Grand Forks - East Grand Forks
Metropolitan Planning Organization

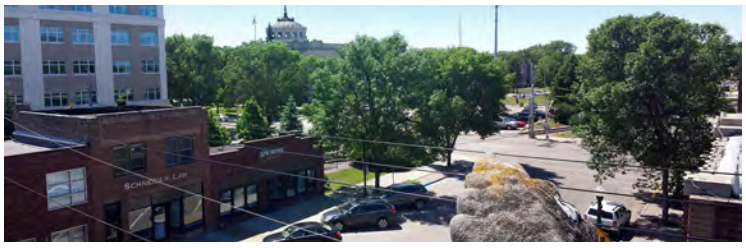
Grand Forks-
East Grand Forks MPO

2045 STREET/HIGHWAY PLAN UPDATE

Kimley»Horn

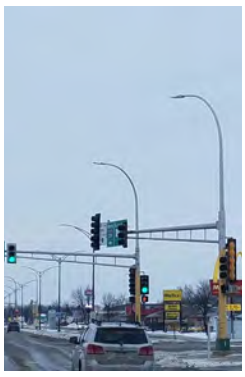
WSB
& Associates, Inc.



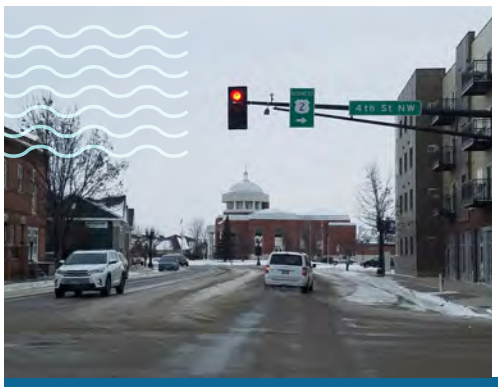












Grand Forks-East Grand Forks MPO
STREET/HIGHWAY PLAN UPDATE

Grand Forks-East Grand Forks 2045 Street/Highway Plan

December 2018

Grand Forks-East Grand Forks Metropolitan Planning Organization

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The contents of the document reflect the authors, who are responsible for facts and accuracy of data presented herein. Contents do not necessarily reflect polices of the States and Federal Department of Transportation.

A RESOLUTION ADOPTING THE YEAR 2045 METROPOLITAN TRANSPORTATION PLAN FOR THE GRAND FORKS – EAST GRAND FORKS METROPOLITAN AREA

WHEREAS, the U. S. Department of Transportation requires the development of a metropolitan transportation plan by a metropolitan planning organization for each urbanized area and area expected to have growth over a twenty-year period; and

WHEREAS, the Grand Forks – East Grand Forks Metropolitan Planning Organization (MPO) has been designated as the policy body with the responsibility of performing transportation planning in the Grand Forks – East Grand Forks Metropolitan Area; and

WHEREAS, the MPO is designated by the Governors of North Dakota and Minnesota as the body responsible for making transportation planning decisions in the Grand Forks – East Grand Forks Metropolitan Area; and

WHEREAS, the existing metropolitan transportation plan was adopted in 2008 and, as in accordance with 23 U.S.C. 134 and 23 CFR 450.322, is being updated to remain current, maintain a twenty-year horizon and comply with new requirements from FAST; and

WHEREAS, the metropolitan transportation plan, in accordance with 23 CFR 450.322, is multi-modal in scope and accounts for all travel modes in the four sections of the plan: Street & Highway, Transit, Pedestrian, and Bicycle; and

WHEREAS, a 2040 long range transportation plan was adopted in December 18, 2013; and

WHEREAS, the MPO has worked with the North Dakota Department of Transportation, which is its lead agency for metropolitan planning activities, to ensure compliance with FAST; and

WHEREAS, the metropolitan transportation plan, in accordance with 23 CFR 450.322, shall be financially constrained to demonstrate that proposed projects have existing and/or reasonably projected sources of funds; and

WHEREAS, the MPO followed its adopted Public Participation Plan to proactively involve the public early and often in the transportation planning process and held a public hearing at the appropriate time for each action regarding the Metropolitan Transportation Plan; and

WHEREAS, the By-Laws of the MPO allow the MPO Executive Board to take action upon adoption of the Street/Highway Plan element of the Metropolitan Transportation Plan sixty (60) days after said plan had been submitted to the representative city or sooner if the representative cities adopted the said plan prior to the 60 day period; and

WHEREAS, the Technical Advisory Committee of the MPO held public meetings on the proposed Metropolitan Transportation Plan; and

WHEREAS, the Planning Commission for Grand Forks, North Dakota, held a public hearing on December 5, 2018, on the proposed Street/Highway element of the Metropolitan Transportation Plan; and

WHEREAS, the City Council for Grand Forks, North Dakota, held a public hearing on December 17, 2018, on the proposed Street/Highway element of the Metropolitan Transportation Plan; and

WHEREAS, the Planning Commission for East Grand Forks, Minnesota, held a public meeting on November 8, 2018, on the proposed Street/Highway element of the Metropolitan Transportation Plan; and

WHEREAS, the City Council for East Grand Forks, Minnesota, held a public meeting on December 18, 2018, on the proposed Street/Highway element of the Metropolitan Transportation Plan; and

WHEREAS, the Executive Policy Board of the Grand Forks – East Grand Forks Metropolitan Planning Organization considered the actions taken by the local governmental agencies; and

NOW, THEREFORE, BE IT RESOLVED, by the Executive Policy Board of the Grand Forks – East Grand Forks Metropolitan Planning Organization adopts the proposed Year 2045 Street and Highway Element as presented with the following amendments:

xx

12/19/2018
Date

Ken Vein
Chairman

Earl Haugen
Executive Director

ORDINANCE NO. **4696**.

AN ORDINANCE AMENDING THE COMPREHENSIVE PLAN, AMENDING CHAPTER XVIII, ARTICLE 8, COMPREHENSIVE PLAN; SECTION 18-0802, ELEMENTS OF THE GRAND FORKS CITY CODE OF 1987, AS AMENDED, PERTAINING TO THE GRAND FORKS-EAST GRAND FORKS 20*45* ~~40~~ TRANSPORTATION PLAN UPDATE.

BE IT ORDAINED BY THE CITY COUNCIL OF THE CITY OF GRAND FORKS, NORTH DAKOTA, THAT:

Section 1. Amending Clause ...

Section 18-0802 (1) is hereby amended as follows:

(C) The Grand Forks-East Grand Forks ~~2040 Long Range~~ 2045 Metropolitan Transportation Plan Update, which contains the following sections.

1. ~~2013~~ *2018* Street and Highway Element, together with all maps, information and data contained within.

Section 2. Effective Date

This ordinance shall be in full force and effect after its passage and approval as provided by law.

Michael R. Brown, Mayor

ATTEST:

Maureen Storstad, City Auditor

Introduction and first reading: November 19, 2018
Public Hearing: December 17, 2018
Second reading and final passage: December 17, 2018
Approved: December 17, 2018
Published: Not required by law.
Recorded:

A RESOLUTION UPDATING THE GRAND FORKS MASTER PLAN FOR THE CITY OF GRAND FORKS, NORTH DAKOTA, AND PROVIDING FOR THE AMENDMENT THEREOF, PURSUANT TO CHAPTER 40-48, NORTH DAKOTA CENTURY CODE, AND FOR THE REPEAL OF ALL SECTION CONFLICT HEREWITHIN.

WHEREAS, the governing body of the City of Grand Forks has created a Planning & Zoning Commission in accordance with state law, and

WHEREAS, Chapter 40-48, North Dakota Century Code, empowers the Planning & Zoning Commission to make and adopt an official Master Plan and to provide for its administration, enforcement, and amendment thereof, and

WHEREAS, the Grand Forks Year 2045 Transportation Plan Update was made with the general purpose of providing a program for the orderly growth of the City of Grand Forks and its environs in the future, which in accordance with present and future needs will provide amenities of life, health, safety, morals, order, convenience, prosperity, and general welfare, and

WHEREAS, the existing Street/Highways Modes element of the Grand Forks Master Plan is in need of an update due to the Federal transportation bill Fixing America's Surface Transportation, and

WHEREAS, the Grand Forks City Planning & Zoning Commission has given due public notice of the hearing related to amending the Street/Highways Modes element of the Master Plan, and

WHEREAS, all requirements of Chapter 40-48, North Dakota Century Code, with regard to the preparation of the plan have been adhered to and met:

NOW, THEREFORE, BE IT ORDAINED BY THE GRAND FORKS CITY PLANNING & ZONING COMMISSION OF GRAND FORKS, NORTH DAKOTA, THAT WE DO ADOPT THE 2018 STREET/HIGHWAYS MODES ELEMENT OF THE GRAND FORKS – EAST GRAND FORKS 2045 METROPOLITAN TRANSPORTATION PLAN AS AN AMENDMENT TO THE GRAND FORKS MASTER PLAN.

Dated this 5th day of Dec, 2018

Meggen Sande,
Secretary, Grand Forks Planning and Zoning Commission

Steve Wasvick,
President, Grand Forks Planning and Zoning Commission

RESOLUTION NO. 18 – 12 - 83

Council Member Vetter, supported by Council Member DeMers, introduced the following resolution and moved its adoption:

WHEREAS, the city of East Grand Forks has an adopted East Grand Forks Comprehensive Plan; and

WHEREAS, the proposed plan update is in general agreement with the other elements of the East Grand Forks Comprehensive Plan, those other elements being the following:

1. The Grand Forks – East Grand Forks 2009 Downtown Plan Update Element, together with all maps, information and data contained therein.

2. 2045 Plan Update of the East Grand Forks Land Use Plan Element, together with all maps, information and data contained therein.

3. The Grand Forks – East Grand Forks 2040 Long Range Transportation Plan Update, which contains the following sections:

    a. Bikeway Element, together with all maps, information and data contained therein.

    b. Pedestrian Element, together with all maps, information and data contained therein.

    c. Transit Element, together with all maps, information and data contained therein.

    d. Street and Highway Element, together with all maps, information and data contained therein.

    e. Intelligent Transportation Systems (ITS) Strategy Element, together with all maps, information and data contained therein.

4. The 1998 East Grand Forks Downtown Plan prepared by Field – Paoli, together with all maps, information and data contained therein.

5. The 2000 Urban Design Plan, together with all maps, information and data contained therein.

6. Greenway Plan Element Update, together with all maps, information and data contained therein.

And

WHEREAS, The Grand Forks – East Grand Forks Metropolitan Planning Organization has prepared a Year 2045 Plan Update of the Grand Forks –East Grand Forks Long Range Transportation Plan Street & Highway Element of the East Grand Forks Comprehensive Plan; and

WHEREAS, 2045 Plan Update of the Grand Forks –East Grand Forks Long Range Transportation Plan Street & Highway Element of the East Grand Forks Comprehensive Plan is a guide for future growth for the City; and

WHEREAS, the Grand Forks –East Grand Forks Long Range Transportation Plan Street & Highway Element may be amended to reflect transportation changes in the community; and

WHEREAS, the Grand Forks –East Grand Forks Long Range Transportation Plan Street & Highway Element s a representation of the transportation goals and values of the city; and

WHEREAS, the City Planning and Zoning Commission further held a public meeting at the East Grand Forks City Hall 12 Noon November 8, 2018 to get input from the citizens of the community; and

WHEREAS, the East Grand Forks Planning and Zoning Commission forwards a recommendation that the 2045 Plan Update to the Grand Forks –East Grand Forks Long Range Transportation Plan Street & Highway Element, be hereby approved and adopted; now therefore

BE IT RESOLVED, By the City Council of the City of East Grand Forks, Minnesota, that the 2045 Plan Update to the Grand Forks –East Grand Forks Long Range Transportation Plan Street & Highway Element of the East Grand Forks Comprehensive Plan, and proposed amendments, be hereby approved and adopted with any further amendments as stated:

Voting Aye: *Riopelle, Tweten, Olstad, Grassel, DeMers, Vetter, and Pokrzywinski.*
Voting Nay: *None.*
Absent: *None.*

The President declared the resolution passed.

Passed: December 18, 2018

Attest:

City Administrator/Clerk-Treasurer

President of the Council

I hereby approve the foregoing resolution this 18th day of December, 2018.

Mayor

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Appendix A. Grand Forks-East Grand Forks Metropolitan Transportation Plan Linkage to NDDOT and MnDOT Plans

Appendix B. Public Engagement Materials and Results (To be provided in future)

Appendix C. Red River Crossing Analysis Technical Report

Appendix D. Regional Travel Demand Forecast Model Technical Report (To be provided in future)

Appendix E. Revenue Forecast

Appendix F. Current Revenue Scenario Projects

Appendix G. Illustrative Projects

Chapter 1. Introduction

Overview

The Grand Forks/East Grand Forks (GF/EGF) Metropolitan Transportation Plan identifies existing and future needs to maintain a robust regional, multimodal transportation system in the near- and long-term future. This plan was successfully developed through ongoing collaboration among Grand Forks, East Grand Forks, Polk County, Grand Forks County, North Dakota Department of Transportation (NDDOT), Minnesota Department of Transportation (MNDOT), the Cities Area Transit (CAT), the Federal Highway Administration (FHWA), Federal Transit Administration (FTA), citizens and business throughout the region, and the Grand Forks-East Grand Forks Metropolitan Planning Organization. With input from these stakeholders, the Metropolitan Transportation Plan outlines outcomes and standards to advance the locally identified issues, vision, goals, and performance targets.

The sections that follow focus on the street and highway components of the region's multimodal transportation system, as illustrated in Figure 1-1. This street and highway plan accounts for changes in the metropolitan area since the last plan adopted in 2013. Actions and strategies outlined here are complemented by the Grand Forks/East Grand Forks Metropolitan Planning Organization's Transit Development Plan (adopted July 2017) and Bicycle and Pedestrian Plan (adopted December 2018). The three documents work together to guide planning and funding for multimodal transportation in the Grand Forks/East Grand Forks metropolitan area.

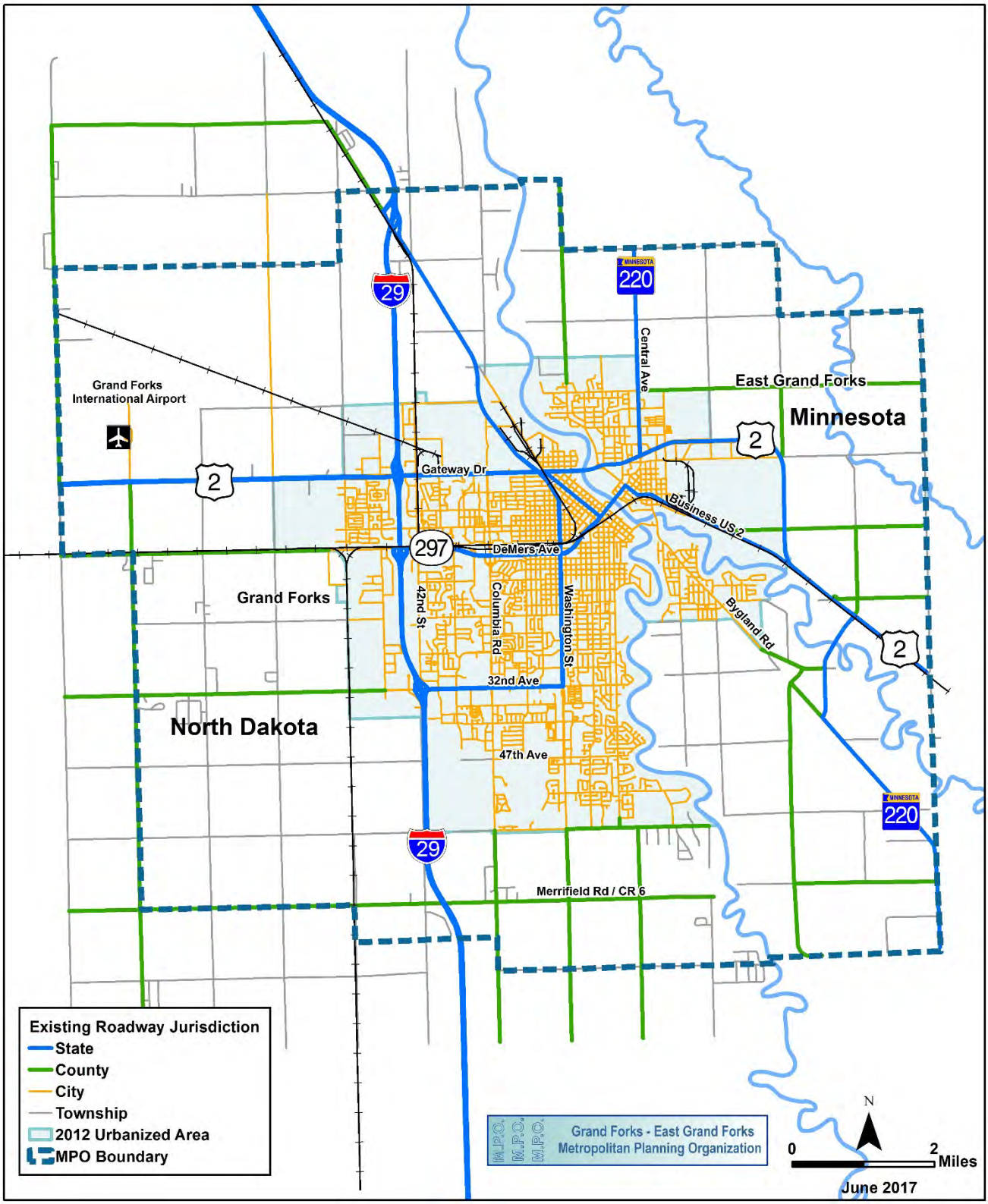
Fixing America's Surface Transportation Act (FAST Act)

This plan is structured to address the planning requirements in the FAST Act that advance a streamlined, performance-based, multimodal transportation system and planning process. Guiding principles of that legislation aim to improve safety, maintain infrastructure quality, reduce traffic congestion, and accordingly improve efficiency of the system and freight movements, while minimizing environmental impact and reducing delays in project delivery.

To be consistent with federal requirements, the GF/EGF MPO aims to:

- Utilize performance-based planning and programming focused on national transportation goals to improve transportation investment decisions and increase accountability of the Federal Highway Programs
- Position programs within a streamlined and simplified program structure with a smaller number of broader core programs
- Comply with federal prioritization of the National Highway System (NHS) and its maintenance
- Identify "State of Good Repair" projects that improve ride quality or extend the life of a roadway, as opposed to expanding the system

Figure 1-1: Grand Forks-East Grand Forks Street and Highway System



Source: Grand Forks-East Grand Forks MPO

The Metropolitan Transportation Plan Update Process

The Grand Forks/East Grand Forks MPO leads the region's multimodal transportation planning process. While this Plan highlights the street and highway components of a multimodal approach, they are just one element of larger regional planning efforts.

This Plan is guided by goals and performance measures that grew out of community values. These objectives represent a wide range of social, technical, environmental, and economic factors that influence the region's transportation system.

Plan Chapters

The following chapters and topics address the GF/EGF transportation system from Plan development through implementation strategies.

Vision, Goals, Objectives, Standards, Performance Measures and Targets

Development of the Plan is based in community input on the vision, goals, objectives, standards, performance measures, and performance targets. Through consultation with the Technical Advisory Committee, Policy Board, and the general public, stakeholders identified priorities for the region's current and future transportation system. The goals, performance measures, and performance targets have been updated to address the FAST Act.

Existing Conditions and Special Studies

To address future needs of the multimodal system, this chapter highlights the current state of the street and highway system and findings from special studies. The chapter addresses:

- Demographics and land use
- Natural and environmental resources
- Carbon footprint
- Roadway characteristics including jurisdiction, number of lanes, functional classification, pavement condition, and bridge condition
- Existing traffic conditions including traffic volumes, intersection level of service, and roadway level of service
- Crashes
- Freight routes, volumes, and crashes
- Programmed regionally significant improvements
- Recent highway studies and their results
    - I-29 Traffic Operations Study (2017, Grand Forks)
    - US 2 and US 2 Business Study (2017, East Grand Forks)
    - Bygland Road Study (2016, East Grand Forks)
    - Glasston Railroad Crossing Study (2016, Grand Forks)
    - North 42nd Street Traffic Operations Study (2016, Grand Forks)
    - 32nd Avenue Safety Audit Review / 32nd Avenue Signal Coordination Plan Update (2016, Grand Forks)
    - US 2 Access Study (2015, Grand Forks)
    - South Columbia Road Traffic Operations Study (2015, Grand Forks)
    - 42nd Street Railroad Grade Separation Study (2014, Grand Forks)
    - Grand Forks-East Grand Forks Freight Rail Access Study (2014, Grand Forks)
    - Grand Forks Air Force Base Traffic Study (2013, Grand Forks)

Identification of System, Issues, and Opportunities

To effectively advance a long-term multimodal plan, project staff worked with stakeholders to address community concerns and desires. This chapter summarizes engagement efforts and frequently occurring themes that shaped

the issues and opportunities addressed throughout the Plan. The planning process included a variety of stakeholder and community engagement opportunities:

- Public meetings and open houses in August 2017 in Grand Forks and December 2017 in East Grand Forks
- Interactive mapping, surveys, and comment forms on the project website: www.theforksstreets2045.org
- MPO Facebook updates and postings
- MPO website updates
- Agency and stakeholder meetings
- Local media press releases and interviews with MPO staff

Some of the key issues identified include:

- Additional southern Red River crossing
- 32nd Avenue South
- Proposed interchange improvements along I-29
- Bygland Road
- Columbia Road
- Washington Avenue
- Belmont Road
- Proposed railroad grade separations at DeMers Avenue and US Highway 2
- US Highway 2
- Demers Avenue through the Grand Forks and East Grand Forks downtowns
- Minnesota TH 220

Range of Alternatives

This chapter identifies potential roadway improvement alternatives to address the identified transportation needs. It provides a summary of the process used to develop various street and highway improvements to address short-, mid-, and long-range issues. The range of alternatives process is intended to result in a comprehensive list of potential improvement projects that address goals, objectives, standards, performance measures and targets, and issues.

The range of alternatives list was developed by identifying improvements in existing planning documents, existing transportation improvement programs, and recent studies. Additional improvements, such as river crossing alternatives, were identified based on stakeholder input and Street/Highway Plan technical analysis results. Public input and partner agency feedback also contributed to the development of the list of projects for evaluation.

The range of alternatives includes projects in six categories:

- MPO TIP: Included in current regional TIP
- Existing + Committed (E + C) Network: Projects expected to be completed using Non-Federal/Non-State funds
- Safety/Operations - HSIP: Projects that will improve the safety and operation of the existing system
- Multimodal, Streetscape, Studies: Projects emphasizing multimodal or streetscape improvements or studies
- State of Good Repair: Projects related to maintenance and preservation of the existing system
- Discretionary: All remaining projects not listed previously

Financial Plan

As a crucial component of the Transportation Plan, the Financial Plan establishes the fiscal context for potential capital and operating investments. This chapter identifies potential funding programs to advance potential improvement projects. It also presents anticipated revenue amounts by program and jurisdiction.

The planning process based the revenue forecast in a locally-derived methodology approved by each State DOT and local partners:

- Establish historical transportation improvement funding programs and amounts
- Establish new transportation improvement funding programs and amounts
- Establish revenue growth rates
- Identify future available revenues for short-range (2023-2027), mid-range (2028-2037), and long-range (2038-2045) timeframes

Recommended Network Improvements and Implementation Program

The long-range planning process concludes by identifying a program of projects for implementation. The process to develop the Implementation Program merges the Range of Alternatives with goals, objectives, standards, and network performance with available revenues. The Implementation Program is also called the fiscally constrained or Current Revenue scenario. Projects listed in the Current Revenue Scenario are eligible to compete for federal transportation funding through the GF/EGF MPO's Transportation Improvement Program (TIP) process.

Development of the Current Revenue Scenario considered:

- Goals, objectives, standards, and network performance outcomes
- Revenue available by timeframe, short-range (2023-2027), mid-range (2028-2037), and long- range (2038-2045)
- Public input – including input on identification and prioritization of needs
- Ability to help maximize useful life of existing pavement and bridge infrastructure by corridor
- Existing investment programs
- Project costs in year of expenditure
- Local knowledge

Current Revenue Scenario

The fiscally constrained Current Revenue Scenario includes $267 million in investments as illustrated in Table 1-1. The Current Revenue Scenario identifies specific projects for Safety/Operations, North Dakota Main Street, State of Good Repair: Interstate, and State of Good Repair: Non-Interstate National Highway System. The majority of investments will go toward maintaining existing pavement and bridges (state of good repair), with some investments emphasizing safety (safety/operations) and livability (North Dakota Main Street). These projects supplement those identified in the 2019-2022 Transportation Improvement Program.

Table 1-1: Current Revenue Scenario Project Type Investment Amounts

Project Type	Investment Amounts	Share
Safety	$4.8 million	2%
North Dakota Main Street	$39.1 million	14%
State of Good Repair: Interstate	$28.9 million	11%
State of Good Repair: Non-Interstate NHS	$194.1 million	73%
Total	$267 million	100%

Illustrative Projects

Some regionally significant projects were not included in the Current Revenue Scenario. These illustrative projects have a regionally significant transportation purpose and need, but costs exceed forecast revenues. Table 1-2 lists some of the highest ranked illustrative projects The Red River crossing projects, 32nd Avenue S and Merrifield Road, shown on the bottom of the table are included on the list as a result of policy direction from the GF/EGF MPO Board that was made considering input from this planning process and public input. The river crossing projects will provide regional connectivity across the Red River, supplementing the three existing river crossings that are forecast to operate with significant congestion in 2045.

Table 1-2: Illustrative "Projects of Significance"

Project Type	Project Description
State of Good Repair	▪ Non-NHS Federal Aid Eligible Streets/Highways
Intersections	▪ 32nd Avenue/South Washington Street ▪ Central Avenue: 17th Street to 23rd Street ▪ US 2 (Gateway Drive): Washington Street to Mill Road ▪ US 2 (Gateway Drive): Cambridge Street to Columbia Road
Additional Lanes	▪ Columbia Road: 14th Avenue S. to 24th Avenue S.
Interstate 29 Interchange Upgrades	▪ North Washington ▪ US 2 (Gateway Drive) DeMers Avenue 32nd Avenue
New Grade Separations	▪ US 2 (Gateway Drive) east of Interstate 29 ▪ 42nd Street: North of DeMers Avenue
New River Crossings	▪ 32nd Avenue ▪ Merrifield Road

Environmental Considerations

The GF/EGF MPO's transportation planning activities are performed at the regional level and projects identified in this plan require more detailed scoping and design analysis to identify detailed social, economic, and environmental impacts. These analyses will be performed as projects are further developed.

