern Alignment Alternative

Impacts and cumulative potential effects from the NAA are anticipated to be similar to those previously described for the Project.

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5.0 Comparison of Alternatives

The Project and three alternatives have been analyzed in this Environmental Impact Statement (EIS) to provide information that identifies their potential significant environmental impacts. This EIS provides details on the potential for significance and measures needed to avoid impacts. The information provided “shall be used as a guide in issuing, amending, and denying permits and carrying out other responsibilities of governmental units to avoid or minimize adverse environmental effects and to restore and enhance environmental quality” (Minnesota Rules, part 4410.0300).

Complete descriptions of the Project and the three alternatives are provided in Chapter 2. A detailed analysis and discussion on the environmental consequences for each alternative are presented in Chapter 3. Chapter 5 pulls information contained in Chapter 3, consolidates the environmental impacts, and focuses on comparing environmental consequences of the reasonable alternatives to the Project. The chapter also includes a discussion on how permitting or other regulatory agencies and local governments, particularly Minnesota Department of Natural Resources (MNDNR), and other interested and/or affected parties can use this information in accordance with Minnesota Rules, parts 4410.0300, 4410.3100, and 4410.7055.

5.1 REASONABLE ALTERNATIVES

According to Minnesota Rules, part 4410.2300, item G, the EIS should compare the potentially significant impacts of the proposed project with those of other reasonable alternatives. The three alternatives analyzed in this EIS include the Base No Action Alternative, the No Action Alternative (with Emergency Measures), and the Northern Alignment Alternative (NAA). Only those alternatives that are considered “reasonable” are included in the Comparison of Alternatives. An alternative is deemed “reasonable” if it meets the project purpose as defined by the project proposer (see also Chapter 1). According to the Diversion Authority:

The purpose of the Project is to reduce flood risk, flood damages, and flood protection costs related to flooding in the Fargo-Moorhead (F-M) metropolitan area. To the extent technically and fiscally feasible, the Project will:

1. Reduce flood risk potential associated with a long history of frequent flooding on local streams including the Red River of the North, Sheyenne, Wild Rice, Maple, Rush and Lower Rush Rivers passing through or into the F-M metropolitan area;
2. Qualify substantial portions of the F-M metropolitan area for 100-year flood accreditation (i.e. meets the standard to be shown on a Flood Insurance Rate Maps (FIRMs) as providing protection) by the Federal Emergency Management Agency (FEMA) under the National Flood Insurance Program (NFIP); and
3. Reduce flood risk for floods exceeding the 100-year flood or greater, given the importance of the F-M metropolitan area to the region and recent frequencies of potentially catastrophic flood events.

5.1.1 Base No Action Alternative

The Base No Action Alternative includes the potential flood risk reduction impact of already completed and currently funded projects, such as levee construction and property buyouts. Under the Base No Action Alternative, there would be no dams on the Red and Wild Rice Rivers, no City of Oxbow, Village of Hickson, Bakke Subdivision (OHB) ring levee or Comstock ring levee, no embankments, no diversion channel, and no upstream staging area. Flooding would continue in the project area, causing approximately 170,000 acres of inundation and social disruptions.

Under the Base No Action, none of the Project impacts described in Chapter 3 would occur. No socioeconomic benefits would occur to the F-M urban area; and socioeconomic impacts would be avoided in the Unbenefited Area.

The Base No Action Alternative does not meet the proposer's defined project purpose because it: 1) does not reduce flood risk from the North Dakota tributaries, 2) does not qualify substantial portions of the F-M metropolitan area for one-percent chance flood (100-year flood) FEMA accreditation, or 3) does not protect from floods greater than the 100-year flood. Therefore, the Base No Action Alternative is not considered a "reasonable" alternative to compare to the Project, and will not be further evaluated in the Comparison of Alternatives.

5.1.2 No Action Alternative (with Emergency Measures)

The No Action Alternative (with Emergency Measures) includes the potential flood risk reduction impact of already completed and currently funded flood damage reduction projects. This alternative also assumes that emergency measures similar to those that have been historically implemented in the project area would continue to be implemented as necessary due to flooding.

The emergency measures would result in a slight socioeconomic benefit to the F-M urban area where structures are protected. There would also be slight socioeconomic impacts immediately upstream of emergency measures.

For reasons similar to the Base No Action Alternative, the No Action Alternative (with Emergency Measures) does not meet the proposer's defined Project purpose; therefore, this alternative is not considered a "reasonable" alternative and will not be further evaluated in the Comparison of Alternatives.

5.1.3 Northern Alignment Alternative

The NAA is similar to the Project. Many potential impacts of the Project also apply to the NAA. One of the primary differences between the two alternatives is the location of impacts in the southern project area. The NAA would move the southern earthen embankment system of the Project north approximately 1.5 miles. The southern boundary of the NAA staging area is between approximately 1.5 miles and three miles north of the Project staging area southern boundary (Figure 7). The remaining features of the NAA would remain the same as the Project. The NAA consists of a dam and diversion channel system including, but not limited to: an earthen embankment system, excavated channels; an inlet control structure; control structures on the Red and Wild Rice Rivers; an upstream flood water staging area (staging area); inlet structures on tributaries; levees and floodwalls in the F-M urban area; non-structural features (such as buyout, relocation, or raising individual structures); and recreation features (such as multipurpose trails and pedestrian bridges). The NAA also includes environmental mitigation projects located inside and outside the project area.

The NAA does meet the proposer's defined project purpose; therefore, this alternative is considered a "reasonable" alternative and will be evaluated in the Comparison of Alternatives. Because the Project and NAA impact footprints differ, some studies or investigations providing environmental effects for the NAA may not have been conducted, or may not have been completed to the same extent as for the Project. Incomplete NAA impact information will be acknowledged within each EIS topic section. If the NAA is pursued beyond the EIS, additional site specific studies would need to be conducted and considered in the final design and construction plans.

Additionally, the design details or construction plans for the structures might need to be modified for reasons such as different topography, soil types or land use. These potential differences or modifications are not anticipated to be significant; therefore, for the purposes of the EIS, the NAA design features are described as being similar to or the same as the Project.

5.2 COMPARISON OF ALTERNATIVES EVALUATION

The Comparison of Alternatives pulls environmental impact information found in Chapter 3 and consolidates it into Table 5.1 below. The intent of this table is to provide a side-by-side summary comparison of potential impacts and to acknowledge possible benefits of alternatives.

The Comparison of Alternatives (Table 5.1) consists of six columns. From left to right, the column contents are as follows:

1. Topic: All of the topic areas covered in Chapter 3 of this EIS. Under each topic name is the section number of Chapter 3 that can be referenced for more detailed information.
    a. Please note that some topics contain many bulleted items and wrap from one page of the table to the next.
2. Proposed Project: Project impacts (environmental or social) found in Chapter 3. Impacts can be positive or negative, qualitative or quantitative.
3. Northern Alignment Alternative: NAA impacts (environmental or social) found in Chapter 3. Impacts can be positive or negative, qualitative or quantitative. Components of the NAA and the Project that are the same, or similar, should be reviewed in the column for the Project. The NAA column contains only the information that is different from the Project.
4. Comparison: Generally, either a statement of "No Difference", or, if differences exist between the Project and NAA, they are outlined. Differences can be positive or negative, qualitative or quantitative.
5. Mitigation: Mitigation or monitoring that is being proposed with the Project. Proposed mitigation for the Project also applies to the NAA. If there are differences in mitigation, they will be outlined in the "Comparison" column.
6. Context & Comments: Statements that help to qualify a bulleted item from a preceding column(s), add context to an impact, or draw attention to a particular detail. Context and comments can be positive or negative, qualitative or quantitative.

5.3 USING COMPARISON OF ALTERNATIVES INFORMATION

Unlike Federal Council of Environmental Quality (CEQ) regulations, which require federal agencies to identify an agency-preferred alternative, the State's statutes have no such requirement. As such, this EIS will not name a "preferred alternative." Rather, the purpose of environmental review is to provide information to the public and units of government on the environmental impacts of a project before approvals or necessary permits are issued. After projects are completed, unanticipated environmental impacts can be costly to undo, and environmentally-sensitive areas can be impossible to restore. Environmental review creates the opportunity to anticipate and correct these problems before projects are built (EQB, 2015*)*. While, as stated above, the EIS must be used a guide, the summary information presented in this chapter will add utility to the document as a guide in issuing, amending, and denying permits and carrying out other responsibilities of governmental units to avoid or minimize adverse environmental effects and to restore and enhance environmental quality.

The Comparison of Alternatives (Table 5.1) goes further to serve the purposes of Minnesota Statutes 2008, section 116D.04, subdivision 6 that states:

> *"Subdivision 6. Prohibitions. No state action significantly affecting the quality of the environment shall be allowed, nor shall any permit for natural resources management and development be granted, where such action or permit has caused or is likely to cause pollution, impairment, or destruction of the air, water, land or other natural resources located within the state, so long as there is a feasible and prudent alternative consistent with the reasonable requirements of the public health, safety, and welfare and the state's paramount concern for the protection of its air, water, land and other natural resources from pollution, impairment, or destruction. Economic considerations alone shall not justify such conduct."*

Permittees can use Table 5.1 to get a general sense of which alternative poses less environmental consequences and greater social/economic benefit. Details of bulleted items in Table 5.1 can be referenced and reviewed in Chapter 3 under the respective topic subsection (Chapter 3 subsections listed under each topic name in the table). When weighing information presented in the Comparison column, economic considerations alone shall not be used a basis to deny or grant a permit. Similarly, environmental impacts should be taken in context when making the judgment of which alternative to permit (see Context & Comments column). When considering permit conditions, permittees should also reference Chapter 6—Effectiveness of Proposed Mitigation Measures, which identifies additional proposed mitigation measures that could reasonably eliminate or minimize environmental impacts of the Project.

Table 5.1 Summary of Environmental and Socioeconomic Effects and Mitigation for Proposed Project and Northern Alignment Alternative

Topic	Proposed Project	Northern Alignment Alternative	Comparisons (Project and Northern Alignment Alternative)	Mitigation	Context & Comments
Hydrology and Hydraulics (see Section 3.1)	• 118,512.70 total inundated acres in project area, 1-percent chance flood (100-year flood) (includes base flooding). • 20,461.30 acres newly inundated in project area, 100-year flood. • 72,923.50 acres protected from inundation in project area. • Benefited Area: Reduction of flood stage through the main stem of the Red River. Reduction of the extent, depth and duration of flooding. Flood damage reduction on lower Wild Rice River. • Unbenefited Area: Increase in the extent, depth and duration of flooding; impacts vary based on	• Similar to Proposed Project, with the following differences: o 120,089.80 total inundated acres in Project Acres, 100-year flood (includes base flooding). o 15,744.80 acres newly inundated in project area, 100-year flood. o 66,629.90 acres protected from inundation in project area.	• 1,577.10 (1%) fewer total inundation acres in project area under Project, 100-year flood. • 4,716.50 (26%) fewer newly inundated acres in project area under NAA, 100-year flood. • 6,293.60 (9%) fewer acres protected in Project area under NAA, 100-year flood.	• There are no specific "Hydrology" mitigation measures. Proposed mitigation for inundation would be discussed under the resource affected. See other topic areas in this table, as well as Proposed Mitigation and Monitoring subsections of Chapter 3 and all of Chapter 6.	• Flood elevations, depths, and duration would differ depending on location (i.e., moving staging area approximately 1.5-3 miles north minimizes inundation impacts in Richland and Wilkin Counties, but increases inundation impacts between the NAA and Project alignments).

Topic	Proposed Project	Northern Alignment Alternative	Comparisons (Project and Northern Alignment Alternative)	Mitigation	Context & Comments
	location. • Diversion of high flows from the Sheyenne and Maple Rivers into the diversion channel. • Abandoned lower portions of the Rush and Lower Rush Rivers, rerouted into the diversion channel.				
FEMA Regulations and the CLOMR Process (see Section 3.2)	• Areal extent of 100-year flood inundation required for Project operation in the staging area would be mapped as floodway. Any additional flood inundation area beyond the staging area but within the FEMA revision reach would be mapped as floodplain. • A FEMA-approved Conditional Letter of Map Revision (CLOMR) would be required.	• Same as under Proposed Project.	• No Difference.	• The April 2015 FEMA/USACE Coordination Plan (Appendix F) states that all impacted insurable structures within the FEMA revision reach would be mitigated through agreed methods consistent with those specified by the NFIP based on depth of flooding at each structure.	• Flood inundation limits, exact structures mitigated and floodway/floodplain limits would differ depending on location (i.e., moving staging area approximately 1.5-3 miles north minimizes impacts in Richland and Wilkin Counties, but increases impacts between the NAA and Project alignments).

Topic	Proposed Project	Northern Alignment Alternative	Comparisons (Project and Northern Alignment Alternative)	Mitigation	Context & Comments
	• After Project completion, a Letter of Map Revision (LOMR) would be submitted.				
Stream Stability (see Section 3.3)	• Benefited Area: limit magnitude of high flow events (>10-year flood), impacting the natural hydrology of the area (e.g., changing riparian vegetation composition and sedimentation rates). • Inundation Area: direct impact by increased depth and duration of flooding. Increased duration could reduce soil bank strength and be more prone to collapse. Increased sedimentation would occur incrementally over decades. If flood inundation extends into the growing season, plants are	• Similar to Proposed Project.	• No Difference.	• The Draft AMMP (Appendix B) includes monitoring recommendations to assess potential impacts pre-construction and post-operation. • Rush/Lower Rush Rivers: Abandoned river sections would be maintained by the water resource district. • To counteract the potentially high shear stresses and velocities, energy dissipation would be incorporated into the structure designs. • Drawdown of the inundated area would be controlled to limit impacts to geomorphology.	• NAA impacts are shifted approximately 1.5-3 miles downstream of the Project. • Geomorphology Report relies on aerial photo and on-site surveys, so tree composition, root density and root depth could not be verified. Additional studies would need to be completed to determine role of vegetation and other aspects of bank stability. • Final design details of the dam and the operating plan were not available; therefore, the potential effects of the Project on bed and channel scour are not known. • Monitoring the drawdown of the inundated area would be helpful to determine extent of sedimentation impacts.

