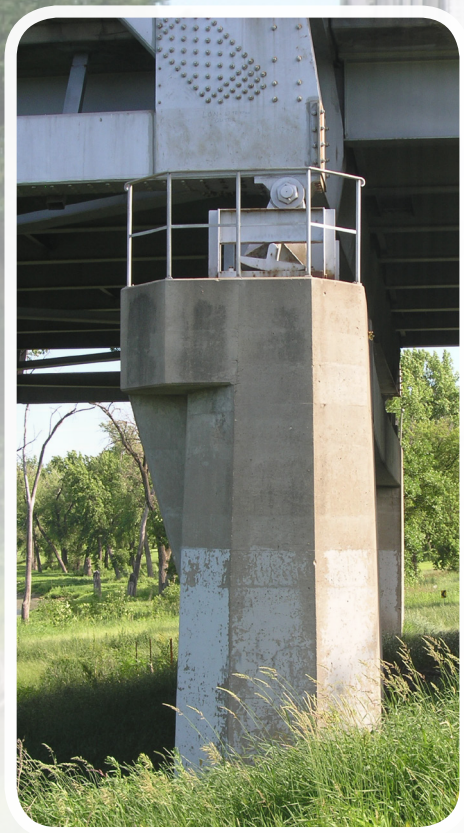
Final Report

US Trunk Highway 2 Red River Crossing (Kennedy Bridge) Planning Study



Prepared for

MINNESOTA DEPARTMENT OF TRANSPORTATION

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Bridge Planning Study

For the Kennedy Bridge
MnDOT Bridge No. 9090/NDDOT Bridge No. 02-350.220

I hereby certify that this report, and referenced technical memoranda, were prepared by me or under my direct supervision and that I am a duly Licensed Professional Engineer under the laws of the state of Minnesota.

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Contents

Acronyms and Abbreviations ..... **IV**

1 Introduction and Report Purpose **1-1**

1.1 Background and Supporting Documents 1-1
1.2 Report Objectives and Project Development Context 1-2
1.2.1 Overall Bridge Study Context and Next Steps 1-2
1.2.2 Study Participants and Project Development Goals/Objectives 1-3
1.3 U.S. Highway 2 Kennedy Bridge Need for Action 1-4
1.4 Bridge Rehabilitation and Project Development Alternatives 1-6

2 Kennedy Bridge Setting and Context **2-1**

2.1 Kennedy Bridge Location and Area Overview 2-1
2.2 Transportation and Environmental Setting 2-2
2.2.1 Kennedy Bridge Traffic and Other Red River Crossings 2-2
2.2.2 Environmental and Historic Features 2-10
2.3 Bicycle and Pedestrian Considerations 2-15
2.4 Issues and Criteria for Project Development 2-17

3 Project Development and Study Findings **3-1**

3.1 Project Development Alternatives 3-1
3.1.1 No Action Alternative 3-1
3.1.2 Bridge Rehabilitation Alternative, Recommendations, and Options 3-2
3.1.3 Bridge Replacement Alternative 3-16
3.2 Comparison of Project Development Alternatives 3-20
3.2.1 Matrix Comparison of Representative Alternatives 3-20
3.2.2 Relationships to Other Anticipated Projects 3-20
3.2.3 Concluding Remarks and Next Steps 3-21

4 References **4-1**

Tables

2-1 Existing (2011) Kennedy Bridge Level of Service 2-4
2-2 Future (2040) Kennedy Bridge Level of Service 2-4
2-3 Bridge Closure Order and River Elevation Action Levels (see also Exhibit 2-2) 2-5
2-4 Bridge Closure Potential Due to Floods (based on 132 years of record) 2-6
2-5 Limited-Time Observations of Bicycle and Pedestrian Activity at the Kennedy Bridge 2-16
3-1 Description and Evaluation of Bridge Rehabilitation Sub-Alternatives 3-3
3-2 US Highway 2 Kennedy Bridge Project Development Alternatives 3-21

Exhibits

1-1 U.S. Highway 2 Kennedy Bridge (Looking South from Grand Forks, ND).....1-1
1-2 U.S. Highway 2 Kennedy Bridge Elevation (Looking North).....1-4
1-3 U.S. Highway 2 Kennedy Bridge Deck Cross Section and Photograph 1-5
1-4 Deflected Condition of Pier 6, South Side.....1-7
2-1 U.S. Highway 2 Kennedy Bridge Location Map.....2-1
2-2 Red River Bridges and Flood Closing Order (see also Table 2-3).....2-6
2-3 U.S. 2 Kennedy Bridge During the 1997 Flood (Aerial View Looking North-Northwest—Source: Corps of Engineers) 2-7
2-4 Area Map Showing Red River Bridge Locations—Existing and Potential Long-term Additions (base map: Google) 2-9
2-5 Environmental Overview Map.....2-12
2-6 Historic Properties.....2-14
2-7 Red River Greenway Trails at the Kennedy Bridge 2-16
3-1 Kennedy Bridge Rehabilitation Elements 3-2
3-2 Cross Section of Separated Bicycle/Pedestrian Path (Trail) at Approach Spans 3-6
3-3 Cross Section of Separated and Attached Bicycle/Pedestrian Path (Trail) at Truss Spans.....3-6
3-4 3D Model Perspective of Bicycle/Pedestrian Structure Attached to Truss Spans.....3-6
3-5 Preliminary External/Separated Trail Layout 3-8
3-6 Baseline and Adjusted Roadway Cross Section Options Internal to the Truss Spans 3-10
3-7 Trail Connection Concept.....3-12
3-8 Range of New Bridge Concepts.....3-19

Appendixes

A MnDOT Draft Statement of Purpose and Need

Acronyms and Abbreviations

AASHTO	American Association of State Highway and Transportation Officials
ADT	average daily traffic
ATR	Automatic Traffic Recorder
CE	Categorical Exclusion
DNR	Department of Natural Resources
DOT	Department of Transportation
EA	Environmental Assessment
EIS	Environmental Impact Statement
Engineering	City of Grand Forks, ND
FEMA	Federal Emergency Management Agency
FHWA	Federal Highway Administration
GF-EGF MPO	Grand Forks-East Grand Forks Metropolitan Planning Organization
HCS	Highway Capacity Software
LOS	level of service
MnCMAT	MnDOT Crash Mapping Analysis Tool
MnDOT	Minnesota Department of Transportation
mph	miles per hour
NAVD	North American Vertical Datum
NDDOT	North Dakota Department of Transportation
NOAA	National Oceanic and Atmospheric Administration
NRHP	National Register of Historic Places
PHF	peak hour factor
PHV	peak hour volume
SAC	Study Advisory Committee
SHPO	State Historic Preservation Office
TM	technical memorandum
USACE	U.S. Army Corps of Engineers
USEPA	U.S. Environmental Protection Agency
USFWS	U.S. Fish & Wildlife Service

SECTION 1

Introduction and Report Purpose

The Minnesota Department of Transportation (MnDOT) led the U.S. Highway 2 Bridge Planning Study through 2013 to develop an approach to maintain this major crossing of the Red River of the North (Red River). The MnDOT team completed the work in consultation with the North Dakota Department of Transportation (NDDOT) and the Federal Highway Administration (FHWA). Section 1 introduces the report by referencing background, listing the supporting technical documents, and by describing the need for action and proposed action/approach for MnDOT's project S.P. 6018-02 (addressing MnDOT Bridge No. 9090; NDDOT Bridge No. 02-350.220).

The Kennedy Bridge is eligible for listing on the National Register of Historic Places (NRHP). Because of this, a proposed action to maintain the crossing could have an adverse effect on a protected historic resource. The Planning Study outlined project development alternatives and issues to be addressed, but it does not establish a preferred alternative nor finalize any determinations under Section 106 of the Historic Preservation Act.

1.1 Background and Supporting Documents

This report provides a summary of the Kennedy Bridge Planning Study, which was the first major step in maintaining the Red River crossing. The proposed action is to rehabilitate or replace the bridge, and to maintain the area's major interregional river crossing on U.S. Highway 2. The Kennedy Bridge (MnDOT Bridge No. 9090; NDDOT Bridge No. 02-358.220), which is 1,261 feet long and provides four highway lanes, also serves as a vital local connection between the cities of Grand Forks, North Dakota and East Grand Forks, Minnesota. The bridge, built in 1963 (Exhibit 1-1), presents a number of technical challenges, historic bridge engineering characteristics, and opportunities for context-sensitive improvements, as presented in Sections 2 and 3.

EXHIBIT 1-1
U.S. Highway 2 Kennedy Bridge (Looking South from Grand Forks, ND)

The Planning Study was organized to provide a series of documents used to commence and focus the overall decision-making process. That process and the results are addressed in a series of technical documents, including the following:

- **Technical Memoranda (2): Pier 6 Movement Capacity; Summary of Pier 6 Movement Records—**The two technical documents address the known issue of movement in the bridge's Pier 6 and provide detailed background data (see Section 1.4).
- **Technical Memorandum (TM): Bridge Rehabilitation Alternatives—**The study's main technical/engineering document, providing an assessment of bridge rehabilitation actions, including alternative levels of investment for rehabilitation and recommendations, which carry into the Final Report. The TM also includes appended information on geotechnical conditions, Red River hydraulics, and scour.
- **TM: Bridge Replacement Options—**Summarizes findings from a supplementary analysis of bridge replacement alternatives, completed to provide a comparison to Bridge Rehabilitation, and to identify the most promising bridge types and alignments, should bridge replacement become a course of action.

More information about the documents is available at the Kennedy Bridge website (www.mndot.gov/d2/projects/kennedybridge) or can be obtained by contacting MnDOT.

1.2 Report Objectives and Project Development Context

1.2.1 Overall Bridge Study Context and Next Steps

The Final Report provides a summary of the Kennedy Bridge Planning Study, with reference to the technical studies. Additionally, it provides contextual information and data regarding functional/transportation background and needs, and establishes the broad vision and framework for a potential bridge rehabilitation project.

The Planning Study addressed issues of project context through development of project goals for bridge rehabilitation and bridge replacement. Based on these factors, and the potential to address needs, bridge rehabilitation is considered the priority action. The bridge rehabilitation concepts identified through the study are structured to cost-effectively address needs, while avoiding or minimizing adverse impacts.

The study also looked at bridge replacement concepts, which would provide more opportunity for functional improvements and fewer maintenance issues in the coming decades compared to rehabilitation—but only with greater initial costs and more adverse environmental impacts. Because the Kennedy Bridge is eligible for listing on the NRHP, the long-term feasibility and cost-effectiveness of bridge rehabilitation must be considered. Based on the study's findings, considering costs, funding, and environmental review steps, a determination will soon be made as to whether rehabilitation of the Kennedy Bridge is confirmed as the preferred alternative.

Section 2 addresses the setting and context for development of a project, including an overview of the environmental and community setting. Section 3 addresses the primary alternatives, including choices and challenges for next steps, as the Planning Study concludes. The next steps will follow one of a few configuration and investment choices for a bridge rehabilitation or replacement project, with bridge rehabilitation screened first to de-

termine if it will perform reasonably. The preferred course of action will be identified by MnDOT and NDDOT after completion and public release of this Final Report. The likely next steps include a more detailed bridge rehabilitation design study (see Section 3).

1.2.2 Study Participants and Project Development Goals/Objectives

The planning work included a series of meetings with a Study Advisory Committee (SAC), two rounds of outreach to the general public, and other meetings and consultations with stakeholders. The invited and participating agencies, given representation on the SAC or with opportunities afforded regularly to provide input, included the following:

- MnDOT
- NDDOT
- FHWA
- City of Grand Forks, ND (Engineering)
- City of East Grand Forks, MN (Department of Public Works)
- Polk County, MN
- Grand Forks County, ND
- Grand Forks-East Grand Forks Metropolitan Planning Organization (GF-EGF MPO)
- Grand Forks Historic Preservation Commission
- U.S. Fish & Wildlife Service (USFWS) (MN & ND)
- U.S. Army Corps of Engineers (USACE) (St. Paul & Bismarck)
- U.S. Environmental Protection Agency (USEPA) (Region 5—MN, Region 8—ND)
- Minnesota Department of Natural Resources (DNR)
- Minnesota Pollution Control Agency
- North Dakota Game & Fish Department
- North Dakota Department of Health—Environmental Health Section
- Minnesota State Historic Preservation Office (SHPO)
- North Dakota SHPO

The planning process developed and refined goals and objectives for development of a transportation improvement project through technical study of the Kennedy Bridge and through input from the agencies and the local communities.[1] During the process, the following goals and objectives were discussed and refined:

- **Set priorities to maintain the U.S. Highway 2 river crossing—**From the beginning of the work, the immediate structural question concerned the known movement of the bridge's Pier 6, which presents an immediate bridge maintenance priority. A clear understanding of the potential for further adjustment in response to movement was needed (see Section 1.4). The other objective was to consider the entire bridge; to outline, prioritize, and define longer-term scenarios to maintain the river crossing—namely, bridge rehabilitation or replacement. Section 1.4 identifies the proposed components of a bridge rehabilitation project, which are also addressed in substantial detail in the Bridge Study's technical memoranda.

[1] SAC meetings/teleconferences were held on 3/6/13, 5/22/13, 7/31/13, 10/2/13, and 12/17/13. Public information meetings (held on 7/17/13, 12/16/13, and 12/17/13) were advertised in local newspapers and through the Web. Additional outreach included presentations to the Grand Forks and East Grand Forks City Councils (12/16/13 and 12/17/13, respectively) and briefings/discussions with the Metropolitan Planning Organization Executive Board on 7/17/13 and 1/15/14. All of the listed agencies were regularly provided documentation of Planning Study meetings.

- **Address community context and the environment—**The study's approach included efforts to understand the Kennedy Bridge setting and the context in which a transportation infrastructure project is being proposed. Section 2 of this report provides more depth on the important factors considered in planning the project. Based on the study team's evaluation of the bridge vicinity and input from stakeholders, the main contextual objectives for project development include the following:
  - **Minimize traffic disruptions—**Development of a project warrants advanced planning to minimize periods of closure and limited capacity at the Kennedy Bridge, as well as considerations for the area's system of river crossing bridges and roadways. This objective was the topic most frequently raised by local stakeholders (see Section 2.2.1).
  - **Accommodate bicycle and pedestrian crossings—**The immediate area includes a remarkable bicycle and pedestrian environment (the Red River Greenway) and there is proven need and community interest in accommodation for bicycles and pedestrians at the crossing. This objective was also raised often by local stakeholders (see Sections 2.3 and 3.1.2.3).
  - **Respect historic resources and other environmental values—**The Kennedy Bridge is eligible for listing on the National Register for Historic Places. Other historic resources are also found in the immediate vicinity. Additional environmental factors include the Red River Greenway, a Minnesota state park and campground, and the Red River itself, with its history of major floods, soil movement, and other natural attributes (see Sections 2.2.2 and 3.1.2.4).

1.3 U.S. Highway 2 Kennedy Bridge Need for Action

The Kennedy Bridge includes the following characteristics (Exhibits 1-2 and 1-3):

- 1,261 feet long overall; 2 steel truss main spans, each 279 feet long, with 19.8-foot vertical portal clearances above roadway; and 11 steel-beam approach spans (5 spans to west and 6 spans to east).
- Eastbound and westbound directions each have two, 12-foot-wide lanes with 3-foot outside shoulders and 1-foot inside buffers next to the median.

EXHIBIT 1-2
U.S. Highway 2 Kennedy Bridge Elevation (Looking North)

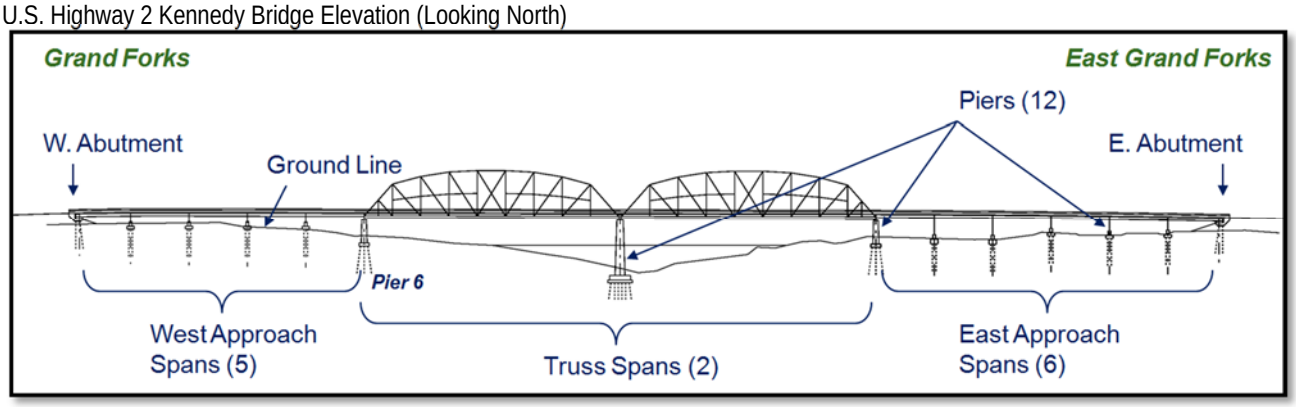
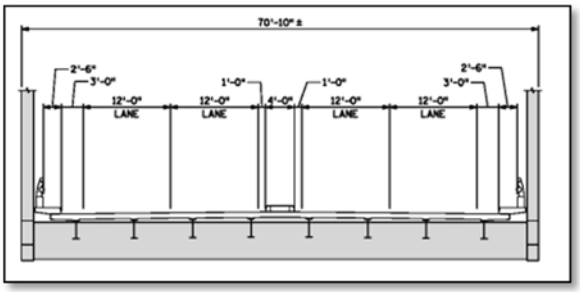


EXHIBIT 1-3
U.S. Highway 2 Kennedy Bridge Deck Cross Section and Photograph



- The bridge has no sidewalks, but each side includes a 2.5-foot-wide raised curb inside the barrier rails (pedestrians and bicycles are prohibited on the bridge, as posted westbound only at the east abutment).

Based on a June 2013 bridge inspection, the Kennedy Bridge has a sufficiency rating of 48.2 (based on a 100-point scale) and is now classified as structurally deficient. The measures do not mean that the bridge is unsafe, but the sufficiency rating provides a scale relative to other bridges through which to determine project development priorities and actions to be taken. In this case, the general condition rating of the substructures (especially Pier 6) had an important role in the structurally deficient classification.

The primary purpose of a Kennedy Bridge project is to provide a structurally sound crossing of U.S. Trunk Highway 2 over the Red River between Grand Forks and East Grand Forks. The need for action was documented in detail by MnDOT in July 2012, in a draft statement of purpose and need, which is attached to this report as Appendix A.

The Kennedy Bridge is fracture-critical in its original design. This means the bridge has a steel superstructure (the steel truss spans) with tension members, which are arranged in a manner whereby if one fails, the bridge could collapse because there is no backup or redundant structural support. The bridge's approach spans also contain pin and hanger details that are considered fracture-critical. A fracture-critical designation does not mean the bridge is unsafe. The fracture-critical features are inherent to the original design of the Kennedy Bridge and make the structure a higher priority for inspection and necessary maintenance.