The GF/EGF MPO solicited input from several Federal, State, and Tribal land management, wildlife, and regulatory agencies on possible environmental mitigation activities that may be appropriate for the types of system improvement projects identified in the plan. Agencies were notified via letter and requested to provide input on the projects and proposed environmental mitigation activities identified during the planning process. There were 50 different agencies from which comments were solicited. The GF/EGF MPO and its jurisdictional partners are committed to minimizing and mitigating the negative effects of transportation projects on the natural and built environments.

Environmental Justice

Executive Order 12898 directs Federal agencies to take appropriate and necessary steps to identify and address disproportionately high and adverse effects of Federal projects, including the transportation planning process, on the health or environment of minority and low-income populations to the greatest extent practical and permitted by law. USDOT Order 5610.2(a) sets forth the USDOT policy to consider environmental justice (EJ) principles in all (USDOT) programs, policies, and activities. It describes how the objectives of EJ will be integrated into planning and programming, rulemaking, and policy formulation. The Order sets forth steps to prevent disproportionately high and adverse effects to minority or low-income populations through Title VI analyses and EJ analyses conducted as part of Federal transportation planning and NEPA provisions. Disproportionate is defined in two ways: the impact is predominantly borne by the minority or low-income population group, or the impact is appreciably more severe than that experienced by non-minority or non-low-income populations.

The MPO addresses Environmental Justice to ensure non-discrimination concerning enacted transportation-related laws, regulations, and policies. The MPO has developed an Environmental Justice Program Manual

designed to provide guidance in meeting EJ mandates and structuring a public participation plan at the project or study level. To certify compliance with, and to address environmental justice, the MPO:

- Identifies residential, employment, and transportation patterns of low-income and minority populations so that their needs can be identified and addressed, and the benefits and burdens of transportation investments can be fairly distributed.
- Ensures that the long-range transportation plan and the transportation improvement program (TIP) comply with the tenets of Environmental Justice.
- Utilizes public involvement processes to eliminate participation barriers and engage minority and low-income populations in transportation decision making.

These areas will be evaluated further as Current Revenue Scenario projects are further developed.

Performance Based Planning

MAP-21 and FAST ACT requires incorporation of performance based planning in the development of the Grand Forks – East Grand Forks MPO metropolitan transportation plan. The requirement in these US Laws defined that the Plan shall include, to the maximum extent practicable, a description of the anticipated effect of the Plan toward achieving the performance measures by linking them with the investment priorities.

The 2045 Street/Highway Plan implements the now promulgated required national performance measures. The Plan integrates the safety plans developed by partner agencies, including each state's Strategic Highway Safety Plan and more localized strategic highway safety plans that apply state-level emphasis areas and strategies consistent with local context and intent to implement. The 2045 Plan also identifies projects for Highway Safety Improvement Program (HSIP) funding (see Chapter 7 Table 7-8 and Table 7-13). These projects are expected to have a positive impact toward meeting safety targets in North Dakota.

This plan also acknowledges the need to update plans that prioritize safety-related projects for HSIP funding. A concern with these safety plans, particularly on the Minnesota side, has been the lack of MPO inclusion in the safety planning process. The most recent Minnesota Strategic Highway Safety Plan greatly improved MPO engagement, but this practice has not carried forward with each respective District and/or County Safety plan update. Further, the Minnesota process for programming funds from the Highway Safety Improvement Program has historically neglected the active engagement of MPOs. Routinely, MnDOT solicits, vets and programs projects without involvement from Greater Minnesota MPOs. This plan recommends improvements to the HSIP project solicitation process, and efforts are underway to improve it.

The 2045 Street/Highway Plan emphasizes projects that support State of Good Repair for pavement and bridges on the Interstate, non-Interstate National Highway System, and Federal Aid-Eligible System in North Dakota and Minnesota (see Chapter 7 Table 7-4, Table 7-5, Table 7-6, Table 7-7, Table 7-10, Table 7-11, and Table 7-12). These projects are expected to have a positive impact toward meeting pavement and bridge condition targets in North Dakota and Minnesota.

The Grand Forks-East Grand Forks MPO understands it is in the early stages of developing a fully compliant, performance-based MTP. As multiple years of data is collected for the performance measures and their targets, the MPO will monitor performance and evaluate if trends are moving toward meeting the targets. The Grand Forks-East Grand Forks MPO commits to making adjustments to planning strategies to meet the performance targets if the desired results are not being met.

Chapter 2. Vision, Goals, Objectives, Standards, Performance Measures and Targets

The metropolitan transportation plan's (MTP) - Streets and Highway Element vision, goals, objectives, standards, performance measures and targets are critical in the planning process because they defined the region's desired outcomes resulting from plan implementation. The Plan's vision, goals, objectives, standards, performance measures and targets were developed in coordination with North Dakota Department of Transportation (NDDOT), Minnesota Department of Transportation (MnDOT), the Federal Highway Administration, the Technical Advisory Committee (TAC), Policy Board, and general public.

The Plan's goals align directly with the ten federal transportation planning factors, and with the federal livability principles and the national transportation performance goals. They also build on the goals, objectives, standards, and performance measures, and performance targets adopted in the previous plan. Several goals, performance measures, and performance targets were updated to address requirements in the Fixing America's Surface Transportation Act (FAST Act), the most recent federal transportation reauthorization bill passed in 2015.

FAST Act Requirements

Federal law identifies seven (7) national performance goals (source: 23 USC § 150). Each Grand Forks-East Grand Forks goal area is consistent with one or more national performance goal, and this alignment is shown in Table 2-1. The Grand Forks-East Grand Forks goals are not listed in order of priority. The national performance goals in order of alignment frequency with the Grand Forks-East Grand Forks goal areas are:

- Freight movement and economic vitality – In alignment with ten (10) Grand Forks-East Grand Forks MPO goals
- System reliability – In alignment with nine (9) Grand Forks-East Grand Forks MPO goals
- Safety – In alignment with nine (9) Grand Forks-East Grand Forks MPO goals
- Infrastructure condition – In alignment with eight (8) Grand Forks-East Grand Forks MPO goals
- Congestion reduction – In alignment with eight (8) 2040 Grand Forks-East Grand Forks MPO goals
- Environmental sustainability – In alignment with seven (7) Grand Forks-East Grand Forks MPO goals
- Reduced project delivery delays – In alignment with six (6) Grand Forks-East Grand Forks MPO goals

The national performance goals are prescribed by law, and MPO-identified objectives, measures, and metrics should not conflict with these national performance goals. Federal law creates flexibility for states and MPOs to define the exact means and methods used to track progress toward achieving locally identified outcomes. Each MPO is required to conduct a robust planning process that results in goals, objectives, measures, and metrics that are compatible with the national goals and are priorities for the local community. The MPO goals were designed to match local interests, while still supporting the national goals. The scope of each MPO goal was compared to each national performance goal. If there was any overlap in the scope of the MPO and the national goals, then it was noted that the federal goal was satisfied by a given MPO goal.

Appendix A also demonstrates the Plan's linkage with NDDOT Statewide Strategic Transportation Plan Goals and MnDOT Statewide Multimodal Transportation Plan Objectives.

Table 2-1: Grand Forks-East Grand Forks Goal Areas and Alignment with National Performance Goals

MPO Goal Number	MPO Goal (also Federal Transportation Planning Factors)	MPO Goal Statement	National Performance Goal(s) Satisfied
1	Economic Vitality	Support the economic vitality through enhancing the economic competitiveness of the metropolitan area by giving people access to jobs, and education services as well as giving business access to markets.	▪ Congestion reduction ▪ Freight movement and economic vitality ▪ Reduced project delivery delays ▪ Safety ▪ System reliability
2	Security	Increase security of the transportation system for motorized and non-motorized uses.	▪ Freight movement and economic vitality ▪ Infrastructure condition ▪ Safety ▪ System reliability
3	Accessibility and Mobility	Increase the accessibility and mobility options for people and freight by providing more transportation choices.	▪ Congestion reduction ▪ Environmental sustainability ▪ Freight movement and economic vitality ▪ Infrastructure condition ▪ Reduced project delivery delays ▪ Safety ▪ System reliability
4	Environmental/ Energy/Quality of Life	Protect and enhance the environment, promote energy conservation, and improve quality of life by valuing the unique qualities of all communities – whether urban, suburban, or rural.	▪ Congestion reduction ▪ Environmental sustainability ▪ Freight movement & economic vitality ▪ Infrastructure condition ▪ Safety ▪ System reliability
5	Integration and Connectivity	Enhance the integration and connectivity of the transportation system, across and between modes for people and freight, and housing, particularly affordable housing located close to transit.	▪ Congestion reduction ▪ Environmental sustainability ▪ Freight movement and economic vitality ▪ Infrastructure condition ▪ Reduced project delivery delays ▪ Safety
6	Efficient System Management	Promote efficient system management and operation by increasing collaboration among federal, state, local government to better target investments and improve accountability.	▪ Congestion reduction ▪ Environmental sustainability ▪ Freight movement and economic vitality ▪ Infrastructure condition ▪ Reduced project delivery delays ▪ System reliability

MPO Goal Number	MPO Goal (also Federal Transportation Planning Factors)	MPO Goal Statement	National Performance Goal(s) Satisfied
7	System Preservation	Emphasize the preservation of the existing transportation system by first targeting federal funds towards existing infrastructure to spur revitalization, promote urban landscapes and protect rural landscapes.	▪ Congestion reduction ▪ Environmental sustainability ▪ Freight movement and economic vitality ▪ Infrastructure condition ▪ Reduced project delivery delays ▪ Safety ▪ System reliability
8	Safety	Increase safety of the transportation system for motorized and non-motorized uses.	▪ Congestion reduction ▪ Freight movement and economic vitality ▪ Infrastructure condition ▪ Reduced project delivery delays ▪ Safety ▪ System reliability
9	Resiliency	Improve resiliency and reliability of the transportation system and reduce or mitigate stormwater impacts of surface transportation.	▪ Congestion reduction ▪ Environmental sustainability ▪ Freight movement and economic vitality ▪ Infrastructure condition ▪ Safety ▪ System reliability ▪ Resiliency
10	Tourism	Enhance travel and tourism.	▪ Environmental sustainability ▪ Freight movement & economic vitality ▪ Safety ▪ System reliability

The FAST Act also retained and strengthened federal emphasis on performance-based transportation planning. This performance-based approach is meant to improve accountability of federal transportation investments, assess risks related to different performance levels, and increase transparency. The FAST Act requires[1]:

- States
  - Undertake performance-based transportation planning that integrates standards and targets encompassing every national, statewide, regional and local entity
- Metropolitan planning organizations (MPOs)
  - Link the investment priorities contained in the Statewide Transportation Improvement Program (STIP) and Transportation Improvement Program (TIP) to achievement of performance targets.

[1] Source: Federal Register. Vol 81, No. 103. May 27, 2016. Rules and Regulations. p.34051.

- Establish targets in the key national performance areas to document expectations for future performance, and document the performance targets and measures in the MPO's metropolitan transportation plan
- Coordinate these targets with states to ensure consistency to the maximum extent practicable. Metropolitan planning organizations may adopt state-identified performance targets, or federal law allows MPOs to identify their own set of performance targets for the measures.
- In their transportation plans, MPOs need to describe these performance targets, evaluate the condition and performance of the transportation system, and report on progress toward the achievement of their performance targets.
- Integrate the MPO planning process and the goals, objectives, performance measures, and targets set by the states in the strategic highway safety plan, the highway asset management plan, and the State freight plan. This integration helps deliver performance elements as part of the MPO's investment decision-making processes. Federal rules do not require explicit integration of these elements in the development of the MPO's long-range transportation plan (LRTP) nor the transportation improvement program (TIP).
- Identify how they will cooperatively implement these performance-based planning provisions with States. The MPO(s) and the State(s) must jointly agree on and document in writing the coordinated processes for the collection of performance data, the selection of performance targets for the metropolitan area, the reporting of metropolitan area targets, and the reporting of actual system performance related to those targets. The documentation must also describe the roles and responsibilities for the collection of data for the national highway system.

States or MPOs may also develop and report on additional measures; neither Minnesota nor North Dakota state statutes require MPOs to adopt state-level performance measures.

While there are federal requirements for performance-based planning, the federal rules focus on nationally-significant near-term measures and performance. Long-term performance and local priorities, like those addressed in an MPO's long-range transportation plan (LRTP), may be better addressed through additional performance measures and targets. Federal and state rules allow for this flexibility in the MPO LRTPs.

Vision

The vision for the Grand Forks – East Grand Forks MPO covers all modal elements for the region's transportation system. The vision was crafted during the update process for the Transit and Pedestrian/Bicycle elements of the 2045 MTP, which involved input from the Technical Advisory Committee, Policy Board, and the general public. The vision for the Grand Forks – East Grand Forks MPO is stated below:

"A community that provides a variety of complementary transportation choices for people and goods that is fiscally constrained."

Street and Highway Plan Goals, Objectives, Standards, Performance Measures and Targets

These goals, objectives, standards and performance measures were reviewed by GF/EGF MPO staff, staff from each state DOT, and the public. They generally reflect the needs and issues of the GF/EGF area. Additional elements of these performance measures include the provision of targets, action initiatives, and monitoring activities to ensure the next Street and Highway Plan update understands past performance and builds upon it. The Grand Forks-East Grand Forks goals are not listed in order of priority.

Goal 1: Economic Vitality

Goal statement: Support the economic vitality through enhancing the economic competitiveness of the metropolitan area by giving people access to jobs, and education services as well as giving business access to markets.

Table 2-2: Objectives and Standards for Goal 1 Economic Vitality

Objective	Standards
1. Coordinate land use and transportation planning, programming, and investments between agencies.	▪ Strengthen and connect existing communities by focusing street and highway system expansion in areas that are contiguous to currently developed areas. ▪ Recognize and identify investments that support the types and locations of future development identified in the Grand Forks and East Grand Forks Land Use Plans. ▪ Coordinate with local governments on the placement of regionally significant developments (e.g., ones that have a major impact on existing networks) and consider both motorized and non-motorized modes of transportation. ▪ Identify prime corridors for industrial uses that are adjacent to major freight operations and truck routes, have facilities for efficient freight and goods movement, and route truck traffic away from incompatible land uses.
2. Enhance the area's economic competitiveness through the movement of goods and services.	▪ Develop and maintain roadway connectivity that is appropriate for the facility type and land-use environment. ▪ Protect operational capacity of interstate and state highways through the GF/EGF MPO area and support the growth of regional intermodal freight capacity.
3. Support efficient local and regional street and highway connections for freight and rail movement.	▪ Participate in state and national freight planning efforts. ▪ Build and maintain relationships with area businesses to increase the understanding of their freight needs. ▪ Improve connections to freight terminals (e.g., air and multimodal), especially the last 1-2 miles of access. ▪ Strategically locate freight rail improvements in areas that currently do not have freight rail access. Investments will support critical rail-street/highway connections for key regional centers and businesses to move goods and services. ▪ Support integrated network of streets, roads, and highways that provide direct routes for freight and rail.

Objective	Standards
4. Consider economic development efforts in the transportation and programming process.	▪ Invite economic development officials to collaborate in the transportation system alternatives analysis process provide documentation of the alternatives' screening process to local economic development officials for review. ▪ Recognize and respond to economic changes at the local, regional, state and national level that influence the metro area's transportation system.

Table 2-3: Performance Measures and Monitoring Activities for Goal 1 Economic Vitality

Performance Measures	Performance Target
1. Land use and economic development initiatives consistent with the LRTP and TIP development initiatives consistent with the LRTP and projects.	▪ Ninety percent (90%) land use and economic development initiatives consistent with the LRTP and TIP projects.
2. Communication/coordination improvement between freight operators and transportation officials.	▪ Communication/coordination improvement between freight operators and transportation officials via minimum of semi-annual meetings.

Action Initiatives

- Document local, state and national freight initiatives that influence the region's transportation system.

Monitoring Activities

Annually

- Track growth corridors through building permits and platting activities.
- Map the locations of major employment centers, including existing and proposed developments, and identify types of transportation available.
- Document locations and conditions of current freight routes.
- Evaluate the LRTP's effectiveness and consistency with new development and economic development decisions.
- Hold at least two joint meetings annually between the freight community and transportation agencies.
- Track number of new developments with multimodal connections.

Every 5 Years

- Evaluate the LRTP's effectiveness and consistency with local comprehensive plans.
- Track the increase in households or jobs by TAZ to identify potential employment and residential growth areas and to assist in the prioritization of future transportation projects.
- Conduct a freight assessment of the GF/EGF MPO area and update the freight section of the LRTP.

Goal 2: Security

Goal statement: Increase security of the transportation system for motorized and non-motorized uses.

Table 2-4: Objectives and Standards for Goal 2 Security

Objective	Standards
1. Identify and maintain security of critical street and highway system assets.	▪ Support improvement projects that do not compromise the security of identified critical street and highway assets. ▪ Evaluate and manage the security of the transportation network, especially in critical areas. ▪ During security threats or events, coordinate traffic operations consistent with the Grand Forks-East Grand Forks Bridge Closure Management Plan.
2. Support state and regional emergency, evacuation, and security plans.	▪ Incorporate state and regional emergency, evacuation, and security plans into transportation plans, project development, and project selection processes. ▪ Develop an implementation plan that responds to various disaster events that might occur within the region including evacuation routes and contingency planning. ▪ Coordinate efforts with local emergency/security/hazardous materials groups.

Table 2-5: Performance Measures and Monitoring Activities for Goal 2 Security

Performance Measures	Performance Target
1. Blockage of emergency transportation routes.	▪ 75 percent of emergency transportation routes remain unblocked.
2. Incident clearance time.	▪ Clearance time for federal aid eligible route incidents under three year average of 30 minutes.

Action Initiatives

- Identify and map emergency transportation routes.
- Maintain coordination with regional/emergency/security/hazardous materials movement plans and personnel.
- Refine and update any GF/EGF MPO transportation security plans or studies.

Monitoring Activities

Annually

- Collect traffic incident response and clearance times.
- Collect detailed flood/emergency traffic incident information (where, when, why).
- Map future roadway projects, both capacity expansion and state of good repair, in comparison to flood prone, low lying, future land use, and critical/sensitive environments.

Every 5 Years

- Evaluate coordination with regional/emergency/security/hazardous materials movement plans and personnel.

Goal 3: Accessibility and Mobility

Goal statement: Increase the accessibility and mobility options for people and freight by providing more transportation choices.

Table 2-6: Objectives and Standards for Goal 3 Accessibility and Mobility

Objective	Standards
1. Mitigate excessive travel delays.	▪ Evaluate all new roadway construction and roadway reconstruction for viability of fiber installation to support future interconnection of traffic signals. ▪ Fund and implement a congestion management process that identifies congestion management strategies to expand roadway capacity prior to adding more lanes on streets and highways. ▪ Identify, map, report, and regularly update corridor congestion levels in the MPO area using volume, capacity, level of service, and amount of delay. ▪ Consider and implement as appropriate innovative intersection improvements, such as roundabouts, that do not stop cross traffic.
2. Maintain an acceptable level of service for all streets and intersections during peak hours.	▪ Strive to deliver level of service C or better at intersections, including peak travel periods (with the understanding that local and state agencies accept a lower level of service D threshold for determining deficiencies at intersections). ▪ Define corridor-specific level of service criteria for corridors within the metro area, including acceptable levels of congestion, and the meaning of congestion in the context of the region.
3. Consider advances in autonomous vehicle and connected vehicle technology in the transportation planning and programming processes.	▪ Participate in national and state autonomous vehicle and connected vehicle planning efforts. ▪ Support implementation in autonomous vehicle and connected vehicle technology that collectively provides increased transportation options for people and freight. ▪ Recognize and address autonomous vehicle and connected vehicle changes at the local, regional, state, and national level that influence the metro area's transportation system.

Table 2-7: Performance Measures and Monitoring Activities for Goal 3 Accessibility and Mobility

Performance Measures	Performance Target
1. Interstate truck travel time reliability	▪ For 2020 and 2022, a ratio of 1.5 or less when comparing the 95th percentile and 50th percentile truck travel times in five different time periods throughout the day on the Interstate
2. Interstate travel reliability	▪ For 2020 and 2022, 90% of person-miles traveled on the Interstate are reliable
3. Non-Interstate travel reliability	▪ For 2020 and 2022, 85% of person-miles traveled on the non-Interstate National Highway System are reliable

Action Initiatives

- Expand and maintain implementation of traffic counting method utilizing cameras at signalized intersection.
- Update Metropolitan Intelligent Transportation System Strategy Plan and Regional Architecture.

Monitoring Activities

Annually

- Track percent of roadways that are regularly congested during weekday and peak-hour periods.
- Evaluate average commute times.
- Assess travel times on key corridors.
- Conduct turning movement counts at key intersections identified in a current study or identified with possible delay of service.
- Evaluate LOS.

Every 5 Years

- Track the volume/capacity ratios, level of service, and the amount of delay on key corridors.
- On a ten-year basis, evaluate mobile phone network origin-destination data to track trip distance, purpose, etc.; and compare against outward growth.
- Evaluate Transportation Improvement Programs (TIP)/State LRTP projects to determine their effectiveness in supporting accessibility and mobility.

Goal 4: Environment/Energy/Quality of Life

Goal statement: Protect and enhance the environment, promote energy conservation, and improve quality of life by valuing the unique qualities of all communities – whether urban, suburban, or rural.

Table 2-8: Objectives and Standards for Goal 4 Environment/Energy/Quality of Life

Objective	Standards
1. Avoid, minimize, and/or mitigate adverse social, environmental, and economic impacts resulting from existing or new transportation facilities.	▪ Initiate corridor preservation and right-of-way acquisition procedures, to strengthen communities and avoid or minimize significant social, environmental, and economic impacts. ▪ Incorporate elements of the Environmental Justice (EJ), Title IV and Limited English Proficiency (LEP) plans into the GF/EGF transportation planning process. ▪ Prioritize transportation improvements that reduce existing transportation impacts on the environment through context sensitive solutions. ▪ Protect, enhance, and mitigate impacts on social, natural, and economic resources when planning, constructing, operating, and maintaining transportation systems. This will include identification of priority resources through available maps, plans, and inventories, and integrating environmentally sustainable practices into street and highway design, construction, and operations.
2. Maintain and improve quality of life along streets and highways.	▪ Work with land use authorities to develop and implement context sensitive projects that incorporate placemaking and "complete streets" principles on new and existing roadways in the GF/EGF MPO area. Tactics may include traffic calming. ▪ Identify and avoid, minimize, and mitigate the impact that transportation and development projects have on historical sites and areas of cultural or historical significance. ▪ Plan and implement a transportation system that considers the needs of all potential users, including children, senior citizens, and persons with disabilities, and that promotes active lifestyles and cohesive communities. A special emphasis should be placed on promoting the environmental and health benefits of alternatives to single-occupancy vehicle travel.
3. Maintain and improve regional air quality.	▪ Provide and promote alternatives to single occupancy vehicle travel through the implementation of traffic demand management strategies, such as carpooling, vanpooling, telecommuting, walking, bicycling, and travel by public transit. ▪ Evaluate air quality monitoring on a regular basis and incorporate mitigation strategies in all transportation and land use plans. ▪ Conduct a regional Greenhouse Gas (GHG) Inventory. ▪ Recognize the role of transportation choices in reducing emissions and support state and regional goals for reducing greenhouse gas and air pollutant emissions.

Table 2-9: Performance Measures and Monitoring Activities for Goal 4 Environment/Energy/Quality of Life

Performance Measures	Performance Target
1. Transportation-related CO2 emissions.	▪ By 2045, reduce transportation-related CO2 emissions by 10 percent below 2010 levels. A reduction of 17,579 tons of transportation- related CO2 emissions is needed every five years.
2. Time/cost of project delivery.	▪ Reduce the time/cost of project delivery by 20 percent.
3. Population characteristics such as low income, minority percentage, gender, disabled percentage and percentage having Limited English Proficiency (LEP)	▪ Maintain EJ, Title VI, LEP plans to ensure they reflect current and future demographics, as well as community needs

Action Initiatives

- Reach agreements/MOUs on linking the planning process with the environmental permitting to reduce the time/cost of project delivery.
- Improve livability by applying measures such as:
  - Context sensitive design including matching design speeds, traffic calming elements, lane widths, and non-motorized elements to surrounding land uses on roadways and bridges
  - Delivering integrated street/highway construction projects that address bicycle, pedestrian, transit, and other infrastructure elements in one construction project
  - Coordinating transportation construction projects to avoid simultaneous construction on facilities that serve as alternate routes

Monitoring Activities

Annually

- Monitor the percent of transportation investment in EO #12898 Environmental Justice census tracts and evaluate any disproportional impacts as defined EO #12898.
- Evaluate the effectiveness of traffic calming measures.
- Evaluate EJ, Title VI, and LEP plans' effectiveness in supporting the GF/EGF MPO's transportation planning process.
- Distribute information through PSAs, Public Presentations, and awareness campaigns.

Every 5 Years

- Evaluate sustainability principles and their effectiveness with TIP projects.
- Conduct a greenhouse gas inventory of transportation related emissions.
- Update EJ, Title VI and LEP plans.
- Evaluate timeline from planning process to delivery of transportation projects to determine linkage between planning and environmental permitting.
- Maintain a list and location of environmentally sensitive properties.
- Evaluate whether agreement/MOUs were reached.

Goal 5: Integration and Connectivity

Goal statement: Enhance the integration and connectivity of the transportation system, across and between modes for people and freight, and housing, particularly affordable housing located close to transit.

Table 2-10: Objectives and Standards for Goal 5 Integration and Connectivity

Objective	Standards
1. Effectively coordinate transportation and land use by promoting the sustainability and livability principles, goals, and objectives from local land use plans.	▪ Identify priority corridors and nodes for infill development, densification, or transit-oriented development. ▪ Increase the use of multi-modal transportation by providing additional transit service and reducing bicycle/pedestrian network gaps. ▪ Promote transportation improvements that support access to employment centers, especially those that provide a mix of employment opportunities (e.g. jobs and income levels). ▪ Promote higher land use densities.
2. Provide a balanced mix of local, collector, and arterial streets to help meet local and regional travel needs.	▪ Map and update street and highway functional classification based on consistency with adjacent land uses, street/highway design, road authority jurisdiction, and use. ▪ Map and invest in the Minnesota Critical Urban Freight and NDDOT Strategic Freight corridors. ▪ Maintain and update street and highway functional classification consistent with FHWA guidelines for mileage by classification, and to reflect the regional definitions established as part of the planning process. ▪ Regularly update and implement access management guidelines for the region's street and highway system.