Topic	Proposed Project	Northern Alignment Alternative	Comparisons (Project and Northern Alignment Alternative)	Mitigation	Context & Comments
	likely to be stressed, which could make them susceptible to disease and insect infestations. • Rush/Lower Rush Rivers: potential aggradation from sediment in abandoned river sections. • Control Structures: Increases potential for bed and channel scour.				
Wetlands (see Section 3.4)	• 1,820 wetland acres directly impacted from diversion channel, connecting channel, excavated material berms, shallow drainage ditches outside berms, tieback embankments, roads, control structures, and OHB ring levee (1,820 acres; mostly seasonally flooded basin types, but also includes 62	• Similar to Proposed Project with the following differences: o Comstock ring levee would not be required. o Indirect and temporary impacts to 148 (estimated) acres in inundated areas.	• Wetlands between the Project and NAA alignments have yet to be field verified, so exact acreages are unknown. • Estimated 8 fewer wetland acres (approximately 5 acres for Comstock levee and 3 acres indirect in inundation area; 0.4%) impacted under NAA.	• Rush/Lower Rush River bisect impacts would be offset by diversion channel design. • A habitat-based wetland replacement approach is proposed (rather than acreage). • USACE, MNDNR, Minnesota Pollution Control Agency (MPCA) and local government units (LGUs) have jurisdiction over wetland impacts and	• About 84% of footprint wetlands are considered to be of low function, including all 8 acres that differ. • Drayton Dam: Most of the wetland areas within the footprint are along the MN bank. • The majority of the mitigation would be in the bottom and side slopes of the diversion channel.

Topic	Proposed Project	Northern Alignment Alternative	Comparisons (Project and Northern Alignment Alternative)	Mitigation	Context & Comments
	acres floodplain forest). • Direct Wetland Impact from Comstock Levee (estimated to be less than 5 acres) • Direct wetland impact from Drayton Dam Mitigation Project (0.5 acres) • Indirect and temporary impacts to 151 (estimated) acres in inundated areas. • Indirect impact by changing wetland function/type from Rush/Lower Rush River bisect.			would approve mitigation for unavoidable wetland impacts. The majority of required coordination has already been accomplished in the FEIS, 404 and Supplemental Environmental Assessment (EA) for wetland mitigation. Corps would follow applicable National Environmental Policy Act (NEPA) and Clean Water Act (CWA) 404 rules for any future changes. • Draft AMMP (Appendix B) includes additional wetland mitigation and monitoring recommendations.	
Cold Weather Impacts on Aqueduct Function and Biotics (see Section 3.5)	• Freezing water could result in negative impacts to fish and other water-dependent resources as a result of temporary blocking of species	• Same as under Proposed Project.	• No Difference	• Monitoring to assess potential impacts to fish migration on the Maple and Sheyenne Rivers would occur once Project features are in place and the Project is put into	• If the aqueduct freezes, it is likely the natural channel would also freeze. • Maple River Aqueduct: The USACE Engineer Research and Development Center (ERDC) Cold Regions

Topic	Proposed Project	Northern Alignment Alternative	Comparisons (Project and Northern Alignment Alternative)	Mitigation	Context & Comments
	passage and biotic connectivity. • Ice build-up within an aqueduct could alter channel flows and result in temporary increases in the upstream water levels. • Heating tubes are proposed to facilitate cold weather operation.			operation. An Aquatic Biological Monitoring Team, in coordination with the Adaptive Management and Monitoring Team (Draft AMMP) Team, would collaborate on how best to identify and define fish passage effectiveness. • Impacts to aquatic habitat on the Maple and Sheyenne Rivers would be verified through the comparison of Index of Biotic Integrity (IBI) scores developed before and after construction. • Current engineering plans include heating components to reduce the potential for freezing or ice buildup.	Research and Engineering Laboratory (CRREL) completed a report, which included the analysis of different operating scenarios and applying predicted results from computer modeling and analysis. • Post-construction and Project operation monitoring efforts would be a key component in determining aqueduct impacts to the riverine systems and any adaptive management response.
Cover Types (see Section 3.6)	• Primary cover type impacts would occur to croplands and wetlands. • Permanent direct	• Similar to Proposed Project with the following differences: o The overall cover type acreage and	• Cover Types between the Project and NAA alignments have yet to be field verified, so exact acreages are unknown.	• Cropland impacts would be mitigated by compensation to landowners such as land purchase and	• Row cropping would not be allowed on exterior embankments, but cutting/bailing of established grasses is

Topic	Proposed Project	Northern Alignment Alternative	Comparisons (Project and Northern Alignment Alternative)	Mitigation	Context & Comments
	impacts under the footprint of the diversion channel, tieback embankments, and the Comstock and OHB levees. • Permanent direct impact from construction of the diversion channel would convert approximately 4,500 acres of cropland to grassland and wetland. • Indirect impacts from inundation during flood events but would not cause a permanent conversion of existing cover types. • Project operation would result in approximately 18,630 acres of indirect cropland impacts in the inundation area during the 100-year flood event.	location. o Comstock ring levee not needed; therefore direct impacts from a ring levee would not occur.	• Less direct construction impact under NAA without Comstock ring levee.	flowage easements. • Direct impacts to floodplain forest would be mitigated at a 2:1 ratio. • Type 1 wetlands (farmed) would be mitigated by creation of wetlands in the diversion channel on the bottom and side slopes.	possible (permanent vegetation cover and associated roots are critical to soil strength and overall structural integrity). • The floodplain forest is the only natural forest habitat in the project area, with impacts totaling approximately 62 acres (less than one percent of all floodplain forest wetland acres in project area).

Topic	Proposed Project	Northern Alignment Alternative	Comparisons (Project and Northern Alignment Alternative)	Mitigation	Context & Comments
	• Grassland would increase between 3,900 and 4,600 acres as a result of Project construction. • Type 1 Wetlands (farmed) would be the primary wetland cover type impacted in the Project and OHB Levee footprint, with impacts totaling approximately 1,477and 44 acres. • Project operation would result in approximately 112 acres of indirect impacts to wooded/forest cover type in the inundation area during the 100-year flood event. • 70 acres of Wooded/Forest cover type (including shelterbelts and windbreaks) would be converted to				

Topic	Proposed Project	Northern Alignment Alternative	Comparisons (Project and Northern Alignment Alternative)	Mitigation	Context & Comments
	grassland or wetland cover in the diversion channel. • Lawn/Landscaping impacts would occur primarily around urban or residential areas, where natural cover has already been converted to human uses. Less than 100 acres of this cover type would be converted to grassland or wetland cover in the diversion channel.				
Potential Environmental Hazards (see Section 3.7)	• Direct impact from construction to parcels with recognized environmental conditions (RECs). • Operation has potential to periodically spread contaminants in inundated areas where Environmental Site Assessments (ESAs)	• Similar to Proposed Project.	• No Difference.	• Once specific properties in the inundated areas are identified for acquisition, additional assessments, such as a Phase I ESA or subsequent Phase II ESA, would be conducted to provide details on the extent of potential contamination and	• None

Topic	Proposed Project	Northern Alignment Alternative	Comparisons (Project and Northern Alignment Alternative)	Mitigation	Context & Comments
	have not been conducted.			specific removal and remediation measures that may be required to avoid impacts.	
Fish Passage and Mortality (see Section 3.8)	• Direct Impact on Red River: 1.0 miles, 17 acres. • Direct loss of river channel to Rush and Lower Rush Rivers: 2.3 and 2.7 miles, respectively. • Direct Impact on Wild Rice River: 0.9 miles, 12 acres. • Direct Impact on Sheyenne River: 0.9 miles, 8.4 acres. • Direct Impact on Maple River: 1.1 miles, 11 acres. • Potential Aquatic Habitat Impacts: direct mortality to macroinvertebrate and fish from crushing and excavation; temporary fish relocation during construction. Operation could change pools,	• Similar to Proposed Project.	• Similar impacts, but NAA may have slightly less fish passage impacts on Wolverton Creek and slightly more impacts on Wild Rice River. By shifting project approximately 1.5-3 miles north, NAA would have slightly less impact to aquatic habitat on Wolverton Creek.	• Aquatic Habitat: macroinvertebrates expected to repopulate once habitat is reestablished. • Fish Passage: Multiple design elements would be required to ensure fish passage (e.g., natural roughness elements). Diversion outlet structure, Rush River rock ramp, and diversion channel between these structures would allow fish passage from the Red River to the Rush River. Design of all other structures is not final. • Fish Stranding: Operation would allow diversion channel flow to gradually decrease. Monitoring would	• Existing habitat for all streams in project area is rated as moderate to poor quality. • Impacts are dependent on Project operation, weather, final design of structures, and timing of operation with fish movement. • Fish Passage: NAA is located further away from the confluence of Wolverton Creek and Red River and closer to confluence of Wild Rice and Red Rivers, which could lower velocities on Red River and Wolverton during drawdown providing better fish passage. • Fish Stranding: This process naturally occurs during flood events. Dependent upon timing of receding water. • Aquatic Habitat: Impacts have potential to extend

Topic	Proposed Project	Northern Alignment Alternative	Comparisons (Project and Northern Alignment Alternative)	Mitigation	Context & Comments
	sedimentation, depths and velocities. • Fish Passage/ Migration Impacts: Project would produce impassable conditions (flow velocities) on Red and Wild Rice Rivers during operation, potentially impacting migrations of walleye, northern pike, and redhorse/ white sucker; and access to Wolverton Creek. Abandonment of Rush/Lower Rush Rivers could impact fish migration from Red/Sheyenne Rivers. Cold weather could freeze the river channel within the aqueduct. • Fish Stranding: If water recedes too quickly, fish may become stranded in pools and die.			need to occur. • Mitigation would include reconstruction of the Drayton Dam to include fish passage, removal of the Wild Rice River Dam, stream restoration projects, and meandering low flow channel in the diversion channel. • Proper design would eliminate the freezing aqueduct concern.	beyond the construction footprint.

Topic	Proposed Project	Northern Alignment Alternative	Comparisons (Project and Northern Alignment Alternative)	Mitigation	Context & Comments
Wildlife and Wildlife Habitat (see Section 3.9)	• Direct impacts during construction include potential for direct mortality, displacement or increased exposure of less mobile species (i.e., small mammals, amphibians, reptiles, ground-nesting birds, including some migratory birds) to predators. • Temporary impacts would primarily include displacement due to human presence, increased noise and visual disturbances related to construction. • The impacts to floodplain forest would have the longest potential temporal loss of habitat function as the loss of habitat would be immediate. • 8 to 25 acres of	• Same as under the Proposed Project. • Specific habitat acreages could vary. Floodplain forest, wetlands, aquatic habitat and other cover types in the NAA embankment and control structure areas have not been surveyed, and therefore, exact acreages are unknown.	• No Difference.	• As outlined in the Draft AMMP (Appendix B), construction-related impacts would be mitigated by replacement of habitat in disturbed areas or at mitigation locations near the project area. • All direct impacts to the floodplain forest would be mitigated at a two to one ratio in farmed wetlands along the Red River. • All non-cropped upland habitat would be replanted with native species, particularly native grasses that are anticipated to have positive impacts on overall habitat value. • To minimize the potential for destabilization or bank erosion, control structures would be constructed in adjacent upland habitats to minimize	• Sedimentation would occur incrementally over several decades, allowing vegetation communities to adapt in these conditions. • For floodplain forests, sites that are likely to be successful for restoration would be historic floodplains along rivers that are currently utilized for intensive agriculture. • Once construction and mitigation are completed, the proposed diversion channel has the potential to provide positive impacts by creating a potential new wildlife corridor and habitat in currently agricultural fields. • Federal, state, and/or local permits that may be required could include provisions such as date restrictions for when construction can occur for particular Project features or other requirements to help minimize effects on wildlife or wildlife habitat based on the factors involved.

Topic	Proposed Project	Northern Alignment Alternative	Comparisons (Project and Northern Alignment Alternative)	Mitigation	Context & Comments
	stream channel habitat impacts. • Direct loss of stream channel aquatic habitat from abandonment of Rush/ Lower Rush Rivers. • Impacts to riparian vegetation during construction may also cause stream bank destabilization. • Displacement and mortality may also occur to wildlife using the diversion channel due to a sudden flow of water. • Wildlife migrate between habitat areas for foraging and cover in the region, meaning impacts to wildlife species and populations can occur indirectly due to impacts to habitat.			the work within the active river channels.	

Topic	Proposed Project	Northern Alignment Alternative	Comparisons (Project and Northern Alignment Alternative)	Mitigation	Context & Comments
State Listed Species and Special Status Species (see Section 3.10)	• Lake Sturgeon: o Construction would temporarily displace lake sturgeon. o The individual footprint impacts of each Project feature would total approximately 49 acres of potential aquatic habitat distributed among the Red, Wild Rice, Sheyenne, and Maple Rivers. o Project operation could limit fish migration. • Black Sandshell: Potential direct impact from construction. Indirect impacts from increased sedimentation.	• Same as under Proposed Project.	• No Difference.	• Mitigation and monitoring effectiveness depend on commitments in the USACE AMP.	• Impacts to migration would depend on timing of migration (beginning, middle, and end), timing of project operation, and frequency of project operation.
Invasive Species (see Section 3.11)	• Construction has the potential to spread aquatic and terrestrial invasive species. Project	• Same as under Proposed Project.	• No Difference.	• Mitigation would help but can be expensive and ineffective once large populations establish.	• Zebra mussels are present in the Red River. • Since most natural plant communities are limited to riparian areas in the

Topic	Proposed Project	Northern Alignment Alternative	Comparisons (Project and Northern Alignment Alternative)	Mitigation	Context & Comments
	operation resulting in inundation within the staging area and adjacent lands has the potential to spread terrestrial invasive species and noxious weeds into areas not previously exposed. • Direct impacts to natural vegetation, such as clearing or excavating, could result in noxious weeds spreading into areas not previously exposed.			• USACE St. Paul District does not currently take action to deal with zebra mussels at its facilities.	project area, noxious weed spread into these areas is of particular concern for the Project. • Noxious weed spread can increase herbicide use.
Cultural Resources (see Section 3.12)	• Diversion channel: Direct impact to 3 National Register of Historic Places (NRHP)-eligible properties, 1 NRHP-recommended eligible site and 2 properties with undetermined NRHP eligibility. • Connecting Channel and Staging Area w/OHB: 2 NRHP-listed sites, 3 NRHP-eligible sites, 10	• Similar to Proposed Project, with the following differences: o Connecting Channel and Staging Area w/OHB: 2 NRHP-listed sites, 3 NRHP-eligible sites, 13 NRHP-recommended eligible sites, and 17 sites listed as NRHP-undetermined eligibility. o Cemeteries: Protected Area—19	• Full comparison cannot be made due to incomplete information. There are several areas within the NAA Area of Potential Effect (APE) that have not had cultural resource surveys completed, so surveys would need to be conducted to fully compare NAA impacts. • Known impacts include: o Under NAA, potential impacts to 3 additional NRHP-recommended	• Cultural mitigation would occur at NRHP eligible/listed properties/sites as per the Programmatic Agreement. Amendment No. 1 to the Programmatic Agreement added “project-related environmental mitigation areas” and “project-	• Full comparison cannot be made due to incomplete information. There are several areas within the NAA APE that have not had cultural resource surveys completed, so surveys would need to be conducted to fully compare NAA impacts. Site information current as of January 1, 2016. • The 3 cemeteries (Hemnes, North Pleasant, and Comstock) that would be impacted under the Project

Topic	Proposed Project	Northern Alignment Alternative	Comparisons (Project and Northern Alignment Alternative)	Mitigation	Context & Comments
	NRHP recommended eligible sites, and 10 sites listed as NRHP-undetermined eligibility. • In-town levees: Major to minor visual impacts. • Cemeteries: Protected Area--20 cemeteries removed from current flooding. Upstream Inundation Area—12 cemeteries with varying level of impact.	cemeteries removed from current flooding. Upstream Inundation Area--10 cemeteries with varying level of impact.	eligible sites, and 7 additional sites listed as NRHP-undetermined eligibility. o 2 fewer cemeteries impacted under NAA (1 added from Project-Benefited Area and 3 dropped from Project staging area.)	related in-town levees" to the Project's area of potential effect to which the Programmatic Agreement applies. • Cemeteries within the staging area are proposed to be mitigated through the purchase of a flowage easement. No Federal mitigation is required for other cemeteries; Diversion Authority would coordinate additional considerations during Project design finalization. • Flood impacts to cemeteries not eligible for NRHP are proposed to receive flowage easements.	but not under the NAA are located between 3.5 – 6 miles upstream of the tieback embankment. Impacts to these cemeteries under the Project are anticipated to range from 0.3 feet to 0.7 feet with durations ranging from 2 – 5 days for a 100-year flood. • The 1 cemetery that would be impacted under the NAA but not under the Project (St. Benedict's Cemetery), is located approximately 1 mile upstream from the tieback embankment. This would likely result (estimated) in several feet and days of additional inundation over existing conditions for a 100-year flood. • The USACE completed a 2015 Draft Cemetery Mitigation Plan that includes potential mitigation measures but none of these measures have been proposed at this time.