Chapter 152 of the Minnesota Legislature 2008 Session Laws (Chapter 152)[2] directed MnDOT to establish a bridge improvement program with an emphasis on structurally deficient and fracture-critical bridges. The Kennedy Bridge is part of a Chapter 152 master bridge list, which identifies 172 bridges meeting the law's criteria. As such, it is to be under contract for rehabilitation or replacement by June 30, 2018. It is also anticipated that improvements to the Kennedy Bridge will be partially funded under the Chapter 152 program.

Chapter 152 and similar bridge management programs, including decision-making and risk-management systems, are often found within the context of Homeland Security and vulnerability. Such programs often place emphasis on fracture critical bridges; however, flooding and other risks are also considered. Minnesota's Office of Homeland Security and Emergency Management (2014), for example, notes MnDOT's responsibilities for 19,600 bridges, with

[2] Codified as Minn. Stat. 165.14.

4,668 bridges on trunk highways (including the Kennedy Bridge). State and federal bridge/asset management programs and advisories also provide evaluation and maintenance frameworks aimed at improving resilience and reducing vulnerability (FHWA, 2011).

The specific needs and considerations identified for the Kennedy Bridge, as explained in substantially more detail in Appendix A, are as follows:

- **Primary Need—**The required element for any alternative is to continue to provide a structurally sound crossing of the Red River of the North at this location. This primary need is the main motivation for the Kennedy Bridge Study. Near-term priority is required for Pier 6 and a long-term perspective is also needed for the entire bridge.
- **Secondary Needs—**Desirable; to be incorporated into reasonable alternatives:
  - Provide a reliable crossing for the traffic demands.
  - Improve bicycle/pedestrian access and connectivity at this location.
- **Other Considerations—**Important project planning factors related to context and anticipated project development alternatives and challenges:
  - **Regulatory requirements, including avoidance of adverse effects to historic resources—**The Kennedy Bridge itself is eligible as a historic structure. Other historic elements are also in the vicinity, as described in Section 2.
  - **Structural redundancy—**The two steel truss spans, as well as approach span details, are fracture-critical in their design (non-redundant). This factor requires sound decision-making for rehabilitation and maintenance approaches.
  - **Geotechnical conditions and river hydraulics—**All bridge design concepts should recognize the site characteristics of soil movement and floodway engineering challenges along the Red River.

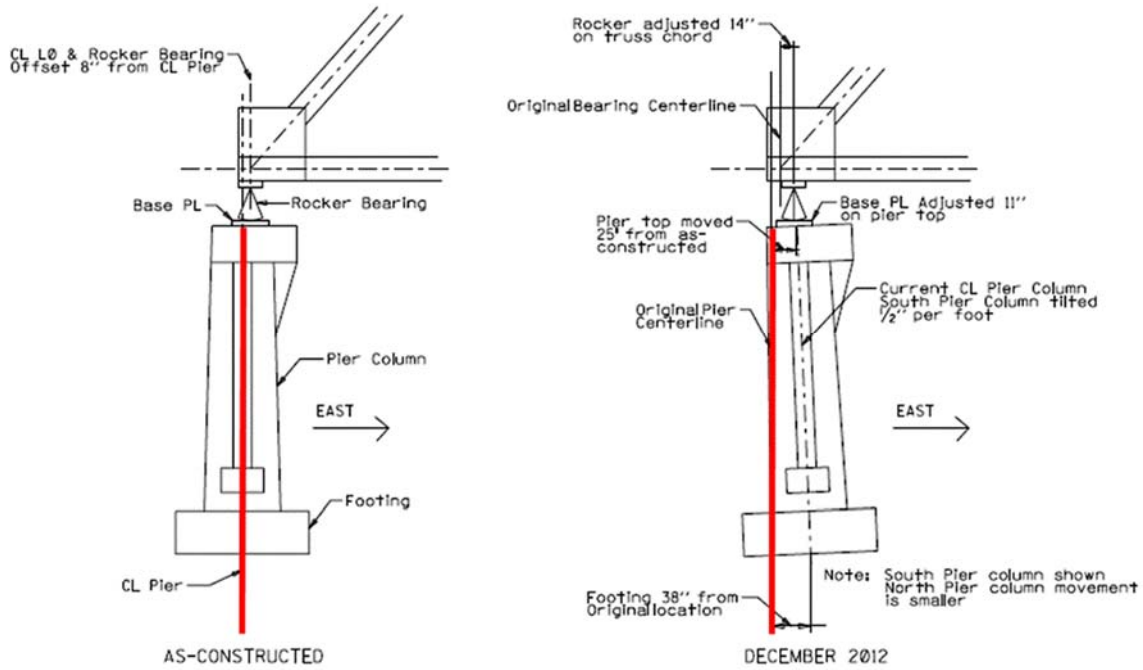
1.4 Bridge Rehabilitation and Project Development Alternatives

A variety of elements were evaluated for a potential bridge rehabilitation project, but Pier 6 (noted in Exhibit 1-2) was a special early focus. The first priority in the Planning Study was to address the movement of Pier 6, which supports the west end of the steel trusses and has gradually shifted due to Red River soil movements. While soil movement issues were anticipated in the original bridge design, the need to address the now substantially shifted position of Pier 6 was a major driver for technical work in the Planning Study (Exhibit 1-4). The key findings on Pier 6 are documented in the Technical Memorandum: *Pier 6 Movement Capacity* (MnDOT 2013a). The key findings included the following:

- The truss bearings have been adjusted periodically in response to pier movement, as anticipated in the original bridge design, cumulatively up to about 14 inches. Substantial additional adjustments could also be made.
- Additional tilt of the pier is a structural concern; therefore, actions should be taken to stabilize or replace the pier.

Monitoring of Pier 6 movement is ongoing and the Planning Study evaluated choices for pier rehabilitation/stabilization or replacement. Replacement of Pier 6 is the most promising course of action to address this most pressing need and will restore Pier 6 to the ideal location in a vertical, non-twisted position. The bearings would be reset to the original location at the ends of the trusses, allowing future adjustments for any additional soil movement.

EXHIBIT 1-4
Deflected Condition of Pier 6, South Side



Other expected bridge rehabilitation elements include blast cleaning and painting, abutment bearing reinforcement, and pier bent straightening. Recent inspection and testing has determined that chloride penetration and deterioration also makes replacement of the bridge deck a high priority (which requires replacement of the integral railings). See more information in Section 3.1 and in the Bridge Rehabilitation TM, which outline varied levels of bridge rehabilitation. Section 3 and the Bridge Replacement TM further support Planning Study conclusions by presenting possible Kennedy Bridge replacement concepts and comparing them to bridge rehabilitation.

SECTION 2

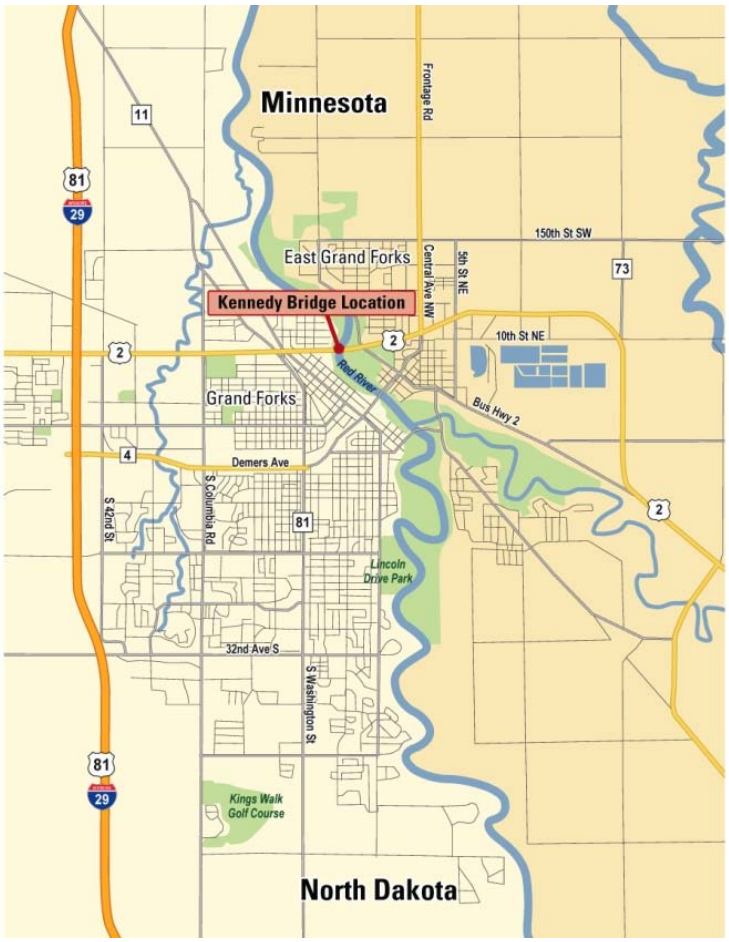
Kennedy Bridge Setting and Context

Section 2 of this Final Report provides background information and data to lay out the context for project development. This information includes the unique attributes of the Kennedy Bridge—its location, setting, role in the transportation system, and its historic and community context. Together, these factors drive the criteria for context-sensitive development of a transportation improvement project, as addressed at the conclusion of this section and in Section 3.

2.1 Kennedy Bridge Location and Area Overview

The U.S. 2 Kennedy Bridge is a border bridge connecting Grand Forks, ND and East Grand Forks, MN (Exhibit 2-1). The project location is about 300 miles northwest of the Minneapolis-St. Paul metropolitan area and about 80 miles north of the border cities of Fargo, ND and Moorhead, MN.

EXHIBIT 2-1
U.S. Highway 2 Kennedy Bridge Location Map



Combined, the greater Grand Forks/East Grand Forks metropolitan statistical area had a 2010 census population of 98,461.[1] The cities are named for and identified with the Red River of the North (Red River) and its fork with the Red Lake River, which joins the Red River just over 1 mile south (upstream) of the Kennedy Bridge. Spring flooding along the Red River has been important to the history and identity of the area, and has caused many Red River bridge closures. The best-known such event is the exceptional flood of 1997 (the worst since 1826), which caused vast and unprecedented damage throughout the region. Grand Forks and East Grand Forks were hit especially hard, with the flood causing the evacuation of most residents and contributing to significant fires in Grand Forks, in addition to the widespread flood damage.

By 2007, the communities and USACE had dedicated an innovative and adaptable flood protection system. The flood control strategy included major land use changes and dedication of the 2,200-acre Greater Grand Forks Greenway throughout the floodway. The Greenway includes a multi-use, paved recreational trail which loops more than 20 miles along both river banks. The Greenway is designated as a National Recreation Trail by the National Park Service.

The following subsections expand on these topics to provide an understanding of the Kennedy Bridge setting and context. The key subjects include traffic volumes crossing the Red River, the potential for bridge closures, the community setting and values, and the resultant criteria for development of a Kennedy Bridge improvement project.

2.2 Transportation and Environmental Setting

The Kennedy Bridge is located within a community setting that is both historic and forward-looking, bringing many related issues to the planning process. The issues identified and addressed through the Planning Study include projected traffic demand, the role of the Kennedy Bridge in the system of three Red River crossings, traffic diversions if bridges are closed (due to flooding or construction), and the surrounding area's context—its history, the community/recreational setting, and environmental features.

2.2.1 Kennedy Bridge Traffic and Other Red River Crossings

2.2.1.1 Level of Service—Performance Measure for Traffic

A traditional operational performance measure for roadways is level of service (LOS). A letter, A through F, is assigned to a roadway or intersection based on performance, with A being the best (no congestion) and F being the worst (gridlock). Because the context for traffic conditions can vary, MnDOT has not formally adopted a desirable LOS for operations of 4-lane urban arterials, such as U.S. 2 at the Kennedy Bridge. However, a mid-range LOS of C/D is often referenced as a reasonable standard, because such levels represent conditions with moderate and expected levels of congestion during peak periods, with little or no congestion the remainder of the day. Locally based transportation planning will also often reference LOS-based traffic performance goals, as does the GF-EGF MPO.[2]

[1] The metropolitan statistical area population includes 52,838 in the city of Grand Forks, ND and 8,601 in the city of East Grand Forks, MN (2010 census).

[2] For example, see: www.theforksmpo.org/Pages/2035LongRangeTranspPlan.htm and www.theforksmpo.org/PDFS/LRTPPerformanceBasedPlanning.pdf.

2.2.1.2 U.S. 2 Traffic Data

MnDOT collects traffic data along U.S. 2, east of East Grand Forks, via an Automatic Traffic Recorder (ATR). The ATR (ID 31) collects information on volumes and vehicle classification continuously to be used for Traffic Analysis. Based on a review of the MnDOT data, the peak hour volume (PHV) during the three highest hours varied from 11.5 to 13.8 percent of the average daily traffic (ADT). PHV is used in analysis of lane capacity in order to analyze for the highest volume hour of the day.

In addition to the ATR, analysis was completed by the GF-EGF MPO for the *GF/EGF Bridge Closure Management Study,* which looked at bridge closures and had peak hour volumes available relative to ADT (GF-EGF MPO 2007). With some structure closures across the Red River, the percentage of PHV compared to ADT was between 6 and 7 percent.

2.2.1.3 Kennedy Bridge Traffic Capacity and Level-of-Service

Highway Capacity Software (HCS) 2010 uses the Highway Capacity Manual as the basis for all capacity and level of service computations. This software was used to determine the existing (2011) LOS across the Kennedy Bridge and future LOS for the 2040 ADT provided by GF-EGF MPO and MnDOT.

Variables assumed and used in both existing and future traffic analysis are as follows:

- Base Free-Flow Speed = 45 miles per hour (mph)—The posted speed limit is 35 mph across the Kennedy Bridge; however, the multilane analysis in HCS does not model free-flow speeds below 45 mph. Therefore the model assumes that drivers travel at speeds over the speed limit when there is no congestion.
- Lane Width = 12 feet (11-foot lanes were not analyzed, but would result in a free flow speed reduction of 1.9 miles per hour)
- Lateral Clearance = 4 feet right, 2 feet left
- Divided roadway
- Access points per mile = 2
- Peak Hour Factor (PHF) = 0.92
- Number of lanes in each direction = 2
- Percent of ADT trucks and buses = 9 (MnDOT Structure Inventory Report)
- Level terrain
- Driver population is familiar with the location and most trips are local
- Directional traffic is split evenly (50/50) across the bridge

Using the data from the MnDOT ATR and bridge closure study, three scenarios were analyzed under each condition that had a larger effect on LOS than the assumed variables. Peak hour volumes of 6, 10, and 15 percent were analyzed to get a range of LOS for the Kennedy Bridge since no hourly volumes were available at the time of the analysis.

The 2011 ADT on the Kennedy Bridge was 22,500 vehicles per day.[3] Based on the analysis, the bridge is currently operating at LOS B to C (Table 2-1).

TABLE 2-1
Existing (2011) Kennedy Bridge Level of Service

PHV*	LOS	Flow Rate (Passenger Cars/Hour/Lane)	Density (Passenger Cars/Mile/Lane)
6%	A	383	8.5
10%	B	638	14.2
15%	C	958	21.3

*** In 2011, MnDOT measured PHV in a range from 11.5 percent to 13.8 percent of the ADT; GF-EGF MPO studies have indicated a PHV factor as low as 6 percent of ADT.**

The future (2040) ADT on the Kennedy Bridge is estimated by the GF-EGF MPO to be 29,910 vehicles per day (an increase of 33 percent from 2011). That forecast level assumes additional Red River crossings, as identified in the GF-EGF MPO's 2035 transportation plan, will not be constructed.

Based on the analysis of the forecast 2040 volumes, future traffic on the bridge would operate at LOS C to D (Table 2-2).

TABLE 2-2
Future (2040) Kennedy Bridge Level of Service

PHV*	LOS	Flow Rate (Passenger Cars/Hour/Lane)	Density (Passenger Cars/Mile/Lane)
6%	B	509	11.3
10%	C	849	18.9
15%	D	1273	28.3

*** In 2011, MnDOT measured PHV in a range from 11.5 percent to 13.8 percent of the ADT; GF-EGF MPO studies have indicated a PHV factor as low as 6 percent of ADT.**

The LOS analyses only addressed performance across the bridge. No signal timing or adjacent intersections were included in the analysis.

The LOS analysis accounted only for normal vehicular traffic scenarios and did not account for adjacent structure closings due to flooding. If vehicles are diverted from adjacent structures onto the Kennedy Bridge due to flooding, the LOS and vehicle flow rate will further decrease from the results above (see Section 2.2.1.4).

In general, the traffic analyses show that the Kennedy Bridge will continue to function well as a 4-lane roadway for more than 20 years, even with the forecast 33-percent increase in traffic volume. As another check, a sensitivity analysis was completed to determine if the above-assumed values caused a large variance in the LOS results. This checking showed that none of the assumptions, other than ADT percentage for PHV, will greatly affect the results (Tables 2-1 and 2-2 include a range of PHV percentages).

[3] MnDOT data for 2011. Based on input from the GF-EGF MPO, traffic counts by NDDOT immediately west of the bridge have often been substantially less than 22,500.

2.2.1.4 System of Local Bridges and Bridge Closure Impacts

The Kennedy Bridge is one of three local bridges across the Red River. Therefore, the local transportation context puts some emphasis on addressing the impacts of Red River bridge closures, which will occur because of floods or construction. As referenced above, the GF-EGF MPO 's *GF/EGF Bridge Closure Management Study* was a source for this Planning Study (GF-EGF MPO 2007). Based on that information and other data, MnDOT's team also completed an independent review, with emphasis on bridge closures due to floods.

The Red River sometimes rises to flood elevations, requiring bridge closures between the two cities for public safety reasons. As shown in Exhibit 2-2, there are three bridges across the Red River between the two cities (the Kennedy, Sorlie, and Point Bridges) and a fourth bridge in East Grand Forks across the Red Lake River (the Murray Bridge). The Kennedy Bridge is unique because it clears the river at a substantially higher elevation than the other bridges, and more than 8 feet higher than the Sorlie Bridge.

Order of Bridge Closings during Floods and Flood History

Exhibit 2-2 and Table 2-3 reference the order in which local bridges are closed in response to flooding and the established community action levels (river elevations and flood stages).[4] The National Oceanic and Atmospheric Administration (NOAA) has tracked historical crests for the Red River of the North at East Grand Forks for the past 132 years.

TABLE 2-3
Bridge Closure Order and River Elevation Action Levels (see also Exhibit 2-2)

Bridge (Closure Order)	**River Elevation (feet)/River Stage (feet)**
Point Bridge (1)	819.0/40.0
Sorlie Bridge (2)	822.5/43.5
Murray Bridge (3)	824.0/45.0
Kennedy Bridge (4)	831.0/52.0

Source: GF/EGF MPO (Notes: the 100-year flood recurrence = 832.4/52.7 feet elevation/stage; see also the footnote referenced to text above).

[4] There are conflicting data sources pertaining to bridge closure action levels, particularly for the Point Bridge. The GF-EGF MPO advised values are presented in Table 2-3 as conservative local action levels, with Point Bridge closure at 40.0 feet flood stage vs. 44.9 feet in other data sources. See: http://www.grandforksgov.com/gfgov/home.nsf/Pages/Flood+Fight and http://water.weather.gov/ahps2/hydrograph.php?wfo=fgf&gage=egfm5&hydro_type=2. All river elevations and flood stages noted in this report are in reference to the 1988 datum (North American Vertical Datum [NAVD] 88) and the gage location is at the Sorlie Bridge.