Table 2-11: Performance Measures and Monitoring Activities for Goal 5 Integration and Connectivity

Performance Measures	Performance Target
1. Daily vehicle miles traveled	▪ By 2045, reduce daily vehicle miles traveled per capita by 10 percent below 2010 levels. A reduction of approximately 2,885 daily vehicle miles traveled is needed every year.

Action Initiatives

- Maintain a functional classification system that identifies the proper adjacent land uses, access control, traffic signal spacing and truck routes.
- Assess land use plans to examine how they affect transportation.

Monitoring Activities

Annually

- Measure the amount of new streets and lane miles added within the region by functional classification.
- Track growth corridors through building permits and platting activities.
- Track land development patterns and map potential compact developments that may be supported by multimodal transportation.
- Review all development proposals.
- Obtain daily vehicle miles travelled data.

Every 5 Years

- Collaborate with local agencies to track the outward expansion of development through statistical and visual means.
- Assist in the update in land use plan.

Goal 6: Efficient System Management

Goal statement: Promote efficient system management and operation by increasing collaboration among federal, state, local government to better target investments and improve accountability.

Table 2-12: Objectives and Standards for Goal 6 Efficient System Management

Objective	Standards
1. Implement best practice programming and innovative financing alternatives.	▪ Include inflation in project cost estimates and report project costs for the forecast year(s) of expenditure. ▪ Identify, track, and pursue alternate funding sources and financing tools to fund local transportation projects, maintenance, and operations. Innovative funding alternatives may include public/private partnerships. ▪ For projects significantly benefitting private entities, develop and implement a cost sharing model to help fund street or highway projects. ▪ Assess developers for the costs of street and highway improvements associated with new developments, where appropriate.
2. Involve all local partners in the transportation planning process.	▪ Collaborate with economic development, transit providers, housing providers, workforce, and other agencies whose clients impact the transportation network to deliver projects that benefit people, businesses, and freight. ▪ Participate and invite nontraditional partners in the transportation planning process. ▪ Execute agreements necessary (e.g., MOUs, cost sharing, service contracts, etc.) to facilitate regional traffic management strategies. ▪ Incorporate environmental stewardship considerations and environmental agency coordination into the planning and implementation of transportation improvements. ▪ Collaborate with local and state agencies in setting performance measures and targets for urban and rural areas.
3. Cooperate across jurisdictional boundaries to create an integrated transportation network.	▪ Establish multijurisdictional protocols for special events (e.g., events and parades). ▪ Encourage region-wide coordination among traffic, emergency, and maintenance agencies (e.g., police, fire, DOTs, and public works). ▪ Continue to develop and maintain a regional travel demand forecast model for use in forecasting future corridor levels of service. ▪ Encourage member jurisdictions to continue participation in the GF/EGF MPO's transportation planning activities.
4. Maintain and update the regional ITS architecture	▪ Implement, where applicable, Active Transportation Demand Management techniques using existing and/or new ITS infrastructure. ▪ Develop and implement coordinated signal timings between jurisdictions and along new corridors. ▪ invest in ITS infrastructure that can record travel times, traffic volumes, turning movements, and other various data points. ▪ Implement, where appropriate, monitoring systems as part of transportation facilities, such as bridges that monitor fatigue, tampering, or failure

Table 2-13: Performance Measures and Monitoring Activities for Goal 6 Efficient System Management

Performance Measures	Performance Target
1. Comparison of programmed dollar amounts to actual obligated dollar amounts.	▪ Have no greater than 25 percent variance when comparing programmed dollar amounts to the actual obligated dollar amounts for projects listed in the GF/EGF MPO TIP.
2. Public Participation Plan - attendance at meetings, prior notice, key points of decision.	▪ Increase the effectiveness of the GF/EGF MPO Public Participation Plan in informing, education and engaging the public in transportation decisions.

Action Initiatives

- None

Monitoring Activities

Annually

- Compare the actual project expenditures to the amounts programed in the local and state investment plans (e.g., CIPs and STIPs). These comparisons should assist in determining whether cost adjustments may be appropriate in the annual listing of obligations identified in the TIP.
- Evaluate the cost sharing opportunities for transportation projects.
- Conduct a customer satisfaction survey through various means of outreach (e.g., online, mailings and open houses). This activity should be done on an annual or bi-annual basis.
- Compare annually the amount of obligated funds to actual expenditures for projects listed in the GF/EGF MPO TIP.

Every 5 Years

- Evaluate the GF/EGF MPO's Public Participation Plan and its effectiveness under federal and state guidelines to engage community members and stakeholders from various groups.
- Evaluate the Long Range Transportation Plan for its effectiveness in public-private partnerships.
- Evaluate the Financial Planning Forecast in the LRTP.

Goal 7: System Preservation

Goal statement: Emphasize the preservation of the existing transportation system by first targeting federal funds towards existing infrastructure to spur revitalization, promote urban landscapes and protect rural landscapes.

Table 2-14: Objectives and Standards for Goal 7 System Preservation

Objective	Standards
1. Identify sufficient funding for the program of projects included in GF/EGF MPO transportation plans.	▪ Inform project finance planning and fiscal constraints by identifying all available funding amounts and their sources. ▪ Identify funding that can be used for operations, maintenance, and facility construction. ▪ Assign more likely construction, operation, and maintenance funding to near-term projects. ▪ Document funding used for "State of Good Repair" projects and document whether a "State of Good Repair" for the federal transportation system can be currently maintained. ▪ Provide technical assistance to local jurisdictions in applying for state and federal funding programs.
2. Cost-effectively preserve, maintain, and improve the existing street and highway system.	▪ Maintain pavement, signal systems, signage, striping and other features of the transportation system to a level that permits safe and multimodal traffic operations. ▪ Continue pavement management programs that include monitoring, reporting, and integrating reporting across jurisdictions. ▪ Continue implementing appropriate preventative maintenance, rehabilitation, or reconstruction projects. Partners will identify projects based on pavement needs documented in an objective and measurable prioritization matrix, and will include elements that improve travel efficiency as identified through the congestion management process. ▪ Develop a life-cycle cost analysis of pavement type done for projects with cost estimates over $2,500,000. (note to reviewers: $2.5 million needs to be updated based on Asset Management plans) ▪ Identify and implement, where appropriate, new pavement technologies. ▪ When developing the transportation improvement program (TIP), prioritize improvement of the existing transportation network over construction of new infrastructure.

Table 2-15: Performance Measures and Monitoring Activities for Goal 7 System Preservation

Performance Measures	MPO Performance Target
1. Percent of Interstate pavement in good condition	▪ 75.6%
2. Percent of Interstate pavement in poor condition	▪ 3%

Performance Measures	MPO Performance Target
3. Percent of non-Interstate NHS pavement in good condition	North Dakota ■ 58.3% Minnesota ■ Two-year target: 50% ■ Four-year target: 50%
4. Percent of non-Interstate NHS pavement in poor condition	North Dakota ■ 3% Minnesota ■ Two-year target: 4% ■ Four-year target: 4%
5. Percent of NHS Bridges in good condition	North Dakota ■ 60% Minnesota ■ Two-year target: 50% ■ Four-year target: 50%
6. Percent of NHS bridges in poor condition	North Dakota ■ 4% Minnesota ■ Two-year target: 4% ■ Four-year target: 4%

Action Initiatives

- Develop a common pavement condition reporting system for the Interstate and non-Interstate National Highway System in North Dakota and Minnesota
- Maintain and update the Pavement Management Systems for the metro area so it can be utilized to guide decisions on which type of pavement work makes best use of funds available to ensure state of good repair and reduce yearly average maintenance costs by evaluating the effectiveness and cost-benefit of preservation and maintenance projects.
- Incorporate and evaluate bridge inspection reports into biennial performance reports.

Monitoring Activities

Annually

- Track the number "ride-quality deficient roadway" miles and "distress deficient roadway" miles in the GF/EGF region and compare to overall Grand Forks County, Polk County, MnDOT and NDDOT system.
- Track the percentage of federal funds programs that is put toward existing and new infrastructure.

Every 2 Years

- Review bridge inspection report.

Every 5 Years

- Update pavement system for metro area.

- Evaluate Transportation Improvement Programs (TIP)/State LRTP projects to determine their effectiveness in achieving system preservation.

Goal 8: Safety

Goal statement: Increase safety of the transportation system for motorized and non-motorized uses.

Table 2-16: Update Objectives and Standards for Goal 8 Safety

Objective	Standards
1. Keep vehicles from encroaching on the roadside in rural areas	■ Continue to install shoulder rumble strips, edge lines, "profile marking" edge line rumble strips, modified shoulder rumble strips, 6-inch edge lines, or embedded wet-reflective pavement markings on section with narrow or no paved shoulders. ■ Continue to install enhanced shoulders, lighting, delineation (for example, Chevrons), or pavement markings for sharp horizontal curves in rural areas. ■ Continue to install improved highway geometry for horizontal curves. ■ Increase skid-resistance pavement surfaces. ■ Continue to install shoulder treatments. ■ Eliminate shoulder drop-offs from paved road to unpaved shoulder. ■ Shoulder edge. ■ Widen and/or pave shoulders.
2. Minimize the likelihood of crashing into an object or overturning if the vehicle travels off the shoulder in rural areas	■ Continue to install safer slopes and ditches to prevent rollovers. ■ Remove/relocate objects in hazardous locations.
3. Reduce the likelihood of a head-on vehicle collision in rural areas	■ Continue to install centerline rumble strips and 6-inch center lines for two-lane rural roads. ■ Continue operation of alternating passing lanes or four-lane sections at key locations. ■ Continue to install cable median barrier for narrow-width medians and multilane roads. ■ Continue operation of buffer space between opposite travel directions. ■ Continue to install directional medians.
4. Reduce frequency and severity of intersection conflicts through traffic control and operational improvements in urban areas	■ Continue operation of multiphase signal operation. ■ Optimize clearance intervals. ■ Restrict or eliminate turning maneuvers (including right turns on red). ■ Continue operation of signal coordination along a corridor or route. ■ Continue operation of emergency vehicle preemption ■ Continue to install countdown timers, advanced walk phase, and other low-cost pedestrian/bicycle facility improvements. ■ Remove unwarranted signals. ■ Continue to supplement conventional red-light running enforcement with traffic signal confirmation lights and other technology enhancements that support enforcement efforts.
5. Reduce the severity of the crash	■ Continue to improve design and applications of barrier and systems to maintain flow of traffic.

Objective	Standards
6. Improve efficiency and effectiveness of aggressive driving/speed enforcement efforts	▪ Strengthen speed detection and public perceived risk of being stopped and ticketed through sustained, well-publicized, highly visible speed enforcement campaigns. ▪ Conduct highly visible, publicized and saturated enforcement campaigns at locations with higher incidence of aggressive driving/speed related crashes. ▪ Enact/support legislation to strengthen penalties such as increased fines for right-of-way and speed violations. ▪ Strengthen the adjudication of speeding citations to enhance the deterrent effect of fines. ▪ Address the perception of widespread speeding by heavy vehicles by first conducting a statewide assessment of commercial vehicle speeds. In response to the assessment results, examine enforcement, safety education, and outreach safety strategies for priority regions or corridors identified as needing improvement.
7. Review crash data	▪ Continue to analyze data to clearly define aggressive driving and identify factors contributing to aggressive driving.
8. Set and communicate appropriate speed limits	▪ Continue to implement active speed warning signs, including dynamic message boards at rural to urban transitions, school zones, and work zones. ▪ Continue operation of in-pavement measures to communicate the need to reduce speeds.
9. Ensure that roadway design and traffic control elements support appropriate and safe speeds	▪ Effect safe speed transitions through design elements and on approaches to lower speed areas.
10. Improve sight distance at signalized and unsignalized intersections	▪ Continue to clear sight triangles. ▪ Redesign intersection approaches. ▪ Change horizontal and/or vertical alignment of approaches to provide more sight distance. ▪ Eliminate parking that restricts sight distance.
11. Improve driver awareness of intersections and signal control	▪ Continue to improve visibility of intersections by providing enhanced signing, delineating, overhead indications, 12-inch lenses, background shields, or pavement markings/messages. ▪ Continue to call attention to intersections by installing rumble strips on intersection approaches. ▪ Continue to improve visibility of intersections by providing appropriate street lighting. ▪ Continue to install larger regulatory and warning signs at intersections, including the use of dynamic warning signs at appropriate intersections. ▪ Continue to provide dashed markings (extended left edge lines) for major road continuity across the median opening at divided highway intersections.

Objective	Standards
12. Improve management of access near signalized and unsignalized intersections	▪ Continue to restrict or eliminate parking on intersection approaches. ▪ Expand driveway closure/relocations. ▪ Provide longer left-turn lanes at intersections. ▪ Expand driveway turn restrictions. ▪ Continue to install left-turn lanes at intersections. ▪ Continue to offset left-turn lanes at intersections. ▪ Continue to install bypass lanes on shoulders at T-intersections. ▪ Continue to provide acceleration lanes at divided highway intersections. ▪ Continue to install right-turn lanes at intersections. ▪ Continue to offset right-turn lanes at intersections. ▪ Expand to provide right-turn acceleration lanes at intersections. ▪ Expand channelized or closed median openings to restrict or eliminate turning maneuvers. ▪ Close or relocate "high-risk" intersections. ▪ Continue to convert four-legged intersections to two T-intersections. ▪ Realign intersection approaches to reduce or eliminate intersection skew. ▪ Continue to improve pedestrian and bicycle facilities to reduce conflict between motorists and nonmotorized travelers. ▪ Convert 2-lane intersection to 3-lane intersection.
13. Choose appropriate intersection traffic control to minimize crash frequency and severity	▪ Continue to construct roundabouts at appropriate locations. ▪ Currently occurring at intersections in Grand Forks: 23th St & 40th Ave S, 34th St & 24th Ave. ▪
14. Improve the roadway and driving environment to better accommodate drivers' needs	▪ Expand the use of advanced guide signs and street name signs. ▪ Continue to increase sign and letter heights of roadway signs. ▪ Provide more all-red clearance intervals at signalized intersections. ▪ Provide more protected left-turn signal phases at high-volume intersections. ▪ Continue to improve lighting at intersections, horizontal curves, and railroad grade crossings. ▪ Continue to improve roadway delineation. ▪ Continue to reduce intersection skew angle.
15. Improve Sight Distance and/or Visibility Between Motor Vehicles and Pedestrians/Bicyclists	▪ Continue to provide crosswalk enhancements. ▪ Continue to implement lighting/crosswalk illumination measures ▪ Continue to eliminate screening by physical objects. ▪ Expand signals to alert motorists that pedestrians/bicyclists are crossing. ▪ Continue to improve reflectivity/visibility of pedestrians/bicyclists.
16. Reduce Vehicle Speed	▪ Continue to implement road narrowing measures. ▪ Continue to install traffic calming—road sections. ▪ Continue to install traffic calming—intersections. ▪ Continue to provide school route improvements.
17. Improve Motorist Safety Awareness and Behavior	▪ Continue to provide education, outreach, and training. ▪ Continue to implement enforcement campaigns.
18. Reduce Effect of Hazards	▪ Fix or remove surface irregularities. ▪ Provide routine maintenance of bicycle facilities.

Objective	Standards
19. Implement a multimodal transportation system that is balanced and integrated with all transportation modes to ensure safe and efficient movement of people and goods	▪ Minimize congestion on roadways and at intersections. ▪ Maintain roadway and other Level of Service standards consistent with regional, county, and municipal comprehensive plans. ▪ Provide a balanced system with viable multi-modal options that are consistent with local comprehensive plans. ▪ Provide infrastructure that supports transportation (transit riders, pedestrians, bicyclists and other alternative transportation modes). ▪ Improve intermodal connectivity and access to intermodal facilities (e.g., airports, transit centers, Interstate bus system, rail, etc.) and activity centers. ▪ Provide more sidewalks and bikeways. ▪ Improve public transit services so they are efficient, frequent, reliable, convenient, safe, easy to use and understand, and promotes other intermodal uses.
20. Increase the safety and security of the transportation system for motorized and non-motorized users	▪ Provide for safer travel by all transportation modes, including pedestrian, bicycling, transit, and automobile. ▪ Encourage measures that reduce congestion. ▪ Encourage strategies that improve emergency response to crash.
21. Reduce the number, severity, and rate of crashes compared to previous years by type of vehicle and transportation facility.	▪ Identify and maintain a database and map of frequent or severe crash locations by transportation facility within the MPO area (intersections, road segment, bicycle/pedestrian facility, and bicycle/pedestrian – vehicle conflict point). The database will include number, type, and severity of crashes. ▪ Identify and implement, where possible, intersection treatments that reduce crashes. ▪ Support policies that prohibit/penalize distracted driving. ▪ Identify funding available to improve the safety of the roadway system. ▪ Coordinate with local, county, and state agencies to develop education, public health, engineering, and enforcement strategies targeted at crash reduction. ▪ Support the region's vision of moving toward zero traffic fatalities and serious injuries, which includes supporting educational and enforcement programs to increase awareness of regional safety issues, shared responsibility, and safe behavior.

Table 2-17: Performance Measures and Monitoring Activities for Goal 8 Safety

Performance Measures	Performance Target
1. Number of traffic fatalities	▪ 3 or fewer traffic fatalities by 2018 ▪ No change in trend
2. Number of fatalities per 100 million vehicle miles traveled	▪ 0.673/mvmt or lower by 2018 ▪ No change in trend
3. Number of crash-related serious injuries	▪ 18 or fewer serious injuries by 2018 ▪ Decline in trend

Performance Measures	Performance Target
4. Number of serious injuries per 100 million vehicle miles traveled	▪ 5.933/mvmt or lower by 2018 ▪ Decline in trend
5. Number of non-motorized fatalities and non-motorized serious injuries	▪ 3 or fewer non-motorized fatal and serious injury crashes by 2018 ▪ Decline in trend

Action Initiatives

- Adopt Vision Zero by 2045
- Update state-, county-, and local-level strategic highway safety plans in cooperation with the MPO
- Conduct travel training as needed

Monitoring Activities

Annually

- Establish safety performance targets in cooperation with state DOTs and local road authorities
- Evaluate intersection crash frequency for all nodes with significant commuter and freight traffic volumes, and compare to critical crash rates.
- Evaluate crash severities.
- Review crash data.
- Identify vehicle crash locations that would benefit from changes in traffic or pedestrian signal operations, raised medians, street lights, and signage.
- Evaluate Highway Safety Improvement Program (HSIP) priorities and their effectiveness in addressing GF/EGF MPO safety needs.
- Report the number of times travel training programs were conducted.

Every 5 Years

- Evaluate Transportation Improvement Programs (TIP)/State LRTP projects to determine their effectiveness in achieving safer roadway system.

Goal 9: Resiliency and Reliability

Goal statement: Improve resiliency and reliability of the transportation system and reduce or mitigate stormwater impacts of surface transportation.

Table 2-18: Objectives and Standards for Goal 9 Resiliency

Objective	Standards
1. Reduce street and highway system vulnerability to snow and storm water	▪ Maintain passable streets and highways under all reasonable weather conditions. ▪ Strategically design and maintain the street and highway system to operate under all reasonable weather conditions. ▪ Assess and mitigate any possible impacts new roadway construction may have on high water events, including proximity to waterways, construction in wetlands or floodways, storm drainage, etc.
2. Support the region's resilience and travel reliability through efficient detour and evacuation routes	▪ During river flood events, reroute traffic consistent with the Bridge Closure Management Plan, or revised to respond to significant, observed delays or changes. ▪ Be trained in and use established alternate routes and intelligent transportation systems (ITS) to maintain street and highway operations during incidents and temporary street or highway blockages. ▪ Provide auxiliary power sources to operate traffic signals when mainline power is interrupted.

Action Initiatives

- Establish agreements with local agencies on reporting closures and time length of closure.

Monitoring Activities

Annually

- Monitor the weather-related closure interruptions.
- Identify locations experiencing frequent closure.

Every 5 Years

- Update Bridge Closure Management Plan.
- Develop a Traffic Incident Management Plan.

Goal 10: Tourism

Goal statement: Enhance travel and tourism.

Table 2-19: Objectives and Standards for Goal 10 Tourism

Objective	Standards
1. Maintain convenient and intuitive street and highway access to major activity centers	■ Develop and use event traffic management plans for major activity centers such as the Alerus Center, Ralph Engelstad Arena, and Greater Grand Forks Greenway including the Red River State Recreation Campground. ■ Identify, coordinate, and communicate traffic plans for simultaneous events.

Action Initiatives

- Develop agreements for data on event traffic management plans.

Monitoring Activities

Annually

- Assemble report on event traffic results.

Every 5 Years

- Review and update as needed any event traffic management plans.

Chapter 3. Existing Conditions

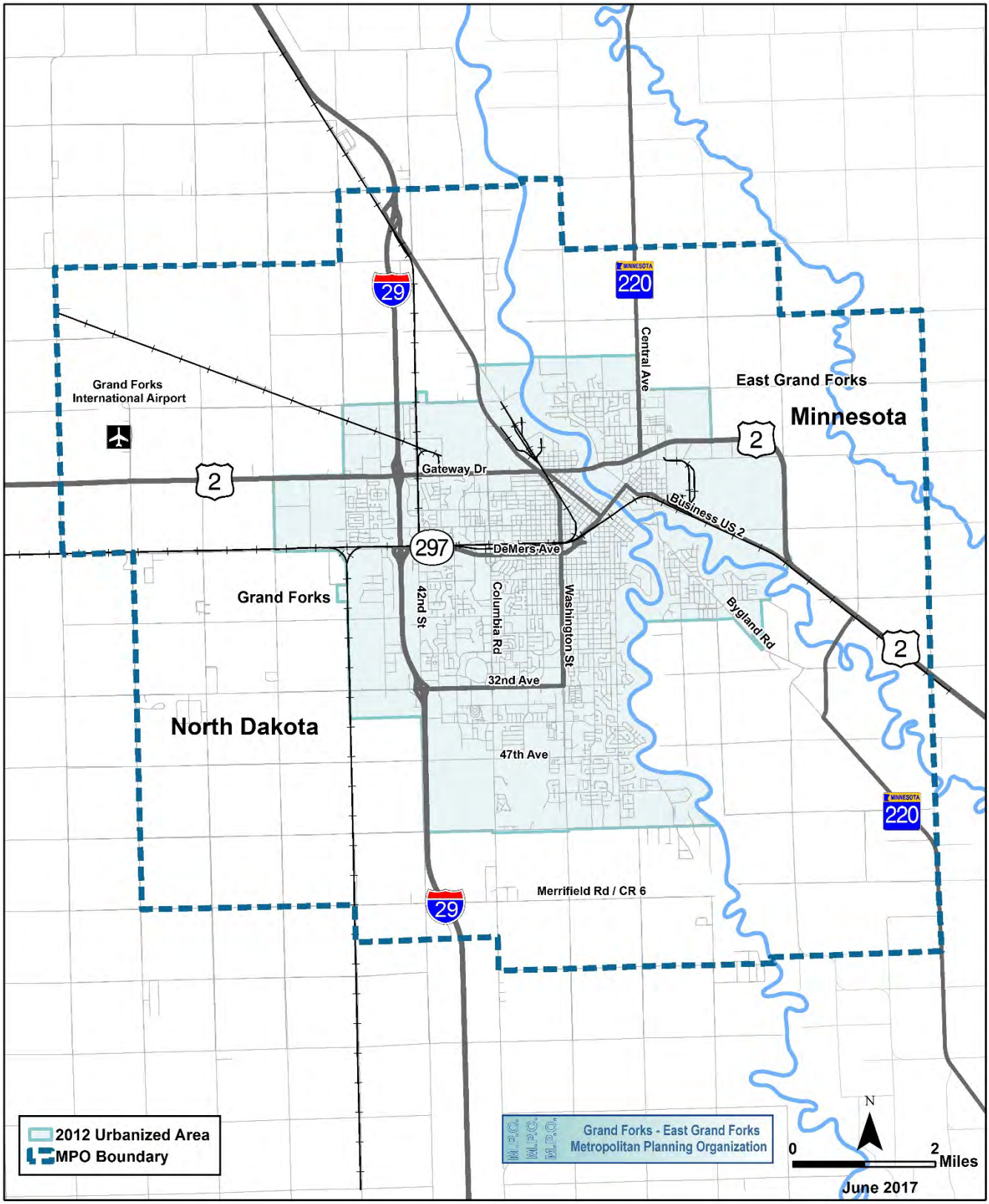
This chapter summarizes existing street/highway conditions for the Grand Forks-East Grand Forks Metropolitan Planning Organization (MPO) area. Planning for the long-term needs of the MPO's street and highway system requires a solid understanding of the various inputs and characteristics that define the function of the current system. Several topics including demographics and land use, street/highway system characteristics, traffic and safety patterns, freight networks, and a summary of recommendations from recent studies are discussed.

Demographics and Land Use

Located in northeast North Dakota and northwest Minnesota, the MPO planning area encompasses the cities of Grand Forks, ND and East Grand Forks, MN. It also includes areas beyond each city that are anticipated to be urbanized it the next 20-years in Grand Forks County, ND and Polk County, MN. See Figure 3-13 for the MPO planning area.

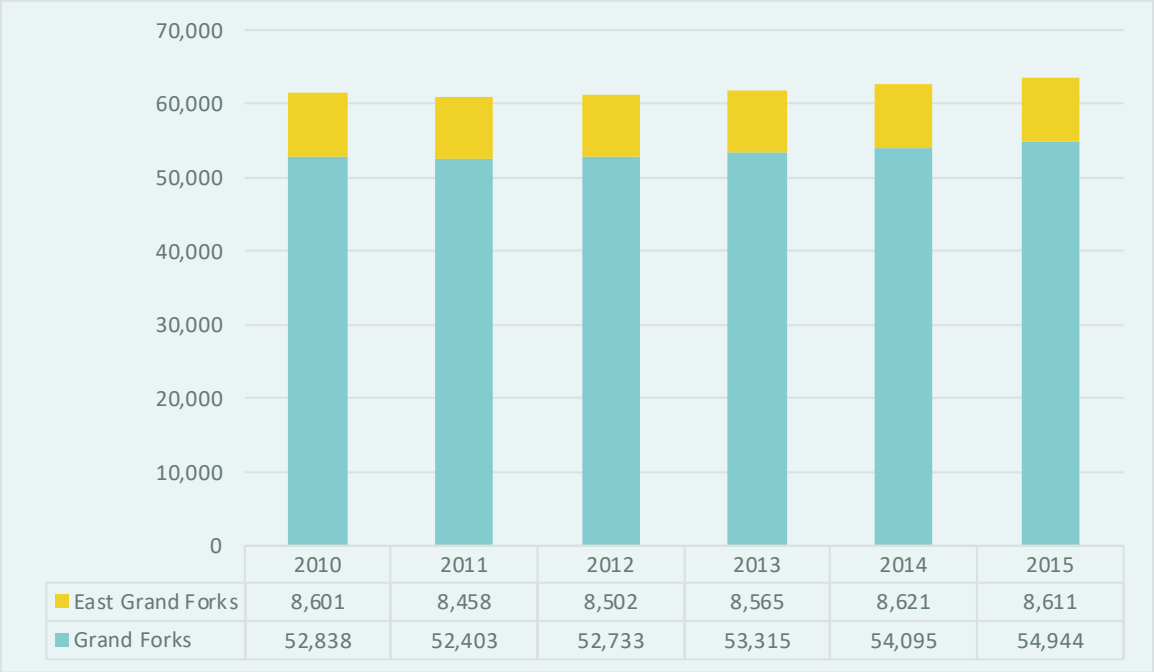
According to the U.S. Census (2010), the populations for the cities of Grand Forks and East Grand Forks were 52,838 and 8,602, respectively. Since 2010, Grand Forks has increased its population by four percent while East Grand Forks has remained close to the 2010 estimate. The 2015 American Community Survey estimates the Grand Forks population at 54,944 and the East Grand Forks population at 8,611; a combined population of 63,555. See Figure 3-2 for population estimates in both cities between 2010 and 2015.