Topic	Proposed Project	Northern Alignment Alternative	Comparisons (Project and Northern Alignment Alternative)	Mitigation	Context & Comments
Infrastructure and Public Services (see Section 3.13)	• Impacts to infrastructure include severed roadways by the diversion channel, roadway alterations, reconstruction, and rerouting, and raised roadways to higher elevations to provide access during flooding, as well as potential detours and rerouting of existing service routes. • The Transportation Plans indicate the Project would primarily impact township roads, county roads, state highways and interstates and their respective bridges. • The North Dakota Overflow Embankment would impact four roads. • The tieback embankment in Minnesota would	• Similar to Proposed Project, with the following differences: o Comstock is not anticipated to have significant new inundation; therefore a ring levee would not be needed; however, wastewater treatment lagoons would need modification. o Specific road crossings, embankment crossings and road grade raises would be determined during the NAA design phase. o County Road 16 will be closed during project operation. o Cass Rural Water District Phase 1 Water Plant would be inundated and require mitigation.	• No Difference.	• Bridges are proposed approximately every three miles to cross the diversion channel. Grade raises would also maintain connectivity across embankments and the diversion channel. • Connections to re-establish accessibility of affected parcels are recommended by the North Transportation Plan. The South Transportation Plan recommends parcels affected by the Proposed Project be purchased or new roadways constructed on a case-by-case basis. • All utilities that would be severed by construction of the Project are proposed to be relocated prior to construction to reconnect affected parcels.	• Roadways requiring improvements to maintain connectivity include, but are not limited to, 29, 81, 94, 52, 75, and 10. • Improvements and/or modifications to the rail lines were not evaluated in the Transportation Plans. Any improvements/ modifications would be coordinated with Burlington Northern Santa Fe and the Red River Valley & Western Railroad. • The proposed road configurations and bridge locations were determined to not affect emergency response times.

Topic	Proposed Project	Northern Alignment Alternative	Comparisons (Project and Northern Alignment Alternative)	Mitigation	Context & Comments
	impact five roads. • Construction of in-town levees and floodwalls would require utilities to be relocated such as energy, water and communication utilities. • Traffic patterns, primarily within the staging area, would permanently change. • Known utilities located in the inundation area include, but are not limited to, electric power lines and rural water supply facilities. • Interstate Highway 29 and United States (U.S.) Highway 75 would be elevated to maintain traffic routes during high flows while in operation. The BNSF Moorhead Subdivision Rail Line would also be				

Topic	Proposed Project	Northern Alignment Alternative	Comparisons (Project and Northern Alignment Alternative)	Mitigation	Context & Comments
	raised to a higher elevation. Except for OHB and Comstock ring levee access roads, all other roadways in the inundation areas would be allowed to flood. • Flood impacts to BNSF mainline operations through the Benefited Area would be minimized. • OHB Levee construction would impact Cass County Highway 81, Cass County road 18, and Cass County Highway 25. • Comstock Levee would require Clay County Highway 2 to be raised to a higher elevation.				
Land Use Plans and Regulations (see Section 3.14)	• Under Project conditions, upstream flooding would discourage development in inundated areas. • The Project may not	• Similar to Proposed Project, with the following differences: o Environmental Land Use: Keeps approximately 1.5 mile s (7,604.9 acres)	• Fewer environmental land use (floodplain) impacts under NAA. • Under NAA, fewer developable land south of Fargo and Moorhead. • Under NAA, less land use	• Mitigation and/or monitoring would be determined by the regulating agency through future coordination.	• Under NAA, Comstock is not anticipated to have significant new inundation; therefore a ring levee may not be needed. • The approximate 1.5 mile

Topic	Proposed Project	Northern Alignment Alternative	Comparisons (Project and Northern Alignment Alternative)	Mitigation	Context & Comments
	be consistent with Comprehensive Plan goals to facilitate traffic movement for the Townships of Mapleton, Pleasant or Warren. • The Project may not be consistent with Pleasant Township's zoning ordinance to "protect public health, safety, morals, comfort, convenience, prosperity and general welfare." • The Project may not be consistent with Holy Cross Township's interim ordinance establishing a moratorium on water impoundment projects. • Project construction and operation may require various LGU approvals, Conditional Use	of current floodplain active. o Connecting channel would be located in Stanley Township, Cass County, instead of Pleasant Township, Cass County.	and regulation impacts to Richland and Wilkin Counties, but more impact to Cass and Clay Counties.		of floodplain between Project and NAA alignments would be active floodplain up to a 10-year event with either alternative. For the NAA, this approximate1.5 mile stretch, during project operation, won't be a natural floodplain since it would experience additional depth/duration inundation from project operation, but it would still have floodplain benefits above the Project. The approximate 1.5 mile area between the NAA and project area alignments represents approximately 5% of the existing floodplain within the project area. • MPCA's Watershed Restoration and Protection Strategy (WRAPS) would be considered during Project review and permitting process. • Minnesota Drainage Law (103E) would be considered during Project review and permitting process.

Topic	Proposed Project	Northern Alignment Alternative	Comparisons (Project and Northern Alignment Alternative)	Mitigation	Context & Comments
	Permits, review of floodplain maps, and zoning amendments.				
Minnesota Dam Safety and Work in Public Waters Regulations and Permitting (see Section 3.15)	• Dam Safety permit required.	• Same as under Proposed Project.	• No Difference.	• Permit conditions may address many topics.	• None.
Socioeconomics (see Section 3.16)	• Estimated cost \$1.79 billion. • 828 Damaged Structures, 100-year: 511 (62%) in ND and 317 (38%) in MN. • 230 parcels impacted, 100-year: 163 (71%) in ND and 67 (19%) in MN. • Estimated average residual annual damage: \$10 million, a reduction over Base No Action in ND and MN of 84% and 38%, respectively. • Estimated Cost of	• Similar to Proposed Project impacts, with the following differences: o Estimated Cost \$1.87 billion. o 1,102 Damaged Structures, 100-year: 725 (65%) in ND and 377 (35%) in MN. o 305 parcels impacted, 100-year: 220 (72%) in ND and 85 (18%) in MN. o Estimated Cost of Land Acquisition and Damages: \$333,781,295. o Average annual	• Construction cost \$81 million (4%) less under Project. 274 (214 non-residential and 60 residential; 33%) fewer structures impacted by flooding under Project conditions, 100-year event. • 75 (14%) fewer parcels impacted by flooding under Project conditions, 100-year event. • Higher cost of land acquisition and damages (approximately \$68 million; 25%) under NAA. • Approximately \$1 million (13%) higher average annual relocation costs to ND under NAA.	• USACE/FEMA Coordination Plan states that all impacted insurable structures in FEMA Revision Reach would be mitigated. • Impacted property owners are proposed to be compensated for loss of property value via easements. • Residential structure mitigation options include elevation, relocation, buy-outs and ring levees. • Non-residential structure mitigation options include dry flood proofing,	• Cost alone is not sufficient cause to dismiss an alternative in State environmental review. • Under Project, Comstock ring levee could allow for relocations of displaced residences, which could increase the tax base for the City and the school district. • If flooding occurs prior to the growing season there may not be impacts to agricultural properties. • Fargo and Moorhead share economic vitality. • All 4 organic farms in the project area are located in MN. • Under NAA, Comstock

Topic	Proposed Project	Northern Alignment Alternative	Comparisons (Project and Northern Alignment Alternative)	Mitigation	Context & Comments
	Land Acquisition and Damages: $265,022,680. • Average annual disruption cost from loss of building function to ND and MN are $1 million and $0 million, respectively. • Average annual relocation costs to ND and MN are $8 and $1 million, respectively. • Flood insurance costs reduced by 17,714 structures in F-M urban area. • Average annual business losses in ND and MN are $183 million and $18 million, respectively. • Social disruptions in the upstream inundation area. • Potentially reduced tax revenue, student populations and property tax base in upstream	disruption cost from loss of building function to ND and MN are $1 million and $0 million, respectively. o Average annual relocation costs to ND and MN are $9 and $0 million, respectively. o Flood insurance costs reduced by 17,646 structures in F-M urban area. o Average annual business losses in ND and MN are $293 million and $32 million, respectively. o Comstock would not need a ring levee; but would require sewage lagoon protection. o Approximately 1,200 acres of inundation to organic farms impacted by NAA.	• 68 more structures require flood insurance under NAA. • No difference between alternatives to loss of building function. • $71 million (35%) less business losses under Project. • Approximately 1,000 (42%) fewer acres of inundation to organic farms under NAA. • 2 fewer (50%) organic farms affected under NAA. • CR 16 impacted under NAA and not under Project.	elevation, relocation, buy-outs and ring levees. • MN State Law (6120.5700, subpart 4a) requires mitigation for all impacts over 0.00’. • Well and septic system impacts would be mitigated by abandonment or modification. • Livestock feed impacts would be minimized by relocations. • Examples of proposed agricultural and organic farm mitigation options include flowage easements, voluntary land acquisitions, and supplemental crop insurance.	would not need a ring levee to protect residential structures from NAA-induced flooding; Comstock population has been on the decline since 1930.

Topic	Proposed Project	Northern Alignment Alternative	Comparisons (Project and Northern Alignment Alternative)	Mitigation	Context & Comments
	inundation areas. • Buyouts, relocations and non-structural measures could cause stress for those residents. • Property owners in inundated areas could experience loss of income and property value. • Temporary construction disruptions for residents behind community ring levees (e.g., OHB ring levee). • Indirect impact to residents regarding perception of living behind a community levee. • Due to the additional flood risk of the Project, Comstock residents would be expected to experience higher levels of stress and anxiety than they do under the baseline	o CR 16 impacted under NAA.			

Topic	Proposed Project	Northern Alignment Alternative	Comparisons (Project and Northern Alignment Alternative)	Mitigation	Context & Comments
	condition. • Flooding could reduce the economic vitality of Comstock as businesses might relocate to other areas not prone to flooding. • The Comstock ring levee may restrict future development due to the increased flood risk in and around the area. Fiscal requirements and resources of school districts would be both positively and negatively affected by the Project. • Construction and operation could impact drinking water wells. • Construction and operation could impact newly inundated septic systems with a modification cost of $15-20,000 each (residential).				

Topic	Proposed Project	Northern Alignment Alternative	Comparisons (Project and Northern Alignment Alternative)	Mitigation	Context & Comments
	• Construction of new insurable structures in FEMA Revision Reach would be limited. • Existing farm buildings in staging area and FEMA Revision Reach would not be compatible with flooding. • Potential for grain and livestock feed spoilage in inundated areas. • Approximately 2,200 acres of inundation to organic farms (between 4 organic farms; about 50% overall organic farm land) impacted by Project. • Construction and operation would reduce stress and threats to life/safety associated with flood fighting in protected and mitigated areas.				

Topic	Proposed Project	Northern Alignment Alternative	Comparisons (Project and Northern Alignment Alternative)	Mitigation	Context & Comments
	• MN is affected socially and economically by flooding in Fargo (loss of employment or income). • Operation and maintenance of the Project is expected to provide employment opportunities.				

6.0 Proposed and Recommended Mitigation and Monitoring

Minnesota Rules, part 4410.2300 states that the Environmental Impact Statement (EIS) must include mitigation measures that could reasonably eliminate or minimize any adverse environmental, economic, employment, or socioeconomic effects of the Project. The term "mitigation" can have different meanings depending on the resource being mitigated or whether it applies to federal, state or local regulations. As this chapter discusses mitigation for Project-wide impacts (both pre- and post-construction; direct and indirect; and operation impacts), the term "mitigation" refers to provisions to compensate for the detrimental aspects of change resulting from the Project.

Chapter 6 provides an overview of proposed Project mitigation and monitoring plans as well as recommendations for additional mitigation to further avoid, minimize, and/or compensate for Project impacts or monitoring needs where applicable. If there are other mitigation requirements that have not been previously identified or proposed by the Diversion Authority or USACE, those have also been included. There are several types of mitigation and monitoring approaches discussed in this chapter. The type of mitigation and monitoring approaches (proposed or recommended) are dependent on the resource impacted and type of Project impacts (potential or known); and may be a required approach by the proposing entity through governing regulations, laws, or policies. Regulatory considerations for certain mitigation and/or monitoring actions or plans may apply.

Adherence to mitigation and monitoring would be necessary to address significant, potentially significant, or uncertain impacts raised in scoping and throughout this EIS process. This chapter references two primary sources: Appendix B— Draft Adaptive Management and Monitoring Plan (Draft AMMP) and Appendix O—Takings, Flowage Easements, and Acquisition Processes (Appendix O). The Draft AMMP focuses on mitigation and monitoring for environmental impacts, whereas Appendix O – Takings, Flowage Easements, and Acquisition Processes provides a detailed legal discussion of proposed and recommended mitigation approaches specific to takings, flowage easements and acquisitions.

Some assurances that the mitigation and monitoring discussed in this EIS, including the attached Draft AMMP, or in a future agreed upon version of what is presented in this chapter and its attachments, would be critical to the MNDNR dam safety and work in public waters permit (combined permit) application decision. Information provided within this chapter, the Draft AMMP, and Appendix O can be used as a guide for permitters when evaluating permit decisions and conditions.