EXHIBIT 2-2
Red River Bridges and Flood Closing Order (see also Table 2-3)

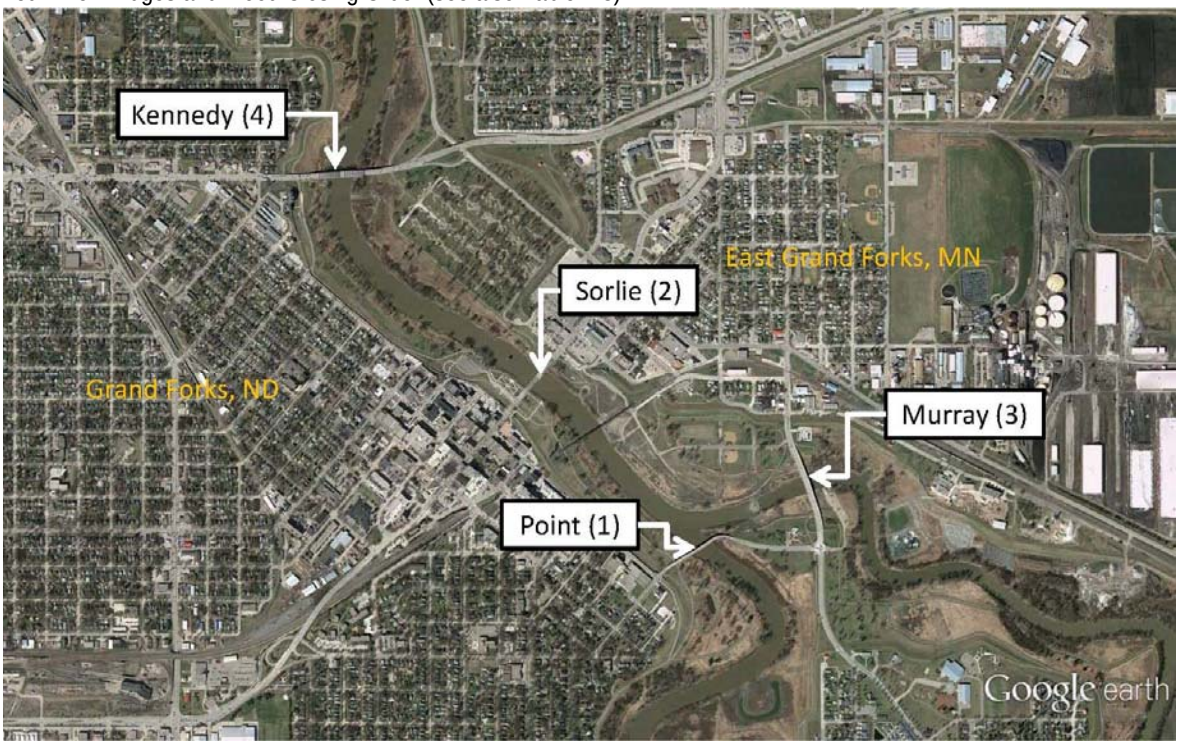


Table 2-4 provides data on traffic demands across the Red River and historic flood data, which demonstrate the potential for bridge closure over the full period of record.

TABLE 2-4
Bridge Closure Potential Due to Floods (based on 132 years of record)

Bridge/Road Closure	**Percentage of Traffic Crossing the Red River**	**Number of Flood Closures (In 132 years of Record)**	**Percentage of Years (Average Probability in Record) ***
Point Bridge	16% (2 lanes)	29	22.0%
Sorlie Bridge	33% (2 lanes)	18	13.6%
Murray Bridge	NA (2 lanes)	14	10.6%
Kennedy Bridge	51% (4 lanes)	1	0.7%

*** Closure potential is based on river stage crests and includes years the bridges were not present to broadly compare probability (sources: http://water.weather.gov/ahps2/crests.php?wfo=fgf&gage=egfm5 and GF/EGF MPO 2007, Bridge Closure Management Study)**

The estimated probability of bridge closure in Table 2-4 is based on the long historic record of 132 years. Today's potential for bridge closure is likely greater based on review of flood stage history and considering increased urbanization and the flood controls completed in

2007 (which contain Red River flood flows at the bridges).[5] However, the relationships between local bridges will remain as shown previously.

Closures of the Kennedy Bridge and Impacts at Other Crossings

The Kennedy Bridge, with its 50-year history, is only known to have been forced closed by Red River flooding in 1997, which was an unprecedented event (see Exhibit 2-3). The 1997 flood crested at 54.35 feet flood stage—more than 4 feet higher than the next-highest floods on record (50.20 feet in 1897 and 49.86 feet in 2011). This was an extreme condition, 1.65 feet higher than the 100-year flood level (52.7 feet stage). During the peak of the 1997 flood, there were no opportunities for the traveling public to cross the Red River locally by roadway for approximately 1 week. Also, as proven by the 1997 flood, the approach roadway to the east includes a low segment still inside the new levee system (see Exhibit 2-3) that will be considered for adjustment.

EXHIBIT 2-3
U.S. 2 Kennedy Bridge During the 1997 Flood (Aerial View Looking North-Northwest—Source: Corps of Engineers)

Source: USACE (Note: the inundated approach roadway near the middle of the photo)

A Kennedy Bridge closure scenario far less extreme than the 1997 flood would be associated with major bridge construction, during which U.S. 2 traffic would be diverted to the Sorlie Bridge and partially to the Point-Murray Bridges to cross the Red River and Red Lake River. The GF-EGF MPO's *GF/EGF Bridge Closure Management Study* addressed a Kennedy Bridge closure scenario, as well as other scenarios (GF-EGF MPO 2007). With closure of only the Kennedy Bridge (for maintenance or other construction), the study found that traffic on the Sorlie Bridge would exceed the road's capacity by more than 40 percent. This scenario would also result in a high level of congestion in downtown Grand Forks/East Grand Forks, as the 2-lane local streets are not capable of carrying traffic as efficiently as the 4-lane U.S. Highway 2 urban arterial. The GF-EGF MPO's study found a substantially lower potential for traffic to divert to the Point and Murray bridges and few capacity concerns for those crossings and connections. With only the Kennedy Bridge closed, the Point Bridge would operate at about 28 percent of its potential capacity and the Murray Bridge at about 18 percent.

[5] Staff review of the Web-based data referenced in Table 2-4 noted that of the 10 highest flood stages on record (over 132 years), 6 of the 10 floods occurred during the last 20 years (1996, 1997, 2006, 2009, 2010, and 2011).

Kennedy Bridge Accommodation of Traffic with Other Bridges Closed

As previously noted, the Kennedy Bridge is the only available detour route if the two other Red River bridges are closed due to flooding. Under this scenario, traffic volumes on the Kennedy Bridge would be substantially increased. To understand potential impacts, Bridge Planning Study staff completed an analysis to further check the potential peak traffic demands and the highway capacity at the Kennedy Bridge.

Based on the referenced *Bridge Closure Management Study*, 20.5 percent of the Kennedy Bridge ADT may be present under peak hour conditions with the other bridges closed (GF-EGF MPO 2007). This is a substantially higher PHV than observed under normal network conditions, with all bridges open. MnDOT measured PHV in a range from 11.5 to 13.8 percent of ADT in 2011, and MPO studies have indicated a PHV factor as low as 6 percent of ADT. For this extreme-case analysis, 20.5 percent was applied to updated and future ADT values. HCS 2010 was used for the capacity and LOS analysis.

The 2011 ADT on the Kennedy Bridge was 22,500 vehicles per day. Based on 20.5 percent PHV, the PHV is 4,612 vehicles in both directions. The capacity analysis showed this volume would operate at a LOS D with 1,309 passenger cars/hour/lane and 29.1 passenger cars/mile/lane.

The 2040 ADT on the Kennedy Bridge is forecast to be 29,910 vehicles per day, assuming no major Red River bridge improvement actions or additions in the area. Based on 20.5 percent of that value, the PHV is 6,132 vehicles per hour in both directions. The capacity analysis showed this volume would operate at a LOS E with 1,741 passenger cars/hour/lane and 40.2 passenger cars/mile/lane.

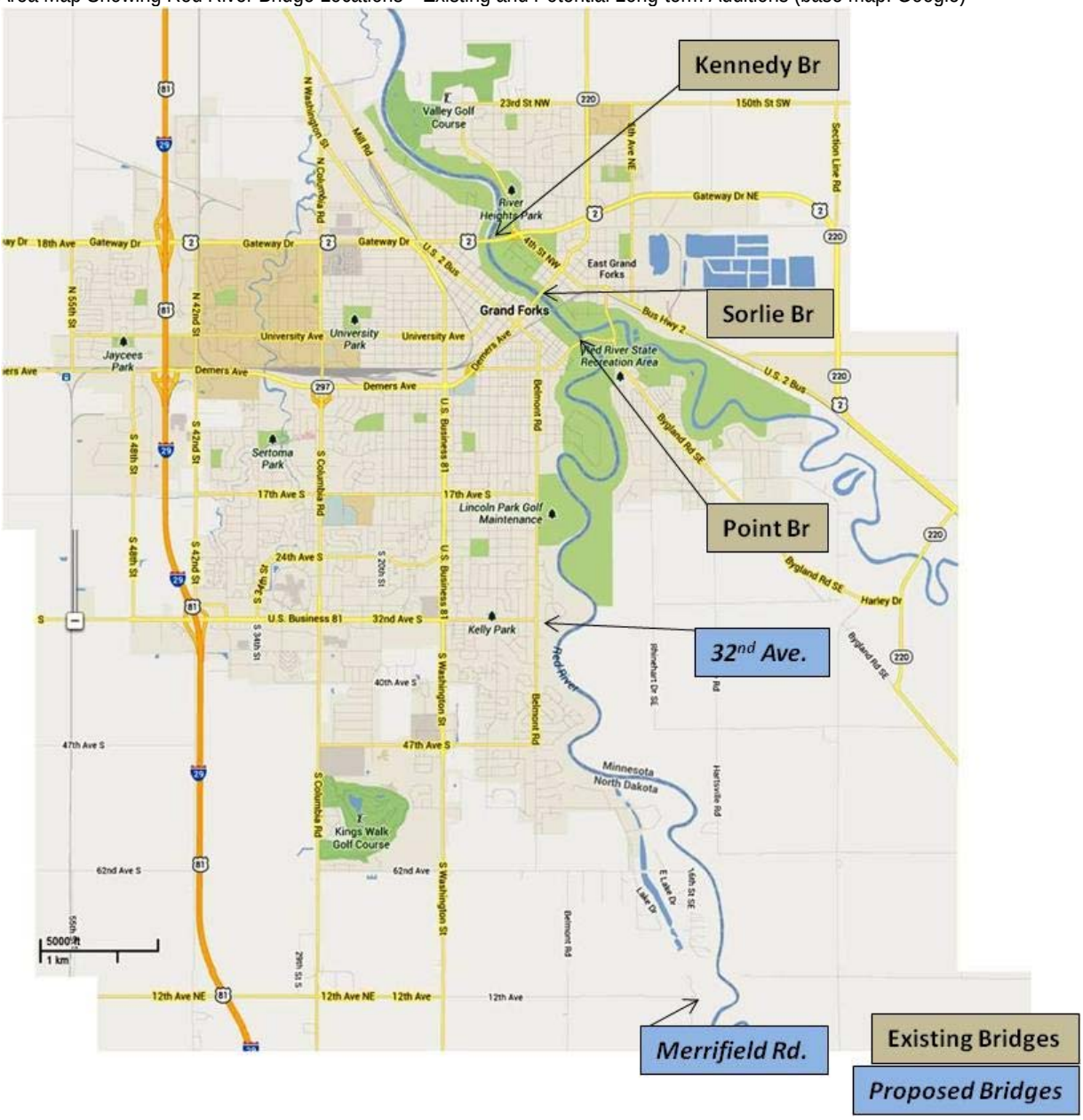
Because running all of the area's river-crossing traffic on the Kennedy Bridge would be a temporary scenario, expected only under extreme conditions, a level of service of D to E is considered acceptable. The forecasted moderate to heavy congestion on the Kennedy Bridge during peak periods is within the range of expected and tolerable congestion levels, with less congestion the remainder of the day.

The capacity analyses completed for this study did not address congestion at surrounding signals and intersections. The metropolitan area's traffic management planning efforts indicate that conditions would also be optimized through signal retiming, other temporary intersection traffic control modifications, and traveler information efforts. Therefore, while running all river-crossing traffic on the Kennedy Bridge is not ideal, traffic can still move reasonably between the two cities with all four lanes open on U.S. Highway 2 and the Kennedy Bridge open.

Long-term Transportation Plans and Possible New Bridge Locations

The GF-EGF MPO has established long-term plans for locations of two additional Red River bridges. The growth trend in the metropolitan area is toward the south and the new bridge crossings identified in long-term plans are at 32nd Avenue South and Merrifield Road (see Exhibit 2-4). These new bridges are not funded projects and, therefore, are not part of the committed future transportation system and have not been factored into the traffic forecasting or traffic impact issues previously discussed.

EXHIBIT 2-4
Area Map Showing Red River Bridge Locations—Existing and Potential Long-term Additions (base map: Google)



2.2.1.5 Crash History and Highway Safety Observations

Crash data was pulled from MnDOT's Crash Mapping Analysis Tool (MnCMAT) and ArcGIS data from the NDDOT. Crash data was reviewed for a 5-year period between 2008 and 2012. The results from 2008 through 2012 showed a total of 19 crashes in the segment along U.S. 2, from 1st Street North (Grand Forks) and 4th Street Northwest (East Grand Forks), a distance of 0.42 mile, including the Kennedy Bridge. Of these, there were no fatal crashes, but two crashes were severe, with incapacitating injuries. There were also 3 injury, 2 possible injury, and 12 property damage crashes in the 5-year period. The crash rate for this segment is 1.1 crashes per million vehicle miles traveled.

The two severe crashes were classified as a rear end and a sideswipe same direction crash, respectively. The severe crash rate for this segment is 0.12 crash per million vehicle miles traveled. Minnesota publishes average crash rates throughout the state based on road types in "Section Green Sheets." In the 2011 update of the Green Sheets, the statewide average crash rate for a similar urban, 4-lane divided roadway was 3.4 crashes per million vehicle miles traveled (including along the roadway and at intersections). Comparing the crash rates along the Kennedy Bridge crossing (1.1) to the statewide average for similar roadways (3.4), there is no evidence of a particular crash problem in the Kennedy Bridge segment.

Stakeholder input on safety obtained during the Bridge Planning Study often highlighted the following safety issues or local preferences:

- **Median on the Kennedy Bridge—**There were favorable comments on the role of a center median on the bridge, specifically that the median has had a role in preventing crashes during icy winter conditions.
- **Ramps Connecting to 4th Street Northwest in East Grand Forks—**Stakeholders sometimes referenced safety concerns associated with the ramp connections, located just east of the Kennedy Bridge. Logically, the west-bound on ramp is most likely to present safety concerns because of the merge it presents with U.S. Highway 2.
- **Bicycles and Pedestrians—**The Bridge Planning Study has addressed accommodations on the Kennedy Bridge for bicycles and pedestrians, with considerably more information provided in the following subsections and in Section 3. Stakeholders have often cited safety as an important factor to consider for bikes/pedestrians—both as justification for proposed improvements and for inclusion in project evaluation criteria.

2.2.2 Environmental and Historic Features

Exhibit 2-5 is an environmental overview map for the vicinity of the Kennedy Bridge. The principal environmental features of this area are summarized in the following subsections.

2.2.2.1 Red River and Floodway/Greenway

The Red River, which flows from south to north through the area, creates a dynamic and challenging environment for maintenance of structures. The Red River itself is the main remaining drainage across the flat lakebed of the enormous, ancient Lake Agassiz, a glacial lake, which drained about 9,500 years ago. Therefore, the Red River is located within a vast and mainly flat basin covering more than 111,000 square miles. These parameters and natural conditions result in a wide floodplain and contribute to the risks from periodic major floods. Additionally, the soils along the Red River are known to creep (move slowly, imperceptibly), generally from the river banks toward the middle of the river (see the reference to Pier 6 movement in Section 1.4). In fact, the west riverbank area (including the area around Pier 6 and to the south) was identified by USACE as a "landslide risk area" to prevent any inappropriate construction activities or designs, temporary or permanent. The City of Grand Forks has also noted a storm sewer outfall in this area (immediately southwest of the bridge), which includes a membrane and riprap covering as bank stabilization features.[6]

[6] City of Grand Forks Engineering, input on the Kennedy Bridge Planning Study (re. landslide risk and the storm sewer).

Locally, the Red River floodway was engineered in the aftermath of the 1997 flood. Flood-damaged homes throughout entire neighborhoods were demolished after the flood, as evident through comparison of the Exhibit 2-3 photograph and the open space shown on Exhibit 2-5 (note also the legacy parcel boundaries on Exhibit 2-5). Floodway areas inside the flood protection system (levees and walls) are now publicly owned open space, designated as the Red River Greenway.

The Greenway, completed in 2007, provides about 2,200 acres of open space and more than 20 miles of multi-purpose paved trails within the floodway on both sides of the Red River. The Greenway is also designated as a National Recreation Trail by the National Park Service. In addition to trails, the recreational features along the Greenway include two golf courses, three disc golf courses, shore fishing sites, and a Minnesota State Park Campground—the Sherlock Park Campground, as shown on Exhibit 2-5.

The Sherlock Park Campground, which is configured around the legacy residential streets and lots, is part of the Minnesota Red River State Recreation Area—essentially, the Greenway space on the Minnesota side of the Red River. In addition to the developed and full-service camping area located south of U.S. 2, the State Campground provides for primitive camping just north of U.S. 2.

2.2.2.2 Section 4(f) Applicability and Section 106 Historic Resources

The publicly owned recreation lands around the Kennedy Bridge (comprising the Greenway) are noteworthy for project development context in that this land will likely meet the definition of a Section 4(f) resource. Section 4(f) of the 1966 Department of Transportation (DOT) Act (49 USC 303, 23 USC 138)[7] provides protection for publicly owned parks, recreation areas, historic sites (public or private), and wildlife refuges from conversion to a transportation use. Section 4(f) applies only if the following criteria are met:

- Federal transportation funds are anticipated or an action is being taken that requires approvals by a federal transportation agency.
- The property is publicly owned and open for public recreation, or meets historic property criteria if privately or publicly owned.

The Section 4(f) evaluation process requires that any impacts from direct use of a publicly owned park, recreation area, historic site, wildlife, or waterfowl refuge for highway purposes be evaluated in context with the proposed highway construction/reconstruction activity. Finally, any such use of the eligible resource can only be allowed if there is no feasible and prudent alternative.

Historic properties are also protected by Section 106 of the National Historic Preservation Act of 1966 as amended (16 USC 470). Both Section 4(f) and Section 106 define "historic" properties as those listed on, or eligible for, the NRHP.[9] Section 4(f) generally defers to the Section 106 review process for identifying historic properties and assessing the potential effect of an undertaking on the properties.