Figure 3-13: MPO Planning Area



Source: Grand Forks-East Grand Forks MPO

Figure 3-2: Grand Forks and East Grand Forks Populations, 2010 to 2015



Source: US Census, American Community Survey

Table 3-1 provides population forecasts to the year 2045 identified in recently adopted land use plans for the cities of Grand Forks and East Grand Forks. The Grand Forks population forecasts are based upon a 1.2 percent annual growth rate, and the East Grand Forks population forecasts are based upon a 0.9 percent annual growth rate. In total, the region's population is forecasted to increase by approximately 39 percent between 2015 and 2045.

Table 3-1: Population Forecasts

City	2010 (US Census)	2015 ACS Estimate	2025	2035	2045
Grand Forks	52,838	54,944	60,247*	67,879*	76,479*
East Grand Forks	8,601	8,611	9,841^	10,764^	11,773^
Total	61,439	63,555	70,088	78,643	88,252

*1.2 percent growth rate assumed per 2045 Grand Forks Land Use Plan

^0.9 percent growth rate assumed per 2045 East Grand Forks Land Use Plan

Source: 2045 Grand Forks Land Use Plan, East Grand Forks 2045 Land Use Plan

Race

Racial composition for both Grand Forks and East Grand Forks is predominantly white (90.7 and 94.9 percent, respectively), as shown in Table 3-2. While minority populations remain low overall, these populations have increased since 2000 in Grand Forks and remained near similar levels in East Grand Forks.

Table 3-2: Race Composition Percentage

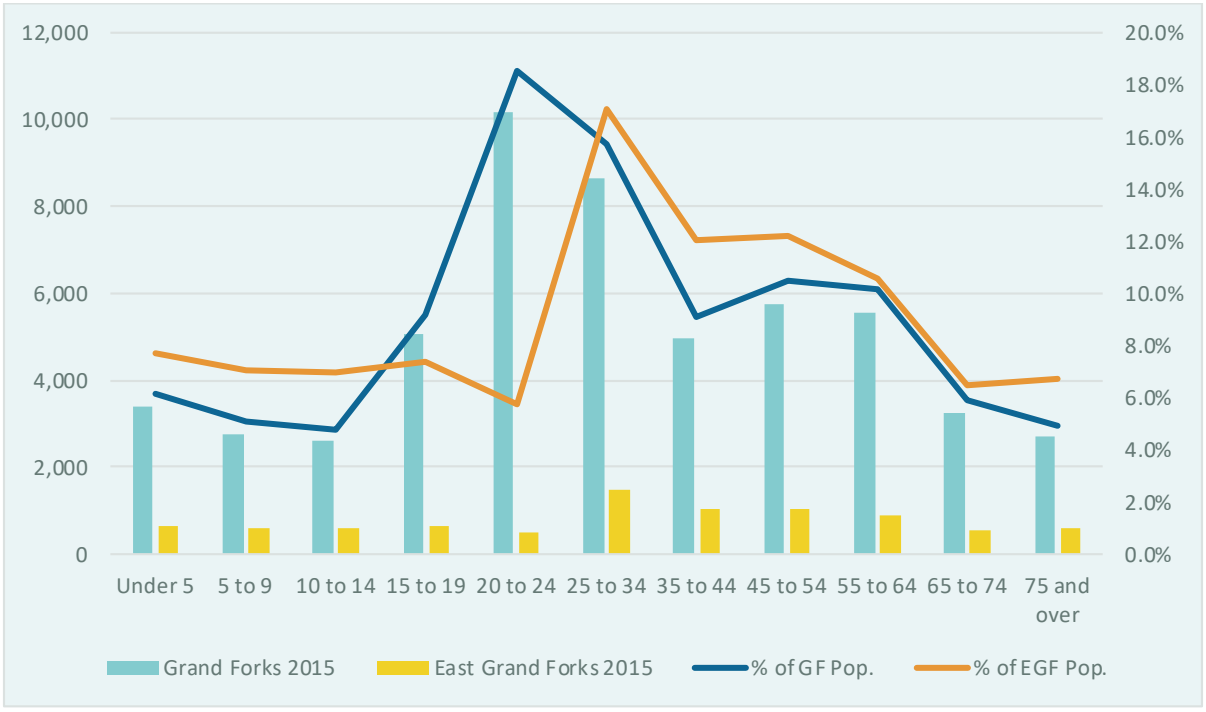
City	White	Black or African American	American Indian and Alaska Native	Asian	Native Hawaiian and Other Pacific	Some other race
Grand Forks	90.7%	3.7%	4.7%	3.2%	0.2%	1.1%
East Grand Forks	94.9%	3.7%	3.3%	1.4%	0.1%	0.6%

Source: 2015 American Community Survey

Age

Grand Forks and East Grand Forks are younger than the United States and their respective state average. The median age is 37.6 years in the United States, 35.4 years in North Dakota, and 37.7 years in Minnesota. In comparison, the median age in Grand Forks is just 28.5 years while in East Grand Forks it is 34.1 years. With the University of North Dakota located in Grand Forks, a younger median adult population is expected. Since 2000, the age groups that have seen the largest percentage of increase are young adults (age 20-35) and senior citizens (age 55+). The aging baby boomer population is expected to have a major impact on the transportation network at the regional and national level. As the elderly age, they become less mobile and more reliant on family, friends, taxis, and public transportation to get around. This, along with recent trends in technology and retail, may result in increases in delivery and on-demand services, such as home delivery of everything from medication to groceries.

Figure 3-3: Age Group



Source: 2015 American Community Survey

Income

According to the 2015 American Community Survey (US Census Bureau), the median household income in Grand Forks is $46,149, while in East Grand Forks the median household income is $55,590. Both Grand Forks

and East Grand Forks have lower median household incomes compared to their respective states ($57,181 for North Dakota and $61,492 for Minnesota).

In terms of poverty, 20 percent of all Grand Forks residents have incomes below the poverty line, compared to 10.6 percent in East Grand Forks. Both states have about 11.5 percent of individuals below the poverty level. The income and poverty levels for Grand Forks may be reflective of the high number of college students present in the community. These individuals commonly hold part-time and lower income jobs as they work though school.

Environmental Justice

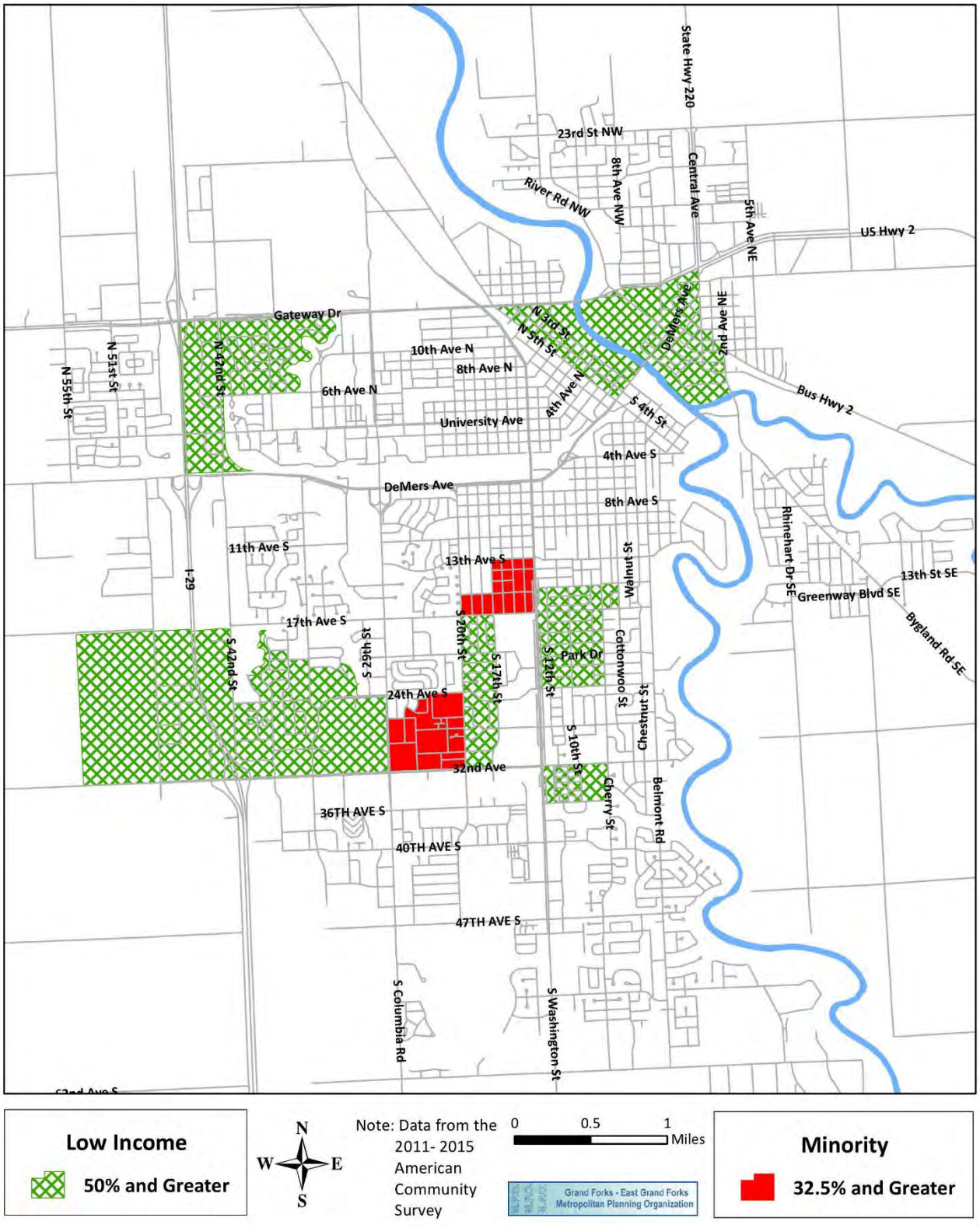
Executive Order 12898 directs Federal agencies to take appropriate and necessary steps to identify and address disproportionately high and adverse effects of Federal projects, including the transportation planning process, on the health or environment of minority and low-income populations to the greatest extent practical and permitted by law. USDOT Order 5610.2(a) sets forth the USDOT policy to consider environmental justice (EJ) principles in all (USDOT) programs, policies, and activities. It describes how the objectives of EJ will be integrated into planning and programming, rulemaking, and policy formulation. The Order sets forth steps to prevent disproportionately high and adverse effects to minority or low-income populations through Title VI analyses and EJ analyses conducted as part of Federal transportation planning and NEPA provisions. Disproportionate is defined in two ways: the impact is predominantly borne by the minority or low income population group, or the impact is appreciably more severe than that experienced by non-minority or non-low income populations.

The MPO addresses Environmental Justice to ensure non-discrimination concerning enacted transportation-related laws, regulations, and policies. The MPO has developed an Environmental Justice Program Manual designed to provide guidance in meeting EJ mandates and structuring a public participation plan at the project or study level. To certify compliance with, and to address environmental justice, the MPO:

- Identifies residential, employment, and transportation patterns of low-income and minority populations so that their needs can be identified and addressed, and the benefits and burdens of transportation investments can be fairly distributed.
- Ensures that the long-range transportation plan and the transportation improvement program (TIP) comply with the tenets of Environmental Justice.
- Utilizes public involvement processes to eliminate participation barriers and engage minority and low income populations in transportation decision making.

According to the most recent Environmental Justice Program Manual, minority populations in Grand Forks were most concentrated east of Columbia Mall between 24th Avenue South and 32nd Avenue South and north of Grand Cities Mall between 13th Avenue South and 17th Avenue South. Concentrations of poverty greater than 50 percent are also located near the two shopping centers, as well as near both downtown areas. See Figure 3-4 for the Environmental Justice Populations map. These areas will be evaluated further to determine whether any disproportionate or adverse effects would occur due to the Range of Alternatives and potential future regionally-significant transportation improvements.

Figure 3-4: Environmental Justice Populations



Source: Grand Forks-East Grand Forks MPO

Workplace and Commuting Patterns

According to the 2015 American Community Survey, most people both live and work within the Grand Forks-East Grand Forks urbanized area. With over 35,000 jobs combined in the two cities in 2014, most employment nodes are located within Grand Forks. Major industry sectors include health care, education, retail, hospitality/food services, and manufacturing. The predominant travel mode for employers is the automobile. The mean travel time to work is under 13 minutes for Grand Forks residents and 14.5 minutes for East Grand Forks residents. MPO data indicates approximately 4,000 East Grand Forks residents commute to Grand Forks for work and approximately 4,000 Grand Forks residents commute to East Grand Forks for work.

Table 3-3: Workplace Location and Travel Patterns

	Percent of People that Live and Work in Same City	Percent of People that Live and Work in Same County	Travel to Work via Automobile	Drive Alone	Mean Travel Time to Work
Grand Forks	84.4%	89.7%	90.1%	82.1%	12.9 minutes
East Grand Forks	22.3%	27.5%	94.6%	86.7%	14.5 minutes

Source: 2015 American Community Survey

Land Uses

The recently adopted 2045 Grand Forks Land Use Plan (2016) emphasizes creating a more compact urban environment, encouraging infill development, creating mixed use areas, and coordinating development with the location of urban services. The Plan utilized the federal Ladders of Opportunity Initiative, which builds on the foundations of sustainable and livable communities to connect low-income and minority transit-dependent residents with economic and educational resources that already exist within the Grand Forks community. The Plan supports mixed use, compact development patterns which provide more transportation choices and strives to increase the share of non-automobile trips.

With a focus on more compact development, the 2045 Grand Forks Future Land Use Plan (Figure 3-5 and Figure 3-6) reallocates and reduces overall acreages for the City's growth tiers compared to the 2040 Future Land Use Map. The three-level tier system for managing timing and sequencing of growth includes: Tier 1 (including existing city limits), where all projected growth within the planning horizon will be accommodated; Tier 2 (Urban Reserve Area), which only allows residential development on existing platted lots and if no other Tier 1 land is available; and Tier 3, agricultural preservation area. The 2045 Future Land Use Map is intended to prevent "sprawl" and to create a pattern of development which provides efficient growth creating quality compact urban places including improved accessibility and mobility. Growth is focused primarily to the south and west of the City adjacent to existing land uses.

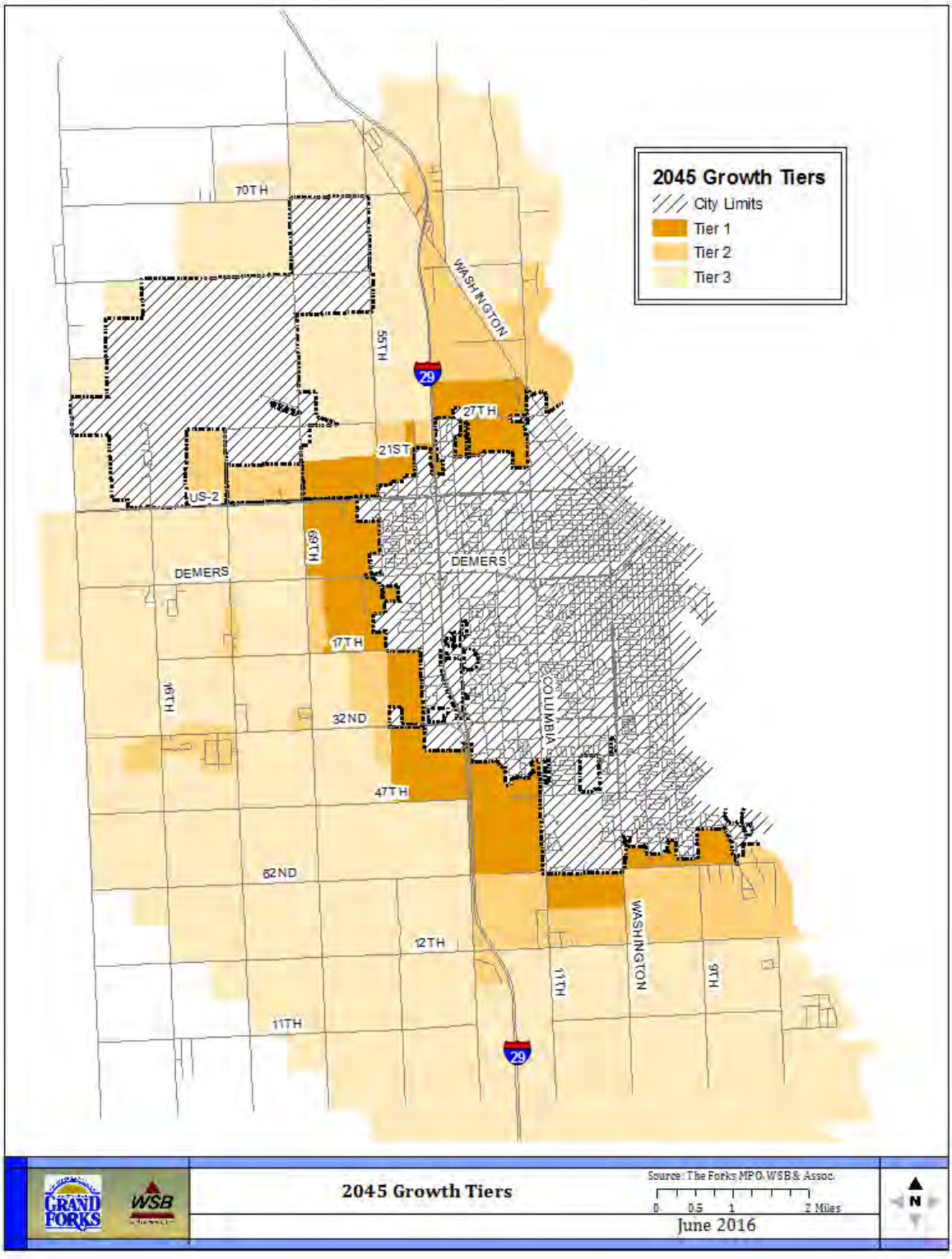
The East Grand Forks 2045 Land Use Plan (Figure 3-7 and Figure 3-8), also recently adopted in 2016, promotes compact, infill development and responsible greenfield development. The City of East Grand Forks utilizes the existing flood protection system as an interim growth boundary, with phased land available to accommodate anticipated growth within the planning horizon. The Plan includes three new land use categories: mixed use, commercial/industrial, and medium density residential. Mixed use districts, whether utilized for infill or greenfield development, will enable the City to become more compact and walkable, provide the choice for a living arrangement that is different from that which dominates in neighborhoods of single-family detached housing, and soften transitions between higher and lower intensity land uses. East Grand Forks growth is focused primarily north along TH 220, to the east along US Highway 2 and also to the south of Rhinehart Drive near the Red River.

Both the 2045 Grand Forks Land Use Plan and the East Grand Forks 2045 Land Use Plan incorporated livability principles into their planning processes in order to enhance the livability of the community while improving access to employment, goods and services. Livable communities provide a mix of affordable housing, increase

transportation options, and lower transportation costs while protecting the environment. Linking transportation and land development results in neighborhoods that are more prosperous, allow people to live closer to jobs, save households time and money, and reduce pollution. The following six principles of livability were utilized as developed by the federal Partnership for Sustainable Communities:

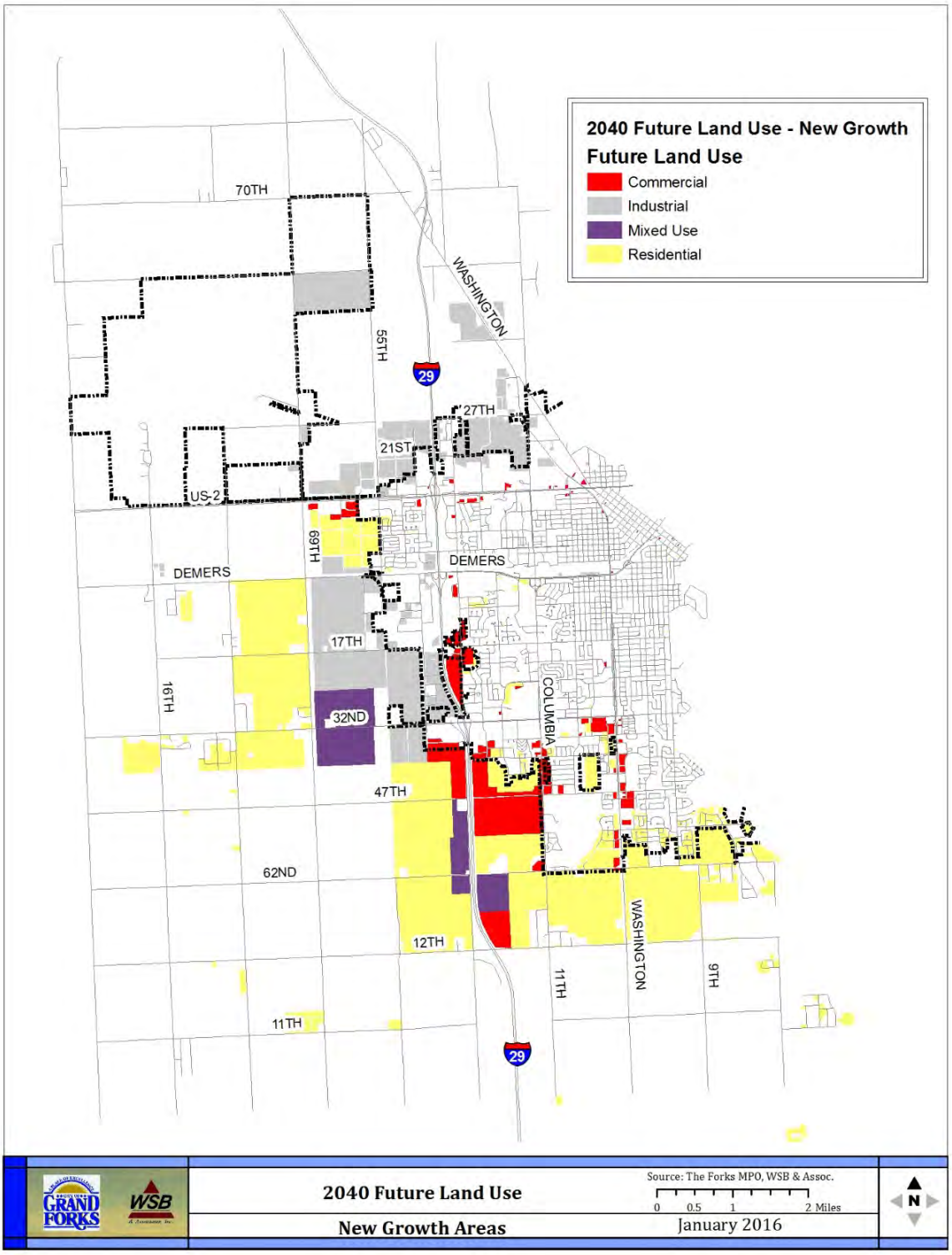
- Provide more transportation choices;
- Promote equitable affordable housing;
- Enhance economic competitiveness;
- Support existing communities
- Coordinate and leverage federal policies and investment; and
- Value communities and neighborhoods.