6.1 INTRODUCTION

Mitigation, monitoring, and adaptive management plans, including an USACE Adaptive Management Plan (AMP), were initially developed as part of the Final Feasibility Report and Environmental Impact Statement (FFREIS) (USACE 2011) and provided a starting point for subsequent plan development as part of the state EIS analysis. Other documents, such as the Supplement Environmental Assessment (Supplemental EA) (USACE 2013) and pertinent studies completed by the USACE, Diversion Authority or other parties; led to the development, revision, or addition of recommended mitigation and monitoring measures identified in the Final Scoping Decision Document (FSDD) (MNDNR 2014) and within this EIS.

Mitigation and monitoring measures were also suggested during the public comment period for the scoping environmental assessment worksheet (SEAW). Public comments on mitigation and monitoring measures were evaluated against exclusionary criteria in Minnesota Rules, part 4410.2300, item G to determine what measures should be carried forward into the EIS for analysis. These included (FSDD 2014):

- Monitoring drawdown of the diversion channel to prevent fish stranding in the channel;
- Monitoring drawdown in the inundation area to prevent fish stranding in the floodplain upstream of the tieback embankment;
- Identification of monitoring and mitigation strategies for invasive species that can be incorporated into the Project operating plan;
- Monitoring of potential impacts of low-flow and no-flow conditions in the aqueducts on the Maple and Sheyenne Rivers using existing Indexes of Biological Integrity (IBIs) to inform future monitoring and mitigation efforts; and,
- Assessment of the need for groundwater monitoring as part of the adaptive management plan.

The Minnesota Department of Natural Resources (MNDNR), in collaboration with federal and state (Minnesota and North Dakota) agencies and local governments, including the USACE and Diversion Authority representatives, also developed a Draft AMMP for this EIS based off of the USACE AMP and proposed mitigation measures for the Project that were identified and discussed in Attachment 6 of the FFREIS. In addition to using previous information provided in the FFREIS, the Draft AMMP took into account new available studies, Project modifications since the Supplemental EA, and concerns identified through this EIS process.

The adaptive management discussions in this chapter, as well as the monitoring plans included in the Draft AMMP, would be revised as new information becomes available pertaining to Project design and/or Project operation; plan detail, participant, funding or schedule refinements; as field data is collected and analyzed; or as necessary for permits by regulatory authorities. Mitigation, monitoring, and adaptive management are proposed to be implemented for the Project through a collaborative effort initially led by the USACE.

Public comments received on the Draft EIS identified concerns pertaining to impacts, mitigation and monitoring on the following topics:

- Cemeteries
- Agricultural land
- Structures
- Roads, ditches and culverts
- Debris removal
- Takings process

Many of the above Draft EIS public comment concerns relate to takings, flowage easements and acquisitions. Following further communication with USACE and the Diversion Authority it was determined that these topics were not well addressed in the Draft EIS and that current information available was either confusing or it did not sufficiently address public concern. In response, the MNDNR developed Appendix O. This Chapter has been updated to reflect this information as applicable. This chapter has also been updated to include additional potential impacts, identify where there may be gaps or insufficiencies in proposed mitigation, and provide additional recommendations for mitigation as feasible for other concerns not directly related to takings, flowage easements or acquisitions. Public comment responses are also provided in Appendix L—Responses to Public Comments Received on the Draft EIS and within the respective topic sections.

6.2 REGULATORY CONSIDERATIONS

It is important to note that for all proposed and recommended mitigation measures, local, state, and federal rules need to be considered. Mitigation measures may require government approval prior to implementation. In accordance with Minnesota Rules, part 4410, any necessary environmental review must be completed prior to issuing project approvals or permits. This includes any local and state permits. Projects occurring within the state of North Dakota would also need to comply with respective local, state, and federal rules for project permitting and approval. If the mitigation is carried out by a federal agency, all applicable rules and procedures for project review and approval would be complied with, including any environmental review requirements.

Some mitigation measures would have state environmental review requirements that must be fulfilled before local or state permits can be issued. With this in mind, this EIS includes the following known proposed mitigation projects: wetland mitigation within the proposed diversion channel, fish passage at the Drayton Dam, and Wild Rice Dam removal. As a prerequisite for federal permitting, the USACE has already completed federal environmental assessments for both the Drayton Dam and Wild Rice Dam mitigation projects.

6.3 TYPES OF MITIGATION

There are several types of mitigation associated with the Project: adaptive management, mitigation for structure impacts (i.e., Federal Emergency Management Agency (FEMA)), and mitigation associated with land use or impacts to agricultural land from Project inundation (outside of FEMA requirements), and construction. The subsections below provide discussion on each main type of mitigation. Adaptive management would be applied to the majority of the natural resource-related impacts, such as wetlands, fish and aquatic biota, and stream stability. Structure mitigation would be required for existing insurable structures that would be newly inundated or that would experience new flood risk potential. Other mitigation measures associated with land use would be used as applicable to the potential Project impact.

6.3.1 Adaptive Management

Adaptive management is a process wherein management actions can be changed in response to a monitored response. Adaptive management is a “learning by doing” management approach which promotes flexible decision-making that can be adjusted in the face of uncertainties 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: assess; design; implement; monitor; evaluate; and adjust.

USACE regulations require that projects take an adaptive management approach to ensure that the mitigation is offsetting significant project impacts (USACE Implementation Guidance for Section 2036a of WRDA 2007, August 2009). The guidance requires mitigation plans to include the following:

1. Monitoring of the mitigation until successful;
2. Criteria for determining ecological success;
3. Description of available lands and the basis for the determination of availability;
4. Development of contingency plans (i.e., adaptive management);
5. Identification of the entity responsible for monitoring; and
6. Establishing a consultation process with appropriate federal and state agencies in determining the success of mitigation.

For the Project, adaptive management includes three primary components: 1) evaluation of predicted environmental impacts, 2) assessment of the effectiveness of the mitigation features, and 3) modification of the Project as needed and feasible to ensure the level of environmental effects predicted in the EIS show no appreciable change to what has developed. There are goals for the adaptive management program for each of those components.

<u>Evaluation of predicted environmental impacts</u>

1. Assess the accuracy of impact predictions by comparing impact predictions to observed physical parameters.
2. Improve the capability of the models used to identify and quantify project-induced impacts.

<u>Assessment of the effectiveness of the mitigation features</u>

1. Determine if the mitigation projects are meeting pre-determined physical parameters (i.e., mitigation performance measures).
2. Determine the system's biological responses to parameters. The predictions would be compared to monitoring results to evaluate the overall effectiveness and ultimately the need for additional response actions.

<u>Modification of Project mitigation</u>

1. Identify response actions that, if implemented, would keep the levels of observed environmental effects of the Project within the predicted or acceptable limits of change.
   a. The response actions could occur any time during the post-construction monitoring phase.
   b. Monitoring would continue for a period necessary to evaluate the effectiveness of the mitigation feature that was changed or mitigation that was added.
   c. In the case of Project operation modifications, it may be necessary to reevaluate existing models and flood event response and planning.

Adaptive management is proposed for the majority of proposed and recommended mitigation measures and monitoring identified in the EIS. The majority of these measures relate to wetlands, fish, wildlife, wildlife habitat, cover types, and stream stability. Adaptive management would be considered during the permitting decision process for the Project and may be a condition of permits.

6.3.1.1 USACE Adaptive Management

The USACE proposed the use of adaptive management for Project impacts, including monitoring plans and mitigation measures, in Attachment 6 of the FFREIS. An AMP was proposed to implement effective adaptive management, which would utilize an Adaptive Management Team (AMT), establish goals and performance standards, develop and implement monitoring plans, and make future project modifications. Information in this AMP has been utilized and presented as applicable within proposed mitigation and monitoring discussions throughout Chapter 3.

6.3.1.2 Environmental Impact Statement Draft Adaptive Management and Monitoring Plan

Since the FFREIS, the USACE and Diversion Authority have continued working with the MNDNR, as well as other agencies, on developing and revising monitoring approaches outlined in FFREIS Attachment 6. During this EIS process, MNDNR, in collaboration with agencies and local governments, including the USACE and Diversion Authority, drafted an AMMP to further define the USACE AMP concept and mitigation and monitoring measures prior to Project construction, including establishment of inter-agency teams (see Appendix B - Draft AMMP for more details on participating agencies).

The Draft AMMP builds upon FFREIS Attachment 6 proposed survey monitoring plan, ongoing communications, and studies completed to date, and therefore, is similar to the USACE AMP. However, it takes the USACE AMP concept a step further, including more detailed monitoring plans and identification of performance standards. The purpose of the Draft AMMP is to provide a framework for evaluating accuracy of predicted environmental impacts, assessing the effectiveness of the proposed mitigation features, determining response actions if necessary, and modifying the Project as needed to ensure the levels of potential environmental effects observed post-Project operation are acceptable compared to predicted environmental impacts or mitigation performance criteria. Proposed pre- and post-construction monitoring is included in the Draft AMMP along with performance criteria and recommended response actions where feasible.

Although the Draft AMMP was a collaborative agency effort, the Draft AMMP was prepared for use in this EIS, and therefore, also includes MNDNR recommendations for the adaptive management approach, specific protocol, and additional studies different to or above that which the USACE and Diversion Authority have proposed. The USACE AMP and the Draft AMMP would continue to be revised through ongoing cooperation efforts, as pre-construction and operation monitoring results are assessed, Project designs are finalized, and as Project permitting requires. (It has yet to be determined if the USACE would fully adopt the Draft AMMP as it is presented in the EIS. A version of the AMP would continue to be revised by the USACE. The MNDNR may also require an updated version of the Draft AMMP as a permit requirement. Ongoing coordination is necessary for efficiency and to meet Project needs). The Draft AMMP is provided in Appendix B and should be referenced for additional details.

6.3.1.3 Contingency Mitigation Funding

Federal Project funding would be provided through construction and until the Project is turned over to the non-Federal sponsors, a length of time that has not yet been determined. Thus, funding would be provided for construction of planned mitigation projects, and potentially some of the initial post-project monitoring. Additional (future) mitigation needs may require funding that has not yet been procured or authorized (i.e., contingency mitigation funding). The Project as proposed would require Minnesota permits, such as the dam safety and work in public waters permits; one of the many regulatory requirements of which may be the inclusion of provisions to compensate for the detrimental aspects of change (i.e., mitigation). Likewise, if mitigation needs are unknown at the time of application or it is determined that there is a potential for additional (future) mitigation needs, a permit may include a condition assuring that mitigation needs would be met or some other form of financial assurance, for example. On February 18, 2016, MNDNR received a dam safety permit application for the Project listing the non-Federal sponsor (City of Fargo, City of Moorhead and Diversion Authority) as the permit applicant and dam owner. The USACE as listed as an “agent” on the permit application. Permit application requirements and processes would be completed as per Minnesota Rules (see Chapter 2 and Chapter 3 for specific permits and information) and would consider information that has been collected for this EIS. Actual permit conditions would be determined through the permitting process. Below are possible options for providing assurance for contingency mitigation that could be considered by the non-Federal sponsors.

- The non-Federal sponsors could pass a resolution stating that they agree to fund contingency mitigation actions identified by monitoring and list how those actions would be paid for. Details and feasibility of this option have not been fully explored at this time.

- Contingency mitigation funding could be secured through the planned Project Operations and Management fund. Funding for Project operation and maintenance is the responsibility of the non-Federal sponsors. Local tax revenue is the currently planned fund source for operation and maintenance expenditures. A portion of tax revenues received for operation and maintenance could be placed in a special fund established for unforeseen expenses, such as additional mitigation needs. Details and feasibility of this option have not been fully explored at this time.

- Non-Federal sponsors could collaborate with the Adaptive Management and Monitoring Plan Team (AMMPT) (synonymous with the USACE’s AMT except as defined in the Draft AMMP) and other appropriate local, state and federal agency representatives to identify the appropriate funding source. This could include the use of local or State funds to address remaining mitigation needs. The non-Federal sponsors could also coordinate with USACE for possible funding under the USACE’s Continuing Authorities Program (CAP) or coordinate with their congressional leaders for authorization and appropriation of additional funds to address contingency mitigation.

6.3.2 Structure Mitigation

In most cases, flood inundation of structures resulting from the Project would require mitigation. Mitigation measures for residential lands are dependent upon the depth of flooding and location of structures (within or outside of the FEMA revision reach) and may be dependent on what state the structure is located in. Structure mitigation is summarized in Chapter 3, Section 3.2 - FEMA Regulations and the Conditional Letter of Map Revision (CLOMR) Process and within Chapter 3, Section 3.16 – Socioeconomics.

As defined within the April 2015 FEMA/USACE Coordination Plan (Appendix F), FEMA would require mitigation for all impacted insurable structures within the FEMA revision reach, which is defined by the Red River profile and limited to where the Project would alter the river profile flood elevation by more than 0.5 feet (See Figures 31 and 32). This includes all of the staging area as well as some areas outside of the USACE defined staging area. Mitigation would follow agreed upon methods consistent with those specified by the National Flood Insurance Program (NFIP) based on the depth of flooding at each structure.

Mitigation methods are subject to further evaluation in future versions as the Project is finalized. In accordance with the NFIP, mitigation would be required for structures that are subject to increases in base flood elevation (BFE) greater than the tolerances set in the 44 CFR 60.3(d). FEMA interprets this increase in BFE as any increase greater than 0.00 feet. Based on the requirements in the NFIP regulations, appropriate mitigation would be determined through the CLOMR process. Because of the magnitude of the Project, FEMA has discussed interpreting standards so that the CLOMR includes a list of structures that would be mitigated before Project completion but that the mitigation of those structures can be delayed until the Project affects the structure flood risk. Structure mitigation could include relocation, buy-outs, elevation, ring levees, and dry-proofing.

Compliance with Minnesota mitigation would be required for all inundation areas that meet the standards and criteria of minimum floodplain management standards for local zoning ordinances as defined in Minnesota Rules, Chapter 6120. This may require mitigation outside of the FEMA revision reach but within the newly designated floodplain for existing insurable structures that would be newly inundated or that would experience increased flood damage potential.

Both FEMA and Minnesota Rules would require mitigation within the defined floodplain, up to the 100-year flood. For impacts to structures that would occur in flood scenarios greater than the 100-year flood, additional mitigation would need to be addressed (see Appendix O).

6.3.3 Other Mitigation

The USACE and the Diversion Authority have proposed a number of mitigation measures that could be used for impacts to land from construction and operation of the Project as discussed throughout this chapter.

The acquisition of flowage easements would be a primary proposed mitigation used for lands inundated within the staging area. This would apply to cemeteries, agricultural properties, including organic farms, as well as other undeveloped nonagricultural land. Flowage easements would provide the legal right to inundate the property to operate the Project. Easements are proposed as a one-time payment to the property owner at the time the easement is obtained. The value of the easement would be determined on an individual property basis. The value may consider factors such as depth, duration, frequency of additional flooding, and highest and best use of property. It may also consider future impacts from delayed planting, yield loss, debris, and limitations to future land use. Flowage easements may be acquired for those properties affected by Project operations outside of the staging area and FEMA revision reach. The USACE has indicated that the determination of whether a flowage easement would be acquired would be based on the findings of an analysis to determine if a taking has occurred. The analysis would determine if the impact rose to the level of a taking under the Fifth Amendment of the United States Constitution[10], and if so, the landowner would be appropriately compensated. More information on the sufficiency of the proposed takings, flowage easements and acquisitions can be found in Appendix O.