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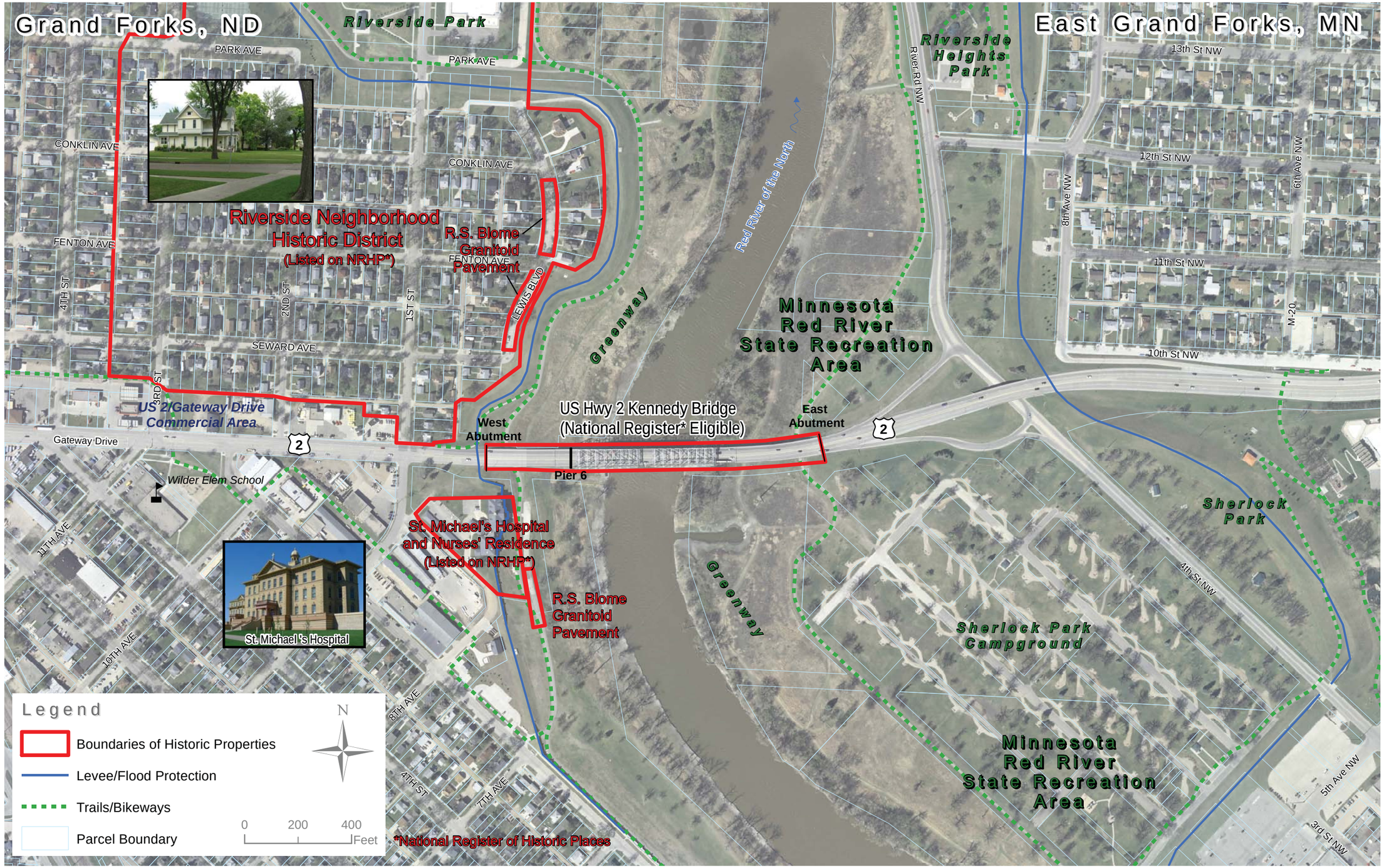
[7] In January 1983, as part of an overall reorganization of the DOT Act, Section 4(f) was amended and codified in 49 U.S.C, Section 303. However, the regulation is more commonly known as "Section 4(f)."

[9] To be eligible for the NRHP, properties must typically be at least 50 years old and must also satisfy at least one of four criteria associated with prehistory or history.



Kennedy Bridge Planning Study
East Grand Forks, MN | Grand Forks, ND

TBG011514142833MKE 2-5_KBPS_Environmental_Overview_v2 04.21.14 sls

Exhibit 2-5
Environmental Overview Map

The Kennedy Bridge area includes several historic resources, identified on Exhibits 2-5 and 2-6. The Kennedy Bridge itself, built in 1963, is eligible for listing on the NRHP based on its significance to engineering (the two, 279-foot-long steel Parker truss spans) and transportation (the river crossing's role in economic development). Other historic properties in the vicinity of the bridge include the following:

- St. Michael's Hospital and Nurses' Residence (now adapted for residential use as Riverside Manor), located south of the bridge approach in Grand Forks
- The Riverside Neighborhood Historic District, a residential area located north of the Grand Forks bridge approach
- Historic "granitoid" pavement, present in some locations around the Grand Forks bridge approach area (see Exhibits 2-5 and 2-6)

Additional information on Kennedy Bridge character-defining features and the significance of the other historic resources is included in Section 3 of the TM: *Bridge Rehabilitation Alternatives*.

2.2.2.3 Other Environmental Resources and Regulations

The Red River floodway, the river's natural environment, and other characteristics must also be taken into account in planning to maintain the river crossing at the Kennedy Bridge. Some of the key applicable environmental regulations include the following:

- **Presidential Executive Order 11988, Floodplain Management (and related)—** The applicability of this Executive Order, and closely related federal, state, and local rules, will depend on the extent to which the proposed project would encroach on the Red River floodway. Any actions taken within the 100-year floodplain can be considered encroachments. But actions considered most challenging to completing project reviews and approvals would be those in the floodplain that involve the addition of new structures, addition of fill, or the replacement of existing structures. Related technical considerations include any adverse effects on natural and beneficial floodplain values, any increased risk of flooding, and the development of any features considered incompatible with the floodplain. In addition, any modifications to the area's engineered flood protection system require approval by USACE and both cities. Because the system is built to protect against a flood event greater than 100-year frequency, hydraulic impacts greater than a 100-year event need to be evaluated. At a minimum, the hydraulic effects at the 250- and 500-year events, which are both below the top of levee elevations, should be evaluated in addition to the 100-year event. Any negative impact to the current level of flood protection would need to be mitigated.[10]

[10] City of Grand Forks Engineering, input on the Kennedy Bridge Planning Study (re. modification approval requirements).

Boundaries of Historic Properties

0 250'
Scale

prep by Gemini Research July 2013

Exhibit 2-6
Historic Properties

- **Federal Clean Water Act (CWA), 33 U.S.C. 1344, Section 404 and 404(b)(1) guidelines and CWA Section 401 Water Quality Certification—**The referenced regulation and sections concern water quality and the regulation and protection of wetlands and aquatic resources. While the Planning Study did not include wetland delineation or other detailed environmental data reviews, wetland characteristics are often observed along the Red River. Similar to the floodplain management issues, greater potential for impacts would be associated with actions that involve addition of new structures, addition of fill, or the replacement of existing structures.
- **Fish and Wildlife Coordination Act (16 U.S.C. 661-666)—**This regulation applies to actions that may involve impoundment of water (surface area of 10 acres or more), channel diversion, channel deepening, or other control or modification of a stream or other body of water. Fisheries may also need to be addressed if the work to be done will impact the river.

The Bridge Planning Study has outlined issues of project need, context, and the potential regulatory issues. Many of these factors are discussed in the previous subsections, with general goals and objectives listed in Section 1.2. Based on these factors, and the ability to cost-effectively address needs, bridge rehabilitation is considered the priority action. In general, the bridge rehabilitation concepts identified through the study were found to sufficiently address needs, while avoiding or minimizing adverse impacts. However, additional design studies and regulatory review will be required to render a project development decision.

More information about project development choices is provided in Section 3, including comparisons between bridge rehabilitation and bridge replacement.

2.3 Bicycle and Pedestrian Considerations

A summary of context for the Kennedy Bridge Study would be incomplete without special attention to bicycle and pedestrian movements. As noted in Section 1.3, the Kennedy Bridge does not accommodate pedestrians and bicycles and, in fact, includes a posted prohibition (westbound only at the east abutment). But the importance of the bridge as a Red River crossing, the popularity of the Greenway trails, and observed demand raised the need to seriously consider improvements as part of any bridge rehabilitation project. Minnesota legislation (passed 2010) requires that all bridge projects funded under Chapter 152 in fiscal year 2012 or later include bicycle and pedestrian accommodations if both sides of the bridge are located within a municipality or the bridge links a pedestrian way, shared-use path, trail, or scenic bikeway. As context for a potential Kennedy Bridge improvement, the comprehensive multi-use trail system can be seen in Exhibit 2-5 (note the presence of the Greenway trails and other multi-use trails).[11] Federal legislation (23 USC Section 217e) provides a similar requirement, for any "bridge deck being replaced or rehabilitated with Federal financial participation and on a highway on which bicycles are permitted to operate at each end." The cited section advises that if (the FHWA) "determines that the safe accommodation of bicycles can be provided at reasonable cost as part of such replacement or rehabilitation, then such bridge shall be so replaced or rehabilitated as to provide such safe accommodations."

[11] The main Greenway trails are typically 14 feet wide.

Because the Kennedy Bridge deck width is constrained by the steel truss, the scope for the Bridge Planning Study originally emphasized the idea of attaching a new structure to the outside of the truss spans. The intent was to check the structural feasibility of this concept. The Study has found that, while this concept is technically feasible, it would also add substantially to rehabilitation project costs and the structure's complexity. Section 3 provides more detailed discussion of these factors, which include the issues of bridge inspection/maintenance and whether an external structure would adversely affect the historic character of the Kennedy Bridge.

The Bridge Planning Study also had the benefit of working with the SAC, and obtaining input from the general public (see Section 1). These efforts confirmed the importance of addressing "bike/ped" accommodations on the Kennedy Bridge. Local planning staff also completed efforts to observe bike/ped demands during the summer of 2013. On portions of June 18, 19, and 22, 2013 (Tuesday, Wednesday, and Saturday), GF-EGF MPO staff observed activity on a Greenway trail under the Kennedy Bridge approach spans and the use of the Kennedy Bridge itself for crossing the Red River. The relevant data are summarized in Table 2-5 and Greenway trail summer usage is shown in Exhibit 2-7.

TABLE 2-5
Limited-Time Observations of Bicycle and Pedestrian Activity at the Kennedy Bridge

	Tuesday, June 18*		**Wednesday, June 19***		**Saturday, June 22***	
Location	**Walking, Running, Blading**	**Biking**	**Walking, Running, Blading**	**Biking**	**Walking, Running, Blading**	**Biking**
Greenway Trail Under Bridge	66	128	72	94	24	70
Kennedy Bridge Crossings	2	3	6	1	0	1

*** The observation periods for each date and location lasted 2 hours.**

EXHIBIT 2-7
Red River Greenway Trails at the Kennedy Bridge

During the reported limited time periods on the three dates (2-hour periods; not full days), a total of more than 450 trail users, including 292 bicyclists, were observed passing under the approach spans. During similar partial-day surveys on the same 3 dates, a total of 13 users

were observed crossing the river on the Kennedy Bridge (5 bicyclists and 8 pedestrians). These observations show that the Kennedy Bridge is located in the midst of a popular multi-use trail system (along the Greenway) and that non-motorized travelers will cross the Kennedy Bridge, even without adequate accommodation and against the posted westbound prohibition (at the east abutment).

Based on these planning inputs and concerns identified for attaching a new trail structure external to the truss, the team also developed concepts to adjust the roadway cross section on the existing bridge, constrained by the width available inside the steel truss spans. Section 3 shows and compares the options for accommodation of bicycles and pedestrians on the Kennedy Bridge, both internal and external to the truss.

2.4 Issues and Criteria for Project Development

The background and context for the Kennedy Bridge, as laid out in Sections 1 and 2, allowed the Planning Study team to understand the key issues and the evaluation criteria for making project development decisions. Section 3 presents the framework for development of a transportation infrastructure improvement project—namely, the options of bridge rehabilitation or bridge replacement (each of which also present a range of choices, or variations).

The objectives for the Planning Study included development of context-sensitive solutions—approaches to address needs while packaging improvements to fit well into the community. Section 3 identifies and compares the principal project development options, which are ultimately evaluated according to the following context-sensitive criteria:

- **Bridge Capital Cost and Project Funding—**Considers project construction costs and funding levels to implement various bridge rehabilitation and bridge replacement concepts.
- **Structural Performance and Maintenance—**This criterion considers the ability of the structure to perform over short-term and long-term periods, up to several decades into the future. It also considers the ability to easily maintain the bridge.
- **Construction Period and Traffic Impacts—**As outlined in Section 2.2.1, keeping the system of bridges to cross the Red River open is important to maintaining reasonable traffic movement. This is especially true for the Kennedy Bridge, which typically carries more than 50 percent of the area's total traffic demand across the river. Therefore, construction staging and duration are important evaluation issues for the Kennedy Bridge, even if complete bridge closure is not required.

- **Historic Preservation (Section 106) Review—**Any reconstruction of the Kennedy Bridge, whether rehabilitation or replacement, would require reviews to determine if the proposed modifications would cause adverse effects to the historic bridge or to other historic resources. In general, greater levels of modification will require more rigorous reviews and may present risks for unavoidable adverse effects (for example, complete bridge replacement, including removal of the existing bridge, would result in a Section 106 adverse effect).[12]

- **Long-Term Traffic and Bike/Ped Function—**This criterion considers the ability of Kennedy Bridge design options to safely and effectively serve vehicular traffic and accommodate bicycles and pedestrians. Other considerations for Kennedy Bridge improvements include:

  — **System of Shared Use Trails—**The Red River Greenway and other trails in the area are typically shared-use paved paths that are 10-14 feet wide.

  — **Trail Connection along the South Side of the Kennedy Bridge—**Local input received during the Planning Study, and previous local plans, most often support a shared-use path along the south side of a new or rehabilitated Kennedy Bridge. The main justification for the south side of the bridge is to create an "inner loop" in the trail system, looking toward the area's central business district to the south. As the Planning Study concludes, it must be noted that this perceived preference is not a design recommendation or decision. Any additional design studies to address trail connections across the Kennedy Bridge will consider options along both the north and south sides (see also Section 3.1.2.3).

- **Project Development Risks and Approval Process—**Finally, the various design options would require different levels of design and environmental review in the project development process. These reviews would focus in particular on design and construction feasibility and risks and any adverse environmental impacts.

As noted previously, rehabilitation of the Kennedy Bridge is considered the priority action. Section 3 concludes this report by providing substantially more information about project development choices and next steps.

[12] The Section 106 review process is an important factor behind this Planning Study, with background in the *Management Plan for Historic Bridges in Minnesota* (MnDOT 2006). That plan provided information and guidance on the management and long-term preservation of historic bridges in Minnesota. It also helped delineate project review procedures, principally a detailed review process in which professional engineers are teamed professional historians. This Planning Study has outlined anticipated actions and Section 106 review issues for the Kennedy Bridge; however, additional design studies and regulatory reviews will be required to render a project development decision.

SECTION 3

Project Development and Study Findings

This concluding section of the Final Report summarizes the engineering concepts considered for long-term maintenance of the U.S. Highway 2 Red River crossing. More detailed engineering information is included in the two Technical Memoranda: *Bridge Rehabilitation Alternatives* and *Bridge Replacement Options* (MnDOT 2013b and MnDOT 2013c). The engineering concepts provide a range of options for bridge rehabilitation and bridge replacement. Therefore, the Planning Study has refined the options to determine the most promising choices available for project development.

3.1 Project Development Alternatives

The Planning Study decision-making framework emphasized the following objectives:

- **Address Pier 6 movement and position**—Determine the need/ability to further adjust Pier 6 for movement; consider monitoring for more movement and longer-term risks/mitigations
- **Address overall bridge condition and secondary needs**—Address overall bridge maintenance, considering all of the other bridge components and secondary needs

The principal choices, or project development alternatives, at the study's conclusion include the following:

- No Action (baseline alternative)
- Bridge Rehabilitation (the priority action)
- Bridge Replacement (as comparison to bridge rehabilitation)

Each alternative is summarized in the subsections below and compared in Section 3.2. As previously noted, rehabilitation of the Kennedy Bridge is considered the priority action.

3.1.1 No Action Alternative

3.1.1.1 Description

The No Action (or no build) Alternative would involve no substantial bridge rehabilitation actions to maintain the bridge long-term. However, this scenario would include continued inspection, monitoring, and minor ongoing maintenance of the Kennedy Bridge. The No Action Alternative is a required consideration for environmental reviews and approvals; but it is typically considered the baseline, for comparison to the action/build alternatives. The characteristics and performance of this alternative include the following:

- Cost—Lowest, includes only routine maintenance
- Pier 6—Potential for more movement and would not be addressed proactively
- Overall Bridge Condition—The deck and other elements would continue to deteriorate, requiring increased maintenance efforts

- Bicycle/Pedestrian Function—Would remain as it is today, discouraging these uses and lacking in safety
- Risks—The No Action Alternative could result in future load restrictions and partial or complete bridge closures

3.1.1.2 Project Development Process

The No Action Alternative does not require any further technical reviews or approvals. However, it would fail to address the identified needs and would not be compliant with Minnesota's Chapter 152 legislation (Minnesota Statute 165.14), which calls for having the bridge under contract for rehabilitation or replacement by June 30, 2018 (or sooner). See also Section 1.3 and Appendix A.

3.1.2 Bridge Rehabilitation Alternative, Recommendations, and Options

3.1.2.1 Description

A detailed description of the Bridge Rehabilitation Alternative, including sub-alternatives, is provided in the TM: *Bridge Rehabilitation Alternatives* (MnDOT 2013b). The bridge rehabilitation elements considered in the TM are noted in Exhibit 3-1. A complete bridge rehabilitation project includes measures to address the major issue of displacement and tilt in Pier 6 (described in Section 1.4) as well other important elements identified and detailed in the Bridge Rehabilitation TM and noted in Exhibit 3-1.

EXHIBIT 3-1
Kennedy Bridge Rehabilitation Elements

3.1.2.2 Bridge Rehabilitation Sub-Alternatives and Findings/Recommendations

The Bridge Rehabilitation TM identifies four bridge rehabilitation sub-alternatives, which are structured to compare varied levels of investment. The rehabilitation sub-alternatives are described and compared in Table 3-1. The TM also includes more detailed discussion supporting the evaluation in Table 3-1.[1]

TABLE 3-1
Description and Evaluation of Bridge Rehabilitation Sub-Alternatives

		Alt. 1	Alt. 2A	Alt. 2B	Alt. 2C
	Component	**Minimal Rehab (1)**	**Moderate Rehab (2)**	**Moderate Rehab - Add Shared-Use Path (3)**	
Description	Underpin Pier 6 (stabilize foundation)	X			
	Replace Pier 6 (replace foundation)		X	X	X
	Protect Trusses from Corrosion	X	X	X	X
	Adjust Approach Span Bent Columns	X	X	X	X
	Reinforce Abutment Bearings	X	X	X	X
	Monitor Pins and Hangers	X			
	Replace Pins and Hangers		X	X	X
	Maintain Deck and Railings	X			
	Replace Deck and Railings		X	X	X
	Add Shared-Use Path (External to Truss)			X	
	Add Shared-Use Path (Internal to Truss)				X
Evaluation	Primary Needs Addressed	Poor	Good	Moderate	Good
	Level of Service for Traffic	Good	Good	Good	Good
	Bike/Pedestrian Accommodation & Safety	Poor	Poor	Very Good	Good
	Construction Impact on Traffic	Low	Moderate	Moderate	Moderate
	Future Maintenance & Inspection	Very Poor	Good	Poor	Good
	Risk of Section 106 Adverse Effect	Low	Moderate	High	Moderate
	Construction Cost (bridge elements only)	$3.8M	$13.4M	$16.4-$17.4M	$13.5M

Notes:

1. Deck replacement is needed to address the primary long-term need, to maintain the vehicular river crossing.

2. Moderate bridge rehabilitation is superior to serve the primary long-term need. A major bridge rehabilitation, involving replacement or addition of steel truss members, is not considered necessary.