Figure 3-5: 2045 Grand Forks Future Land Use Growth Tiers



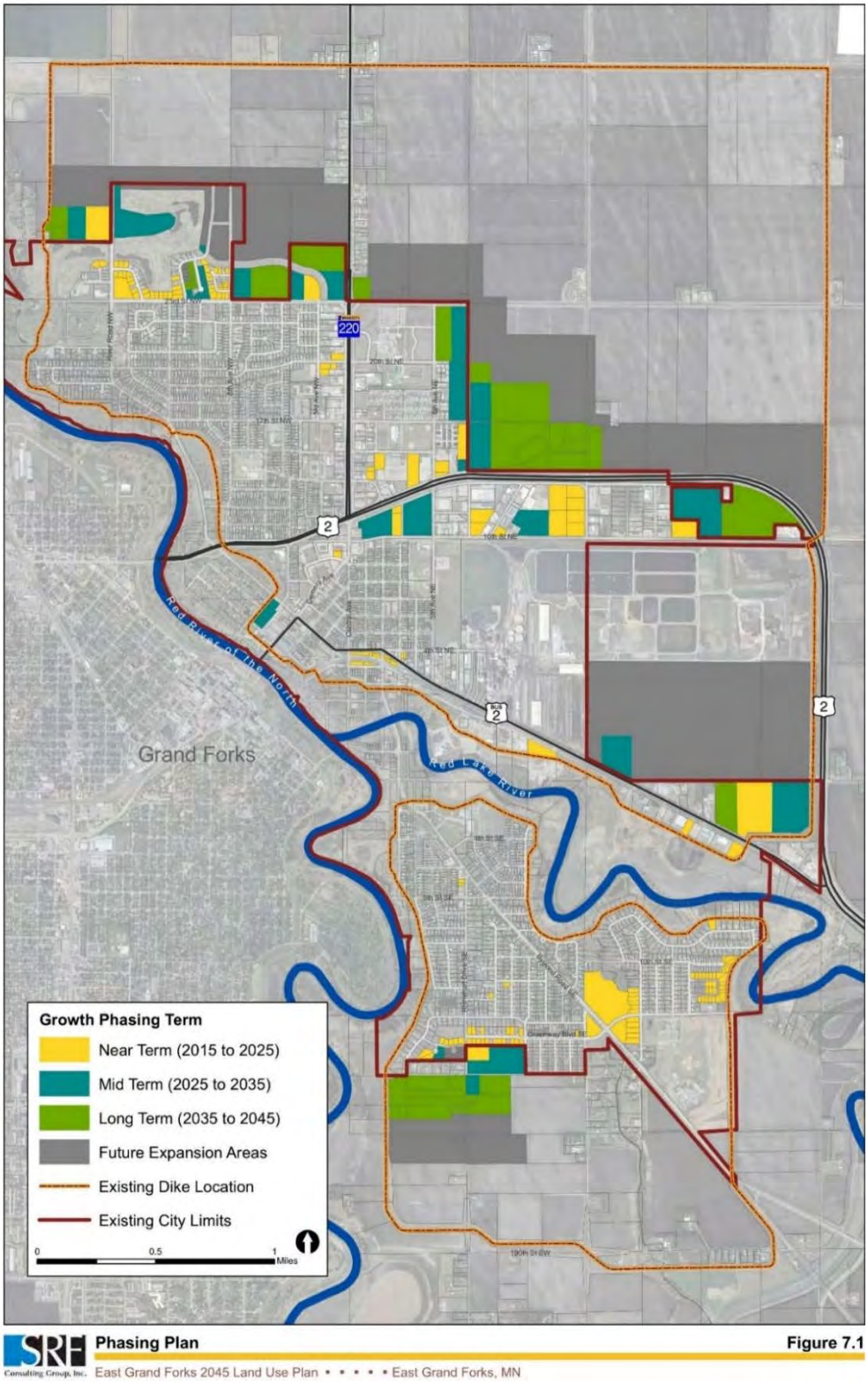
Source: 2045 Grand Forks Land Use Plan

Figure 3-6: 2045 Grand Forks Future Land Use New Growth Areas



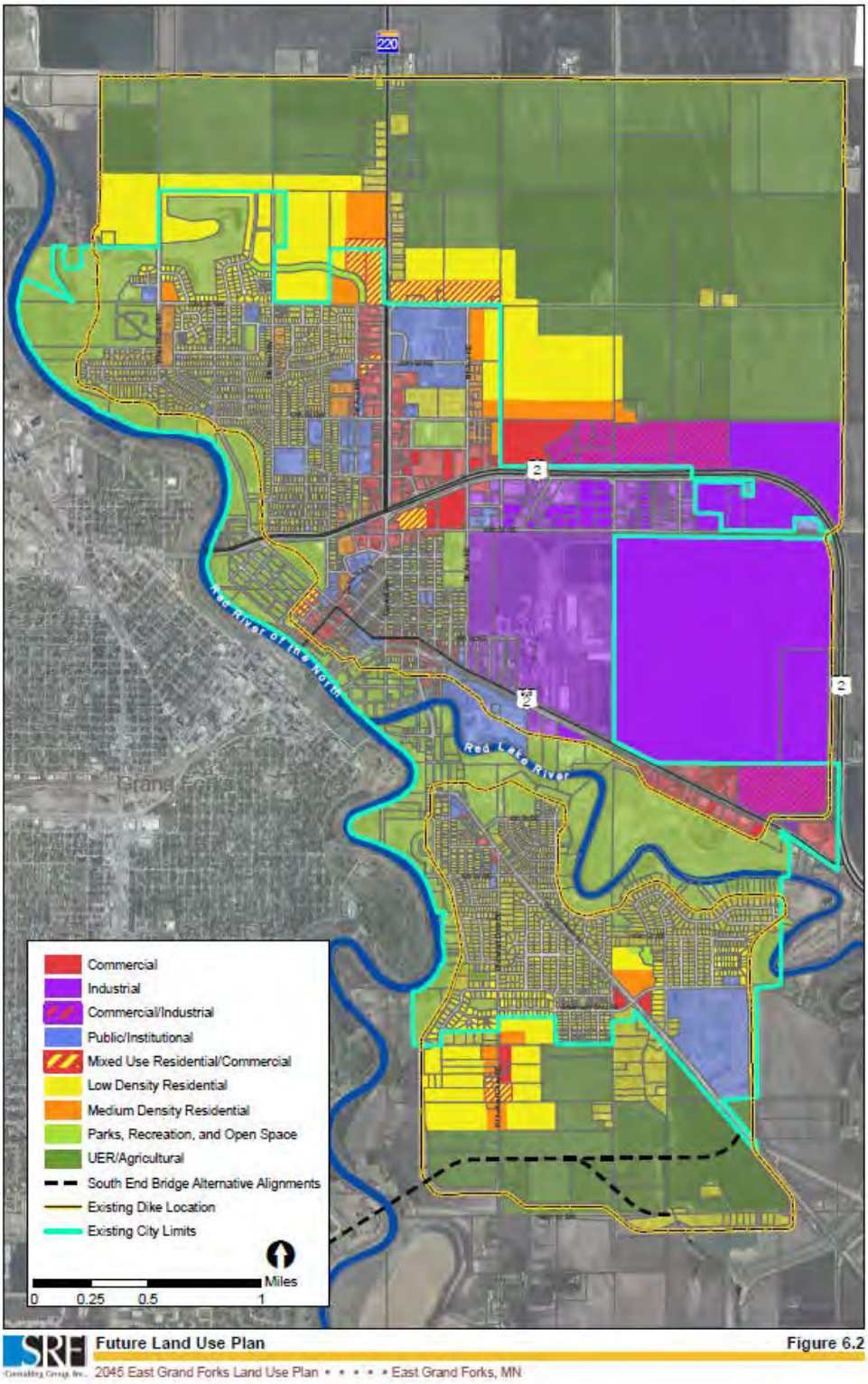
Source: 2045 Grand Forks Land Use Plan

Figure 3-7: East Grand Forks 2045 Future Land Use Growth Phasing



Source: East Grand Forks 2045 Land Use Plan

Figure 3-8: East Grand Forks 2045 Future Land Use



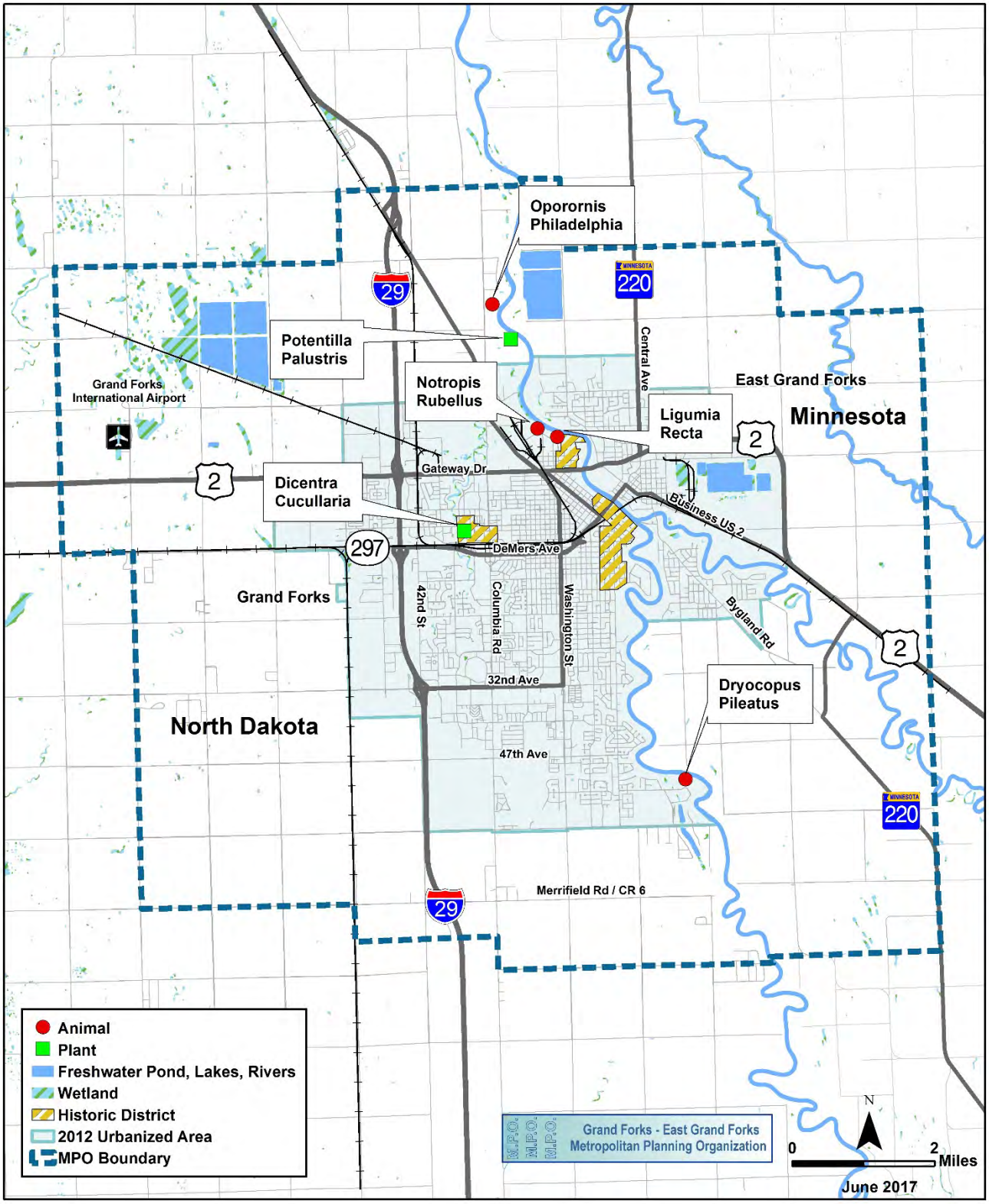
Source: East Grand Forks 2045 Land Use Plan

Natural and Environmental Resources

There are numerous environmentally-sensitive areas found throughout the Grand Forks-East Grand Forks region. An overview of some of the identified sensitive areas, including wetlands, species of concern, and identified cultural sites, is provided in Figure 3-9.

Many of these sensitive areas are too small or too numerous to map at a metropolitan-level and can only be clearly identified through a project-level analysis. Some areas are yet to be identified and will only become known once a project-level analysis is completed. When a programmed project is ready to move into the design and engineering phase, the project sponsor will be responsible for conducting the necessary analyses as required by state and federal regulations to determine the type, location, and impact to environmentally sensitive areas within the project study area.

Figure 3-9: Environmental Constraints



Source: Grand Forks-East Grand Forks MPO

Carbon Footprint

A pound of carbon dioxide (CO_2) emitted today from a gas powered motorized vehicle may still be in the atmosphere decades to hundreds of years from now. Therefore, measuring greenhouse gases associated with transportation systems is closely linked to CO_2. However, this level of assessment is difficult to measure, considering data availability and scale. To evaluate change over time in the metropolitan area's carbon footprint from a transportation perspective, the analysis from the 2040 Street and Highway Plan was updated to compare the number of vehicle miles traveled (VMT) for passenger cars and light trucks.

The assessment looked at 2015 and 2010 VMT data. VMT was extrapolated out to determine an estimate for GHG emissions (see Table 3-4). The results document an increase in VMT between 2015 and 2010. VMT had been leveling off nationwide since the economic recession in 2008. However, low gas prices and an improved economy have led to increases in VMT. Long-term trends are uncertain due to changes in energy production, improved gas mileage and increased electrification/hybrid technologies in new vehicles, and the potential impact of ride sharing and automated technologies. Therefore, VMT should be continually monitored to determine if travel behaviors are changing within the region.

Table 3-4: Carbon Footprint for Vehicle Miles Traveled

	Total Vehicle-Miles Traveled by Year by Passenger Cars and Light Trucks[2]	Average Miles of Travel per Gallon of Fuel Consumed[3]	Gallons of Fuel Consumed by Year by Passenger Cars and Light Trucks	Metric Tons of Carbon Dioxide or CO_2 Equivalent
2006	269,698,500	20.04	13,458,009	119,642
2010	265,428,000	20.04	13,244,910	117,747
2015	294,365,293	22.0	13,380,241	118,950
2006-2010 Difference	**(-4,270,500)**	**(no change)**	**(-213,009)**	**(-1,895)**
2010-2015 Difference	**(+28,937,293)**	**(+1.96)**	**(-135,331)**	**(+1,203)**

Source: FHWA Highway Statistics for Urbanized Areas 2015 and 2010
https://www.epa.gov/energy/greenhouse-gases-equivalencies-calculator-calculations-and-references

In the region, the increase in VMT resulted in an increase in carbon emissions over the five-year period. This increase is quantified into measurable outcomes by using the Environmental Protection Agency's (EPA) Greenhouse Gas Equivalent Calculator (see Table 3-5). For example, the increase in VMT and CO_2 equated to the 258 additional passenger vehicles on the transportation network annually. The increase in CO_2 emissions results in an increase in the metropolitan area's carbon footprint from an environmental perspective.

[2] Assumes Passenger cars and light trucks account for approximately 90% of vehicles on Grand Forks-East Grand Forks roads.
[3] In 2007, the weighted average combined fuel economy of cars and light trucks combined was 20.4 miles per gallon (FHWA 2008). In 2015, the weighted average combined fuel economy of cars and light trucks combined was 22.0 miles per gallon (FHWA 2017).

Table 3-5: Carbon Footprint Equivalence

	Carbon Footprint Equivalence for VMT from Passenger Cars and Light Trucks of Value Increase from 2015 to 2010
258	Annual CO_2 emissions from the number of passenger vehicles
135,366	CO_2 emissions from the number of gallons of gasoline consumed
2,785	CO_2 emissions from the number of barrels of oil consumed
15.9	CO_2 from the number of tanker trucks worth of gasoline
6.6	CO_2 emissions from burning of the number of railcars worth of coal

Source: Based on EPAs Greenhouse Gas Equivalencies Calculator
https://www.epa.gov/energy/greenhouse-gas-equivalencies-calculator

Street/Highway System

There are several ways to evaluate and characterize roadway networks. As a summary of the existing street/highway system characteristics for the Grand Forks-East Grand Forks MPO area, the following topics are discussed in this section:

- Jurisdiction
- Number of Roadway Lanes
- Functional Classification
- Federal Aid Roadways
- Pavement Condition
- Bridge Condition

Jurisdiction

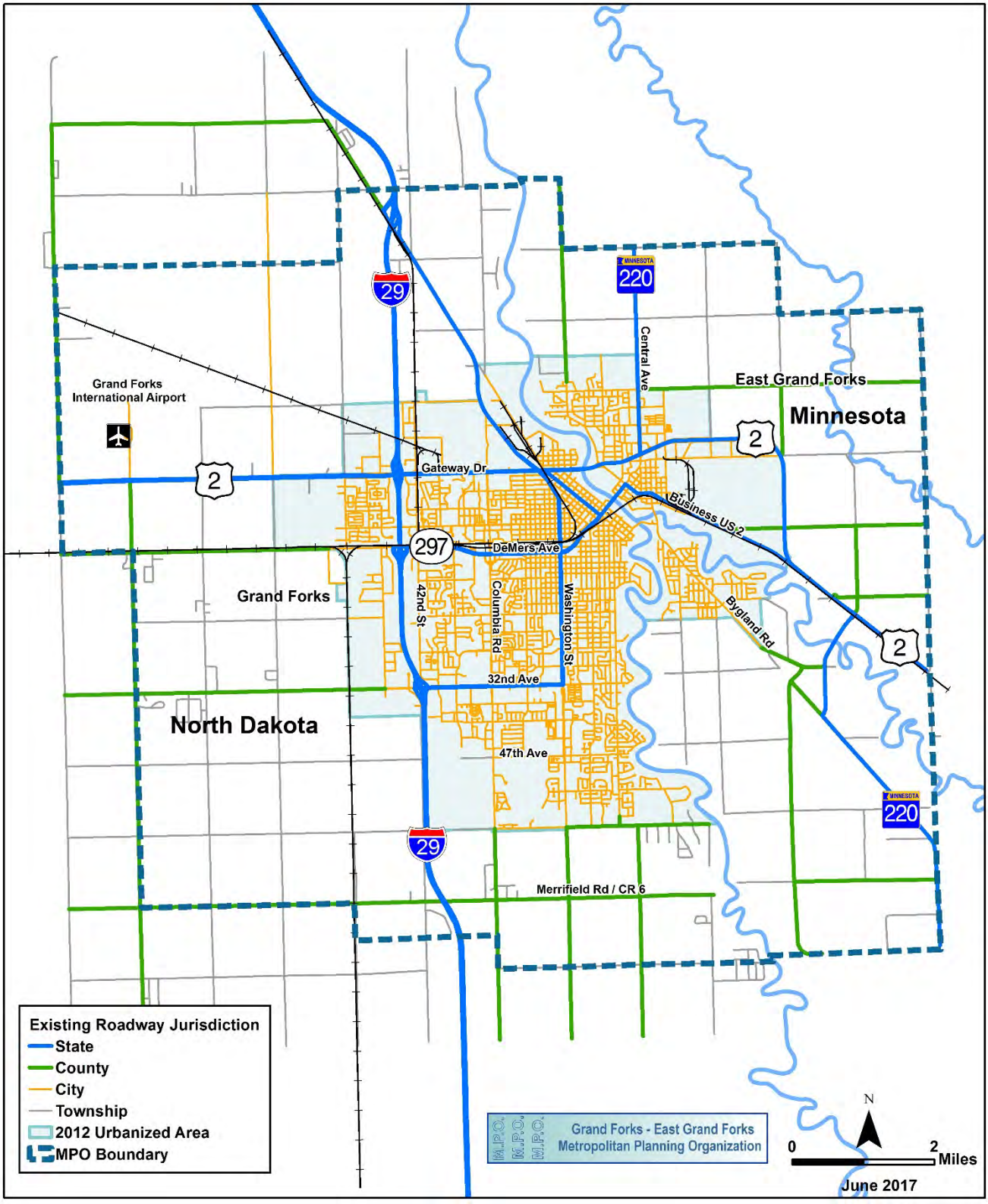
Roadway jurisdiction refers to the agency responsible for owning and maintaining a roadway. Roadway jurisdiction often closely corresponds with roadway functional classification to ensure that the system adequately distributes traffic to the appropriate roadway. For example, state owned roads (interstates and trunk highways) typically accommodate higher traffic volumes and longer-distance trips between population centers. County owned roads accommodate moderate traffic volumes and serve regional trips, while city and township provide lower traffic volumes to serve localized trips.

Figure 3-10 shows the breakdown of roadways by jurisdiction for the region and Table 3-6 summarizes roadway mileage by jurisdiction. The following agencies own and maintain the region's public roadways.

- State
  - North Dakota Department of Transportation
  - Minnesota Department of Transportation
- County
  - Grand Forks (ND)
  - Polk (MN)
- City
  - Grand Forks (ND)
  - East Grand Forks (MN)
- Township
  - Brenna (ND)
  - Falconer (ND)
  - Grand Forks (ND)
  - Rye (ND)

- Walle (ND)
- Bygland (MN)
- Grand Forks (MN)
- Huntsville (MN)
- Rhinehart (MN)
- Sullivan (MN)

Figure 3-10: Existing Roadway Jurisdiction



Source: Grand Forks-East Grand Forks MPO

Table 3-6: System Mileage by Roadway Jurisdiction

Jurisdiction	State		County		Township		City		Total	
	Miles (mi)	Percent (%)	Miles (mi)	Percent (%)	Miles (mi)	Percent (%)	Miles (mi)	Percent (%)	Miles (mi)	Percent (%)
North Dakota	37.6	10.8%	23.3	6.7%	58.0	16.6%	230.4	66.0%	349.3	100%
Minnesota	18.1	12.7%	21.3	15.0%	42.2	29.7%	60.6	42.6%	142.2	100%
MPO Study Area	55.7	11.3%	44.6	9.1%	100.2	20.4%	291.0	59.2%	491.5	100%

Source: Grand Forks-East Grand Forks MPO

North Dakota state statutes limit the state highway system mileage to not exceed seven percent all public roads in the state. County highways eligible for federal aid funds are also limited to 22,500 miles statewide by statute. These rules impact the ability to change the roadway jurisdiction and designation of roadways as they change in function due to growing cities and changing traffic patterns.

Number of Roadway Lanes

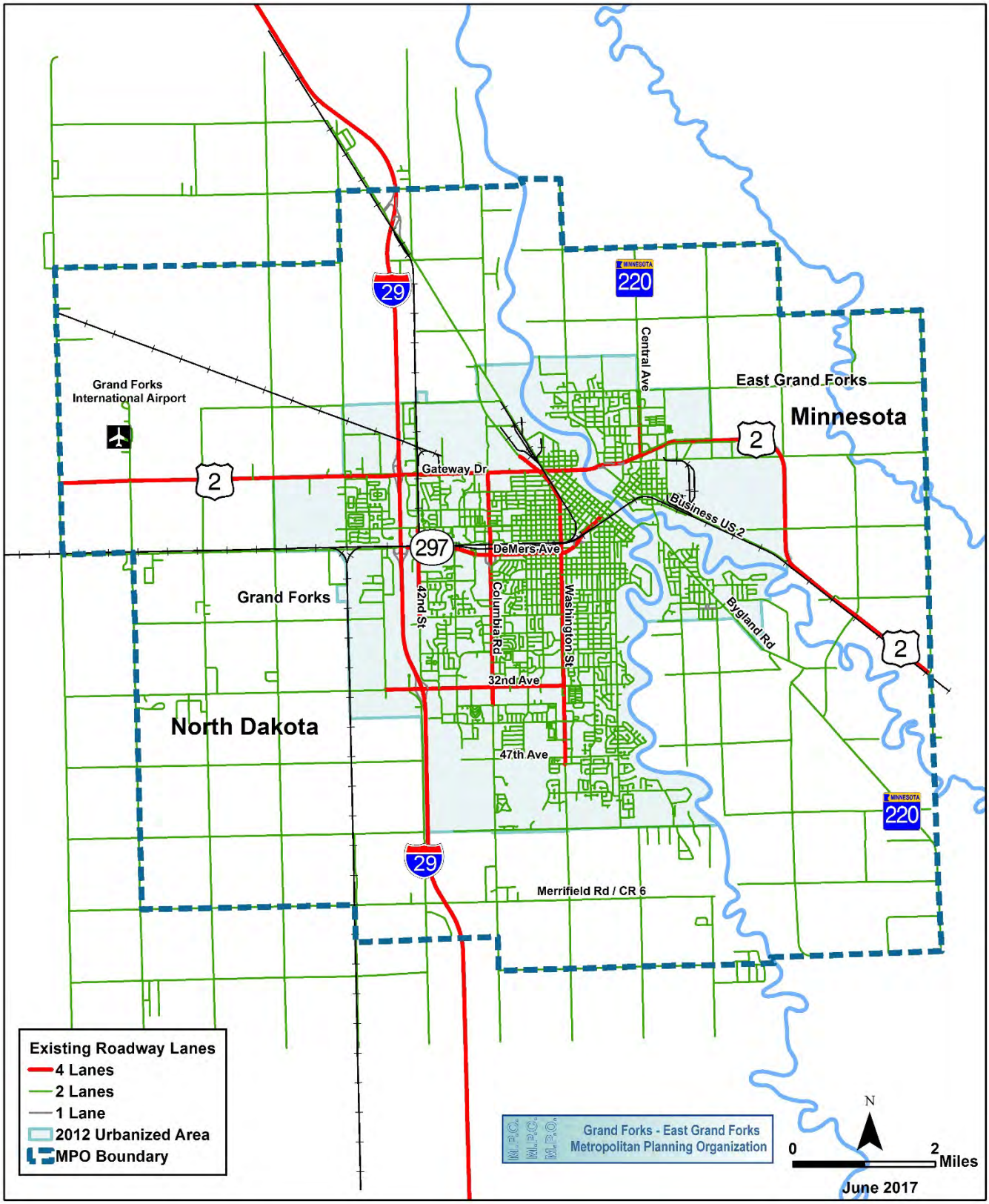
A summary of the number of lanes by centerline lane-miles are described in Table 3-7 and displayed in Figure 3-11. Four lane roadways include the major north-south arterials (I-29, Columbia Road, Washington Street) and east-west arterials (US 2, DeMers Avenue, 32nd Avenue). Over 90 percent of roadways within the region have two-lanes.

Table 3-7: Centerline Lane Miles

Roadway Type	Four Lanes	All Others	Total
North Dakota	32.7	316.6	349.3
Minnesota	7.6	134.6	142.2
MPO Study Area	40.3	451.2	491.5

Source: Grand Forks-East Grand Forks MPO

Figure 3-11: Existing Number of Roadway Lanes



Source: Grand Forks-East Grand Forks MPO

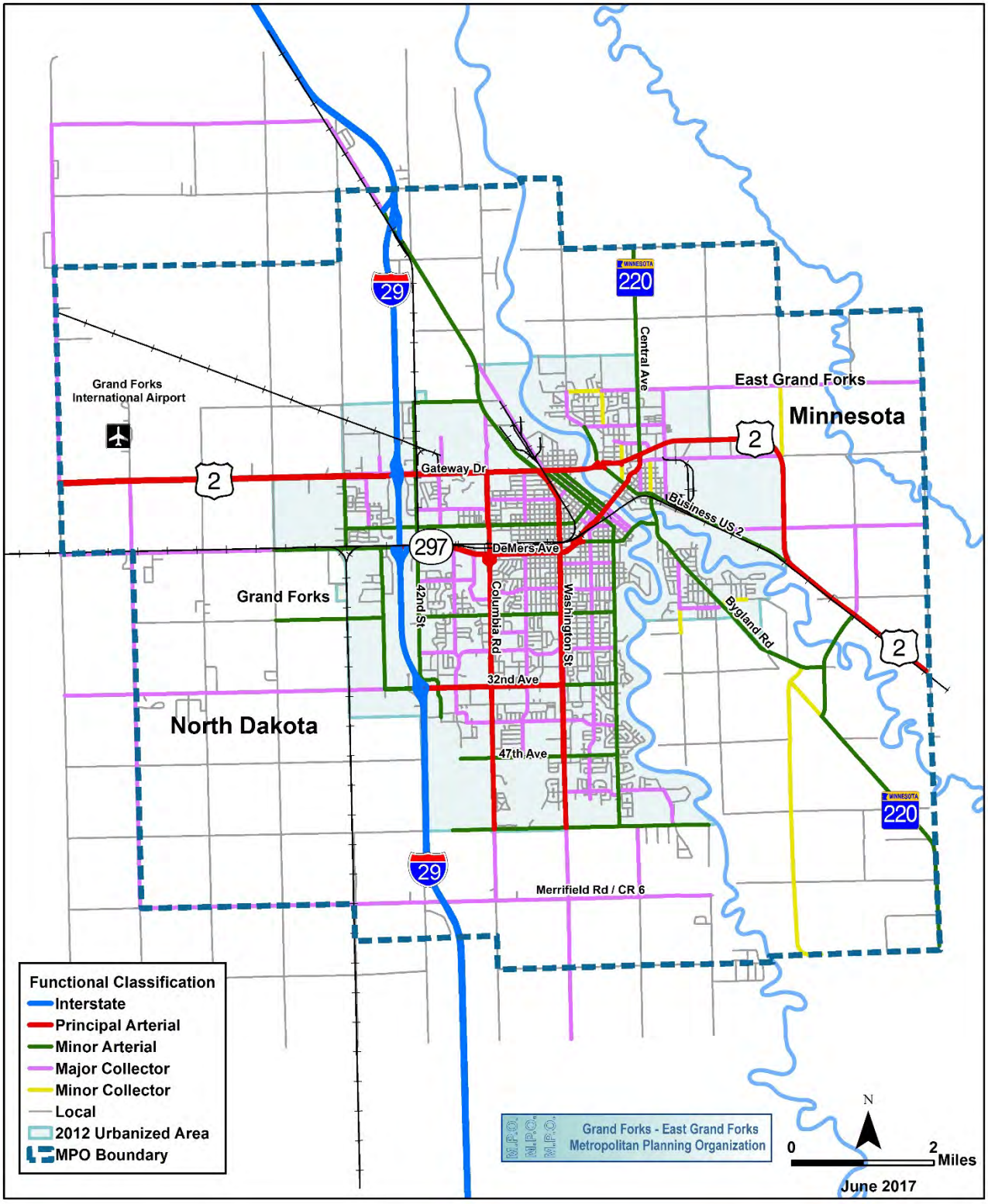
Functional Classification

The functional classification system groups roadways into classes based on roadway function and purpose. Functional classification is based on both transportation and land use characteristics, including roadway speeds, access to adjacent land, connection to important land uses, and the length of trips taken on the roadway. The functional classification system organizes a roadway and street network that distributes traffic from local neighborhood streets to collector roadways, then to minor arterials and ultimately the principal arterial system. Roads are placed into categories based on the degree to which they provide access to adjacent land and mobility for through traffic. Functional classification gives an indication of the relative hierarchy of roadways in the transportation network.