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[10] The 5th Amendment of the US Constitution requires just compensation when private property is taken for public use. CFR 49 Part 24 - Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970, PL 91-646, as amended, details benefits to the property owner and/or displaced residential renters for Federal and Federally Assisted Programs.

The USACE has stated that property acquisitions would primarily be governed under Public Law 91-646, the "Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970" (Uniform Act) and grants protections and assistance for those affected by federally funded projects. This would apply to all necessary property acquisitions.

Mitigation is proposed for infrastructure impacted by the Project including: roads, bridges, and other public infrastructure. Mitigation would occur by reconstruction and/or other improvements due to impacts from construction of the diversion channel and flood inundation. Mitigation could occur through constructing bridges, relocating roadways, terminating roadways, improving roadways, modifying railroads, and relocating utilities. This mitigation is proposed to be completed as part of Project construction.

Mitigation for impacts to infrastructure resulting from Project operation is proposed to be addressed within the Operation and Maintenance Plan and within individual flowage easements. Mitigation for infrastructure impacts occurring on private property has been proposed to be addressed through individual flowage easements or would be the responsibility of the property owner following acquisition of the flowage easement (see Appendix O for additional information on flowage easements and acquisitions).

6.4 PROPOSED MITIGATION AND MONITORING, RECOMMENDATIONS, AND OTHER REQUIREMENTS

The mitigation and monitoring proposed by the USACE and Diversion Authority was evaluated to determine if it would be sufficient in addressing impacts identified for each resource category. In some cases where there are impacts, no mitigation is proposed. In other cases, mitigation is proposed, but adaptive management is a strong component of that mitigation that requires ongoing monitoring. Finally, there is uncertainty around some of the potential impacts, and therefore, mitigation has not been proposed at this time or the proposed mitigation could be insufficient. The evaluation of effectiveness included a review of proposed mitigation, proposed mitigation with adaptive management, and adaptive management as a way to address potential future impacts (post-Project construction and operation) by technical and subject matter experts. Following the evaluation, technical and subject matter experts provided, as needed, recommended mitigation measures that could be implemented to enhance the effectiveness of the proposed mitigation and monitoring measures as well as other required mitigation and monitoring that has not been previously identified by the USACE or Diversion Authority. More information and discussion on proposed and recommended mitigation can be found in Appendix O and the Executive Summary "Areas of Controversy and Issues to be Resolved".

The tables (Tables 6.1 – 6.19) below, organized by EIS topic, summarize the proposed mitigation and MNDNR recommended additional mitigation and monitoring or other required mitigation and monitoring identified during the development of this EIS. Note that the Draft AMMP is included in both the "proposed" and "recommended" columns. As previously noted, the Draft AMMP was a collaborative effort that used the USACE AMP as a basis for evaluation, yet contains additional details beyond that of the AMP, including new and additional recommendations.

Table 6.1 Summary of Hydrology and Hydraulics Proposed and Recommended Mitigation and Monitoring

Known or Potential Impact Type (approx. acreage when applicable)	**Proposed Mitigation and/or Monitoring Description** (sources: FFREIS (AMP), Supplemental EA, Ag Impacts Mitigation Plan, Operating Plan, FEMA/USACE Coordination Plan, Draft AMMP)	**EIS Recommended or Other Required Mitigation and Monitoring** (sources: EIS and Draft AMMP, Appendix O)
• Flood inundation beyond existing floodplain (an estimated 20,000 acres) resulting in impacts to various natural resource features and socioeconomics as covered within the EIS.	• Mitigation specific to Project hydrology was not proposed in the USACE environmental review documents. Hydrologic changes in the project area caused by the Project may impact a number of resources. Mitigation specific to identified or potential resource impacts are discussed under the appropriate resource categories.	• Red River hydrology and hydraulics should be monitored from United States Geological Survey (USGS) gages as part of the Geomorphology Monitoring Plan. Three new gages are proposed to be added at the three control structures; diversion channel inlet, Red River, and Wild Rice River. During critical flood events, field monitoring and measurements should be completed to validate gage information and used to compare existing hydraulic conditions to Project-predicted and Project-actual hydraulic conditions.

Table 6.2 Summary of FEMA Regulations and the CLOMR Process Proposed and Recommended Mitigation and Monitoring

Known or Potential Impact Type (approx. acreage when applicable)	**Proposed Mitigation and/or Monitoring Description** (sources: FFREIS (AMP), Supplemental EA, Ag Impacts Mitigation Plan, Operating Plan, FEMA/USACE Coordination Plan, Draft AMMP)	**EIS Recommended or Other Required Mitigation and Monitoring** (sources: EIS and Draft AMMP)
• 100-year flood inundation to residential and non-residential insurable structures.	• More than two feet flood inundation within FEMA revision reach (residential and non-residential): Acquisition or relocation of homes in manner consistent with federal law and policy and applicable state eminent domain law. • Up to two feet flood inundation within FEMA revision reach: Would be evaluated for non-structural measures, such as ring levees, relocation, or elevating structures. Acquisition may be considered in areas where risk and safety analysis indicates that leaving in place would be	• Out-costs for ring levees (i.e., operation, maintenance, recertification) should be included with mitigation. Accredited levees must have government (local, state, federal) ownership and/or responsibility for inspection. All ring levees must meet FEMA accreditation requirements. • For portion of staging area in MN: Minnesota state law does not allow for the development of structures within the floodway. • Minnesota state law requires mitigation for

Known or Potential Impact Type (approx. acreage when applicable)	**Proposed Mitigation and/or Monitoring Description** (sources: FFREIS (AMP), Supplemental EA, Ag Impacts Mitigation Plan, Operating Plan, FEMA/USACE Coordination Plan, Draft AMMP)	**EIS Recommended or Other Required Mitigation and Monitoring** (sources: EIS and Draft AMMP)
	inappropriate.	structures located within the floodplain – this would include the newly defined floodplain or those that would experience an increase in flood damage potential on existing structures. • Mitigation would need to be completed prior to the Letter of Map Revision (LOMR) being issued or flood insurance would be required. • Mitigation could include landscaping, structure relocation, flood proofing, or elevating structures.
• Greater than 100-year flood inundation for residential and nonresidential structures.	• The FEMA/USACE Coordination Plan does not address mitigation above the 100-year flood event.	• Additional recommendations for structures not considered in the FEMA/USACE Coordination Plan can be found in Table 6.19.
• 100-year flood inundation to land including agricultural and organic farms.	• Areal extent of flood inundation required for Project operation within the staging area would be mapped as FEMA floodway; other inundated areas within the staging area would be mapped as FEMA floodplain. Flowage easements are proposed to be obtained. • Inundated land outside of the staging area and within the FEMA revision reach would be mapped as FEMA floodplain. USACE has proposed to perform an analysis to determine if a taking has occurred, and flowage easements are proposed to be obtained only where impacts rise to the level of a taking (See Appendix O).	• Additional recommendations for properties not considered in the FEMA/USACE Coordination Plan can be found in Table 6.19.
• Greater than 100-year flood inundation to land including agricultural and organic farms.	• The FEMA/USACE Coordination Plan does not address mitigation above the 100-year flood event.	• Additional recommendations for land not considered in the FEMA/USACE Coordination Plan can be found in Table 6.19.

Table 6.3 Summary of Stream Stability Proposed and Recommended Mitigation and Monitoring

Known or Potential Impact Type (approx. acreage when applicable)	Proposed Mitigation and/or Monitoring Description (sources: FFREIS (AMP), Supplemental EA, Ag Impacts Mitigation Plan, Operating Plan, FEMA/USACE Coordination Plan, Draft AMMP)	EIS Recommended or Other Required Mitigation and Monitoring (sources: EIS and Draft AMMP)
• Modification and control of water flow from Project construction and Project operation (alteration of flood flow frequency and velocity; modification of existing floodway and floodplain; channel abandonment and aqueducts channel/substrate alteration effects).	• Monitoring and adaptive management to track before and after Project changes and adjust management of the Project through Geomorphology Assessments. • **Geomorphology Assessment** – **Monitoring** - Includes: Pre- and post-construction geomorphic surveys once prior to Project construction and twice following construction. The pre-construction survey was completed in 2010 and 2011 (Geomorphology Report of Fargo, North Dakota and Moorhead Minnesota Flood risk Management Project, West 2012). Post-construction would potentially occur at five to ten years and 20 years following completion of Project construction. Additional surveys may occur if deemed necessary through the adaptive management process. • **Geomorphic Assessment Tasks**: Analysis of hydrology, bank stability, sediment transport, and morphological classification. • Final control structure designs should account for energy dissipation. Once design is finalized, shear stresses and velocities flowing out of the control structures should be verified to be lower than the threshold values for stiff clay. • Adaptive management approach: Following Project operation, if bank failures or increasing bank instability is observed under the typical receding limb rate, the drawdown should be decreased systematically until a solution is reached by the AMMPT. The AMMPT would consider potential impacts that would result from decreasing the drawdown (e.g., agricultural impacts) in	• Adaptive management approach: Following Project operation, if bank failures or increasing bank instability is observed under the typical receding limb rate, the drawdown should be decreased systematically until a solution is reached by the AMMPT. The AMMPT would consider potential impacts that would result from decreasing the drawdown (e.g., agricultural impacts) in their approach. • Monitoring (listed below) would be the basis for identifying the need for additional response/mitigation actions as described in detail in the Draft AMMP. • **Cross Sections:** No less than three pre-construction surveys should to occur prior to Project construction completion. Post-construction surveys every two years for three sampling cycles (assumes Project operation has not occurred). Following three sampling events, the Geomorphology Monitoring Team (GMT) would assess findings and determine whether more sampling is necessary and at what frequency. If Project is operated, sampling would occur as soon as possible following Project operation. • **Cross Sections:** Additional and revised cross section survey locations (from those defined in the Geomorphology Report (West 2012) have been included in the Draft AMMP in an effort to provide a more complete assessment of potential Project

Known or Potential Impact Type (approx. acreage when applicable)	Proposed Mitigation and/or Monitoring Description (sources: FFREIS (AMP), Supplemental EA, Ag Impacts Mitigation Plan, Operating Plan, FEMA/USACE Coordination Plan, Draft AMMP)	EIS Recommended or Other Required Mitigation and Monitoring (sources: EIS and Draft AMMP)
	their approach.	impacts. • **Longitudinal Profile:** To collect bed topography data and other data that may otherwise be missed when performing cross-sections. Pre- and post-construction surveys to follow the same schedule as Cross Sections. (This was not completed during 2010-2011 geomorphology survey). • **Cross Section and Geomorphic Assessments Qualifications:** For consistency and as supported by the MNDNR, the MNDNR highly recommends for quality assurance/quality control that these assessments should be completed by those trained in Rosgen III channel stability assessment certified by the MNDNR or other Rosgen course. Data management analysis should use one consistent data management tool; recommended data management tool is the RIVERMORPH data management software package associated with the Rosgen Stream assessments. If this data management tool is not utilized, then the software used should be in a format that is transferable to RIVERMORPH. • **Hydrology and Hydraulic Monitoring:** USGS gages used in study area. Addition of three new gages is proposed at the three control structures; channel inlet, Red River, and Wild Rice River. • **Bathymetry**: Every 10-20 years in absence of large geomorphic change events. • **Sediment Samples:** Of both instream and bed and

Known or Potential Impact Type (approx. acreage when applicable)	**Proposed Mitigation and/or Monitoring Description** (sources: FFREIS (AMP), Supplemental EA, Ag Impacts Mitigation Plan, Operating Plan, FEMA/USACE Coordination Plan, Draft AMMP)	**EIS Recommended or Other Required Mitigation and Monitoring** (sources: EIS and Draft AMMP)
		bank samples to determine sediment load and particles. Pre- and post-construction surveys to follow the same schedule as Cross Sections. • **Bed Scour:** Monitoring at the water control structures should be completed once the design and operating plan is finalized for these structures. • **Communication with Local Agencies:** Annual or more frequent communication should be established with representatives from local agencies regarding channel morphology. • **Field Reconnaissance:** A reconnaissance of the detailed study reaches should be conducted immediately prior to the completion of the Project and of the diversion channel immediately following its completion (to establish baseline as a conditions) and every five years thereafter for the first ten years. If no significant changes are noted, reduce to every ten years. • **LiDAR**: Should be completed to complement cross section data on the reaches in areas that are not surveyed. To occur once every three years focused in the river corridor. • **Water Quality:** Sample for water quality way to assess river response to Project. Sampling frequency would be dependent on data being gathered (some continuous and some parameters would follow sediment sampling frequency). • **Aerial Photography:** To capture trends in the land surface – use and observations of impacts (Project

Known or Potential Impact Type (approx. acreage when applicable)	**Proposed Mitigation and/or Monitoring Description** (sources: FFREIS (AMP), Supplemental EA, Ag Impacts Mitigation Plan, Operating Plan, FEMA/USACE Coordination Plan, Draft AMMP)	**EIS Recommended or Other Required Mitigation and Monitoring** (sources: EIS and Draft AMMP)
		and other causes). Every one to two years for five years or immediately following Project operation. If no significant changes have occurred after five years, the frequency can be reduced to every four to five years. If no significant changes have occurred after 15 years, the frequency can be reduced to every ten years.

Table 6.4 Summary of Wetlands Proposed and Recommended Mitigation and Monitoring – Forested Wetlands

Known or Potential Impact Type (approx. acreage when applicable)	**Proposed Mitigation and/or Monitoring Description** (sources: FFREIS (AMP), Supplemental EA, Ag Impacts Mitigation Plan, Operating Plan, FEMA/USACE Coordination Plan, Draft AMMP)	**EIS Recommended or Other Required Mitigation and Monitoring** (sources: EIS and Draft AMMP)
• 62 acres of direct impacts to floodplain forest.	**Mitigation** • A two to one mitigation ratio would be applied for floodplain forest impacts. • Floodplain lands would be acquired that are currently in agriculture or pasture, and re-establish woodland on those tracts. Restore native floodplain forest and herbaceous vegetation. These areas would also provide wildlife habitat. • USACE would develop a site restoration plan, including tree planting areas, and clearing, treatment and management schedule of the site(s). A combination of direct seeding and seedling trees would be used as needed. Site(s) would be managed for effective growing. Site(s) would be protected and managed into perpetuity by an agreement for	**Mitigation** • Acquisition, monitoring, management, and easement acquisition should be the responsibility of the non-Federal sponsor. **Monitoring Plan** • Monitoring through adaptive management (as detailed in the Draft AMMP) to evaluate whether the specific ratios proposed for wetland mitigation would replace lost function and temporal loss. The AMMPT would weigh in on monitoring reports and decide whether additional response actions are needed. The monitoring plan should also include a post-event assessment. Particularly if the Project would go into operation prior to good root establishment. The rate and amount of

Known or Potential Impact Type (approx. acreage when applicable)	**Proposed Mitigation and/or Monitoring Description** (sources: FFREIS (AMP), Supplemental EA, Ag Impacts Mitigation Plan, Operating Plan, FEMA/USACE Coordination Plan, Draft AMMP)	**EIS Recommended or Other Required Mitigation and Monitoring** (sources: EIS and Draft AMMP)
	management as a wildlife management area by the MNDNR or North Dakota Game and Fish Department (NDGF). **Monitoring Plan** • 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 and following major wind storms. • Adaptive management would be used to monitor the mitigation sites. Monitoring would include measurement of specific 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.	sedimentation could impact these species. Mitigation sites should be monitored for sedimentation impacts and habitat function. Monitoring would evaluate impacts to wetland type and seed banks from various flood events. Wetland performance standards would include hydrology and vegetation observations over a period of several years. The Project consists of several monitored wetland types, each have different performance ranges for hydrology and vegetation.