3. Sub-alt. 2C is technically the same as 2A except 2C adds the bike/pedestrian accommodations internal to the truss.

[1] The alternatives developed for the Bridge Planning Study were structured to illustrate the possible range of rehabilitation actions to be taken. The Planning Study does not identify all details to develop a preferred alternative, nor does it finalize any regulatory determinations. Final project decisions and determinations will require support from additional detailed design studies.

The Kennedy Bridge rehabilitation sub-alternatives provide two main choices for project development, with options provided in sub-alternative 2 for accommodation of bikes and pedestrians:

1. **Minimal Bridge Rehabilitation—**The Bridge Study team identified a minimal level of bridge rehabilitation as a sub-alternative for comparison to more complete bridge rehabilitation schemes. Most importantly, this level of rehabilitation does not include deck replacement, which results in substantial short-term costs savings. However, the poor condition of the existing original bridge deck is a high priority, based on recent inspections and testing, which found evidence of chloride penetration and deterioration, including under-deck delamination of concrete (with concrete pieces sometimes falling from the underside of the deck). A modern conventional deck has a projected life of 50 years before significant rehabilitation is expected to be necessary. The existing deck, built to lesser 1960 standards, was repaired with an overlay to extend service; however, it now is reaching the end of its practical service life.

2. **Moderate Bridge Rehabilitation—**The moderate bridge rehabilitation approach developed in this study is far superior to serve the primary long-term needs. As shown in Table 3-1, this approach includes the replacement of Pier 6 (including the foundation), the pin and hanger assemblies in the approach spans, and the deck (with integral railing).[2] The variations on the moderate rehabilitation package include the following sub-alternatives:

   - **2A—**Baseline for moderate bridge rehabilitation, including only the long-term rehabilitation elements and no shared-use path for bicycles/pedestrians.

   - **2B—**The moderate bridge rehabilitation elements with a shared-use path, provided external to the truss spans, on a separate structure attached to the truss spans.

   - **2C—**The moderate bridge rehabilitation elements with a shared-use path, provided internal to the truss spans, through adjustment of the roadway cross section.

From among the choices, the design team recommends serious consideration of 2B and 2C, the moderate rehabilitation choices that provide a shared-use path. Sub-alternative 1, minimal rehabilitation, would stabilize Pier 6 in its displaced position and would not include replacement of the deteriorating deck. Because of these characteristics, the minimal rehabilitation package would fail to address the primary long-term need of providing a structurally sound river crossing. Considerable delays in implementing a deck replacement, as implied by sub-alternative 1, should only be considered if funds are highly constrained.

Sub-alternative 2A provides all of the bridge rehabilitation elements required to address the primary need for action. The added elements include complete replacement of Pier 6 and replacement of the deck, which also serves to strengthen truss spans. [3] However, the 2A bridge rehabilitation package by itself would not address the important secondary need

[2] As clarification, a "major" bridge rehabilitation is not considered necessary. This would involve replacement or addition of steel truss members, which are in good condition for the Kennedy Bridge and do not warrant replacement. Additionally, the bridge engineering team determined that adding members to provide structural redundancy is not a prudent level of action.

[3] The replacement of Pier 6 is feasible with minimal additional cost compared to underpinning and stabilizing the pier in its current displaced and tilted position, with little or no difference in traffic impacts during construction.

of providing for bicycles and pedestrians. Furthermore, the Bridge Study's development of sub-alternative 2C showed that bicycle/pedestrian improvements can be provided with no significant difference in technical approach and cost (see next section). Therefore, sub-alternatives 2B and 2C (both providing for a shared-use path on the bridge) are recommended for further comparison at the conclusion of the Bridge Planning Study. The sub-alternatives help outline MnDOT's current priorities for development of a bridge rehabilitation project. Additional design studies and a formal environmental review of a proposed project may bring changes to these/other alternatives to determine a preferred alternative.

3.1.2.3 Design Options for a Bicycle/Pedestrian Trail on the Kennedy Bridge

The Bridge Planning Study was scoped to focus on providing a Bicycle/Pedestrian trail improvement as a modification to the Kennedy Bridge (U.S. Highway 2). While a completely separate bicycle/pedestrian bridge nearby could be a viable project, it was outside the scope of the Bridge Study to address location and structure options for a second, separate, bridge. The options considered in the Planning Study, and the background for developing and evaluating the options, are discussed in the following subsections.

New Bike/Pedestrian Structure (*External* Shared-Use Path)—Because the Kennedy Bridge deck width is constrained by the steel truss, the first concept evaluated was to attach a new structure to the outside of the truss spans. The new structure would continue immediately next to the approach spans and the profile would be set at/above the Kennedy Bridge low-beam clearance profile.[4] While this concept is technically feasible, it would add substantially to rehabilitation project costs and the structure's complexity. Some important considerations would be whether bridge inspections and maintenance can be completed effectively with the added structure and whether it would adversely affect the historic character of the Kennedy Bridge, or other historic properties (see more in Sections 3.1.2.4 and Section 3.2). Exhibits 3-2 through 3-4 provide cross sectional and 3D perspective views of the design concept for an external path or trail.

Exhibit 3-5 provides a plan view of the external structure, shown along the south side of the Kennedy Bridge, per local preference; however, additional design studies must not preclude addressing options along the north side per Section 2.4. See Section 3.2 for a comparison of this design with other project development alternatives.

Adjusted Roadway Cross Section Inside the Truss (*Internal* Shared-Use Path)—Given the above-referenced challenges to adding a new structure for a shared-use path, the design team also developed concepts to adjust the roadway cross section on the existing bridge, constrained by the width inside the steel truss spans (67 feet–4 inches). With a posted speed limit of 35 mph, the traffic engineering has the potential to be adjusted to accommodate bicycles and pedestrians without widening. The relatively low posted speed, and traffic volumes that are often well below capacity, allow bicycles and pedestrians to be accommodated adjacent to vehicular traffic without physical separation. Overall, this approach can provide a reasonable environment for bicyclists and pedestrians, within norms based on similar urban arterials and bridges.

[4] Supporting the separate path structure with Kennedy Bridge approach spans is not feasible. This warrants completely separate new bridge spans next to the approaches, with spacing provided for inspection/maintenance.

EXHIBIT 3-2
Cross Section of Separated Bicycle/Pedestrian Path (Trail) at Approach Spans

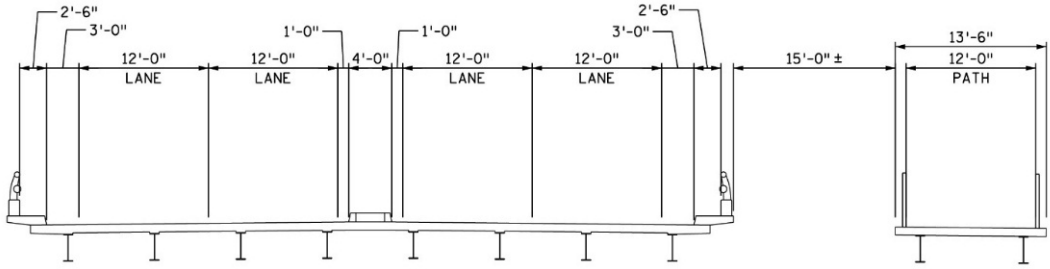


EXHIBIT 3-3
Cross Section of Separated and Attached Bicycle/Pedestrian Path (Trail) at Truss Spans

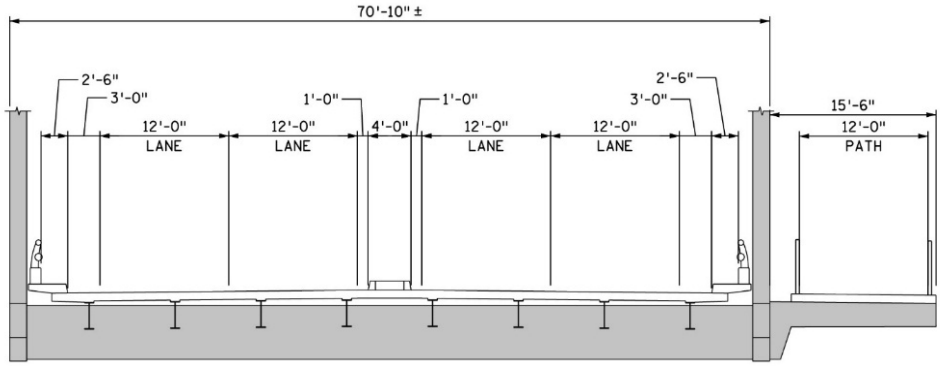
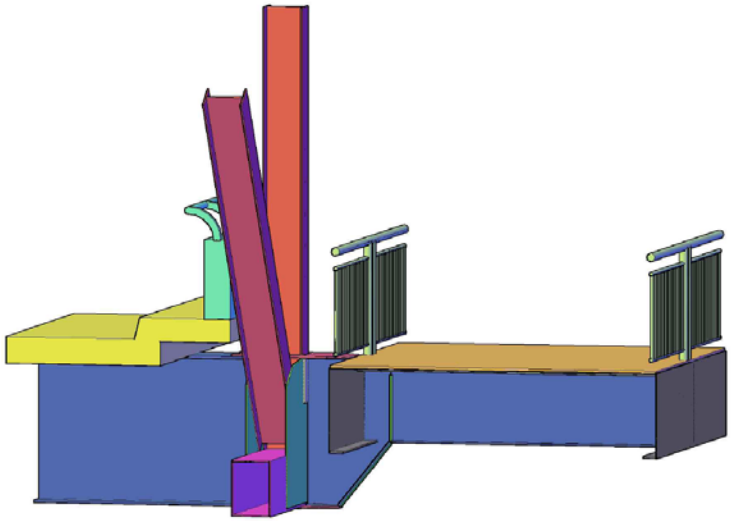


EXHIBIT 3-4
3D Model Perspective of Bicycle/Pedestrian Structure Attached to Truss Spans



Several roadway cross sections were considered. In developing the adjustments, designers considered the desirability of a center median and the preference for 12-foot-wide lanes (full width, as they are today). But with limited width available, some compromises had to be considered. New design standards allow consideration of 11-foot-wide traffic lanes (or

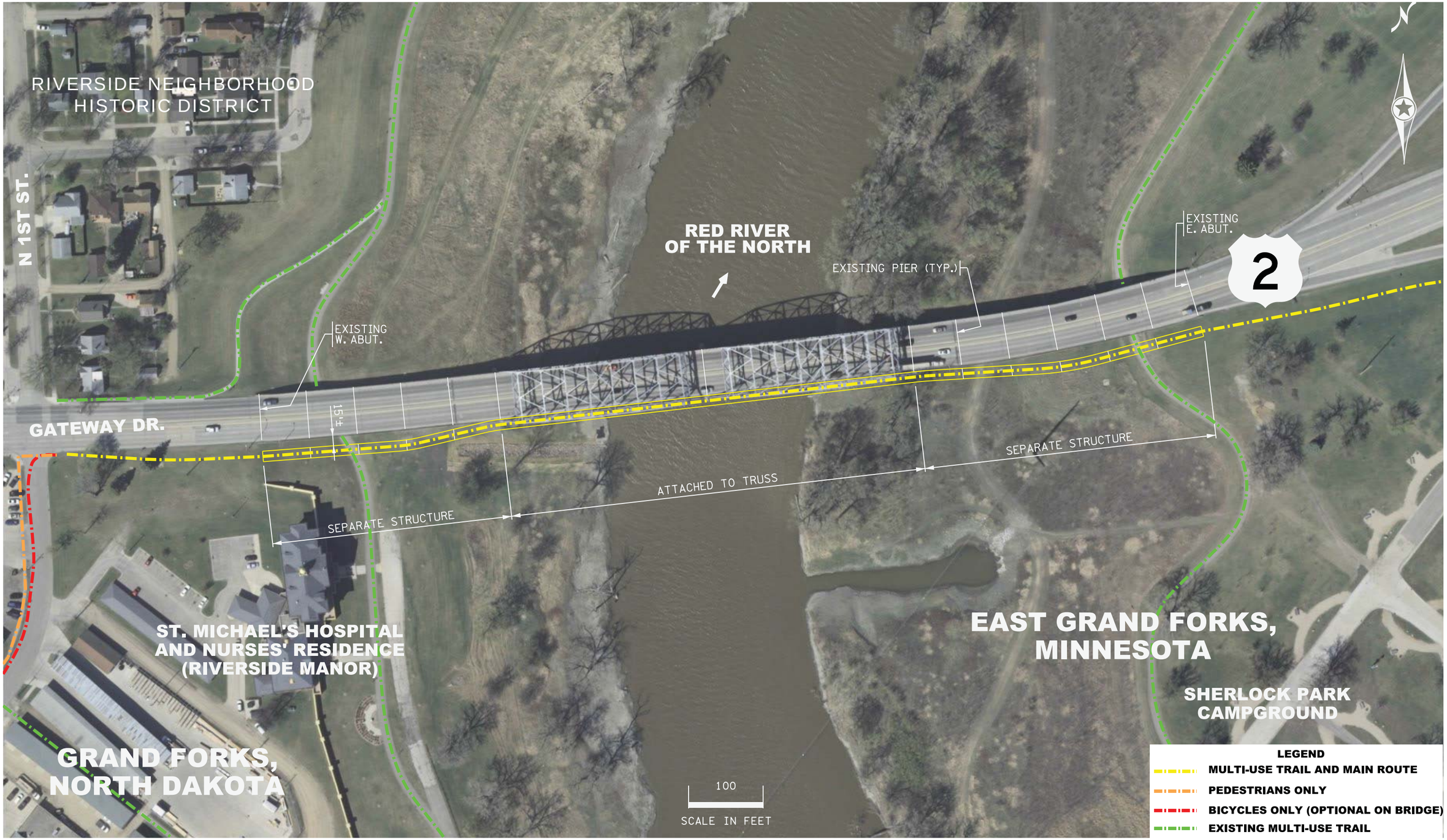
even 10-foot-wide lanes). Other considerations include clearance width to curb and gutter or barrier (curb reaction width is more flexible now than in the past), and the desire for a raised median. In addition, there is a joint along the centerline of the existing bridge approach spans. The longitudinal joints are integral to the unique original design of the Kennedy Bridge approach structures—that is, they provide a nearly invisible separation of the parallel approach structures, allowing the spans to move with the dynamic soils and hydraulics of the Red River. The joints will ideally remain along the centerline of the roadway because the deck condition would deteriorate faster if the joints are repeatedly driven over. Alternatively, the joints could be considered for elimination or adjustment with a new roadway cross section. However, the evaluations below of the adjusted roadway cross section concepts all consider the priority of retaining the approach span joints.

In recent design practice, 11-foot lanes have been considered a feasible and acceptable option and studied for safety effects. When existing 10- and 11-foot urban and suburban lane widths were studied, the lane width effects in the analyses were generally either not statistically significant or indicated that narrower lanes were associated with lower, rather than higher, crash frequencies.[5] This research also showed that 11-foot lanes can slightly reduce speeds and lane capacity (travel speeds are reduced by approximately 1.9 mph). For this study, 11-foot-wide lanes were considered potentially acceptable, given the constrained space inside the truss spans. Additionally, the limited space warranted consideration of wide curb lanes or shared lanes for bicyclists in the roadway. The cited research and experience in urban environments shows no significant difference in safety for bicyclists between in-roadway options and options providing a curb-separated, shared-use path.

The team also received and factored in local preferences, based on input received at meetings. These included preferences to maintain a center median for roadway safety in slippery conditions, a preference for physical separation of bicycles from the roadway, and identification of one shared-use path connected to the area's trails along the south side of the bridge. Local comments also referenced "wide load" movements across the bridge, including occasional crossings by agricultural machinery that can reportedly block the use of two lanes in a given direction by general traffic, eastbound or westbound. Some stakeholders, including GF-EGF MPO Executive Board members, expressed concerns about the wide loads as related to bicycle/pedestrian safety on the bridge, for shared-use path concepts inside the truss spans. The GF-EGF MPO Board also officially recorded a preference for the external/separate trail structure versus the cross section adjustments inside the truss spans.[6]

[5] Ports et al., Relationship of Lane Width to Safety for Urban and Suburban Arterials, TRB 2007 Annual Meeting. See also the MnDOT design memo at: http://dotapp7.dot.state.mn.us/edms/download?docId=1378703 (Traveled Lane Width Standards for State Highways, 2013)

[6] See GF-EGF MPO Board minutes of December 18, 2013 and January 15, 2014 (http://www.theforksmpo.org/Pages/Minutes.htm)



Kennedy Bridge Planning Study
East Grand Forks, MN | Grand Forks, ND

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Exhibit 3-5
Preliminary External/Separated Trail Layout

Based on reviewing more than a dozen cross sections to accommodate bicycles and pedestrians internal to the existing steel trusses, Exhibit 3-6 includes the five roadway cross section options initially considered most feasible.