The MPO has grouped roadways into six classes of roadways: interstate, principal arterial, minor arterial, major collector, minor collector, and local. Figure 3-12 shows the functional classification system for the region. Table 3-8 provides the total centerline miles for each functional classification category.

The MPO works in partnership with each state transportation agency (NDDOT and MnDOT) to periodically review the statewide Functional Classification System. Comprehensive reviews are undertaken approximately every 10 years. MnDOT recently updated its Functional Classification System for greater Minnesota (including the MPO area) in 2015 to reflect guidance revisions made by FHWA in 2013.

Figure 3-12: Roadway Functional Classification



Source: Grand Forks-East Grand Forks MPO

Table 3-8: System Mileage by Functional Classification

Totals by State	Interstate	Principal Arterial	Minor Arterial	Major Collector	Minor Collector	Local	All Roads
North Dakota side	16.2	24.4	38.5	52.2	4.0	213.9	349.3
Minnesota side	-	8.2	15.9	16.3	8.8	92.9	142.2
Total Miles	16.2	32.6	54.4	68.5	12.8	306.8	491.5

Source: Grand Forks-East Grand Forks MPO

Guidelines have been established by the FHWA for an approximate mix of roadway functional classifications within an urban area. Table 3-9 presents these federal guidelines and compares them to the functional classification mileage totals for the metropolitan area. System ratios of functional classification mileage are consistent with FHWA guidance.

Table 3-9: Functional System Summary Compared to FHWA Guidelines

Facility Type	MPO Area	FHWA Urban Guidance*
Principal Arterials (including Interstates)	10%	5 - 14%
Principal Arterials plus Minor Arterials	21%	12 - 28%
Collectors	17%	6 - 32%
Local Streets	62%	62 - 74%

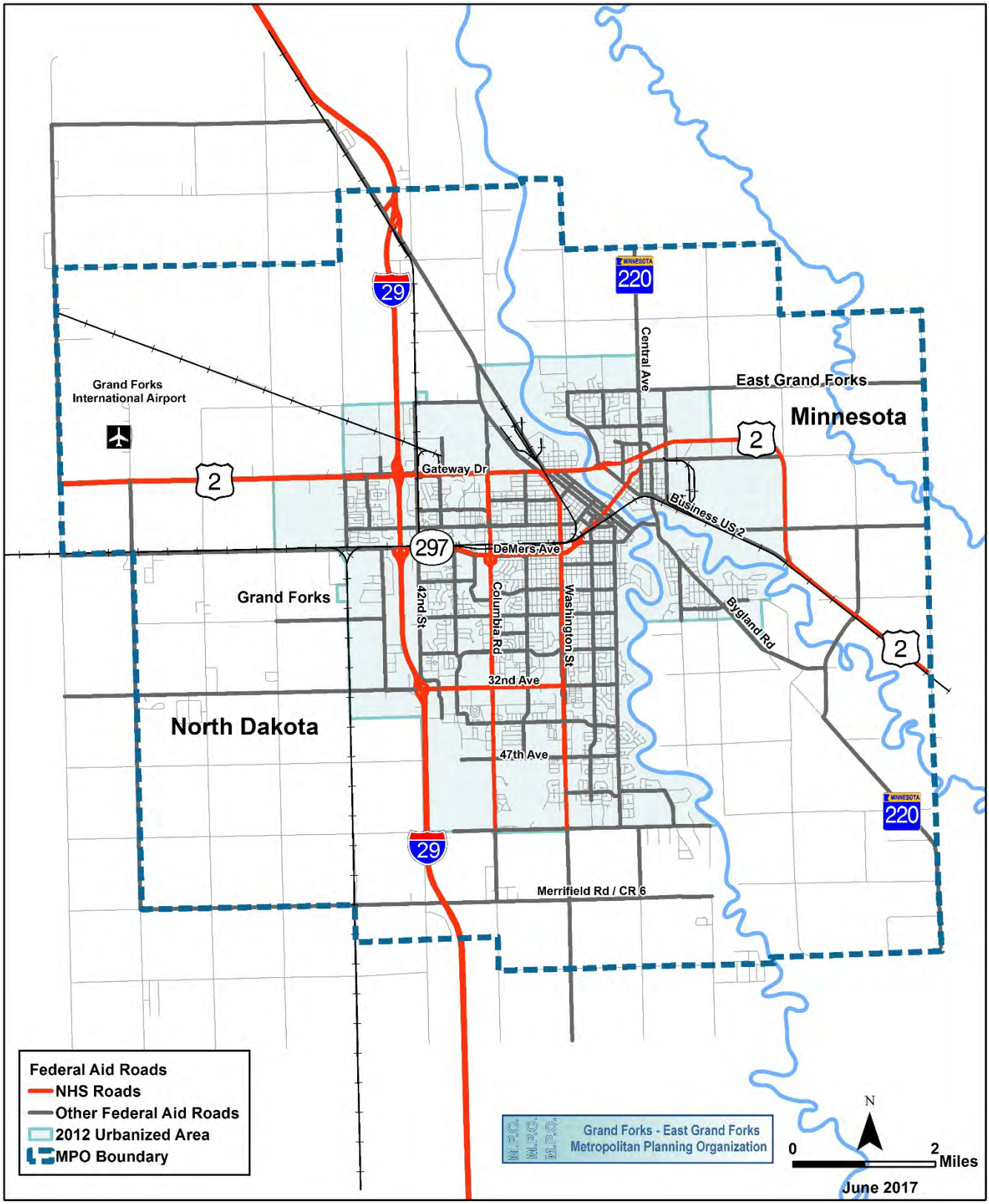
*Source: FHWA Highway Functional Classification Concepts, Criteria and Procedures, 2013 Edition – Rural States and Urban System Ranges Used (Rural States are Defined as Having 75% of Their Population in Urban Centers)
https://www.fhwa.dot.gov/planning/processes/statewide/related/highway_functional_classifications/section03.cfm

Federal Aid Roadways

The National Highway System (NHS) includes the interstate highway system as well as other arterial roadways important to the nation's economy, defense, and mobility. The NHS was developed in the 1990s by the U.S. Department of Transportation in cooperation with the states, local officials, and metropolitan planning organizations (MPOs). MAP-21 legislation converted existing principal arterials to be part of the National Highway System and limited the total system to a defined mileage. This limits the ability to expand the number of Principal Arterial mileage within the MPO area.

Figure 3-13 shows the NHS system and other federal aid eligible roadways within the MPO area. "NHS Roads" include roads with the Interstate and Principal Arterial functional classification. "Other Federal Aid Roadways" include Minor Arterials, Major Collectors, and Minor Collectors within the urbanized area. Per updated FHWA guidance in 2015, Minor Collectors in rural areas are no longer federal aid eligible. Local roads are not eligible for federal aid.

Figure 3-13: Federal Aid Roads



Source: Grand Forks-East Grand Forks MPO

Pavement Condition

Pavement condition data is collected periodically to assist in monitoring the quality of the street and highway system and to help determine the appropriate level of rehabilitation needed for particular segments. The most recent pavement condition data were available for Grand Forks roadway segments in 2013 and East Grand Forks segments in 2015. Table 3-10 and Figure 3-12 present estimated average pavement condition index (PCI) values for each city based on the available data. The average system wide pavement condition has decreased from 2008 levels in Grand Forks. Pavement condition within East Grand Forks has increased on average since 2008.

Table 3-10: Pavement Trends by Pavement Condition Index (PCI)

Year	Grand Forks Average PCI	East Grand Forks Average PCI	Grand Forks Weighted Average PCI	East Grand Forks Weighted Average PCI
1999	63.9	67.2	n/a	n/a
2003	86.3	87.0	78.1	74.9
2008	76.7	76.8	82.0	79.9
Current	72.7 (2013)	79.2 (2015)	69.9 (2013)	82.0 (2015)

Source: Grand Forks-East Grand Forks MPO

Table 3-11 summarizes the percentage of current pavement condition for the GF/EGF MPO area by general pavement condition categories (good, satisfactory, fair, poor, very poor).

Table 3-11: Current MPO Pavement Condition Index (PCI)

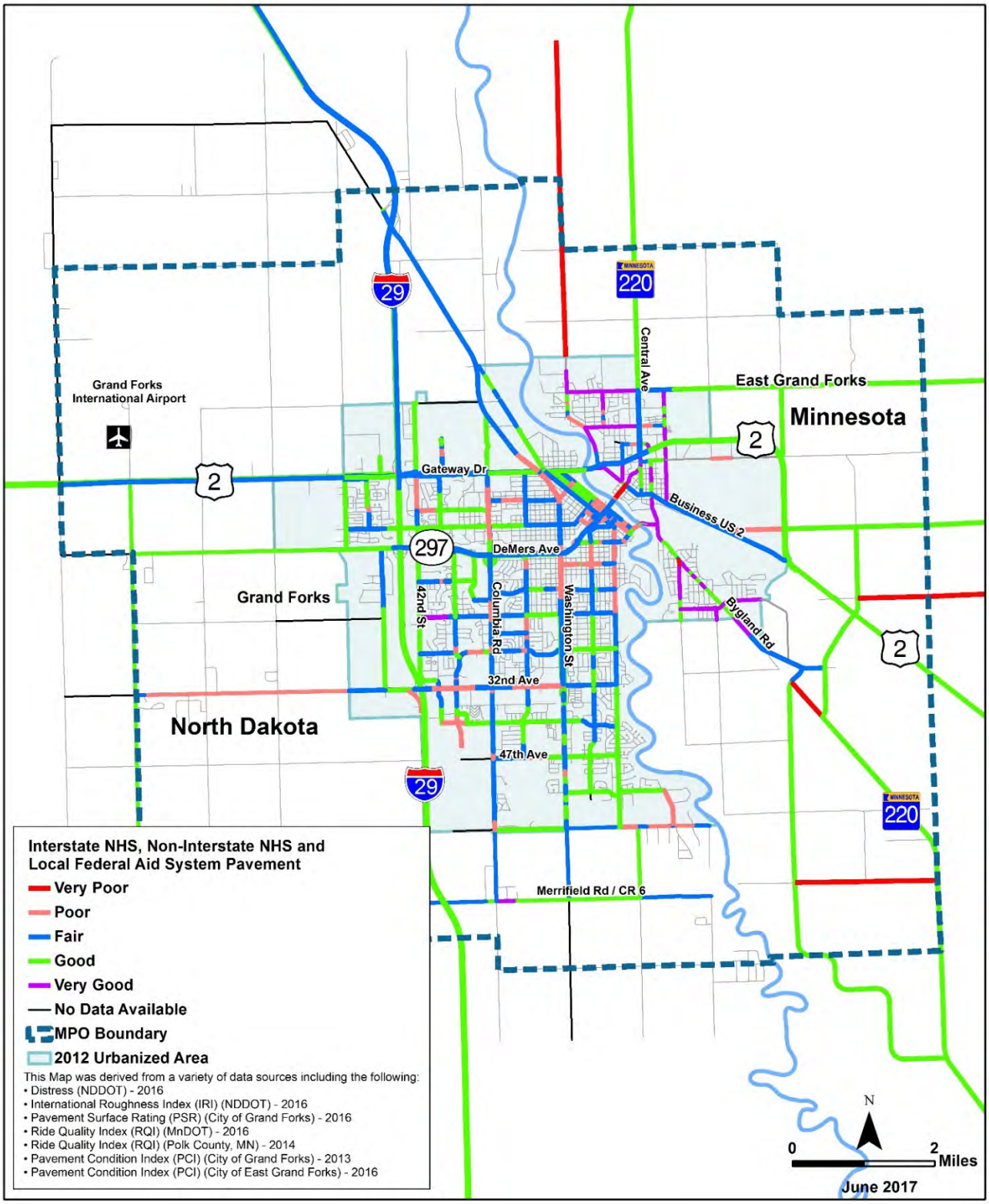
Pavement Condition	GF/EGF MPO Area		MN-Side		ND-Side	
	Local Roads	State Roads	Local Roads	State Roads	Local Roads	State Roads
Good	35%	7%	24%	9%	40%	<1%
Satisfactory	21%	7%	7%	4%	27%	13%
Fair	17%	21%	2%	0%	24%	72%
Poor	7%	0%	2%	0%	9%	0%
Very Poor	<1%	0%	<1%	0%	<1%	0%
No Data	21%	66%	64%	87%	0%	14%

Source: Grand Forks-East Grand Forks MPO

The above referenced table represents PCI data provided by the Ctiy of Grand Forks (2013) and the City of East Grand Forks (2016) and is incomplete. After considerable research with MnDOT, NDDOT, the City of Grand Forks, the City of East Grand Forks, Grand Forks County and Polk County, it was determined that pavement condition data derived from a consistent methodology with consistent metrics of meaure does not currently exist for the GF/EGF MPO planning area.

Figure 3-14 on the following page combines 7 different pavement condition data sets with different collection methodologies and condition rating metrics. This map provides a visual generalization of pavement condition for the entire GF/EGF MPO planning area.

Figure 3-14: Pavement Condition



Source: Grand Forks-East Grand Forks MPO

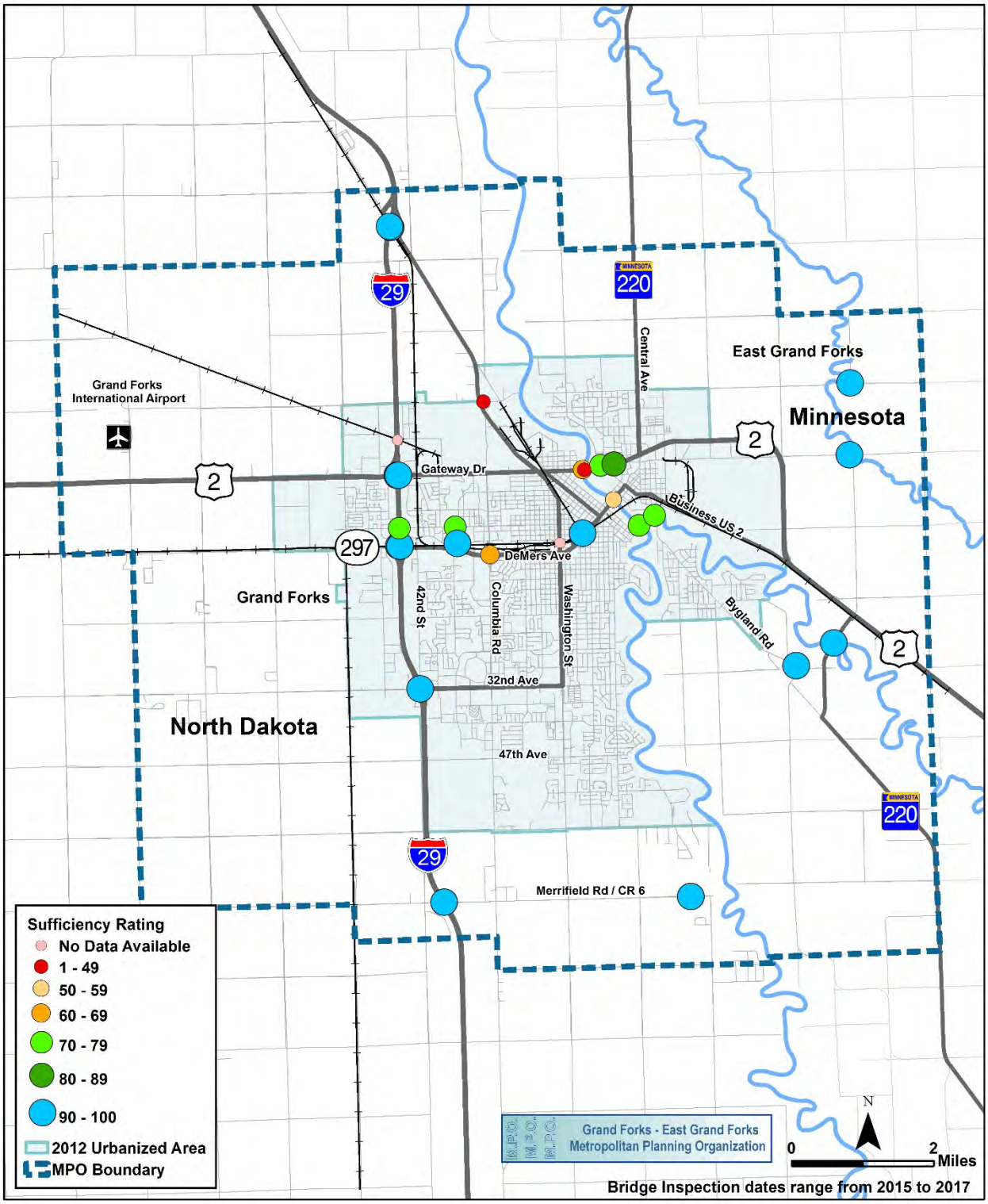
Existing Bridge Conditions

Area bridges are inspected on a regular basis by the respective State Departments of Transportation. Following an inspection, a sufficiency rating is given to each bridge. The sufficiency rating is a means of quantifying a bridge's ability to remain in service. Sufficiency rates are conducted biannually. The rating scale is 0 to 100, with 100 considered an entirely sufficient bridge and 0 an entirely deficient bridge. The sufficiency rating formula includes factors for structural condition, bridge geometry, and traffic considerations. Prior to the FAST Act and MAP-21, a bridge with a sufficiency rating of 80 or less was eligible for Federal Bridge Rehabilitation funding. A bridge with a sufficiency rating of 50 or less is eligible for Federal Bridge replacement funding. Under the Fast Act, Federal Bridge Funds were combined into the Surface Transportation Block Grant Program (STP).

As part of the inspection, it is also noted if bridges are found to be functionally obsolete or structurally deficient. Bridges that are functionally obsolete may be in good condition, but do not meet current engineering design standards. A bridge is identified as structurally deficient if one or more load carrying elements is found to be deficient. The fact that a bridge is classified under the Federal definition of "structurally deficient" does not imply that it is unsafe. A structurally deficient bridge, when left open to traffic, typically requires regular maintenance and repair in service and may eventually require rehabilitation or replacement to address the deficiencies. To remain in service, structurally deficient bridges are often posted with weight limits to restrict the gross weight of vehicles using the bridges to less than the maximum weight allowed by statute.

Figure 3-15 and Table 3-12 show the sufficiency ratings and locations of the bridges in the MPO area. Of the 49 bridges in the area, 35 have sufficiency ratings greater than 80, 10 have sufficiency ratings between 80 and 50, and 4 have sufficiency ratings less than 50.

Figure 3-15: Bridge Sufficiency Ratings



Source: Grand Forks-East Grand Forks MPO, MnDOT, NDDOT

Table 3-12: Bridge Sufficiency Ratings

Facility	Feature	Location	City/ County	Year Built	Most Recent Year Inspected	Operating/ Load Rating**	Sufficiency Rating**	NHS/ Non-NHS
Interstate 29	Railroad	North of US 2 Interchange	City of GF	1967	2013	NA	**NA**	NHS
Washington St.	Railroad	North of DeMers Ave.	City of GF	1937	2015	NA	**NA**	NHS
27th Avenue North	English Coulee	27th Ave. North	City of GF	1947	2015	0	**20.7**	Non-NHS
Kennedy Bridge	Red River	US 2	City of GF/EGF	1963	2015	74.7	**48.2**	NHS
Sorlie Bridge	Red River	DeMers Ave.	City of GF/EGF	1929	2015	36.9	**52.3**	NHS
Columbia Road	Railroad	DeMers Ave.	City of GF	1984	2015	39.0	**65.1**	NHS
Kennedy Bridge	Red River	East of US 81	City of GF/EGF	1963	2015	74.7	**67.4**	NHS
Louis Murray Bridge	Red Lake River	2nd Ave.	City of EGF	NA	2016	39	**75.3**	Non-NHS
University Avenue	Underpass	Interstate 29	City of GF	1968	2015	74.7	**78.4**	Non-NHS
University Avenue	English Coulee	University Ave.	City of GF	1985	2015	99.9	**79**	Non-NHS
4th Street NW	Underpass	US 2	City of EGF	NA	2016	40.6	**79.5**	Non-NHS
Point Bridge	Red River	Minnesota Ave.	City of GF/EGF	1967	2016	76.5	**79.9**	Non-NHS
US Highway 2	Bike Tunnel	6th Avenue NW	City of EGF	NA	2017	42	**82.6**	NHS
Interstate 29	Underpass	Demers Ave.	City of GF	1968	2015	60.3	**91.1**	NHS
Merrifield Road	Cole Creek	Golf Course	City of GF	1990	2015	99.9	**92.4**	Non-NHS
Campus Road	English Coulee	UND Campus	City of GF	2013	2015	56.3	**92.6**	Non-NHS
DeMers Avenue	Skyway Bridge	4th Avenue S.	City of GF	1972	2015	80.7	**93.4**	NHS
Interstate 29	Underpass	Demers Ave.	City of GF	1968	2015	60.3	**94.1**	NHS
TH 220	Red Lake River	TH 220	Polk County	NA	2017	32.6	**94.5**	Non-NHS
Interstate 29	Underpass	32nd Ave.	City of GF	1967	2015	72.3	**95.3**	NHS
Interstate 29	Underpass	Washington St.	City of GF	1968	2015	99.9	**95.6**	NHS
Interstate 29	Underpass	US 2	City of GF	1968	2015	76.5	**96**	NHS

Facility	Feature	Location	City/ County	Year Built	Most Recent Year Inspected	Operating/ Load Rating**	Sufficiency Rating**	NHS/ Non-NHS
Interstate 29	Underpass	Washington St.	City of GF	1968	2015	99.9	**96.6**	NHS
Interstate 29	Underpass	US 2	City of GF	1968	2015	76.5	**97**	NHS
CSAH 19	Grand Marais Creek	CSAH 19	Polk County	NA	2015	24	**98.1**	Non-NHS
Interstate 29	Underpass	Merrifield Rd.	Polk County	1968	2015	55.8	**98.7**	NHS
Bygland Rd. SE	Diversion Channel	Bygland Rd. SE	Polk County	NA	2016	62.4	**100**	Non-NHS
Township Rd 300	Grand Marais Creek	Township Rd 300	Polk County	NA	2016	36	**100**	Non-NHS

Existing Traffic Conditions

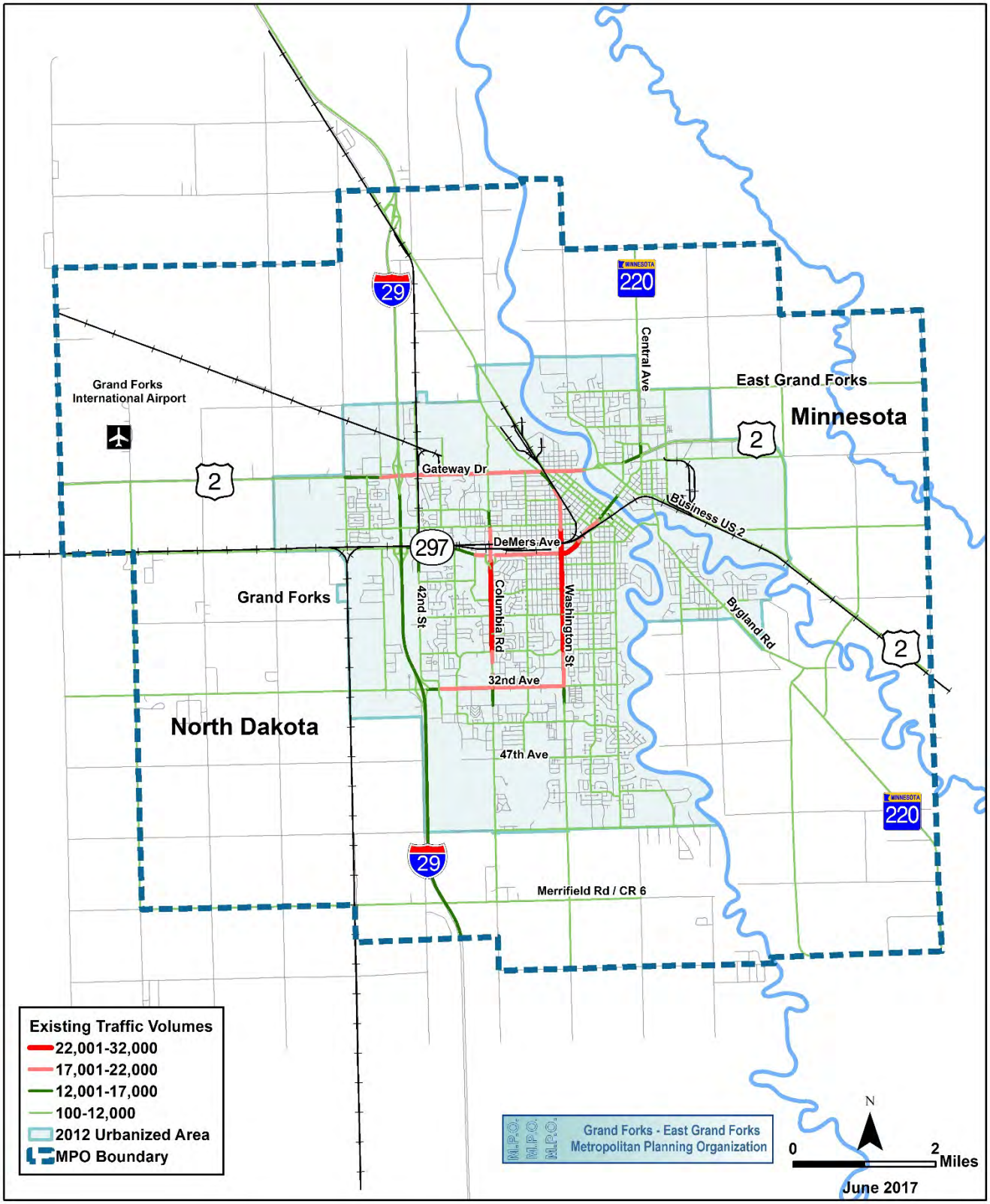
Current traffic patterns and the operations of the street and highway network are summarized in the following sections.