Table 6.5 Summary of Wetlands Proposed and Recommended Mitigation and Monitoring – Non-Forested Wetlands

Known or Potential Impact Type (approx. acreage when applicable)	**Proposed Mitigation and/or Monitoring Description** (sources: FFREIS (AMP), Supplemental EA, Ag Impacts Mitigation Plan, Operating Plan, FEMA/USACE Coordination Plan, Draft AMMP)	**EIS Recommended or Other Required Mitigation and Monitoring** (sources: EIS and Draft AMMP)
• 1,700 acres of non-forested wetland impact.	• Wetland replacement for diversion channel including side slopes and upland, at a 1.19 to 1 ratio and would be mitigated through revegetation/wetland creation at the bottom of the diversion channel and management of upland inside slopes. • Adaptive management would be used to monitor the mitigation sites. Monitoring would include measurement of specific 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.	• North Dakota wetland mitigation plan proposed wetland replacement based on function, not by specific wetland type. This would require monitoring and reporting of habitat function. A range of performance measure standards are discussed in the USACE AMP mitigation and monitoring plan for wetlands. • A project-specific wetland replacement plan for Minnesota is needed and should be developed under the direction of the Wetland Conservation Act (WCA) local government unit(s) (LGU(s)) per WCA requirements. • Wetland performance standards should include hydrology and vegetation observations over a period of several years. The Project consists of several monitored wetland types, each have different performance ranges for hydrology and vegetation.

Table 6.6 Summary of Wetlands Proposed and Recommended Mitigation and Monitoring – Oxbow/Hickson/Bakke Ring Levee Wetlands

Known or Potential Impact Type (approx. acreage when applicable)	**Proposed Mitigation and/or Monitoring Description** (sources: FFREIS (AMP), Supplemental EA, Ag Impacts Mitigation Plan, Operating Plan, FEMA/USACE Coordination Plan, Draft AMMP)	**EIS Recommended or Other Required Mitigation and Monitoring** (sources: EIS and Draft AMMP)
• 53 acres of direct impact.	• Mitigation sites include Forest River site (already constructed) and the Oxbow Country Club site. The remaining sites would be developed through Ducks Unlimited In-Lieu Fee Program.	• No additional recommendations or requirements at this time.

Table 6.7 Summary of Wetlands Proposed and Recommended Mitigation and Monitoring – Inundation Wetlands

Known or Potential Impact Type (approx. acreage when applicable)	**Proposed Mitigation and/or Monitoring Description** (sources: FFREIS (AMP), Supplemental EA, Ag Impacts Mitigation Plan, Operating Plan, FEMA/USACE Coordination Plan, Draft AMMP)	**EIS Recommended or Other Required Mitigation and Monitoring** (sources: EIS and Draft AMMP)
• Potential impacts to wetland in the unprotected Project inundation area from sedimentation and subsequent function loss are unknown.	• Wetland mitigation is not specifically proposed for the staging area and inundation areas for potential indirect impacts resulting from sedimentation.	• Monitoring of the inundation areas should occur to assess potential indirect impacts to wetlands due to Project operation. Considerations for the wetland mitigation and monitoring plan should include sedimentation monitoring and habitat function monitoring. In the event that negative impacts are observed, additional replacement requirements that meet federal and state replacement requirements would also be necessary.

Table 6.8 Summary of Cold Weather Impacts on Aqueducts Function and Biotics Proposed and Recommended Mitigation and Monitoring

Known or Potential Impact Type (approx. acreage when applicable)	**Proposed Mitigation and/or Monitoring Description** (sources: FFREIS (AMP), Supplemental EA, Ag Impacts Mitigation Plan, Operating Plan, FEMA/USACE Coordination Plan, Draft AMMP)	**EIS Recommended or Other Required Mitigation and Monitoring** (sources: EIS and Draft AMMP)
• Potential impacts to fish passage and biological connectivity as well as habitat.	• The mitigation and adaptive management proposed under Fish Passage and Biological Connectivity that includes monitoring fish, macroinvertebrates, and physical habitat would apply. • Current engineering plans include heating components to reduce the potential for freezing or ice buildup.	• Monitoring of surface ice in the heated and unheated portions of the aqueduct compared to ice formation on the Maple and Sheyenne Rivers. • Monitoring of backwater stage increase upstream of the proposed aqueducts compared to historic gage data.

Table 6.9 Summary of Cover Types Proposed and Recommended Mitigation and Monitoring

Known or Potential Impact Type (approx. acreage when applicable)	**Proposed Mitigation and/or Monitoring Description** (sources: FFREIS (AMP), Supplemental EA, Ag Impacts Mitigation Plan, Operating Plan, FEMA/USACE Coordination Plan, Draft AMMP)	**EIS Recommended or Other Required Mitigation and Monitoring** (sources: EIS and Draft AMMP)
• Impacted land, primarily, cropland, within the construction footprint, would be acquired. • Impacts would occur primarily to croplands and wetlands.	• Cropland impacts would be mitigated by compensation to landowners for direct cropland impacts, such as land acquisition for Project construction. Owners of croplands that are purchased for the Project would be compensated at fair market value.	• No additional recommendations or requirements at this time.
• Direct and indirect impacts to forested and non-forested wetlands.	• Refer to Wetlands Tables 6.4 – 6.7.	• Refer to Wetlands Tables 6.4 – 6.7.

Table 6.10 Summary of Potential Environmental Hazards Proposed and Recommended Mitigation and Monitoring

Known or Potential Impact Type (approx. acreage when applicable)	**Proposed Mitigation and/or Monitoring Description** (sources: FFREIS (AMP), Supplemental EA, Ag Impacts Mitigation Plan, Operating Plan, FEMA/USACE Coordination Plan, Draft AMMP)	**EIS Recommended or Other Required Mitigation and Monitoring** (sources: EIS and Draft AMMP)
• Direct impacts to parcels from Project construction that may contain Recognized Environmental Conditions (RECs).	• Once Project designs are more refined and parcels have been identified for acquisition, the USACE would conduct additional Phase I Environmental Site Assessments (ESAs) and any necessary Phase II ESAs as recommended to determine if RECs are present and if remediation/mitigation is necessary. RECs could be mitigated through removal of REC, soil and groundwater remediation projects or other measures.	• Minnesota Rules, part 7035.0805 requires that a building survey be completed to identify potential asbestos containing materials, lead based paint, and any regulated/hazardous materials that require special handling or disposal prior to demolition of relocation of structures. Regulated materials would need to be mitigated/disposed of in accordance with local, state, and federal laws by a licensed hazardous waste contractor.
• Flood inundation to properties containing RECs.	• Mitigation for structures that would be impacted from inundation would be determined on a case-by-case basis as the level of impact (depth of flood impact) would be taken into consideration when determining a mitigation course of action. Refer to FEMA CLOMR and Socioeconomics discussions for more details.	• RECs should be considered during property evaluations and should be identified and properly mitigated for those properties that would be affected by inundation as a result of Project operation.

Table 6.11 Summary of Fish Passage and Biological Connectivity Proposed and Recommended Mitigation and Monitoring

Known or Potential Impact Type (approx. acreage when applicable)	**Proposed Mitigation and/or Monitoring Description** (sources: FFREIS (AMP), Supplemental EA, Ag Impacts Mitigation Plan, Operating Plan, FEMA/USACE Coordination Plan, Draft AMMP)	**EIS Recommended or Other Required Mitigation and Monitoring** (sources: EIS and Draft AMMP)
• Channel abandonment: o Lower Rush River: 2.7 miles o Rush River: 2.3 miles	• A low flow channel would be constructed in a sinuous nature from the Maple River downstream to the outlet of the diversion channel into the Red River to mimic a more natural stream channel.	• Monitoring would be the basis for identifying the need for additional response/mitigation actions. Ecological function of the proposed low-flow channel needs to be monitored post-construction and operation to determine its effectiveness. See Draft AMMP.

Known or Potential Impact Type (approx. acreage when applicable)	**Proposed Mitigation and/or Monitoring Description** (sources: FFREIS (AMP), Supplemental EA, Ag Impacts Mitigation Plan, Operating Plan, FEMA/USACE Coordination Plan, Draft AMMP)	**EIS Recommended or Other Required Mitigation and Monitoring** (sources: EIS and Draft AMMP)
		• Construction Avoidance Periods: Proper timing of Project construction would need to be considered in order to minimize or avoid further potential impacts to the fish community.
• Red River connectivity - operation of control structure.	• Construct Drayton Dam Fish Passage, including installation of a new rock-ramp spillway and removal of portions of the existing dam.	• Consider additional ways to reduce frequency of operation by, for example, constructing more in-town levees (or other flood reduction project(s)) that would allow for flows through town to be greater than 17,000 cubic feet per section (cfs).
• Wild Rice River connectivity – operation of control structure.	• Remove the Wild Rice River Dam.	• No additional recommendations or requirements at this time.
• Impacts to connectivity in the project area.	• Monitoring would occur following Project operation at predefined locations. Techniques for monitoring would be determined following Project construction but would generally include evaluation of hydraulic conditions and biological sampling. See Draft AMMP for more details.	• Monitoring for fisheries impacts should be evaluated on a broader scale, as a fish connectivity barrier on the main stem can have impacts on upstream and downstream reproduction. Monitoring plan sampling techniques need to take into account large river species. See Draft AMMP – Considerations for benthic fishes on the Red River. • Final diversion channel and control structure designs should be reviewed by the AMMPT and the ABMT to ensure that they are designed to minimize the potential for impacts to fish passage.
• Impacts to aquatic biota and potential habitat in the project area.	• Fisheries, physical habitat, and macroinvertebrate assessments would be completed pre- and post-Project operation to establish baseline and Project conditions. At least two fish monitoring events would be conducted prior to construction of the Project and that the survey locations would include areas near the footprint of the	• Fish community monitoring at sites identified within the Aquatic Biological Monitoring Plan (ABMP) in the Draft AMMP (currently 21 sites listed in the Draft AMMP but number may be adjusted by the ABM Team) should be conducted at least two times prior to Project construction and two additional

Known or Potential Impact Type (approx. acreage when applicable)	Proposed Mitigation and/or Monitoring Description (sources: FFREIS (AMP), Supplemental EA, Ag Impacts Mitigation Plan, Operating Plan, FEMA/USACE Coordination Plan, Draft AMMP)	EIS Recommended or Other Required Mitigation and Monitoring (sources: EIS and Draft AMMP)
	Project structures (i.e., control structures, aqueducts, rock-ramps, etc.), as well as sites above or below the features. As of 2015, one pre-construction fish survey has already been completed. • Adaptive management would be used by the AMMPT to determine if additional mitigation is necessary based on assessment results.	times prior to Project operation. It is recommended that monitoring be conducted on a two or three-year return frequency for the pre-construction/operation surveys. After the Project construction is complete, additional monitoring events and assessments would be required to monitor future changes and assess impacts. The number of sites that are surveyed could vary depending on final Project design and due to the adaptive nature of this approach. Changes to survey sites would be recommended by the ABMT. See Draft AMMP. • Follow up surveys and assessments should follow the protocols and methodologies used in the initial assessment (URS, 2013), and if possible, should occur during the same time of the year. • Metrics where sites have scored well, such as taxa richness of fish-eating species or relative abundance, would be good to track across monitoring events, including pre-construction, post-construction and Project operation.
• Direct impacts to aquatic habitat from Project construction; o Maple River: 11 acres o Sheyenne River: 8 to 9 acres o Wild Rice River: 12 acres o Red River: 14 acres	• Stream restoration would be completed that includes stream remeandering, bank grading, riffles/grade control, riparian buffer strips and other actions. • The aquatic habitat within constructed channels would be measured (quantity and quality) and compared against pre-construction conditions to assess if additional aquatic habitat mitigation is necessary.	• Possible stream restorations on a different river that is not impacted by the Project or that may be located outside of the project area. The stream reconstruction projects should be restricted to other streams within the Red River basin to ensure the impacts from the Project are offset within the overall watershed. Consider large restoration efforts basin-wide if monitoring shows significant

Known or Potential Impact Type (approx. acreage when applicable)	Proposed Mitigation and/or Monitoring Description (sources: FFREIS (AMP), Supplemental EA, Ag Impacts Mitigation Plan, Operating Plan, FEMA/USACE Coordination Plan, Draft AMMP)	EIS Recommended or Other Required Mitigation and Monitoring (sources: EIS and Draft AMMP)
		impacts occurring. Large restoration efforts would require financial assurance. • Construction Avoidance Periods: Proper timing of Project construction would need to be considered in order to minimize or avoid further potential impacts to the fish community.
• Potential fish stranding after Project operation.	• Visual Assessment to evaluate fish stranding after Project operation would be completed by non-Federal sponsors • Design change to include diversion inlet structure gates to allow for more control over receding waters within diversion channel.	• Operation should ensure that fish would have the ability to follow the receding hydrograph, i.e., prevent stranding.

Table 6.12 Summary of Wildlife and Wildlife Habitat Proposed and Recommended Mitigation and Monitoring

Known or Potential Impact Type (approx. acreage when applicable)	Proposed Mitigation and/or Monitoring Description (sources: FFREIS (AMP), Supplemental EA, Ag Impacts Mitigation Plan, Operating Plan, FEMA/USACE Coordination Plan, Draft AMMP)	EIS Recommended or Other Required Mitigation and Monitoring (sources: EIS and Draft AMMP)
• 62 acres of direct impacts to floodplain forest.	• See descriptions under Wetlands as wildlife habitat replacement would be incidental to wetland replacement.	• See descriptions under Wetlands as wildlife habitat replacement would be incidental to wetland replacement.
• Direct impacts to aquatic habitat from Project construction; o Maple River: 11 acres o Sheyenne River: 8 to 9 acres o Wild Rice River: 12 acres o Red River: 14 acres	• See descriptions for Fish Passage and Biological Connectivity.	• See descriptions for Fish Passage and Biological Connectivity.