Option A has no bicycle or pedestrian facilities and replaces the deck in kind with the existing lane configuration and widths, without a raised curb. The advantages and disadvantages of Option A are as follows:

Option A Advantages

- Four, 12-foot lanes with median
- Minimum shoulder and buffer requirements met
- Approach span joint protected by median
- Good cross section continuity with roadway approaches

Option A Disadvantages

- No pedestrian accommodation
- No bicycle accommodation
- No buffer from traffic if pedestrians use the paved shoulder (similar to observed use on the existing 2-foot-wide curb buffer)

Option B accommodates bicyclists using shared-use bicycle lanes in the roadway and pedestrians using a 6-foot-wide raised sidewalks. Under this option, bicyclists ride in a widened outside lane with other motorists across the bridge and the use of pavement markings encourage motorists to leave enough space for bicyclists. The advantages and disadvantages are as follows:

Option B Advantages

- Four, 12-foot lanes
- Raised sidewalk on both sides of bridge
- Bicycle access on both sides of bridge
- Approach span joint is centered, and not within lane lines

Option B Disadvantages

- No median
- Shared bicycle lane with traffic in outside lanes (not supported locally)
- Sidewalks are insufficient width for a shared-use path (some bikes would use)
- No approach span joint protection

Option C provides a non-uniform cross section with a raised pedestrian sidewalk along one side of the bridge (the south side is shown based on local preference). As with Option B, bicyclists are accommodated through shared-use lanes with motorists. The advantages and disadvantages are as follows:

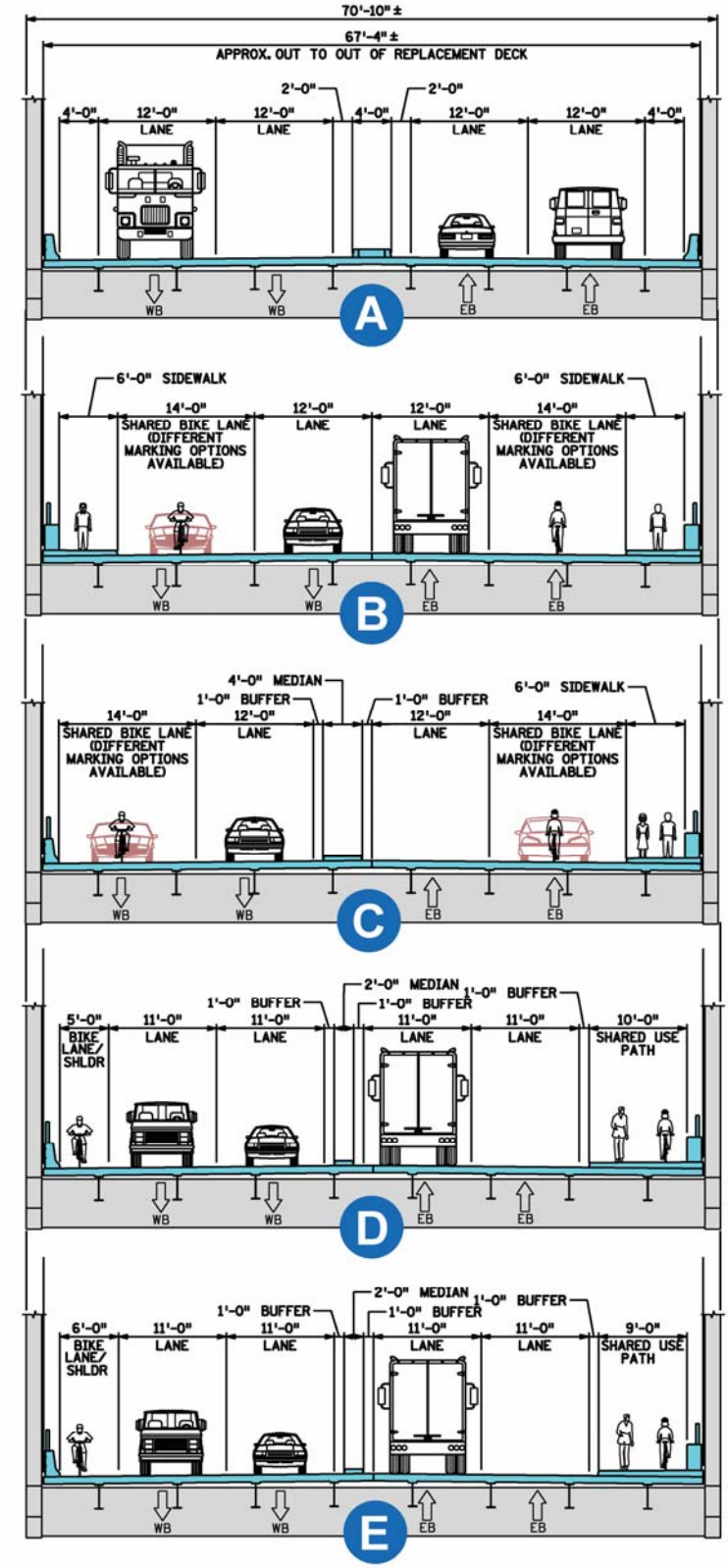
Option C Advantages

- Four, 12-foot lanes with median
- Bicycle and pedestrian facilities provided with a roadway cross section similar to existing, including median width
- Good cross section continuity with roadway approaches (better than Option B)

Option C Disadvantages

- Shared bicycle lane with traffic in outside lanes (not supported locally)
- Buffers to median are 1 foot
- Sidewalk is insufficient width for a shared-use path (some bikes would use)
- Approach span joint not protected by the median (without further adjustment)

EXHIBIT 3-6
Baseline and Adjusted Roadway Cross Section Options Internal to the Truss Spans



Options D and E were among the last cross section concepts developed and provide a raised shared-use path for bicycles and pedestrians along one side of the structure (south side shown) and a 5- or 6-foot shoulder, optionally marked as bike lane, on the other side. Option E removes 1 foot from the shared use path in order to create a wider (6-foot) shoulder and to better position the approach span joint. The advantages and disadvantages of Options D and E are as follows:

Options D & E Advantages

- Four travel lanes with a median
- Separate raised shared-use path with sufficient width (9 to 10 feet) for both bicycles and pedestrians
- Flexibility provided to position the approach span joint outside travel lane
- Shoulder with option for a marked bike lane opposite the shared-use path

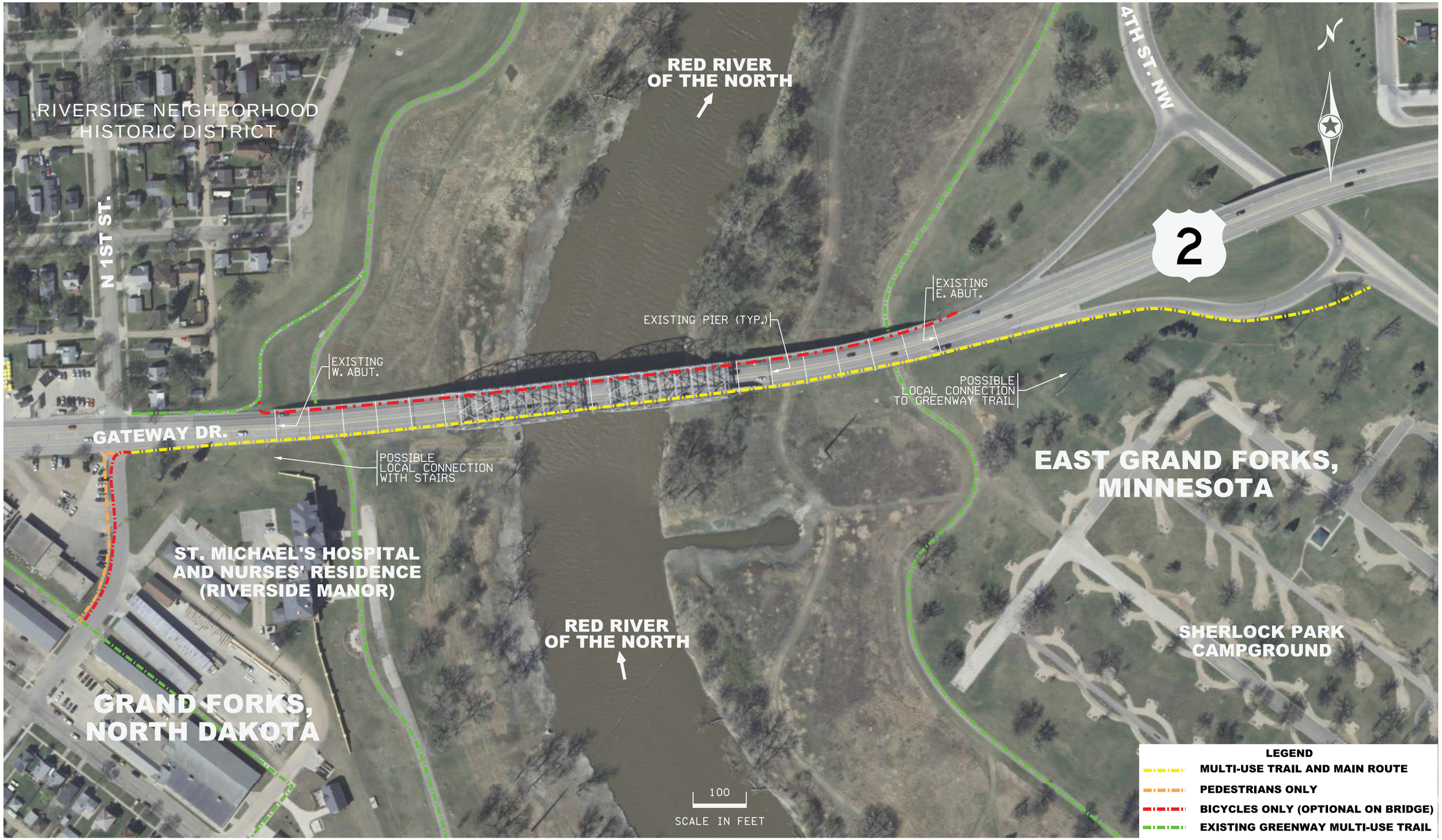
Options D & E Disadvantages

- 11-foot-wide lanes (minimal effect on traffic; might reduce speed slightly)
- Narrow median problematic for maintenance (damage is more likely than with a wider median)
- Buffers to shared-use path and median are 1 foot
- Approach span joint not protected by the median (without further adjustment)

In conclusion, given the constraints of the cross sections inside the steel trusses, Option D is recommended by MnDOT's Bicycle and Pedestrian Section as the "preferred" cross section layout for a bicycle/pedestrian accommodation internal to the trusses. This preliminary recommendation was arrived at with the understanding that MnDOT's functional design leaders used maximum design flexibility to accommodate the many demands within the constrained corridor. More background on related design guidance is provided in the Bridge Rehabilitation TM, with reference to the *2012 AASHTO Guide for the Development of Bicycle Facilities* and the *MnDOT Road Design Manual* (AASHTO 2012, MnDOT 2012). Other remaining considerations for design concepts inside the truss, which would require more detailed design study, include safety factors, such as checking sight distance for motorists approaching the bridge (the Kennedy Bridge approaches include both vertical and horizontal roadway curvature that affect sight distance).

This Bridge Planning Study does not conclude with a final decision among the main sub-alternatives outlined herein for Kennedy Bridge rehabilitation, including accommodations for bicycles and pedestrians. However, it does support the Bridge Rehabilitation Alternative as the priority action and it provides background to support that priority and to support development of a project to include bicycle/pedestrian accommodations. Therefore, the comparison of project development alternatives in Section 3.2 includes the major choices for bridge rehabilitation with a shared-use path, *internal* or *external* to the trusses.

Another consideration as project development continues should be the development of connections between any shared-use path on the bridge and the greater community roadway and trail network. Exhibit 3-7 provides a sketch level concept only, which is based primarily on providing connections from a shared-use path along the south side of the Kennedy Bridge.



Kennedy Bridge Planning Study
East Grand Forks, MN | Grand Forks, ND

TBG011514142833MKE 3-7_KBPS_Trail_Connection_Concept_v2 04.21.14 sls

Exhibit 3-7
Trail Connection Concept
Trail Layout

While additional connections to local/Greenway trails are highly desirable and would be addressed as noted, trail connection designs would require detailing in a project development process with cooperation and participation from local governments and other land-management entities (for example, the Minnesota State Park). Similarly, snow removal from a multi-use path typically requires cooperative agreements and understandings with local governments or other owning entities. MnDOT and NDDOT do not clear snow from paths as part of winter highway maintenance (including multi-use path areas on bridges).

3.1.2.4 Bridge Rehabilitation Project Development Process

The Bridge Rehabilitation Alternative would require project development to move forward into a substantially higher level of design investigation to refine the rehabilitation concepts. Because the Kennedy Bridge is eligible for the NRHP, the design process for all alternatives must comply with Section 106 of the National Historic Preservation Act. To avoid an adverse effect under Section 106, the bridge rehabilitation and its design details must meet the Secretary of the Interior Standards for the Treatment of Historic Properties. Avoiding an adverse effect under Section 106 is important to avoid invoking Section 4(f) of the 1966 Transportation Act, which does not allow federally-funded or -licensed projects to "use" a historic property unless there is no prudent and feasible alternative, and which requires that such use include all possible measures to minimize harm to historic properties.

Considering the rehabilitation elements identified for the Kennedy Bridge, the following issues would be addressed:

- **Pier 6, Other Substructure Elements, and Steel Members—**The replacement of Pier 6 is feasible to complete with an in-kind architectural style, which should greatly reduce the potential for a Section 106 Adverse Effect based on this one element.
- **Deck and Railing Maintenance or Replacement—**Replacement of the deck and integral railings may also provide opportunities to build elements that are similar in style to the existing. However, railings identical to the existing may not be reasonable based on modern crash protection and strength objectives, including protection of the historic truss elements. Nevertheless, the Bridge Rehabilitation TM identifies potential replacement railings, which are modern in their performance specifications, but similar in appearance to the existing. Therefore, there appears to be some potential to reach a finding of No Adverse Effect even with replacement railings.
- **Addition of a Shared-Use Path—**The most important comparison of impacts for bridge rehabilitation is the choice between designs providing a shared-use path internal to the steel trusses and the concept with an external/separate structure attached to the truss spans. The internal path designs provide a relatively low risk for a Section 106 Adverse Effect. In contrast, the external path structure may prove challenging to justify in project development based on additional costs, potential for a Section 106 Adverse Effect, and conflicts with the primary need of maintaining a structurally sound river crossing. More discussion of the issues anticipated for the external structure is incorporated in the following subsections.

The project development process, and environmental documentation, for a Kennedy Bridge rehabilitation project could vary in complexity depending on details to be included, including whether the external shared-use path is included in the project. As noted in Section 2.4,

the review process would include teamwork among professional engineers and professional historians. While this Planning Study has outlined anticipated actions and Section 106 review issues, additional detailed design studies and regulatory reviews will be required to complete the Section 106 review and reach final project development decisions.

As an example of detailed design review, the addition of a new external bicycle/pedestrian structure presents challenges as related to need, additional costs, bridge design, and environmental impact. For example, while the steel truss spans can provide sufficient capacity to support an external structure, the addition of a cantilevered trail presents several other challenges. Principally, the design team observed that attaching to the truss spans is in conflict with the primary need of maintaining the trusses, because it would create additional load and hinder inspection and maintenance—for example, by blocking or impeding favorable inspection and maintenance access to gusset plates and lower chord areas. Therefore, while the external structure design approach is technically feasible, the historically eligible fracture-critical trusses (to which an external shared-use path structure would be attached) have raised concerns about how desirable the design approach would be. As previously noted, these and other observations drove the effort to explore bicycle/pedestrian options internal to the trusses.

Other potential issues associated with the external shared-use path structure may include the following:

- **Multiple Section 4(f) Issues and Process Complexity; Potential Delays—**Adding the external structure would raise the potential for a Section 106 adverse effect based on the Kennedy Bridge alone. But the external structure, complete with its piers in floodway and other physical elements, may also present Section 4(f) conflicts with the numerous state and local park/Greenway jurisdictions and with the viewshed for the historic St. Michael's Hospital and Nurses' Residence. Comprehensive evaluations of the issues would add substantially to the project development schedule and, considering the ground rules for Section 106 and Section 4(f), could still result in findings and recommendations opposed to the external structure.

- **Geotechnical and Hydraulic Considerations—**Because the external structure would require new foundations and piers for approach spans, the concept raises technical and regulatory complexities. The complexities include design and maintenance of a new structure, partially on new foundations and partially attached to the existing bridge, in the setting's highly dynamic soils. Therefore, as with the Kennedy Bridge, the potential for movement and adjustments must be designed into the separate/attached elements of the new structure. Building new piers in the floodplain, and presumably next to existing bridge piers, brings other complexities and risks for geotechnical and construction engineering and in addressing Red River hydraulics.

For a Kennedy Bridge rehabilitation project, the likely choices for environmental documentation are:

- **Categorical Exclusion (CE)—**Bridge rehabilitation, including deck replacement, is included in lists of actions normally found to have no significant social, economic, and environmental effects. Such actions could be approved environmentally using an effi-

cient CE checklist approach, per 23 CFR 771.117.[7] This approach is possible, but is not a given, for a Kennedy Bridge rehabilitation project. The main questions about using a CE would be whether replacement of Pier 6, and of the deck/railing elements, would cause a Section 106 adverse effect. A design and project development process that does not include the external shared-used path structure would also be easier to develop than a project that does include the added structure. An Environmental Assessment (EA) level of review is more typical in cases where potential adverse impacts warrant extra review for significance.

- **EA—** A more detailed level of environmental study would be appropriate to address possible adverse effects. As noted above, an EA process is fitting for a more complex bridge rehabilitation project because the EA's objective is to determine if project effects can be managed to result in no significant adverse impacts. For example, evaluations of the issues associated with the external structure would add complexity to the project development process and would seem to warrant an EA. In this case, the issues and impacts (e.g., historic, hydraulic, geotechnical) would likely be compared in more detail to the concepts for providing a shared-use trail internal to the truss.

In summary, an EA process for a Kennedy Bridge rehabilitation project with the external shared-use path structure would be more complex and would likely take longer to complete than a baseline bridge rehabilitation project not addressing the external structure. This is based on additional design and environmental complexities and reviews—including studies of many alternatives. Several issues are previously identified in this report, including the potential for the external structure to create conflicts with the primary need for action. And again, the ground rules for Section 106 and Section 4(f) could still result in findings and recommendations opposed to the external structure.

3.1.2.5 Alternative Rehabilitation Scenario: Possible Later Bicycle/Pedestrian Structure Project

Another project development scenario for bridge rehabilitation is to completely separate a new shared-use path structure from the Kennedy Bridge rehabilitation project. The "separation" could be either physical, as a new trail bridge not immediately adjacent to U.S. Highway 2, and/or administrative, as a separate future project. For example, a new and separate project development process might be justified in the future if bicycle and pedestrian usage demonstrates a need for more capacity. This scenario illustrates that a short-term decision to exclude the external structure from project development would not preclude later consideration of a similar approach, as well as other physically separated bicycle/pedestrian structures.

Studies of completely separate trail structures, without attachment to the Kennedy Bridge, were beyond the scope of the Planning Study. Completing such studies, particularly for any new trail structure(s) located entirely outside the U.S. Highway 2 right-of-way, would involve alternative location and alignment comparisons. Development of such a project would

[7] Bridge rehabilitation, including deck replacement, is included in the list of actions which may be processed and approved through a CE in the Programmatic Categorical Exclusion Agreement Between FHWA and MnDOT 1998 (see document at this Web link: http://dotapp7.dot.state.mn.us/edms/download?docId=620464). *NOTE*: The cited document highlights bridge rehabilitation as one of a few eligible actions "with higher potential for environmental impacts." Additional detailed consideration must be given to potential bridge rehabilitation project impacts before a CE could be selected for environmental documentation.

also require studies for many of the same environmental impact issues identified herein for the external path structure, and possibly more issues.

3.1.3 Bridge Replacement Alternative

3.1.3.1 Description of Alternative and Options Evaluated

A Bridge Replacement Alternative was identified in the Bridge Planning Study; but bridge replacement would only be pursued if bridge rehabilitation cannot provide a feasible and prudent solution, meeting the primary need of maintaining a structurally sound crossing at this location. At the conclusion of the Planning Study, there was no evidence that the Bridge Rehabilitation Alternative is infeasible or imprudent. That preliminary finding was reached, in part, based on comparison of bridge rehabilitation to bridge replacement concepts (see Section 3.2 for more information about the comparison of alternatives).

The Bridge Replacement Alternative was explored primarily to provide a comparison to Bridge Rehabilitation and to identify the most promising bridge types and alignments, should replacement become a course of action in future project development.[8] To develop the bridge replacement concepts, design parameters were generated, which set the primary requirements for bridge replacement. These were developed by coordinating with MnDOT, NDDOT, and the other agencies/stakeholders included in the Planning Study process.

The main considerations for the bridge replacement study were design parameters, which led to two "families" of replacement bridge types—deck type and though type. The replacement bridge types were also considered in reference to potential alignment choices, as briefly summarized in the following subsections (see the Replacement Bridge TM for more detailed information).