Traffic Volumes

Figure 3-16 shows the range of year 2015 average daily traffic volumes for the roadway system. Arterial roadways that provide connections across Grand Forks and along commercial centers experienced the highest traffic volumes. These arterials include Interstate 29, US 2/Gateway Drive, DeMers Avenue, 32nd Avenue, Columbia Road, and Washington Street. These roadways have four lanes and are intended to carry higher traffic volumes to serve regional trips.

Since 2005, South Washington Street, South Columbia Road, and 32nd Avenue South have experienced increases in traffic volumes as Grand Forks has continued developing south of 32nd Avenue South. On South Washington Street, 2015 traffic volumes range from around 22,000 vehicles per day near 32nd Avenue South to around 30,000 vehicles per day near DeMers Avenue. South Columbia Road experiences around 26,000 vehicles per day between 24th Avenue South and DeMers Avenue. Between South 42nd Street and South Washington Street, 32nd Avenue South experiences around 20,000 vehicles per day.

Figure 3-16: Existing Traffic Volumes



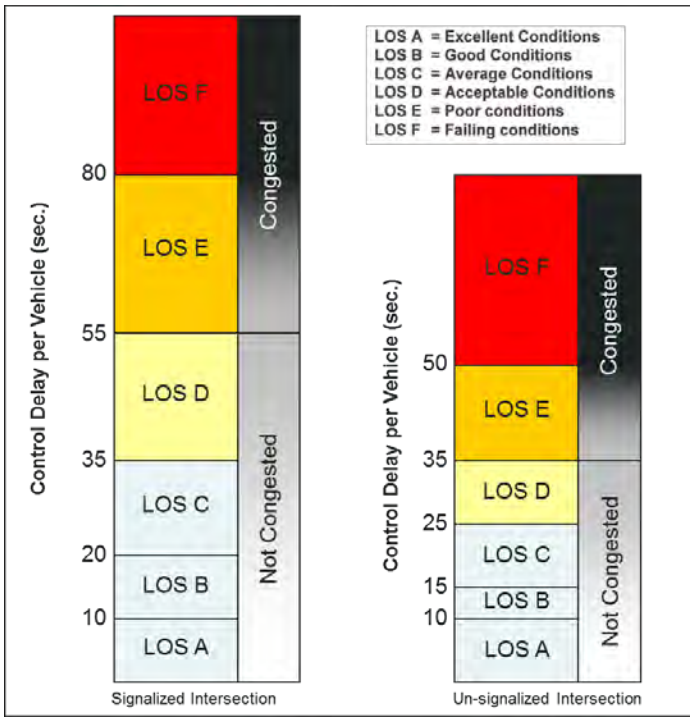
Source: Grand Forks-East Grand Forks MPO. Note: Ranges reflect planning-level roadway capacity volumes for two-lane (up to 12,000), three-lane divided (up to 17,000), four-lane undivided (up to 22,000), and four-lane divided (up to 32,000) roadways

Existing Intersection Level of Service

The ability of an intersection to accommodate traffic is affected by the number and type of vehicles, desired turning movements, intersection geometrics, and traffic control devices. Intersection Level of Service (LOS) is defined as the delay to vehicles caused by the intersection's traffic control. Intersection LOS typically focuses on operations during the peak periods of the day that experience the highest traffic volumes. Thus, the intersection LOS analysis gives a "worst case" result for each intersection and more clearly identifies operational problems at the intersections.

The intersection operational analysis process includes determining the LOS for the key intersections under the existing peak hour traffic conditions. Many jurisdictions consider LOS D as the lowest acceptable LOS for urban intersections. NDDOT had not historically, but now does also consider LOS D as acceptable at urban intersections. Figure 3-17 presents the intersection LOS thresholds, in terms of seconds of vehicle delay, as defined in the Highway Capacity Manual.

Figure 3-17: Level of Service



Source: Highway Capacity Manual

To evaluate intersection level of service (LOS) along important regional corridors, 50 intersections were identified by MPO staff. In addition, previous studies were reviewed to document the results of 11 recent intersection LOS analyses. The evening (p.m.) peak period was selected for evaluation as this timeframe generally experiences the highest traffic volumes. The 61 evaluated intersections and LOS results are listed in Table 3-13 and mapped in Figure 3-18. Overall, the system's intersections generally operate within LOS A-C conditions. There are four intersections where a LOS D was recorded (S. Columbia Road & 17th Avenue S., S. Columbia Road & 32nd Avenue S., S. Washington Street & DeMers Avenue, and N. 42nd Street & University Avenue when trains are present). No intersections were recorded with a LOS E or F.

Three intersections that were recorded at LOS D in the 2040 Street/Highway Plan Update have seen a decrease to LOS C or B. They are S. Washington Street & 17th Avenue S., S. Washington Street & 32nd Avenue S., and Central Avenue NE (TH 220) & Gateway Drive.

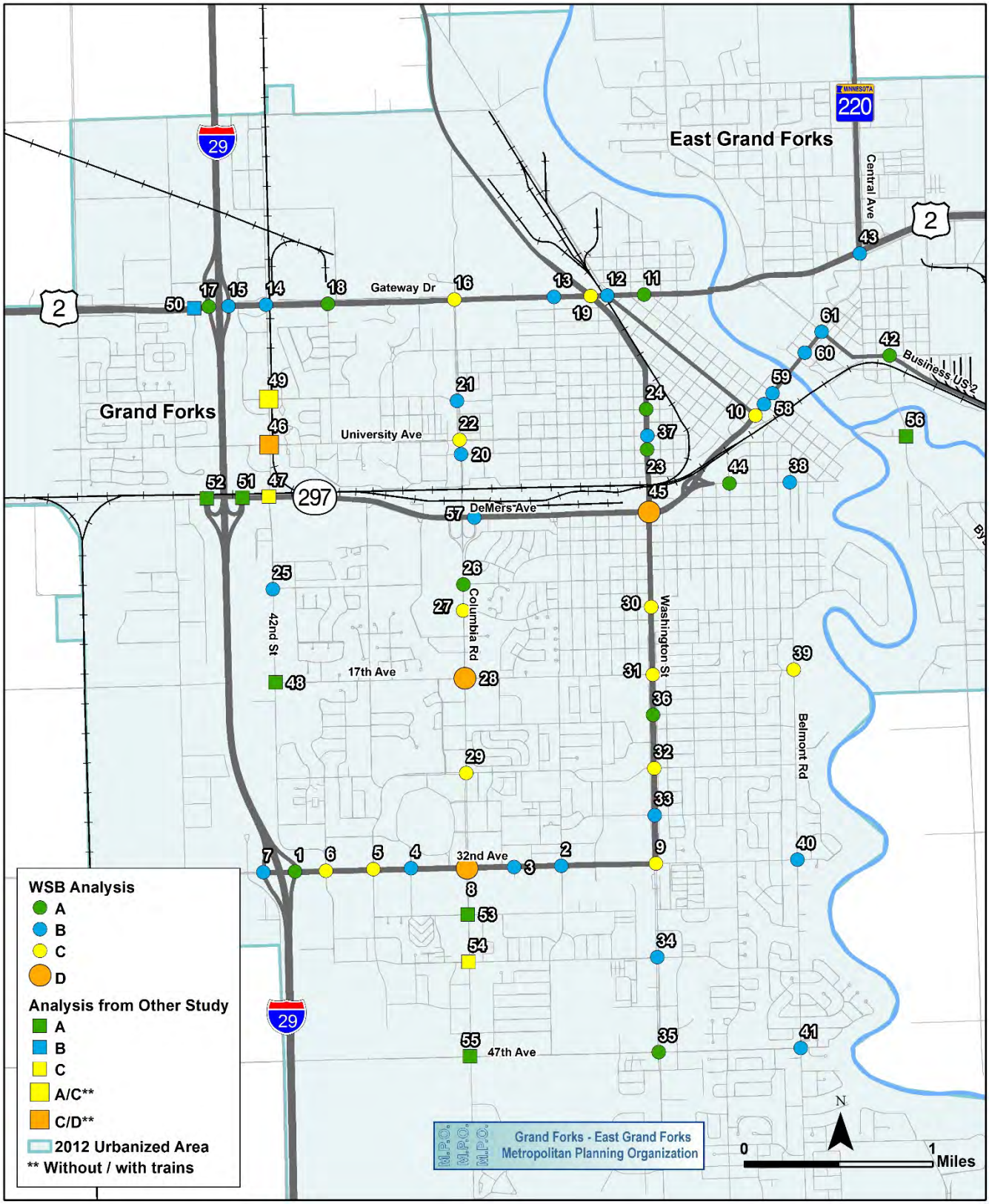
Table 3-13: Intersection Level of Service

Map ID	Intersection	PM Peak LOS		Map ID	Intersection	PM Peak LOS
1	I-29 East Ramp & 32nd Avenue S.	A		**32**	S. Washington Street & 24th Avenue S.	C
2	S. 20th Street & 32nd Avenue S.	B		**33**	S. Washington Street & 28th Avenue S.	B
3	S. 24th Street & 32nd Avenue S.	B		**34**	S. Washington Street & 40th Avenue S.	B
4	S. 31st Street & 32nd Avenue S.	B		**35**	S. Washington Street & 47th Avenue S.	A
5	S. 34th Street & 32nd Avenue S.	C		**36**	S. Washington Street & Campbell Drive	A
6	S. 38th Street & 32nd Avenue S.	C		**37**	N. Washington Street & University Avenue	B
7	I-29 West Ramp & 32nd Avenue S.	B		**38**	Belmont Road & 4th Avenue S.	B
8	S. Columbia Road & 32nd Avenue S.	D		**39**	Belmont Road & 17th Avenue S.	C
9	S. Washington Street & 32nd Avenue S.	C		**40**	Belmont Road & 32nd Avenue S.	B
10	N. 5th Street & DeMers Avenue	C		**41**	Belmont Road & 47th Avenue S.	B
11	Gateway Drive & N. 3rd Street	A		**42**	4th Street NE & 2nd Avenue NE	A
12	N. 5th Street & Gateway Drive	B		**43**	Central Avenue NE (TH 220) & Gateway Drive	B
13	N. 20th Street & Gateway Drive	B		**44**	Cherry Street & 4th Avenue S.	A
14	N. 42nd Street & Gateway Drive	B		**45**	S. Washington Street & DeMers Avenue	D
15	I-29 East Ramp & Gateway Drive	B		**46***	N. 42nd Street & University Avenue	C/D**
16	N. Columbia Road & Gateway Drive	C		**47***	N. 42nd Street & DeMers Avenue	C
17	I-29 West Ramp & Gateway Drive	A		**48***	S. 42nd Street & 17th Avenue S.	A
18	Stanford Road & Gateway Drive	A		**49***	N. 42nd Street & 6th Avenue N.	A/C**
19	N. Washington Street & Gateway Drive	C		**50***	N. 47th Street & Gateway Drive	B
20	N. Columbia Road & 2nd Avenue N.	B		**51***	East I-29 Ramp & DeMers Avenue	A
21	N. Columbia Road & 6th Avenue N.	B		**52***	West I-29 Ramp & DeMers Avenue	A
22	N. Columbia Road & University Avenue	C		**53***	S. Columbia Road & 36th Avenue S.	A
23	N. Washington Street & 2nd Avenue N.	A		**54***	S. Columbia Road & 40th Avenue S.	C
24	N. Washington Street & 5th Avenue N.	A		**55***	S. Columbia Road & 47th Avenue S.	A
25	S. 42nd Street & 11th Avenue S.	B		**56***	1st Street SE & 3rd Avenue SE	A
26	S. Columbia Road & 11th Avenue S.	A		**57**	S. Columbia Road & DeMers Avenue	B
27	S. Columbia Road & 13th Avenue S.	C		**58**	S. 4th Street & DeMers Avenue	B
28	S. Columbia Road & 17th Avenue S.	D		**59**	S. 3rd Street & DeMers Avenue	B
29	S. Columbia Road & 24th Avenue S.	C		**60**	2nd Street NW & DeMers Avenue	B
30	S. Washington Street & 13th Avenue S.	C		**61**	4th Street NW & DeMers Avenue	B
31	S. Washington Street & 17th Avenue S.	C				

* Intersection LOS as documented from recent studies

** Without/with trains

Figure 3-18: Intersection Level of Service



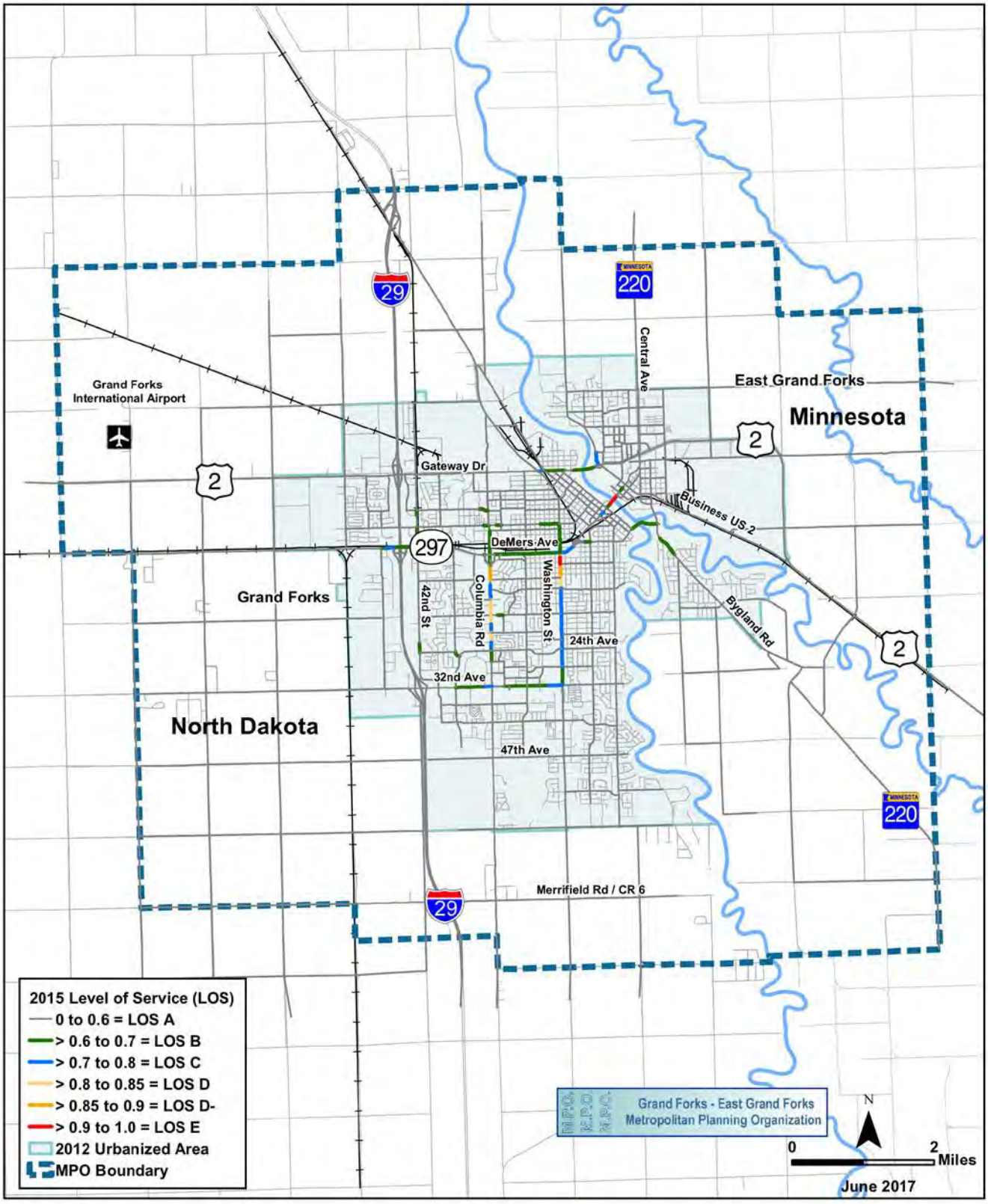
Existing Roadway Segment Level of Service

The regional travel demand forecast model prepared by the Advanced Traffic Analysis Center (ATAC) for the Street and Highway Plan identified existing LOS for key roadway segments within the MPO area. The model utilized roadway characteristics and 2015 average daily traffic volumes to determine LOS via a volume to capacity ratio. This analysis identified three road segments experiencing LOS D:

- South Columbia Road between 11th Avenue South and DeMers Avenue
- South Columbia Road between 17th Avenue South and Knight Drive
- South Washington Street between 8th Avenue South and DeMers Avenue

There were no segments that were identified as a LOS E or F as part of this analysis. See Figure 3-19 for a map of LOS by roadway segment.

Figure 3-19: 2015 Level of Service by Road Segment



Safety/Crash Analysis

When Moving Ahead for Progress in the 21st Century Act (MAP-21) was passed in 2012, the law regarding the connection between safety planning and long range transportation planning changed from "should be consistent with" to "shall integrate." With this new requirement, the relationship between statewide Highway Safety Improvement Programs and Strategic Highway Safety Programs strengthened, and all levels of transportation planning have now taken steps towards integrating strategic safety planning into plans.

Traditionally, safety improvement locations were determined by using a site-specific approach: a safety analysis that identified high-crash locations (also known as dark spots) based off historical crash trends. Safety funding would then be utilized to improve those specific areas.

Recently, a systemic approach to safety has been emphasized in transportation planning. The systemic safety approach is a technique that supplements the site-specific approach by identifying roadway characteristics that lead to severe and fatal crashes. Instead of solely taking a reactive approach to safety by improving areas where crashes have already occurred, the systemic approach introduced a proactive approach by improving high-risk roadways before crashes occur. Planning bodies in both Minnesota and North Dakota have already begun the integration process on a statewide level and are currently updating their safety plans. For more information regarding safety planning, please refer to these plans.

The passage of MAP-21introduced two changes from programs in the past: increased safety-specific funding and the use of penalties. Previously, safety funds within the state of North Dakota had been apportioned from the Urban Roads Program fund pool, but safety is now funded by a stand-alone program. The state of Minnesota also funds transportation safety through a stand-alone program. MAP-21 also introduced a financial penalty for states that do not make significant progress in improving safety.

In the late 1990's, the American Association of State Highway and Transportation Officials (AASHTO) developed a recommended safety program development process that sorted crash data into twenty-two emphasis areas. Those emphasis areas were further divided up into six categories: drivers, special users, vehicles, highways, emergency service, or management. By utilizing the systemic approach, transportation agencies identify projects that specifically cater to one or more emphasis area.

Site-Specific Crash Analysis

The existing site-specific traffic safety analysis for the Grand Forks-East Grand Forks MPO area was based on evaluation of crash data available from the NDDOT and MnDOT. Due to current limitations in accessing 2016 or later crash data for Minnesota communities, crash data for the four-year period from January 1, 2012 to December 31, 2015 was used for the analysis.

A total of 48 intersections were identified that experienced 12 or more crashes during the four-year analysis period. The average crash rate for these intersections was approximately 0.7 crashes per million entering vehicles (MEV), and was consistent between Grand Forks and East Grand Forks. The 48 identified intersections with 12 or more crashes are shown in Figure 3-20.

Spatial aggregation processing was performed to collect crashes associated with intersections. Total traffic passing through the intersection was then computed using NDDOT and MnDOT AADT (Annual Average Daily Traffic) data, and then an intersection crash rate was computed for each location.

To evaluate the performance and condition of intersections, grounded on computed crash rates, Expected Crash Rate tables from MnDOT Green Sheets were used. The expected crash rates for similar intersections from the MnDOT Green Sheets were applied to crashes occurring in both North Dakota and Minnesota to ensure consistency in the safety analysis and since NDDOT does not offer similar crash analysis tools. MnDOT Expected Crash Rate tables classify state-wide averages of crash rates and other parameters for different classes of intersections and segments. These parameters are computed separately for three years, five years, and ten years of historic crash data. Since this analysis was based on four years of crash data, an average of three-year and five-year tables were used to compare results. Based on the AADT and segments information for the

intersections, expected crash rates were calculated and compared for each intersection. A total of 26 intersections were found to have crash rates above the expected crash rates. The attached tables summarize the types of crashes occurring at each of these 26 locations and how expected crash rates compare to actual crash rates.

Based on the information in Table 3-14, two types of crashes are more frequent than other types:

- Angle or Turn Crashes: Angle and turn crashes accounted for approximate 54 percent of total crashes in the metropolitan area.
- Rear End Crashes: Rear end crashes accounted for approximately 32 percent of total crashes in the metropolitan area.

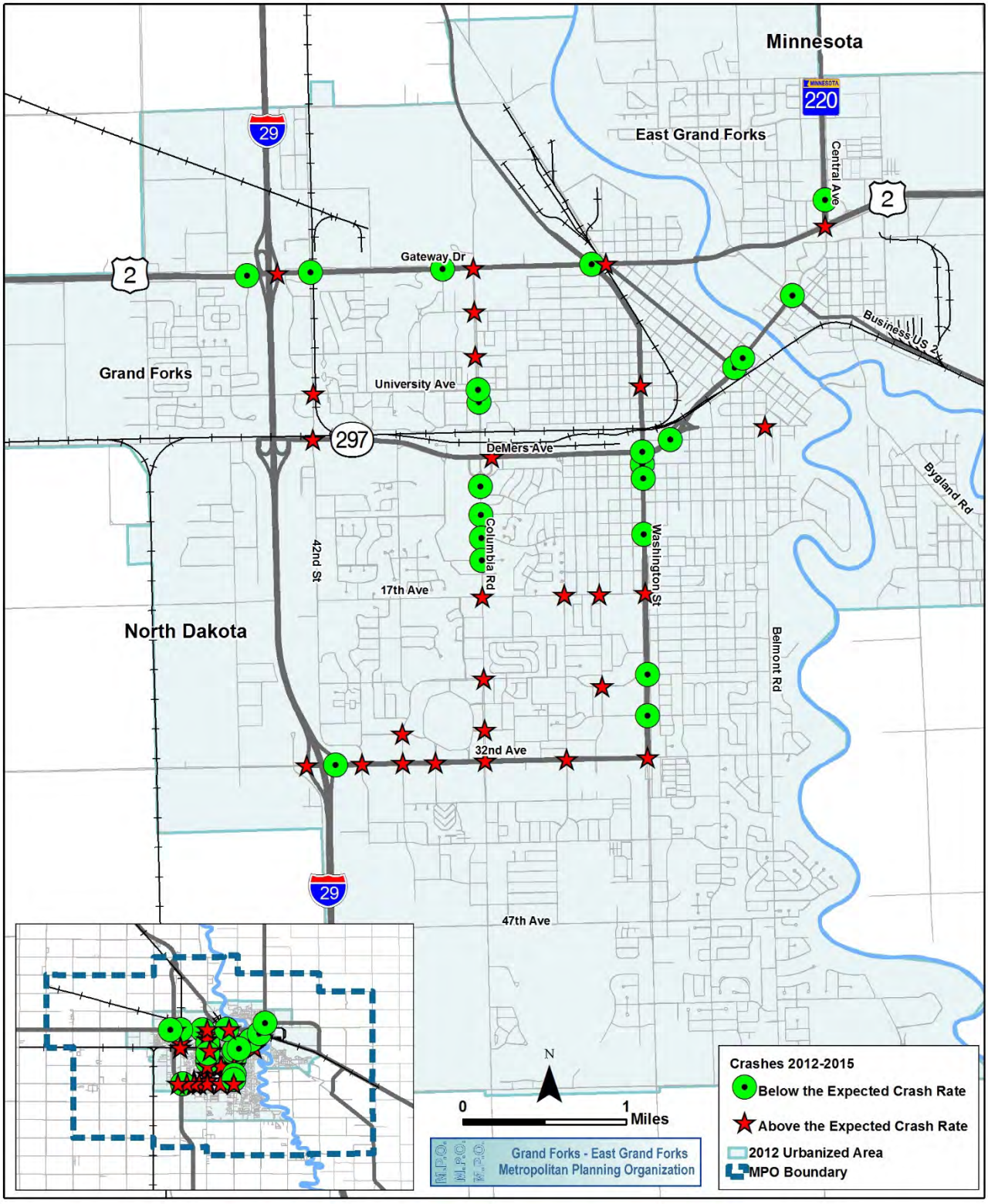
The number of severe crashes for the intersections that have higher than expected crash rates are listed in Table 3-15. Based on this analysis, it was found that:

- Three intersections experienced over 50 crashes during this timeframe. They were: S. 34th Street & 32nd Avenue S. (64), N. 42nd Street North & DeMers Avenue (60), and S. 31st Street & 32nd Avenue S (52).
- There were no fatal incidents reported in any of the high crash rate intersections from 2012-2015.
- 31 percent of the total crashes that occurred at the high crash rate intersections involved injury related crashes.