Table 6.13 Summary of State Listed Species and Special Status Species Proposed and Recommended Mitigation and Monitoring

Known or Potential Impact Type (approx. acreage when applicable)	**Proposed Mitigation and/or Monitoring Description** (sources: FFREIS (AMP), Supplemental EA, Ag Impacts Mitigation Plan, Operating Plan, FEMA/USACE Coordination Plan, Draft AMMP)	**EIS Recommended or Other Required Mitigation and Monitoring** (sources: EIS and Draft AMMP)
• Interruption of bald eagle nesting.	• Bald eagles nests would be monitored during spring construction season. The project area would continue to be monitored during the upcoming years to ensure that no new nests would be impacted by Project construction. There would be raptor nest surveys completed in the spring of the year preceding construction within or near any affected wooded areas.	• No additional or requirements recommendations at this time.
• Mortality of mussels from Project construction.	• Additional mussel surveys are being considered for Project footprint areas to verify whether impacts to mussel resources would be substantial. This would include determining presence of the black sandshell, mapleleaf and Wabash pigtoe mussels.	• Recommend that additional mussel surveys be completed for Project footprint areas.
• Interruption of cardinal and whip-poor-will nesting.	• To the extent practicable, vegetation clearing activities would be done so as to avoid affecting nesting individuals.	• No additional recommendations or requirements at this time.
• Interruption of bird nesting and rearing periods.	• Tree clearing on forested land would occur during the winter months in order to not impact listed bird species during their nesting and rearing periods.	• No additional recommendations or requirements at this time.
• Interruption to migration and spawning for lake sturgeon during Project operation.	• Monitoring would occur following Project operation as predefined locations. Techniques for monitoring would be determined following Project construction but would generally include evaluation of hydraulic conditions and biological sampling. See Fish Passage and Biological Connectivity for more details.	• See descriptions for Fish Passage and Biological Connectivity.

Table 6.14 Summary of Invasive Species Proposed and Recommended Mitigation and Monitoring

Known or Potential Impact Type (approx. acreage when applicable)	**Proposed Mitigation and/or Monitoring Description** (sources: FFREIS (AMP), Supplemental EA, Ag Impacts Mitigation Plan, Operating Plan, FEMA/USACE Coordination Plan, Draft AMMP)	**EIS Recommended or Other Required Mitigation and Monitoring** (sources: EIS and Draft AMMP)
• Invasive species establishment at disturbance sites (i.e., mitigation and construction sites).	• An invasive species management plan, including pre-construction monitoring data previously collected by the USACE and post-construction monitoring of biota and physical habitat for both construction sites and mitigation sites, would be prepared. The plan would outline the inspection procedures and occurrences to ensure compliance. Best Management Practices (BMPs) would be followed to prevent the introduction and spread of aquatic or terrestrial invasive species during Project construction and monitoring. • Wetland mitigation sites 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. • 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 seeded areas would be monitored per the Project plans and specifications. • The non-Federal sponsors would be responsible for	• Control of invasive species may be needed at specific mitigation sites for functional lift/enhancement if monitoring shows that functions being replaced are not adequate. Minnesota wetland replacement requirements usually have specific performance criteria that must be met (e.g., max. percent cover of invasive species). • The construction of this project would involve work in zebra-mussel infested waters. The Corps should develop a plan for reducing the risk of spreading zebra mussels during construction, including: decontamination of construction equipment before it's used at another site, taking precautions with any water that is moved/transported/diverted from the site during the project, and proper disposal of any solid fill to reduce risk of spreading zebra mussels.

Known or Potential Impact Type (approx. acreage when applicable)	**Proposed Mitigation and/or Monitoring Description** (sources: FFREIS (AMP), Supplemental EA, Ag Impacts Mitigation Plan, Operating Plan, FEMA/USACE Coordination Plan, Draft AMMP)	**EIS Recommended or Other Required Mitigation and Monitoring** (sources: EIS and Draft AMMP)
	noxious weed control on the whole Project perpetually as part of the Operations, Maintenance, Repair, Rehabilitation, and Replacement (OMRR&R).	
• Invasive species spread and establishment in inundation areas.	• A monitoring plan would be prepared that would include procedures on survey for identifying invasive species, treatment plans, and follow-up surveys to confirm that treatments are effective. • Monitoring would be completed on an annual basis in accordance with the OMRR&R and adaptive management plan.	• No additional recommendations or requirements at this time.

Table 6.15 Summary of Cultural Resources Proposed and Recommended Mitigation and Monitoring

Known or Potential Impact Type (approx. acreage when applicable)	**Proposed Mitigation and/or Monitoring Description** (sources: FFREIS (AMP), Supplemental EA, Ag Impacts Mitigation Plan, Operating Plan, FEMA/USACE Coordination Plan, Draft AMMP)	**EIS Recommended or Other Required Mitigation and Monitoring** (sources: EIS and Draft AMMP)
• Flood impacts to eligible or listed National Register of Historic Places (NRHP) properties and cemeteries.	• USACE and Diversion Authority would comply with Section 106 through consultations and Programmatic Agreement with North Dakota and Minnesota State Historic Preservations Officers. Programmatic Agreement for the Fargo-Moorhead Metropolitan Area Flood Risk Management Project was signed in June and July 2011, and Amendment 1, signed in 2013. • Programmatic Agreement defines the Project's Area of Potential Effects and contains stipulations for cultural resources avoidance, minimization, and mitigation measures. • The USACE completed a 2015 Draft Cemetery Mitigation	• Adopt State Historic Preservation Office (SHPO) recommendations (per SHPO correspondence). • See Appendix O for potential mitigation measures.

Known or Potential Impact Type (approx. acreage when applicable)	Proposed Mitigation and/or Monitoring Description (sources: FFREIS (AMP), Supplemental EA, Ag Impacts Mitigation Plan, Operating Plan, FEMA/USACE Coordination Plan, Draft AMMP)	EIS Recommended or Other Required Mitigation and Monitoring (sources: EIS and Draft AMMP)
	Plan that includes potential mitigation measures but none of these measures have been proposed at this time.	
• Flood impacts to cemeteries not eligible for NRHP.	• Federal mitigation plan consists of requiring the non-Federal sponsor to acquire flowage easements within the staging area.	• Adopt recommendations from the Draft Cemetery Mitigation Plan that go beyond flowage easements that fully consider potential impacts from Project operation specific to each cemetery. • See Appendix O for potential mitigation measures.
• Flood impacts to cemeteries outside the staging area.	• The Draft Cemetery Mitigation Plan does not identify any proposed mitigation for these cemeteries.	• See Appendix O for potential mitigation measures.

Table 6.16 Summary of Infrastructure and Public Services Proposed and Recommended Mitigation and Monitoring

Known or Potential Impact Type (approx. acreage when applicable)	Proposed Mitigation and/or Monitoring Description (sources: FFREIS (AMP), Supplemental EA, Ag Impacts Mitigation Plan, Operating Plan, FEMA/USACE Coordination Plan, Draft AMMP)	EIS Recommended or Other Required Mitigation and Monitoring (sources: EIS and Draft AMMP)
• Diversion channel construction impacts on existing roads and bridges.	• Construction of road and rail bridges over the diversion channel would be completed to mitigate transportation connectivity impacts.	• Construction of roads and bridges as well as changes to other infrastructure may cause impacts to resources, which should be evaluated accordingly during permitting. • Coordination with entities such as the U.S. Postal Service is recommended so that road closures can be anticipated in advance and planned for.
• Flood inundation of existing roads, culverts and ditches.	• Interstate Highway 29 (I-29) and Highway 75 would be raised in the staging area to prevent inundation during Project operation. Small portions of Highways 81, 18, and 2 would be raised to maintain access to OHB and Comstock. All other roads in the staging area would be	• The Diversion Authority should develop a process for Project-related clean-up and repair, including identifying responsibility, priorities, and local government coordination.

Known or Potential Impact Type (approx. acreage when applicable)	Proposed Mitigation and/or Monitoring Description (sources: FFREIS (AMP), Supplemental EA, Ag Impacts Mitigation Plan, Operating Plan, FEMA/USACE Coordination Plan, Draft AMMP)	EIS Recommended or Other Required Mitigation and Monitoring (sources: EIS and Draft AMMP)
	allowed to flood under Project operation. • Debris would be removed from public land and would be captured in the forthcoming Operation and Maintenance Plan.	
• Change in traffic patterns to roads that were not designed for increased traffic.	• Road improvements to maintain mobility.	• No additional recommendations or requirements at this time.
• Flood inundation of existing railroads.	• Railroads would be raised as needed through the inundation area.	• Additional studies are needed to evaluate potential impacts of railroad improvements or raises.
• Project construction or flood inundation of existing utilities.	• Utilities that cannot withstand occasional flooding in the inundation area would be abandoned, modified, or relocated, depending on the situation in accordance with applicable regulations.	• Additional studies are needed to evaluate potential impacts of modifying or relocating utilities. For example, high voltage transmission lines would require coordination and possible approval from the MN Public Utilities Commission.

Table 6.17 Summary of Land Use Plans and Regulations Proposed and Recommended Mitigation and Monitoring

Known or Potential Impact Type (approx. acreage when applicable)	Proposed Mitigation and/or Monitoring Description (sources: FFREIS (AMP), Supplemental EA, Ag Impacts Mitigation Plan, Operating Plan, FEMA/USACE Coordination Plan, Draft AMMP)	EIS Recommended or Other Required Mitigation and Monitoring (sources: EIS and Draft AMMP)
• Increased flooding of the inundation area, restricting development and/or use of areas o Depending on inundation depth and location (within or outside of the staging area).	• The USACE has indicated regulations would be followed as required by federal law, and would continue to work with state and local entities for Project implementation. • FEMA would require that the areal extent of flood inundation required for operation within the staging area be mapped as FEMA floodway, other inundated areas within the Staging Area would be mapped as FEMA floodplain. Development restrictions would apply	• Project construction may require permits and LGU approval. Conditional use permits (CUP) may be required. MNDNR may be involved with some of the local permit reviews, such as variances and CUPs that may include specific mitigation. • Zoning amendments could be needed at the county, township, and municipal level once the Project is in operation and impacts can be monitored and

Known or Potential Impact Type (approx. acreage when applicable)	**Proposed Mitigation and/or Monitoring Description** (sources: FFREIS (AMP), Supplemental EA, Ag Impacts Mitigation Plan, Operating Plan, FEMA/USACE Coordination Plan, Draft AMMP)	**EIS Recommended or Other Required Mitigation and Monitoring** (sources: EIS and Draft AMMP)
	per FEMA regulations. See Section 3.2-FEMA CLOMR for more details.	quantified. • Current floodplain ordinance and map revisal: the impact of the Project on the existing floodplain may require LGU review of current floodplain ordinances and maps. • Enhanced land use controls (e.g., “no build zones”) downstream of the dam in the benefited area (e.g., the hydrologic shadow of the dam, or areas impacted by flood events greater than the 100-year). • Minnesota state law would not allow development to occur within the designated floodway (i.e., the inundated portions of the staging area on the MN side). Existing structures that would be within the newly designated floodplain would require flood insurance or would need to be mitigated. Restrictions for future development on parcels within the floodplain would apply per MN law.

Table 6.18 Summary of Dam Safety and Work in Public Waters Proposed and Recommended Mitigation and Monitoring

Known or Potential Impact Type (approx. acreage when applicable)	**Proposed Mitigation and/or Monitoring Description** (sources: FFREIS (AMP), Supplemental EA, Ag Impacts Mitigation Plan, Operating Plan, FEMA/USACE Coordination Plan, Draft AMMP)	**EIS Recommended or Other Required Mitigation and Monitoring** (sources: EIS and Draft AMMP)
• Dam construction on the Red River and Wild Rice River.	• No specific mitigation was described in the USACE environmental review documents. The Project would require a MNDNR Dam Safety Permit, which has specific requirements for approval and possible mitigation.	• MNDNR dam safety and work in public waters permit would include necessary design, mitigation, and operation conditions for the Project. Application requires that specific studies be completed (by licensed engineers) and approved prior to permit approval. See Dam Safety Section 3.15 for further details on application process and permit approval criteria.

Table 6.19 Summary of Socioeconomics Proposed and Recommended Mitigation and Monitoring

Known or Potential Impact Type (approx. acreage when applicable)	**Proposed Mitigation and/or Monitoring Description** (sources: FFREIS (AMP), Supplemental EA, Ag Impacts Mitigation Plan, Operating Plan, FEMA/USACE Coordination Plan, Draft AMMP)	**EIS Recommended or Other Required Mitigation and Monitoring** (sources: EIS and Draft AMMP)
• Flood inundation to residential and nonresidential structures in the staging area.	• See Table 6.2 (FEMA) above. • Flood insurance would be purchased for structures that are allowed to remain.	• See Table 6.2 (FEMA) above. • Financial assurance for unforeseen impacts.
• Project operation flooding to land including agricultural.	• See Table 6.2 (FEMA) above.	• See Table 6.2 (FEMA) above. • Provide supplemental crop insurance. • Clean-up of debris following each Project operation. • Appraisal for the flowage easement should consider future impacts of Project operation. • Assess and compensate drainage ditch authorities for Project-related damage following each operation. • Financial assurance for unforeseen impacts. • Non-Federal sponsors purchase the impacted land.

Known or Potential Impact Type (approx. acreage when applicable)	**Proposed Mitigation and/or Monitoring Description** (sources: FFREIS (AMP), Supplemental EA, Ag Impacts Mitigation Plan, Operating Plan, FEMA/USACE Coordination Plan, Draft AMMP)	**EIS Recommended or Other Required Mitigation and Monitoring** (sources: EIS and Draft AMMP)
• Organic Farms	• Mitigation for organic farms is proposed to be the same as for agricultural land.	• Provide supplemental crop insurance. • Approach organic farmers to discuss early buy-out options. • Clean-up of debris following each Project operation. • Potential impacts to certification should be determined prior to flowage easement issuance. • Appraisal for the flowage easement should consider future impacts of Project operation. • Flowage easements must consider "Going Concerns" for Minnesota businesses per Minnesota Constitution. • Financial assurance for unforeseen impacts.
• Century Farms	• Depending on structure eligibility, see Table 6.15 (Cultural) or Table 6.2 (FEMA) above.	• Depending on structure eligibility, see Table 6.15 (Cultural) or Table 6.2 (FEMA) above. • See above rows for organic farms and agricultural land recommendations, as applicable.
• Businesses in Unbenefited area	• Options include (impact-dependent): buy-outs, relocations, flowage easements, non-structural measures. • Proposed mitigation would go to the landowner; no mitigation is currently proposed for the lessee.	• Flowage easements must consider "Going Concerns" for Minnesota businesses per Minnesota Constitution. • Financial assurance for unforeseen impacts.
• Infrastructure and Public Services and Utilities	• See Table 6.16 (Infrastructure) above. • Development of a Utility Relocation Plan. • Completed transportation plan.	• See Table 6.16 (Infrastructure) above. • Financial assurance for unforeseen impacts.
• Unbenefited Area Access to Health Care and Emergency Services	• OHB and Comstock ring levee residents would have at least one access road maintained during Project operation. • Detour routes.	• Local Emergency Flood Plans (evacuation plans and routes) may need to be updated, particularly in areas with new inundation.