Replacement Bridge Design Parameters

The Replacement bridge design parameters included requirements for addressing known soil movement issues, structural redundancy, river hydraulics, and geometric requirements to meet projected traffic demands and satisfy engineering parameters for roadway alignment and profile. Some of the key parameters were:

- **Fixed Pier Near the Center of the Red River**—Because soil movement appears to be minimal near the center of the river channel, it is desirable to locate a main river pier at that location (same as the existing Kennedy Bridge).
- **Horizontal Earth Movement**—The bridge superstructure, substructure, foundation, and bearings must be designed to accommodate earth movement, or have features to allow structural adjustments to be made in the field by maintenance crews.
- **Structural Redundancy**—A replacement bridge must have a structurally redundant superstructure; any replacement bridge should not be fracture critical like the existing Kennedy Bridge.

[8] The bridge replacement alternatives addressed in the Bridge Planning Study were developed to illustrate a possible range of costs and impacts, primarily for comparison to bridge rehabilitation. A complete evaluation of bridge replacement, to develop a project, would require more detailed engineering design and regulatory reviews—including accounting for more alternatives. For example, bridge replacement alternatives could be considered which retain the existing Kennedy Bridge repurposed for bicycle/pedestrian use.

- **Bridge Type**—The reasonable range of replacement bridge types was determined primarily based on types considered cost effective for the setting. For example, a signature-type cable bridge or bridge with spans exceeding 300 feet is not in the reasonable range because longer spans are not necessary for the setting and would result in unnecessarily high costs.
- **River Hydraulics and Bridge Profile**—Given the periodic floods of the Red River, a replacement bridge would need to meet the requirements of the Federal Emergency Management Agency (FEMA), MnDOT, NDDOT, both states' DNRs, and USACE. Design parameters for a new bridge profile would not only include clearance above anticipated 100-year recurrence floods, but also hydraulic design to ensure no worsening of floods.
- **Construction Staging and Traffic**—Considering the need to maintain the crossing and public input, two lanes of traffic in each direction should be maintained throughout the majority of bridge construction and demolition, lasting approximately 2 years. Less capacity could also be provided for short durations to transition traffic through stages of construction.
- **Approach Roadway and Bridge Alignment**—The Planning Study considered a range of alignments for a replacement bridge, all on or near the existing Kennedy Bridge alignment. The two most promising alignments were found to be north of the existing bridge, thereby creating the potential to build a new bridge while keeping the existing bridge open. Other alignments, to the south or along the existing bridge, were considered less promising because of greater potential for adverse impacts.

Representative Replacement Bridge Types

The bridge types considered ranged from steel girder to arch/truss type bridges, and these were evaluated along the north alignments to generate a range of costs. The Bridge Replacement TM discusses the full range of viable options for replacement bridge types along the two alignments and Exhibit 3-8 summarizes the alignments and bridge types for the projected lowest and highest probable construction costs. With Reference to Exhibit 3-8, the bridge type families considered were:

- **Deck Type Bridge Superstructures**—Deck bridges with straight beams are common, employing below-deck beams to span a range of distances. The family of deck types considered in the Planning Study included steel I-girders, steel tub girders, concrete girders, and concrete boxes (Exhibit 3-8). To best illustrate likely solutions, the steel bridge types in this family were selected for concept layout and cost estimating. The concrete beam bridge types are not considered as viable because they would not accommodate the pier movement and adjustments required for a Red River bridge. The steel girder bridge types can accommodate movement and adjustment well, as well as roadway curvature; therefore, they could be used with either alignment in Exhibit 3-8. The range of estimated costs for the selected steel deck type bridges was about $23 million to $30 million (bridge construction only).
- **Through Type Bridge Superstructures**—Through bridges are less common than deck bridges, but familiar, like the 1963 Kennedy Bridge—employing a superstructure above the deck to provide longer spans and/or to flatten roadway profile through less beam

depth below deck. The family of through types considered in the Planning Study included steel tied arch or modern truss types, with longer river spans than a deck bridge, yet still with a middle pier (Exhibit 3-8). The through bridge types do not accommodate curvature well and, therefore, may be more compatible with a straighter alignment as shown in the bottom layout on Exhibit 3-8. The range of estimated costs for the selected steel through type bridges was about $33 million to $39 million (bridge construction only).

Replacement Bridge Performance and Tradeoffs

A replacement for the Kennedy Bridge would perform well, certainly addressing the primary need to maintain a sound river crossing far into the future. A new bridge, with modern engineering technology, would provide a structurally redundant system (it would not be fracture critical). A new bridge would also provide superior performance for all modes (vehicular, bicycle, and pedestrian) and for bridge inspection and maintenance.

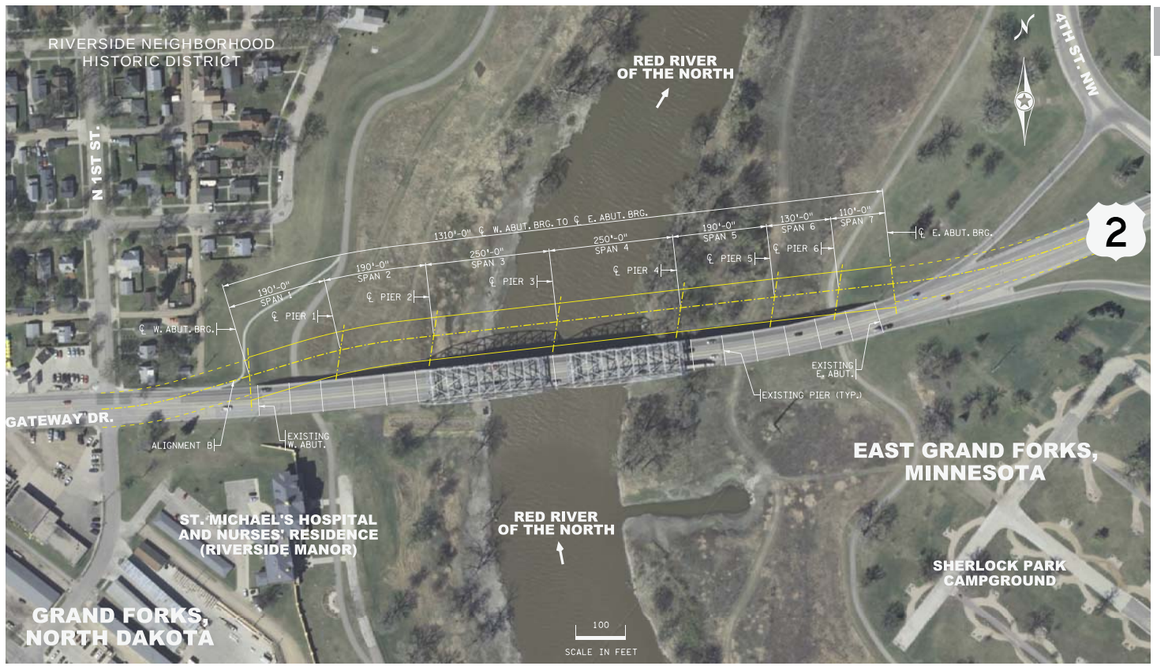
The tradeoffs for the Replacement Bridge Alternative are primarily matters of cost and feasibility, given the good potential performance of a Bridge Rehabilitation Alternative, with its lower costs and fewer adverse impacts. A Bridge Replacement, while offering superior performance, is evidently not required to address either primary or secondary needs. Therefore, its higher level of performance could be judged as marginal compared to the benefit/cost tradeoffs of bridge rehabilitation (see Section 3.2).

3.1.3.2 Bridge Replacement Project Development Process

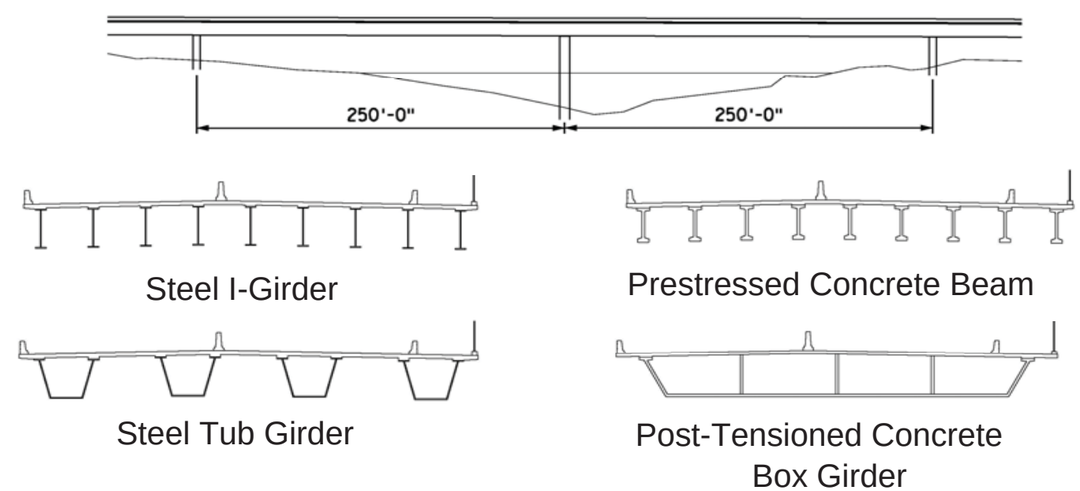
A replacement bridge would involve additional environmental impacts, including the Section 106 Adverse Effect of removal of the existing historic Kennedy Bridge. As noted in Section 2, there are additional historic and recreational resources that would be impacted by a replacement bridge project. This would include much greater potential for adverse effects on the Riverside Neighborhood Historic District, other historic structures, and on state and local parklands.

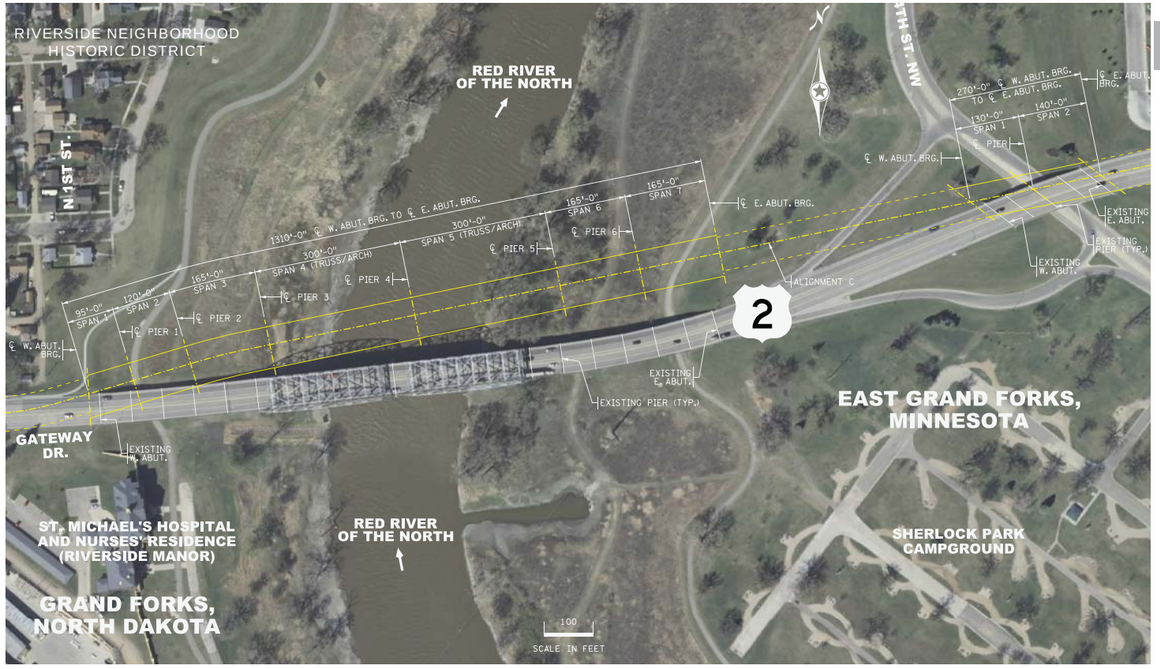
In addition, a replacement bridge would involve new geotechnical and hydraulic designs. Therefore, the environmental documentation process for a bridge replacement project would be much more involved than that required for rehabilitation of the existing bridge in the same footprint. The process would also be more complex because it would require studies of many more alternatives, including studies to support decisions to not move forward with rehabilitation (a difficult case to make for this bridge, given its adequate current capacity and the comparison of alternatives—see Section 3.2). The level of environmental documentation would be at least an EA and could warrant an Environmental Impact Statement (EIS) if many adverse impacts are anticipated and if there is controversy.

In summary, development of a Kennedy Bridge replacement project can be expected to take substantially longer than the baseline bridge rehabilitation package (without an external shared-use path structure). Many potential issues for such a project have been identified, including the apparent difficulty of developing a defensible case for bridge replacement.



Deck Type Bridge Superstructures





Through Type Bridge Superstructures

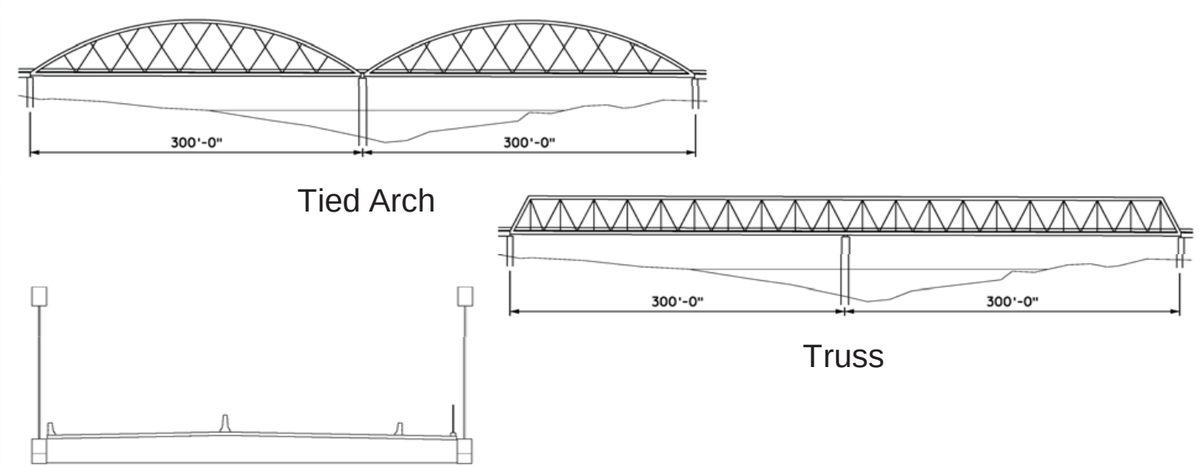


Exhibit 3-8
Range of New Bridge Concepts

3.2 Comparison of Project Development Alternatives

3.2.1 Matrix Comparison of Representative Alternatives

The next steps, following the Bridge Planning Study, will include recommendations for project development based on the concepts/alternatives addressed to date. Table 3-2 provides a matrix comparison of the three representative project development alternatives:

- **Bridge Rehabilitation A (bicycle/pedestrian accommodation *internal* to truss)—**Pier 6 replacement, deck replacement/reconfiguration, painting, other structural adjustments, and replacement railings on both truss spans and approach spans to meet vehicle and bike/ped standards.
- **Bridge Rehabilitation B (bike/ped trail on separate *external* structure, attached to truss spans)—**Pier 6 replacement, deck replacement/reconfiguration, painting, other structural adjustments, construction of separate/external trail structure, and replacement railings on both truss spans and approach spans to meet vehicle standards.
- **Bridge Replacement—**New wider bridge adjacent to existing with required tie-ins at west and east ends, possible improvements to ramps at 4th Street, and possible replacement of bridges over 4th Street.

The three alternatives are compared to illustrate the wide range of alternatives and sub-alternatives, to outline MnDOT's current priorities for development of a bridge rehabilitation project. Additional design studies and a formal environmental review of a proposed project may bring changes to these/other alternatives to determine a preferred alternative.

The project development choices in Table 3-2 outline the possible next steps and issues to be considered at the completion of the Kennedy Bridge Planning Study. In this manner, the information above provides a concluding summary of the many issues and design concepts discussed throughout this Final Report, in the Planning Study's technical memoranda, and with stakeholders throughout the process.

3.2.2 Relationships to Other Anticipated Projects

Section 2.2 discusses relationships between the Kennedy Bridge and other local Red River bridges. A complete project development process will continue to demand consideration of these relationships—especially in reference to the historic Sorlie Bridge, as it is also now being evaluated for rehabilitation or replacement. Therefore, as part of project development, relationships to potential modifications to the Sorlie Bridge should be addressed, both physically and in scheduling for construction. Avoidance of adverse traffic impacts from concurrent construction activities should especially be considered and avoided.[9] Similarly, coordination with any other local transportation projects should be considered along with any other relevant community project plans and actions.

[9] In current planning and programming, Kennedy Bridge construction is targeted for 2016 and Sorlie Bridge construction for 2018. Both bridges are listed on the Chapter 152 master bridge list, which identifies 172 bridges meeting the law's criteria (see Section 1.3). As such, the bridges are to be under contract for rehabilitation or replacement by June 30, 2018.

TABLE 3-2
US Highway 2 Kennedy Bridge Project Development Alternatives

Evaluation Criteria	Bridge Rehabilitation A (Internal Bike/Ped)	Bridge Rehabilitation B (External Bike/Ped)	Bridge Replacement
Bridge Capital Cost	$13.5 Million *	$16.4–$17.4 million *	$23–$39 million *
Structural Performance and Maintenance	Addresses primary need; good long-term service life with regular maintenance; inspection issues similar to the existing bridge	Addresses primary need, with conflicts; good long-term service with regular maintenance; however, inspection of the original truss members around the external structure and maintenance access would be blocked or limited	Addresses primary need and adds structural redundancy; longest service life; superior inspection and maintenance access provided through design of any replacement bridge type
Construction Period and Traffic Impacts	About 1 year of temporary traffic impacts and capacity restrictions	About 1 year (similar to Rehabilitation A)	About 2 years of temporary traffic impacts with periodic capacity restrictions
Historic Preservation (Section 106) - Risk of Adverse Effect	Low to moderate potential for adverse effects	Much higher potential for adverse effects	Removal of historic bridge is an adverse effect; potential additional impacts to the Riverside Neighborhood Historic District
Long-Term Traffic and Bike/Ped Function	4 roadway lanes; median is feasible Ped/bike on bridge deck Good performance for all modes; shared-use path and bike shoulder options	4 vehicle lanes with median Separate ped/bike path on external structure Superior performance for all modes; one exclusive shared-use path	4 vehicle lanes with median Separate ped/bike path included in wider bridge deck Superior performance for all modes; one exclusive shared-use path
Project Development Risks and Approval Process	Lowest-risk and least potential for adverse impacts, including Section 106 adverse effects; smallest footprint; prompt reviews and approvals possible through a CE or an EA prepared in parallel with detailed design	Substantially higher project development risks (Section 106, hydraulic, and other impacts); increased footprint; review and approvals more complex, through an EA; potential to add months or years to the design/approval process	Highest project development risks (many adverse impacts, including Section 106, with largest footprint); review and approvals most complex, through an EA or EIS; potential to add years to the design/approval process

* The preliminary cost estimates are for bridge and required roadway construction only and are subject to additional reviews (no roadway work is assumed for the rehabilitation alternatives). Additional costs, not addressed in the estimates, would include design engineering, approach roadway/ramp reconstruction, drainage features, off-bridge trail adjustments, and right-of-way if needed.