Known or Potential Impact Type (approx. acreage when applicable)	**Proposed Mitigation and/or Monitoring Description** (sources: FFREIS (AMP), Supplemental EA, Ag Impacts Mitigation Plan, Operating Plan, FEMA/USACE Coordination Plan, Draft AMMP)	**EIS Recommended or Other Required Mitigation and Monitoring** (sources: EIS and Draft AMMP)
• Social (e.g., effects of relocations, stress, community tie impacts)	• There is no proposed mitigation for these impacts.	• No additional recommendations or requirements at this time.
• Well, septic and groundwater impacts	• Removal or abandonment within footprint or those that are associated with structures that are relocated/buy-outs. • Well monitoring near Project inundation area. Modifications may be made to prevent contamination to drinking water.	• Regulations in accordance with Minnesota Rules, part 4725 must be followed. • Follow guidelines for the Minnesota Department of Health flood precautions for private water wells. • Include cost (as part of proposed mitigation) for floodproofing, abandonment or relocation of septic systems due to new inundation.
• Tenants (e.g., farmers, businesses, residents)	• Proposed mitigation would go to the property owner; no mitigation is currently proposed for tenants.	• Relocation assistance. • Advance notification of Project operation. • Provide supplemental crop insurance.
• Agricultural impacts (e.g., mobilization impacts, bisected properties, changes to soil chemistry, sedimentation/erosion, transportation of plant pathogens, invasive species and noxious weed spread, planting delays)	• There is no proposed mitigation for these impacts.	• Follow recommendations outlined in the NDSU Initial Ag Impact Study. • Mitigation for these types of impacts should consider the type of agriculture (traditional vs. organic) property. • Financial assurance for unforeseen impacts. • Provide supplemental crop insurance.
• Uninsurable farm structures, grain/livestock food spoilage	• Uninsurable farm structures would be mitigated, but specific measures have not yet been determined. • Livestock operations would not be allowed in the staging area. • Relocations or other mitigation for grain food storage has not yet been determined.	• Financial assurance for unforeseen impacts. • Flowage easements should account for damages to uninsurable structures.
• Cemeteries	• See Table 3.15 (Cultural) above.	• See Table 3.15 (Cultural) above. • Financial assurance for unforeseen impacts.

Known or Potential Impact Type (approx. acreage when applicable)	**Proposed Mitigation and/or Monitoring Description** (sources: FFREIS (AMP), Supplemental EA, Ag Impacts Mitigation Plan, Operating Plan, FEMA/USACE Coordination Plan, Draft AMMP)	**EIS Recommended or Other Required Mitigation and Monitoring** (sources: EIS and Draft AMMP)
• Impacted land, primarily cropland, within the construction footprint	• See Table 6.9 (Cover Types) above.	• See Table 6.9 (Cover Types) above.
• Comstock and OHB ring levees.	• Comstock ring levee would be designed in collaboration with local officials and would allow for future development. All residents within Comstock would be protected by the ring levee. • OHB ring levee would require the relocation of 42 homes to different sites within the OHB levee. An additional 60 residential lots would be added within the ring levee for other displaced residents within the unprotected area. • The Diversion Authority would compensate the City of Oxbow and the Kindred School District for loss of tax base for a period of up to four years caused by the temporary loss of the 42 homes.	• No additional recommendations or requirements at this time.

7.0 Consultation and Coordination

7.1 AGENCY COORDINATION

State and federal agencies have participated in the preparation of the Draft and Final Environmental Impact Statement (Draft EIS and Final EIS). Minnesota Environmental Policy Act (MEPA) provides guidance for agencies to evaluate potential environmental and socioeconomic impacts from the Project and alternatives. Agency representatives relied on the framework developed in MEPA for completing the Environmental Impact Statement (EIS) process. Following is an explanation of the core agencies involved in the preparation of this Draft EIS.

7.1.1 Minnesota Department of Natural Resources

The Minnesota Department of Natural Resources (MNDNR) is the Responsible Government Unit (RGU) for implementation of MEPA for the Project. Preparation of the Draft EIS involved several divisions of the MNDNR including Ecological and Water Resources, and Fish and Wildlife. MNDNR managed the EIS process which included review and approval of work plans, analyses, impact assessments, and technical reports/memoranda, and collaborated with the Diversion Authority (as project proposer) and the United States Army Corps of Engineers (USACE).

7.1.2 Diversion Authority

The Project Proposer is the Flood Diversion Board of Authority (Diversion Authority). The Diversion Authority and its members worked with the USACE on the Fargo-Moorhead Metropolitan Flood Risk Management Final Feasibility Report and Environmental Impact Statement (FFREIS) used to develop the Project. The Diversion Authority, as the project proposer, was a collaborative partner and provided data and information used in this Draft EIS.

7.1.3 United States Army Corps of Engineers

The USACE is working with the Diversion Authority to design and construct the Project. USACE is also a collaborative partner with MNDNR in the implementation of MEPA. The USACE completed the FFREIS and a Supplemental Environmental Assessment (EA), feasibility report, and National Environmental Policy Act documents used, as applicable, during development of this Draft EIS. The USACE also assisted in gathering information used in this Draft EIS.

7.2 PUBLIC INVOLVEMENT

Public notification, opportunities for the public to obtain information, and public commenting on the Project began during the project scoping process and the preparation of the scoping environmental assessment worksheet (SEAW). In April 2013, the MNDNR prepared a SEAW and a Draft Scoping Decision Document (DSDD) to provide information about the Project, identify potentially significant environmental impacts, determine what issues and alternatives would be addressed in the Draft EIS, and determine the level of analysis required for the Draft EIS. A 30-day public comment period occurred from April 15, 2013 to May 15, 2013, which included a public meeting held on May 8, 2013 (see Table 7.1). The comments received were considered in making revisions to the DSDD prior to the MNDNR issuing the Final Scoping Decision Document (FSDD) on February 10, 2014.

The Draft EIS was published and circulated in accordance with the rules and requirements of Minnesota Rules (EQB Rules) 4410, MEPA requirements. The comment period for the Draft EIS was open from September 14 through October 28, 2015, which included a public meeting held on October 14, 2016 (see Table 7.1). The comments received were considered in making revisions to the Final EIS. Responses to substantive comments received during the public comment period are included in Appendix L.

Table 7.1 Public Meetings

Date	Location	Description
May 8, 2013	Moorhead, MN	Public meeting (SEAW) with open house format followed by formal presentation and comment period.
October 14, 2015	Moorhead, MN	Public meeting (Draft EIS) with open house format followed by formal presentation and comment period.

The Final EIS has been published and distributed in accordance with Minnesota Rules, part 4410.2700. The Final EIS was distributed to allow for a minimum 10-day comment period to satisfy rule requirements. Written comments pertaining to the adequacy of the Final EIS will be accepted during the public comment period.

8.0 List of Preparers

Table 8.1 List of Preparers

Name and Affiliation	Environmental Impact Statement (EIS) Role/Area of Expertise and Qualifications
Minnesota Department of Natural Resources	
Luther Aadland	River Scientist B.A. Concordia College-Moorhead, MN; M.S. North Dakota State University; Ph.D. University of North Dakota 28 years experience in river research and restoration
Jason Boyle	State Dam Safety Engineer B.S. University of North Dakota, Civil Engineering; Master of Engineering University of North Dakota, Environmental/Water Resources 15 years experience in dam safety
Ian Chisholm	Supervisor – Stream Habitat Program B.S. University of Wisconsin – Stevens Point; M.S. University of Wyoming, Laramie, WY 26 years experience in river assessment and research, and water management
Melissa Doperalski	Natural Resource and Regulatory Technical Consultant B.S. University of Wisconsin – Stevens Point / Wildlife and Conservation Biology; M.S. University of Wisconsin – Stevens Point / Natural Resources and Landscape Ecology 17 years in natural resources and regulatory review
Kate Frantz	Environmental Review Planning Director B.S. University of Minnesota—Twin Cities in Environmental Science, Emphasis in Soil and Wetland Sciences 8 years environmental permitting and planning experience
Dave Friedl	Clean Water Legacy Specialist B.S. University of Minnesota St. Paul-Fisheries Management 29 years in Fisheries Management, 7 years in stream research and clean water issues
Neil Haugerud	River Ecologist B.A. Gustavus Adolphus College, Biology; M.S. South Dakota State University, Wildlife and Fisheries Sciences 12 years experience in river research and restoration

Name and Affiliation	Environmental Impact Statement (EIS) Role/Area of Expertise and Qualifications
Suzanne Jiwani	Floodplain Mapping Engineer B.S. University of Minnesota, Twin Cities, Civil Engineering; M.S. Colorado State University, Fort Collins, Civil Engineering (Water Resource Engineering) 39 years experience in field, 14 years at current position in DNR
Lisa Joyal	Endangered Species Review Coordinator B.S. University of Montana, Wildlife Biology; B.S. University Montana, Zoology; M.S. University of Maine, Orono, Wildlife Ecology 15 years in wildlife biology, 10 years in environmental review
Nathan Kestner	DNR Regional Environmental Assessment Ecologist B.S. Environmental Studies – St. Cloud State University 15 years of professional experience
Mary Presnail	Floodplain Hydrologist B.S. University of Minnesota, Environmental Science Policy and Management; M.S. University of Minnesota, Natural Resource Science and Management 3 years experience in hydrology
Don Schultz	Area Wildlife Manager B.S. University of Minnesota, Wildlife Management; M.S. University of Minnesota, Wildlife Management 30 years as DNR Wildlife Manager
Jim Solstad	Hydrologist B.S. University of Minnesota, Civil Engineering 35 years professional experience, hydrologic and hydraulic analyses
Jill Townley	Project Manager B.E.D. University of Minnesota—Twin Cities, Landscape Architecture M.U.R.P University of Minnesota—Humphrey Institute, Urban and Regional Planning, emphasis in Environmental Planning 9 years experience in project management and planning
Laura Van Riper	Terrestrial Invasive Species Coordinator B.A. Gustavus Adolphus College, Biology; Ph.D. University of Minnesota – Twin Cities, Ecology 10 years professional experience in invasive species ecology and management
Jamison Wendel	Red River Fisheries Biologist B.S. North Dakota State University; M.S. University of North Dakota 16 years experience in fisheries management

Name and Affiliation	Environmental Impact Statement (EIS) Role/Area of Expertise and Qualifications
U.S. Army Corps of Engineers	
Aaron W. Buesing	Hydraulic Engineer B.S. and post-graduate study University of Minnesota, Civil Engineering 24 years of experience
Craig Evans	Planner, Chief Plan Formulation Section B.C.E. University of MN, Twin Cities, Civil Engineering; M.A. Hamline University, Public Administration 28 years professional experience
Virginia Gnabasik	Cultural Resources/Archaeologist B.A. University of Wisconsin-Milwaukee, Anthropology; M.A. Eastern New Mexico University, Anthropology/Archaeology 34 years professional experience
Grant Riddick	Geologist (PG) B.S. Ft. Lewis College, Durango, Colorado, Geology 28 years experience
Rebecca Seal-Soileau	Geologist B.S. University of Minnesota - Institute of Technology, Physics ; PhD University of Minnesota, Geology; 24 years of experience
Jonathan Sobiech	Biologist B.S. University of Minnesota, Recreation and Resource Management and Forestry; M.S. St. Mary's University of Minnesota, Natural Resource Analysis 13 years professional experience
Elliott L. Stefanik	Biologist, Chief, Environmental Planning Section B.S. University of Wisconsin Platteville, Biology (emphasis in Field Biology); M.S. University of Wisconsin La Crosse, Biology (emphasis in Fisheries) 18 years professional experience (15 years with USACE)
Diversion Authority	
Mark Bittner	Director of Engineering City of Fargo B.S. Civil Engineering UND (1973) 42 years experience in civil engineering
Jeremy Cook	Senior Economist HDR Engineering B.A. Economics, M.A. Economics 13 years experience in economics

Name and Affiliation	Environmental Impact Statement (EIS) Role/Area of Expertise and Qualifications
John Glatzmaier	Project Manager CH2M Hill B.S. and M.S. Civil Engineering, B.S. Computer Science 15 years' experience in civil engineering 8 years experience in construction
Matt Metzger	Civil Engineer Barr Engineering B.S. Civil Engineering 11 years experience in civil engineering
Erik Nelson	GIS Technician Houston Moore Group B.S. Geography/GIS 7 years experience in GIS
Gregg Theilman	Senior Project Manager Houston Moore Group B.S. Civil Engineering 25 years experience in civil engineering
Kyle Volk	GIS Coordinator Houston Moore Group B.S. Civil Engineering 10 years experience in civil engineering
Robert Zimmerman	City Engineer City of Moorhead B.S. and M.S. Civil Engineering, Ph.D. Engineering 25 years experience in civil engineering
Wenck Associates, Inc.	
Bryce Cruey	Professional Engineer (PE), Certified Floodplain Manager (CFM) B.S. Environmental Resource Engineering 8 years in related field
Amy Denz	Project Manager B.S. Natural Resource Management 17 years in natural resource and environmental science, 9 years in environmental review
Alicia Konsor	Environmental Scientist B.S. Plant Biology; B.S. Ecology, Evolution, and Behavior 5 years environmental review, 5 years in natural resource management
Brandon Gebhart	Water Resources Engineer Professional Engineer – Civil (Wyoming) B.S. Civil Engineering 20 years in Civil Engineering

Name and Affiliation	Environmental Impact Statement (EIS) Role/Area of Expertise and Qualifications
Michael Gorecki	Alexander Aaron, Inc. President B.A. Kalamazoo College; M.A., PhD (abd) University of Cincinnati 30 years of Water Resource Economics experience
Suresh Hettiarachchi	Water Resources Engineer (MN) MSC 15 years in hydrologic cycles, specializing in environmental hydraulics
Lucius Jonett	Water Resources Scientist and Landscape Designer B.S. Electrical Engineering; Masters in Landscape Architecture and Graduate Certificate in Stream Restoration 3 years in stream and ravine stabilization, 3 years in TMDL work and environmental review
Jeff Madejczyk	Fisheries Biologist B.S. Ecology; M.S. Fisheries Biology 17 years in fisheries biology, 8 years environmental review
Chris Meehan	Water Resources Coordinator MCE, University of Minnesota BSCE, University of Minnesota 13 years in water resource engineering
Peter Miller	Principal Oversight B.S. Natural Resources and Environmental Studies 20 years in project management and wetland science
Joel Toso	Hydrologist and Water Resources Engineer BSCE, MSCE (Hydrology), PhD (Hydraulics), MSCE (Hydrology) Professional Engineer (MN), Professional Hydrologist (AIH) 29 years in water resources engineering

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