3.2.3 Concluding Remarks and Next Steps

The tradeoffs conveyed in Table 3-2, including costs, long-term performance, bike/pedestrian function, and project development process, capture the essence of the Kennedy Bridge context and the need for action with a timely project design and construction process. The following key points will also be considered as MnDOT and its partners select and begin the Kennedy Bridge project development process:

- Bridge rehabilitation is the priority action; the Planning Study has confirmed that bridge replacement would be much more costly, would bring other adverse impacts, and is not

likely to be supported by relevant data and regulatory process reviews. Considering structural analysis and inspection, the Planning Study found the steel truss spans to be in satisfactory condition, capable of accommodating further movements and adjustments. But the bridge deck is in poor condition, requiring replacement, and the integral railings are substandard (the railings are in need of replacement integrally with the bridge decks on both truss spans and approach spans).

- Replacement of Pier 6 is the most pressing bridge rehabilitation component; the next steps into project development should avoid any undue delay in design and construction of the pier replacement. Monitoring of Pier 6 should also continue, including after pier replacement, to observe performance of the improvement.
- The Bridge Planning Study has presented the important tradeoffs for the choices and issues to be addressed as project development begins. MnDOT and its partners will collaborate on the results of the Bridge Planning Study and in taking the next steps.
- The project development process will move forward based on the final reports and will continue to seek and reflect stakeholder input. As previously noted, the detailed design and project review/approval process would include teamwork among professional engineers and historians to address Section 106 issues and reach final decisions.

SECTION 4

References

American Association of State Highway and Transportation Officials (AASHTO). 2012. *Guide for the Development of Bicycle Facilities*.

Chiglo, Jon, MnDOT. 2013. *Traveled Lane Width Standards for State Highways*. http://dotapp7.dot.state.mn.us/edms/download?docId=1378703. September.

Federal Highway Administration. 2011. *Framework for Improving Resilience of Bridge Design.*

Grand Forks-East Grand Forks Metropolitan Planning Organization (GF-EGF MPO). 2012-2014. *Technical Advisory Committee (TAC), Executive Board, and Finance Committee Meetings*.

GF-EGF MPO. 2007. *GF/EGF Bridge Closure Management Study*.

GF-EGF MPO. 2006. *2035 Long Range Transportation Plan*. http://www.theforksmpo.org/Pages/2035LongRangeTranspPlan.htm.

GF-EGF MPO. 2013. LRTP Performance Based Planning. http://www.theforksmpo.org/PDFS/LRTPPerformanceBasedPlanning.pdf. April.

City of Grand Forks, North Dakota. 2014. Flood Flight. http://www.grandforksgov.com/gfgov/home.nsf/Pages/Flood+Fight.

Minnesota Department of Transportation (MnDOT). 2013a. *Technical Memoranda: Pier 6 Movement Capacity; Summary of Pier 6 Movement Records. May 21*.

MnDOT. 2013b. *Technical Memorandum: Bridge Rehabilitation Alternatives, Kennedy Bridge.*

MnDOT. 2013c. *Technical Memorandum: Bridge Replacement Options, Kennedy Bridge.*

MnDOT. 2012. *Road Design Manual*.

MnDOT. 2006. *Management Plan for Historic Bridges in Minnesota.*

MnDOT. 1998. *Programmatic Categorical Exclusion Agreement with FHWA, Programmatic Categorical Exclusion Agreement Between the Federal Highway Administration and the Minnesota Department of Transportation*. http://dotapp7.dot.state.mn.us/edms/download?docId=620464. February.

Minnesota Office of Homeland Security and Emergency Management. 2014. *Minnesota State Hazard Mitigation Plan*.

National Weather Service. 2013. Historical Crests for the Red River of the North at East Grand Forks. http://water.weather.gov/ahps2/crests.php?wfo=fgf&gage=egfm5.

Potts, Ingrid; Harwood, Douglas; Richard, Karen. 2007. *Relationship of Lane Width to Safety for Urban and Suburban Arterials*.

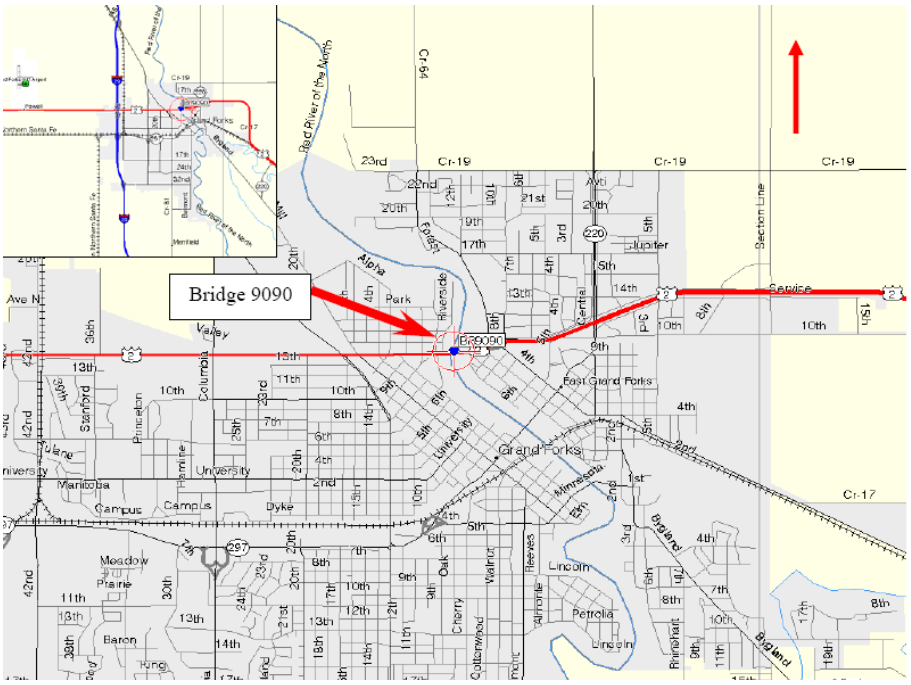
Appendix A
MnDOT Draft Statement of Purpose and Need

Minnesota Department of Transportation

District 2
3920 Highway 2 West
Bemidji, MN 56601

Red River of the North – Kennedy Bridge

US TH 2 – S.P. 6018-02, MnDOT Bridge #9090
US TH 2, ND/DOT Bridge #02-350.220



Introduction: Transportation System Background and Context

Mn/DOT Bridge #9090 (ND/DOT Bridge #02-358.220) is a Minnesota/North Dakota border bridge located over the Red River of the North on U.S. Trunk Highway 2 (US TH 2). It is partially located within the corporate limits of East Grand Forks, Minnesota and Grand Forks, North Dakota. This route serves as a connection between North Dakota and Minnesota, as well as access from US TH 2 in Minnesota to Interstate Highway 29 (I-29) in North Dakota. I-29 bisects the United States in a north/south direction. US TH 2 bisects the United States in an east/west direction between Maine and Idaho.

US TH 2 is a 4-lane roadway with 12' driving lanes and 4' shoulders. The posted speed limit in East Grand Forks is 35 mph. US TH 2 is rated as a ten-ton route.

The average daily traffic (AADT) is 20,800, with a heavy commercial average daily traffic (HCADT) of 1,770 with the posted speed limit of 35 mph. The next closest crossing of the Red River between Minnesota and North Dakota, on the Trunk Highway System is located on US TH 2B, approximately one mile south in the urban area of Grand Forks/East Grand Forks (Sorlie Bridge) with the next closest crossing located approximately 20 miles north in Oslo, Minnesota.

Anticipated Project Funding:

The Minnesota Department of Transportation (MnDOT) anticipates utilizing Federal and State funding relative to the bridge and associated roadway work.

The North Dakota Department of Transportation (NDDOT) anticipates utilizing Federal and State funding relative to the bridge and associated roadway work.

SUMMARY OF PURPOSE AND NEED

The primary purpose of this project is to provide a structurally sound crossing of U.S. TH 2 (TH 2) over the Red River of the North at East Grand Forks, Minnesota. Section A below describes the bridge structural conditions that need to be addressed by the project.

There are also secondary needs to consider during the development and evaluation of alternatives for this project. These needs (summarized in Section B below) include maximizing maintenance of traffic during construction; possibilities for addressing additional existing bridge operational deficiencies; and providing improved accommodations for pedestrian/bicycle traffic. There are also other factors that should be considered in the development and evaluation of alternatives, as described in the Other Considerations section below.

A. PRIMARY NEED: A STRUCTURALLY SOUND BRIDGE

The primary reason for undertaking this project is to address the condition of the bridge structure (described in detail below) to continue to provide a crossing of the Red River..

Bridge Background:
This bridge was constructed in 1963 and is a 13 span structure consisting of two Parker Truss style high truss main spans and 11 steel multi-beam approach spans. The trusses are constructed of steel members assembled with a combination of welds and high strength bolts. The roadway width is 28 feet, with a maximum vertical clearance of 19.8 feet. The total length of the structure is 1,261 feet.

MnDOT Assessment of the Condition of Bridge #9090:
The original deck (1963) is a 7" monolithic cast in place deck and has non-coated reinforcing steel. The typical service life for this type of deck is approximately 50 years. The deck was scarified and a low slump overlay was placed in 1984 to extend the life of the bridge deck for another 20 years and protect the black bars in the deck. The overlay is reaching the end of its service life. The expansion joints were also rehabilitated in 1984. The deck is currently in satisfactory condition with a National Bridge Inventory (NBI) condition code rating of 6.

<u>Approaches</u>
The bridge railing is substandard in height and structural capacity.

The superstructure is in good condition. Rust is beginning to form on the approach spans. There is some active corrosion in the bottom flange of the fascia beams.

Pin and hangers located along the bottom chord are not fracture critical, but do require special inspection.

The steel columns at Bents 2 to 5 and 9 to 13 exhibit some surface rust. The embankment on the west side of the river appears to be unstable and erosion of the soil is evident. The fixed hinges that support the stringers on the top of the steel pier bents are securely attached to the top of the bent. When soil movement occurs, bents are adjusted back to plumb.

There are pedestrian trails under the bridge structure on the North Dakota approach (parallel to the river) near where the District Bridge Maintenance crew has performed concrete deck delamination removal with the overhangs appearing to be in the worst condition. The falling pieces of the deteriorating concrete deck present a hazard to pedestrians, thus requiring delamination removal.

Main Spans

The bridge railing on the truss will need to be analyzed to determine its crashworthiness upon impact which may lead to modification.

The superstructure is in satisfactory condition with a NBI condition rating of 6. The current structural condition of the bridge can support legal loads, however, 'permitted' overweight Type C loads are restricted to traveling down the center of the two lanes.

There appears to be more rust exhibited at either end of each trust (L0 and L0') and at the splice connections than at other splice locations. At all four corners of each truss (L0 and L0') there is an enclosed area on the top of the bottom chord that traps water and debris. This water and debris are causing corrosion to the top of the bottom chord and the inner surface of the vertical gusset plates.

AASHTO M270 Grade 100 (ASTM A514/A517) steel, more commonly known asT-1[1] steel is located on portions of the bottom chord. In 2007 and 2008, cracks were found on T1 steel at the L0 south side of the west truss. The cracks are re-inspected annually. Other defects that have been found in this welding are lack of fusion, lack of fill, and undercut.

At panel points L1A, L1A', L2' and L2, the vertical gusset plates are stiffened with angles along the unsupported length. These angles are only tack welded to the gusset plate and the space between the welds has allowed moisture and rust to develop between the angle and the gusset plate. This rust has caused the tack welds to crack in many locations. At L1A' on the north truss, stiffening angles have become detached from the gusset plate. They have been reattached by bolting. Tack welds at stiffening angles are monitored during inspection and repaired as necessary.

It should also be noted that at random floor-beam locations, pack rust has developed between the horizontal connection plate and the bottom of the floor-beam. This pack rust is a maximum ¼" at random locations and has slightly distorted the plates. At L3N, west span, the bottom connection plate appears to have been bent upward during original construction to enable the connection of the bottom flange of the floor-beam which appears to be slightly higher than the bottom of the lower chord.

[1] T1 steel is an alloy steel composed of several elements. T1 Steel is composed of 18 percent tungsten (higher than normal to promote durability) or molybdenum, which was used as a replacement for Tungsten after 1940. Chromium makes up only 3 to 4 percent of T1 grade machine steel, with cobalt being altogether absent from its alloy. These elements are then treated at high heat in order to form high speed steel.

A major consideration along the Red River of the North is the instability of the subsurface conditions, due to deep subsoil movement. Other bridges across the Red River of the North in this area experience substructure movements, and this bridge is no exception. Substructure movements on this bridge have occurred in the last 20 years and are irregular and unpredictable. The substructure is in fair condition with a NBI condition code of 5.

Pier 6 has diagonal cracks on both faces of the pier. The cracks go in the opposite direction of each other and could indicate torsion or twisting of the pier. Pier 6 has exhibited substantial movement due to subsurface instability, and is nearing the expansion adjustments provided. The rockers have shifted to the west, the south side of the pier has moved to the east, and the north side of the pier has moved further north. There are two remaining 7" adjustments that can be made at Pier 6 without major modifications to the pier or truss bearings/gussets. North Dakota and Minnesota have jointly agreed that a plan to accommodate additional pier movement will be developed when only one adjustment remains. Continued movement will necessitate modifications or replacement of the pier and/or rocker bearing and gusset plate modifications. Movement at the Pier 6 bearing is monitored on a six-month basis. The total movement has been measured 26 inches since September 1997. The last three measurements taken in on March 7, 2012, March 22, 2012, and May 14, 2012 indicate that the pier have moved approximately 1 inch. The last significant movement took place in 2003/2004 and measured approximately 8 inches. Movement of the pier has occurred at each measurement and is anticipated to occur at future measurements.

At Pier 7, the rocker bearings on the south truss have shifted in opposite directions. There are sliding plate bearing in Spans 5 and 8. The keeper plates for several of these bearings have cracked due to pack rust.

General

The bridge was last painted in 1996, however, large areas of the paint are failing and will need substantial repair.

Inspections of this bridge have indicated the following conditions which require monitoring and/or responsive action:

- Pack rust at various connections due to active corrosion, including distortion of members. Required to be cleaned and painted routinely.
- Cracked tack welds that vary in severity. Required to be ground out and possibly repaired.
- Section loss up to 32% on gusset plates. This will continue to lower the structural capacity without action.
- Delamination of concrete from the bottom of the deck exposing reinforcing steel.
- Pigeon issues, including corrosion due to pigeon droppings. (This structure is a pigeon "haven" of which presents an inspection hazard as well as has created corrosion of which the bridge inspectors were required to remove an excess of 2.0' of pigeon droppings by cutting into the gusset plates to flush out the pigeon droppings where the upper and lower chords meet.)

B. SECONDARY NEEDS

Maintenance of Traffic:
The communities of East Grand Forks, Minnesota, and Grand Forks, North Dakota, have a need for a continued reliable river crossing and connection to the US Trunk Highway system and the nearby Interstate highway system at this location. The United States Air Force Military Base, University of North Dakota, agricultural community, manufacturing enterprises, emergency services, commuters, and interstate commercial traffic share this need. The Grand Forks/East Grand Forks area is an economic hub for the region that consists of approximately 150 miles in all directions, including Canada. The lack of a continued dependable river crossing at this location, or the temporary closure of the bridge would have an adverse effect upon the communities and the movement of interstate traffic. US TH 2 is a Principal Arterial route with an AADT of 20,800 that connects two communities in two States. The detour route for unrestricted trunk highway traffic is nearly 50 miles; therefore, provisions for maintenance of traffic during construction will be a consideration. The closest river crossing without clearance or weight restrictions is location approximately 50 miles south at Halstad, Minnesota (MnDOT Bridge #54004). This crossing is also a border bridge, jointly owned and maintained by MnDOT and NDDOT.

The MnDOT Bridge #4700 (Sorlie Bridge), one mile to the south, accommodates an existing volume of approximately 13,000 AADT with the HCADT being approximately 1,200 with the posted speed limit of 30 mph. TH 2B is a ten-ton route. Although, the Sorlie Bridge on its own accord is able to accommodate an AADT of 13,000, the timing of the signal lights and geometrics of the roadways located in the downtown areas of East Grand Forks, Minnesota/Grand Forks, North Dakota cannot accommodate an increase in traffic (e.g., if traffic were detoured from TH 2/Kennedy bridge to the Sorlie bridge during construction), without operational issues.

During annual spring flooding, the Kennedy Bridge is one of four river crossings that typically remain open between Moorhead, Minnesota and the Canadian border. Historically, this bridge has been the last bridge to close during extreme flood events. If the elevations of the flood waters became high enough, this bridge would likely be the last river crossing to remain open between Moorhead, Minnesota and Canada. The west approach touches down within the protected area of the North Dakota flood area and on the east side of the river, the approach fill area floods; however, emergency levies and other measures have proven successful in keeping this river crossing open during flood events.

Pedestrian Background and Needs:
The East Grand Forks Metropolitan Planning Organization has identified a desire for improved pedestrian access, mobility and connectivity to the existing river crossing[2]. East Grand Forks and Grand Forks currently has 46 miles of paved pedestrian/bicycle trails that traverse both Cities and Greenway areas. There is an existing multi-use trail underpass under US TH 2 just to the west of MnDOT Bridge #9090. Construction of a 10' multi-use trail to connect the existing trailhead at 12th St. NW to the US TH 2 multi-use trail underpass will be constructed during the

[2] East Grand Forks Northwest Street Network Study. (Draft Report October 28, 2011.) Prepared by Alliant Engineering, Inc. The purpose of the study is to provide a comprehensive look at the future needs of specific intersection(s), provide enhanced north-south connectivity while considering multi-modal needs (transit, pedestrian and bicycle) of the area.

2012 construction season. This construction project will utilize funding received from a Transportation Enhancement (TE) Grant. An additional 18 miles are currently planned. It is anticipated that a portion of the 18 mile multi-use trail will also be constructed during the 2012 construction season.

There is a need to consider opportunities to provide bicycle/pedestrian accommodations on the TH 2/Kennedy bridge to provide better access to the accommodations provided on the approaches and the Park located in the vicinity of the bridge on the Minnesota side of the Red River of the North.

C. ADDITIONAL CONSIDERATIONS

Regulatory Requirements: Historical Resources:
The existing bridge was determined by the Minnesota State Historic Preservation Office (SHPO) to be eligible for listing on the National Register of Historic Places as a significant example of major river crossings in Minnesota. This bridge is significant for its exceptional main span length of 279 feet for the Parker steel thru-truss under *Criteria C* (Engineering) at the State level of significance. This bridge is also eligible under *Criteria A* (Transportation) at the State level of significance because the bridge represents an initiative to improve and expand transportation networks in the region, opening new areas in Minnesota to economic development.

Structural Redundancy:
Minnesota Bridge #9090 is a fracture critical bridge with non-redundant structural design (main spans only). Chapter 152 of the Minnesota Legislature 2008 Session Laws (Chapter 152) directs MnDOT to establish a bridge improvement program with an emphasis on structurally deficient and fracture critical bridges. It is anticipated that this bridge will be partially funded under the Chapter 152 program which includes a requirement that if the bridge is repaired but not replaced, an explanation of the reasons for the repair instead of replacement is required to be submitted to the Minnesota State Legislature.

River Hydraulics:
Hydraulics along the Red River of the North is a consideration, with respect to any bridge structure improvement work that may be contemplated. The hydraulics is very complicated and any change must be carefully analyzed to determine impacts both upstream and downstream of this site. Due to frequent flooding, minor erosion around substructure units occurs.

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