In June 2017, NDDOT provided results of a statewide Highway Safety Improvement Program (HSIP) crash analysis for urban intersection crash locations using updated 2014-2016 crash data. Nine intersections were identified in Grand Forks in the top 50 statewide intersections for most crashes. These intersections and rankings include: S. Columbia Road & 17th Avenue S. (10), S. 34th Street & 32nd Avenue S. (11), S. Washington Street & 17th Avenue S. (14), Washington Street & DeMers Avenue (24), S. 20th Street and 32nd Avenue S. (26), S. Columbia Road & 32nd Avenue S. (31), S. 31st Street & 32nd Avenue S. (40), S. Washington Street & 32nd Avenue S. (44), and DeMers Avenue & N. 42nd Street (46).

Both state DOT agencies develop strategic statewide highway safety plans with recommended strategies to improve roadway safety. Incorporating these plans and strategy approaches into the future projects and performance measurements will help address current safety issues in the MPO area.

Figure 3-20: Intersection Crash Rates



Source: NDDOT and MnDOT

Table 3-14: 2012-2015 Crash Types at Key Intersections (above expected crash rate)

Intersection	Angle/ Turn	Head On	Rear End	Side Swipe	Other
S. 31st Street & 32nd Avenue S.	45	0	6	0	1
S. Columbia Road & 24th Avenue S.	28	0	7	3	0
N. Columbia Road & 10th Avenue N.	16	0	3	0	0
S. Columbia Road & 32nd Avenue S.	11	0	21	9	1
S. 17th Street & 17th Avenue S.	13	0	3	0	0
S. 20th Street & 17th Avenue S.	9	1	2	0	0
S. Washington Street & 17th Avenue S.	17	1	16	2	4
S. Columbia Road & 17th Avenue S.	12	3	10	4	3
S. 17th Street & 24th Avenue S.	8	0	4	0	1
S. 20th Street & 32nd Avenue S.	38	0	4	0	2
S. Columbia Road & 27th Avenue S.	14	1	5	1	3
I-29 & Gateway Drive	7	0	8	1	0
I-29 & 32nd Avenue S.	11	0	2	2	0
N. 42nd Street & DeMers Avenue	33	1	17	3	6
S. Columbia Road & DeMers Avenue	6	0	20	0	0
Mill Road & Gateway Drive	12	0	10	1	3
N. Columbia Road & Gateway Drive	18	0	15	2	4
S. 34th Street & 30th Avenue S.	10	0	1	1	1
S. Washington Street & 32nd Avenue S.	9	1	31	1	4
S. 34th Street & 32nd Avenue S.	38	1	19	4	2
S. 38th Street S. & 32nd Avenue S.	23	1	9	1	1
N. 42nd Street & University Avenue	7	1	6	1	2
Belmont Road & 4th Avenue S.	9	0	3	0	0
N. Columbia Road & 6th Avenue N.	3	0	6	3	0
N. Washington Street & University Avenue	19	2	9	0	1
Gateway Drive & Central Avenue NW	11	2	18	4	1

Source: NDDOT and MnDOT

Table 3-15: 2012-2015 Crash Rates and Number of Crashes at Key Intersections (above expected crash rate)

Intersection	Actual Crash Rate	Expected Crash Rate	Total Crashes	Fatal Crashes	Injury Crashes
S. 31st Street & 32nd Avenue S.	1.54	0.71	52	0	22
S. Columbia Road & 24th Avenue S.	0.97	0.71	38	0	8
N. Columbia Road & 10th Avenue N.	1.24	0.52	19	0	8
S. Columbia Road & 32nd Avenue S.	0.88	0.71	42	0	16
S. 17th Street & 17th Avenue S.	0.97	0.52	16	0	7
S. 20th Street & 17th Avenue S.	0.69	0.52	12	0	2
S. Washington Street & 17th Avenue S.	0.88	0.71	40	0	16
S. Columbia Road & 17th Avenue S.	0.76	0.71	32	0	10
S. 17th Street & 24th Avenue S.	0.88	0.52	13	0	4
S. 20th Street & 32nd Avenue S.	1.17	0.71	44	0	22
S. Columbia Road & 27th Avenue S.	0.76	0.71	24	0	8
I-29 & Gateway Drive	0.82	0.52	16	0	4
I-29 & 32nd Avenue S.	0.91	0.52	15	0	2
N. 42nd Street & DeMers Avenue	1.48	0.71	60	0	16
S. Columbia Road & DeMers Avenue	0.97	0.71	26	0	11
Mill Road & Gateway Drive	0.77	0.71	26	0	7
N. Columbia Road & Gateway Drive	0.98	0.71	39	0	12
S. 34th Street & 30th Avenue S.	0.92	0.52	13	0	3
S. Washington Street & 32nd Avenue S.	1.38	0.71	46	0	8
S. 34th Street & 32nd Avenue S.	1.37	0.71	64	0	24
S. 38th Street S. & 32nd Avenue S.	1.02	0.71	35	0	11
N. 42nd Street & University Avenue	0.75	0.71	17	0	4
Belmont Road & 4th Avenue S.	1.00	0.52	12	0	5
N. Columbia Road & 6th Avenue N.	0.84	0.52	12	0	0
N. Washington Street & University Avenue	0.87	0.71	31	0	9
Gateway Drive & Central Avenue NW	1.14	0.71	36	0	9

Source: NDDOT and MnDOT

System-Wide Crash Analysis

An additional safety analysis was performed as the MPO developed its targets for the safety performance measures as the region works toward no fatalities by 2045. The analysis identified findings and trends for number of traffic fatalities, fatality rate, number of serious injuries, serious injury rate, and number of non-motorized fatalities and serious injuries throughout the system.

Number of Traffic Fatalities

The annual number of fatalities ranged from 0 to 4 between 2007 and 2015. Over this time period, the region experienced a declining trend in the number of fatalities. The five-year rolling average ranged from 1.8 to 2.6 with a declining trend of 0.04 per year. For 2018, the region established a target of 3 or fewer traffic fatalities with no change in the declining trend, as described in Chapter 2.

Traffic Fatality Rate

The traffic fatality rate per 100 million vehicle miles traveled (mvmt) is also declining for the region. Between 2007 and 2015, the five-year rolling average ranged from 0.550/mvmt to 0.795/mvmt with a declining trend of 0.0122 per year. For 2018, the region established a target of 0.673/mvmt or lower with no change in the declining trend.

Number of Crash-Related Serious Injuries

The annual number of traffic crash-related and life-altering serious injuries ranged from 8 to 24 between 2007 and 2015. Over this time period, the region experienced a rising trend in the number of serious injuries. The five-year rolling average ranged from 15 to 19.4 with a rising trend of 1.2 per year. For 2018, the region established a target of 18 or fewer serious injuries with a decline in the trend.

Serious Injury Rate

The traffic crash-related serious injury rate per 100 million vehicle miles traveled (mvmt) is rising for the region. Between 2007 and 2015, the five-year rolling average ranged from 4.587/mvmt to 5.933/mvmt with a rising trend of 0.367 per year. For 2018, the region established a target of 5.933/mvmt or lower with no change in the declining trend.

Number of Non-Motorized Fatalities and Serious Injuries

The annual number of non-motorized fatalities and serious injuries ranged from 0 to 5 between 2007 and 2015. Over this time period, the region experienced a rising trend in the number of non-motorized fatalities and serious injuries. The five-year rolling average ranged from 2.4 to 3.4 with a rising trend of 0.18 per year. For 2018, the region established a target of 3 or fewer non-motorized fatalities and serious injuries with a decline in the trend.

Systemic Safety Approach

In keeping with MAP-21's requirement to integrate the systemic safety approach into transportation plans, the Grand Forks – East Grand Forks MPO incorporated crash data and performance measures from safety plans and programs in North Dakota and Minnesota. A common criticism of the site-specific/black spot safety approach found earlier in this section is that once all crashes are taken into account, locations with high traffic volumes tend to be over-represented. The systemic approach seeks to alleviate that problem by focusing on risk factors that may not have already caused – but have the potential to cause –severe or fatal traffic crashes. Together, the two safety approaches are complementary to developing a safety plan that is both reactive and proactive in reducing crashes. Adding systemic improvements is a low-cost process that yields high benefits in the long run.

The Federal Highway Administration recommends four steps in the systemic safety planning process. After selecting the focus crash type, it is necessary to answer the question "where are the crashes occurring?" The FHWA recommends utilizing a crash tree diagram to approach this question. (http://safety.fhwa.dot.gov/systemic/fhwasa13019/element1.cfm)

Figure 3-21: FHWA System Safety Planning Process



Source: Federal Highway Administration

For the systemic-based crash assessment, crash trees were utilized from both North Dakota and Minnesota plans. Most applicably, the North Dakota Local Road Safety Program specific to Grand Forks, the Polk County Safety Plan, and the Minnesota DOT District 2 Highway Safety Plan provided crash trees that further the understanding of crashes that have not been identified by the site-specific approach. Although the data accounts for more than just the MPO area, the crash trees still remain relevant in identifying roadway characteristics that can be alleviated by the systemic approach to highway safety.

The crash trees highlighted below signify the dynamics of crashes that occurred in Grand Forks County and Polk County from 2008-2012. Unlike the dark spot approach described above – which has been criticized for overemphasizing intersection crashes – these trees represent the types and severities of crashes in addition to intersection crashes.

After creating region-specific crash trees, NDDOT and MnDOT identified the most common roadway characteristics that present a potential risks for each of these crashes. From there, a list of countermeasures were identified and applied to specific roadway segments that exhibited those characteristics. The project applications in both North Dakota and Minnesota reflect those identified roadway segments, and have been incorporated into Chapter 8 to determine appropriate performance measures for the LRTP.

Crash Trees

For the Grand Forks County crash tree analysis, data was taken from 5,041 crashes that occurred in a 5-year period from 2008 to 2012. The Polk County crash tree analysis utilized data from 1,535 crashes that occurred between 2007 and 2011. The District 2 (Minnesota) crash tree analysis used data from 3,975 crashes between 2006 and 2010. For each of these crash data sets, five years of data was examined to prevent the possibility of examining an abnormal year, as well as reduce the chance for significant changes in roadway conditions such as reconstructed roads or changed speed limits. The Grand Forks County and Polk County crash trees below reflect the crashes by road type, area, and crash type category, while the District 2 crash trees reflect the crashes by area and then crash type.

Figure 3-22: Grand Forks Region Crash Data Overview – Rural and Urban Local Road Systems (2008 to 2012)

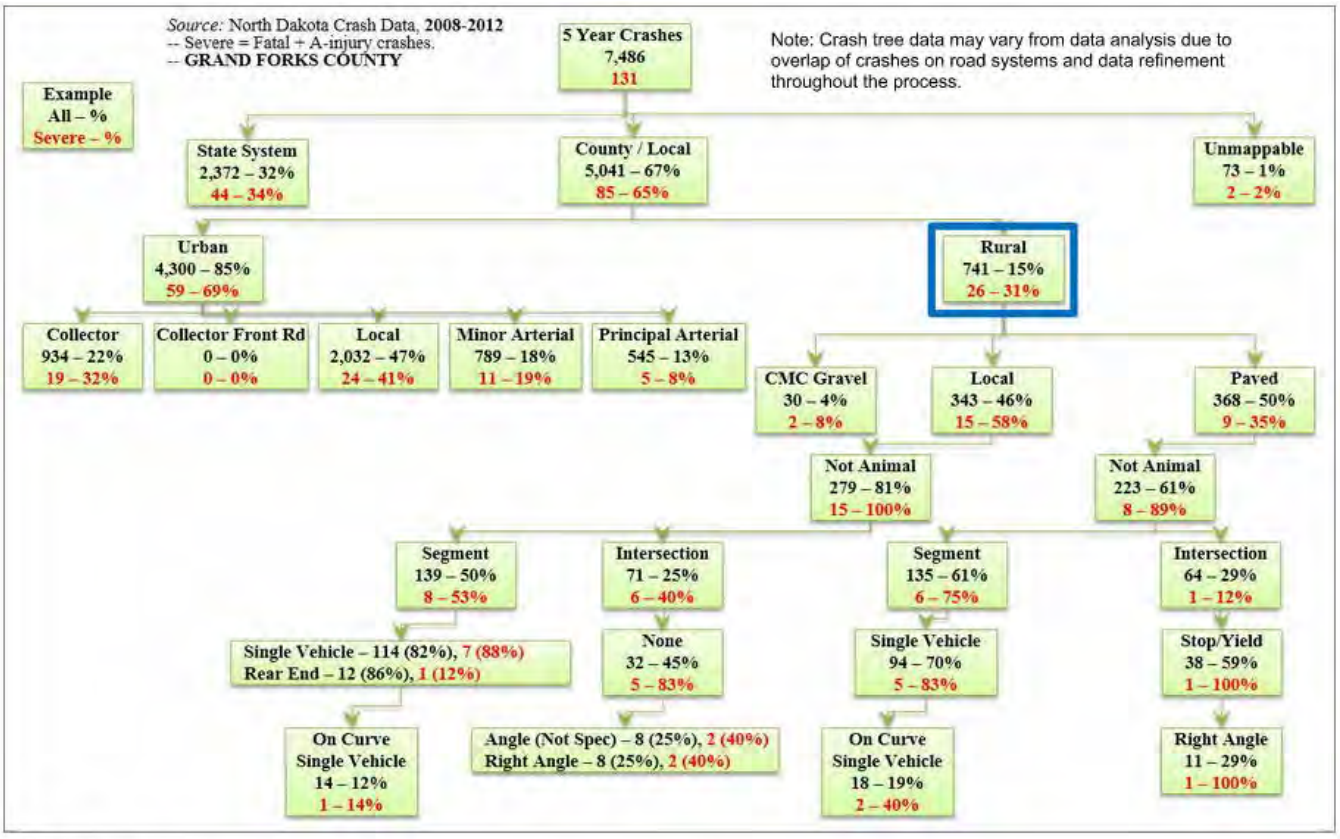


FIGURE 2-1
Grand Forks Region Crash Data Overview – Rural and Urban Local Road Systems (2008 to 2012)

Source: North Dakota Local Road Safety Program: Grand Forks

Figure 3-23: Grand Forks Region Crash Data Overview – Rural and Urban Local Road Systems (2008 to 2012)

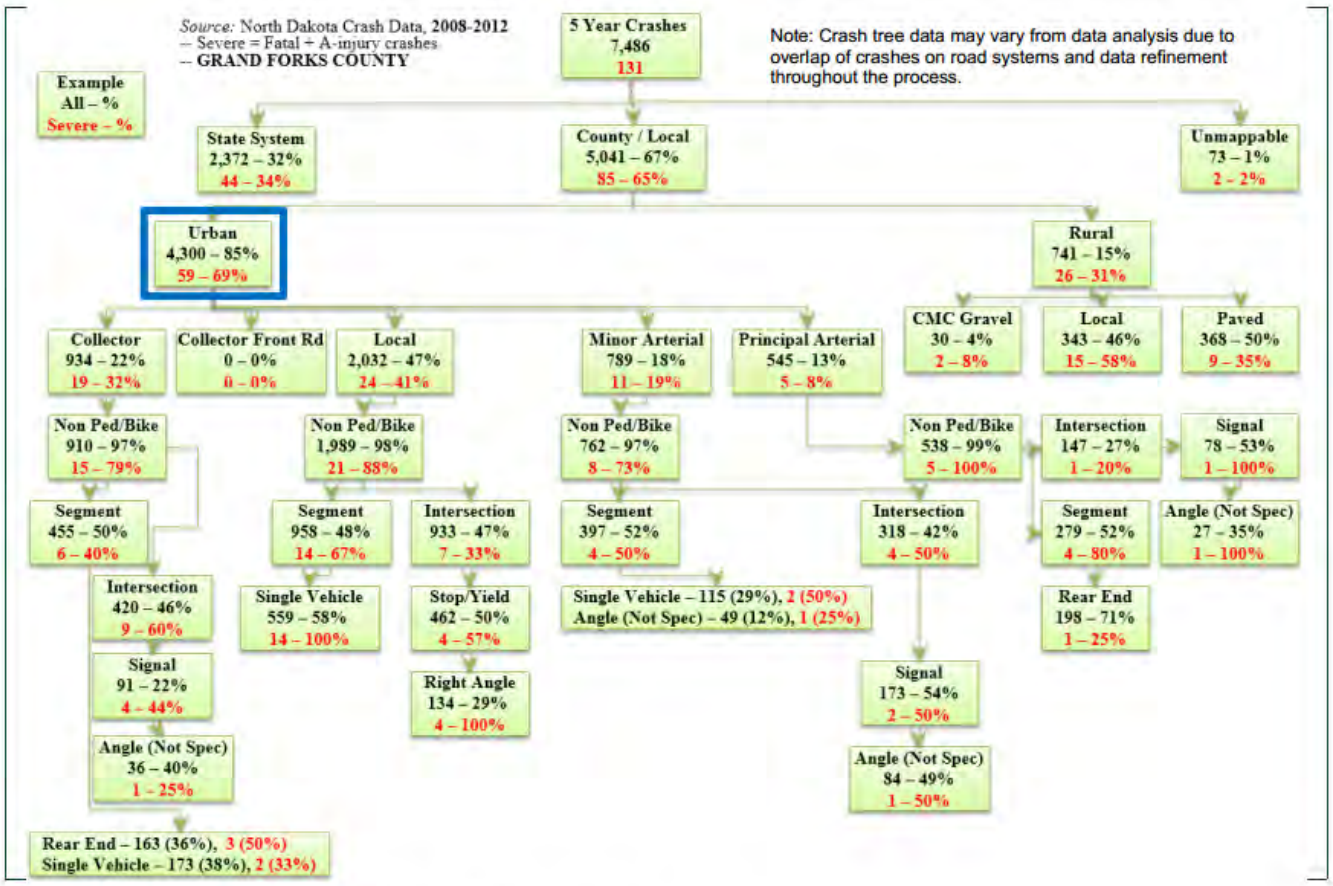


FIGURE 2-1 (Continued)
Grand Forks Region Crash Data Overview – Rural and Urban Local Road Systems (2008 to 2012)

Source: North Dakota Local Road Safety Program: Grand Forks

Figure 3-24: Polk County Crash Data Overview

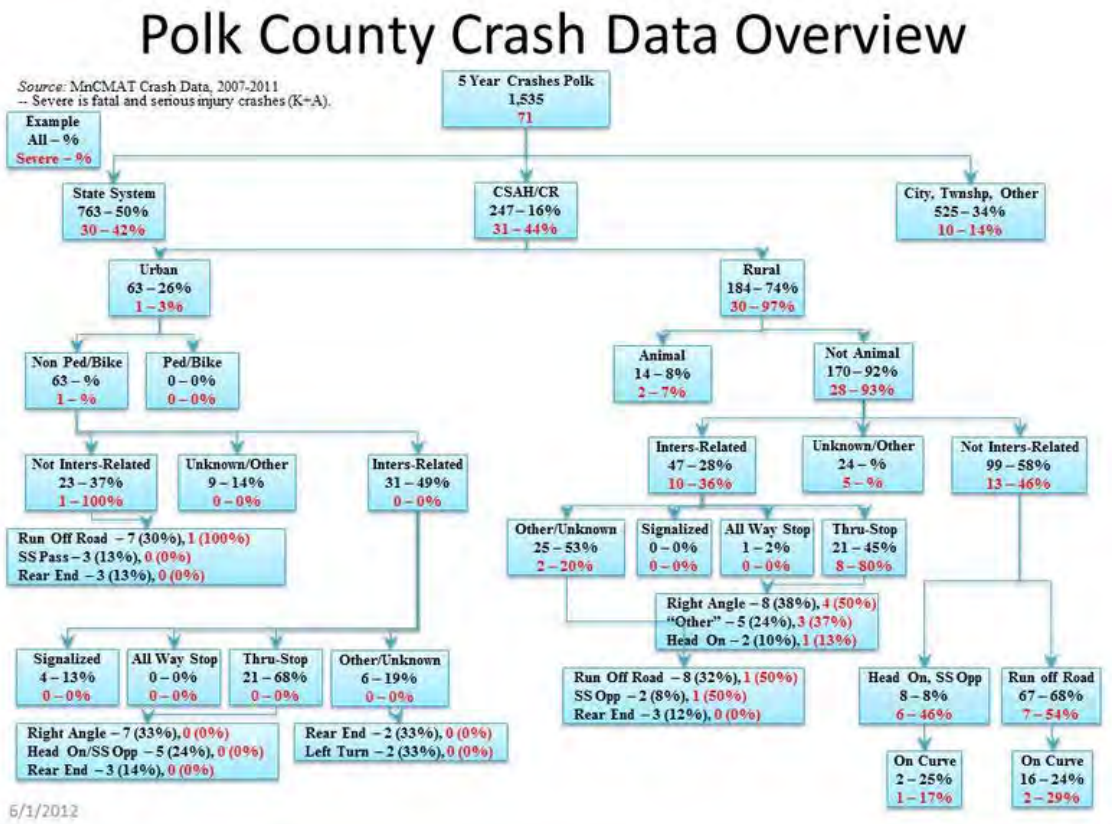


Figure 3-2
Polk County Crash Data Overview

Source: Polk County Safety Plan

Figure 3-25: MnDOT District 2 Crash Disaggregation

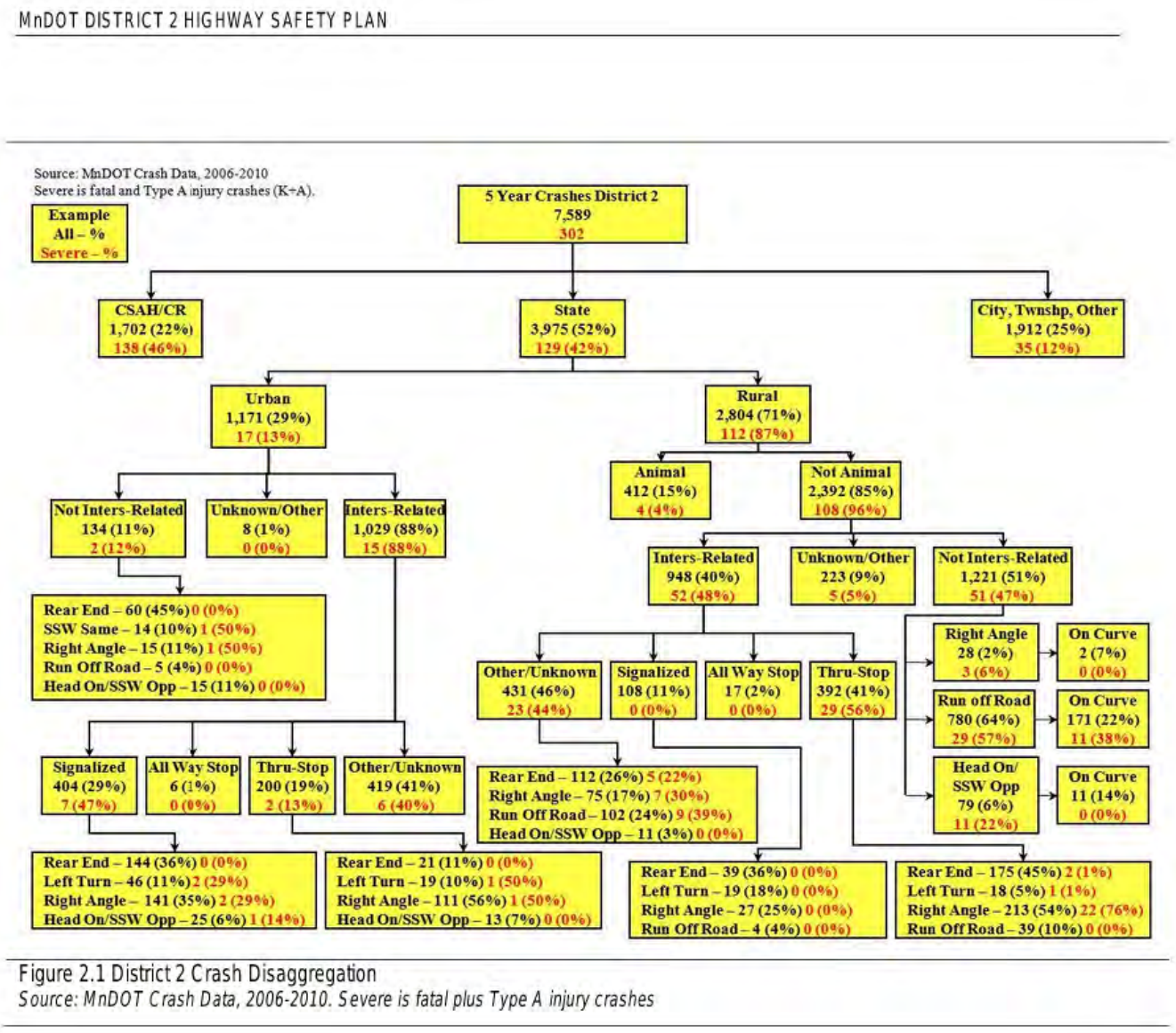


Figure 2.1 District 2 Crash Disaggregation
Source: MnDOT Crash Data, 2006-2010. Severe is fatal plus Type A injury crashes

Source: MnDOT District 2 Highway Safety Plan

Based on the data found in each of these crash trees, the states of North Dakota and Minnesota have identified projects that focus on crucial AASHTO emphasis areas. Primarily, roadway agencies have the most control in reducing crashes that related to infrastructure-based emphasis areas such as lane-departure crashes and intersection crashes. As a result, the projects strictly adhere to improvements that relate to roadway conditions.

There are two criteria that are examined to identify candidates for safety investments: high-crash locations and at-risk locations. A crash analysis identifies locations with serious crashes, and then evaluates basic roadway characteristics of locations with serious crashes. Those characteristics – also called risk factors – are then used to determine the risk of future crashes. Rather than wait for a location to become a "dark spot," the systemic approach addresses those risk factors to reduce the potential for serious and fatal crashes.

The maps below detail the results from identifying low-cost, safety-related infrastructure projects focused on safety emphasis areas. Specifically, projects were developed based off high priority rural and urban improvements.

- In Grand Forks County, high-priority rural roadway projects addressed the most common type of serious segment-related crash: a single-vehicle, lane departure crash. High-priority rural curve projects focused on enhancing curve delineation, reducing rear-end and head-one crashes, and reducing right-angle crashes.
- In Polk County, high priority rural roadway projects were developed that specifically targeted edge improvements and enhanced delineation. In both rural and urban areas, there was an effort to develop projects that upgraded signs and pavement markings, installed street lights, and improved visibility at unsignalized intersections.
- In Minnesota District 2, projects were developed that targeted the most practical solutions to rural areas: improvements to the edges and centerlines of rural highways, enhanced delineation of horizontal curves in rural areas, realignment of intersections to reduce skew, upgrading signs and pavement marking, installing street lights, clearing sight triangles, and providing ITS warning systems at rural STOP controlled intersections.

Figure 3-26: Grand Forks County Projects Location Map – Roadway Segments and Intersection Projects

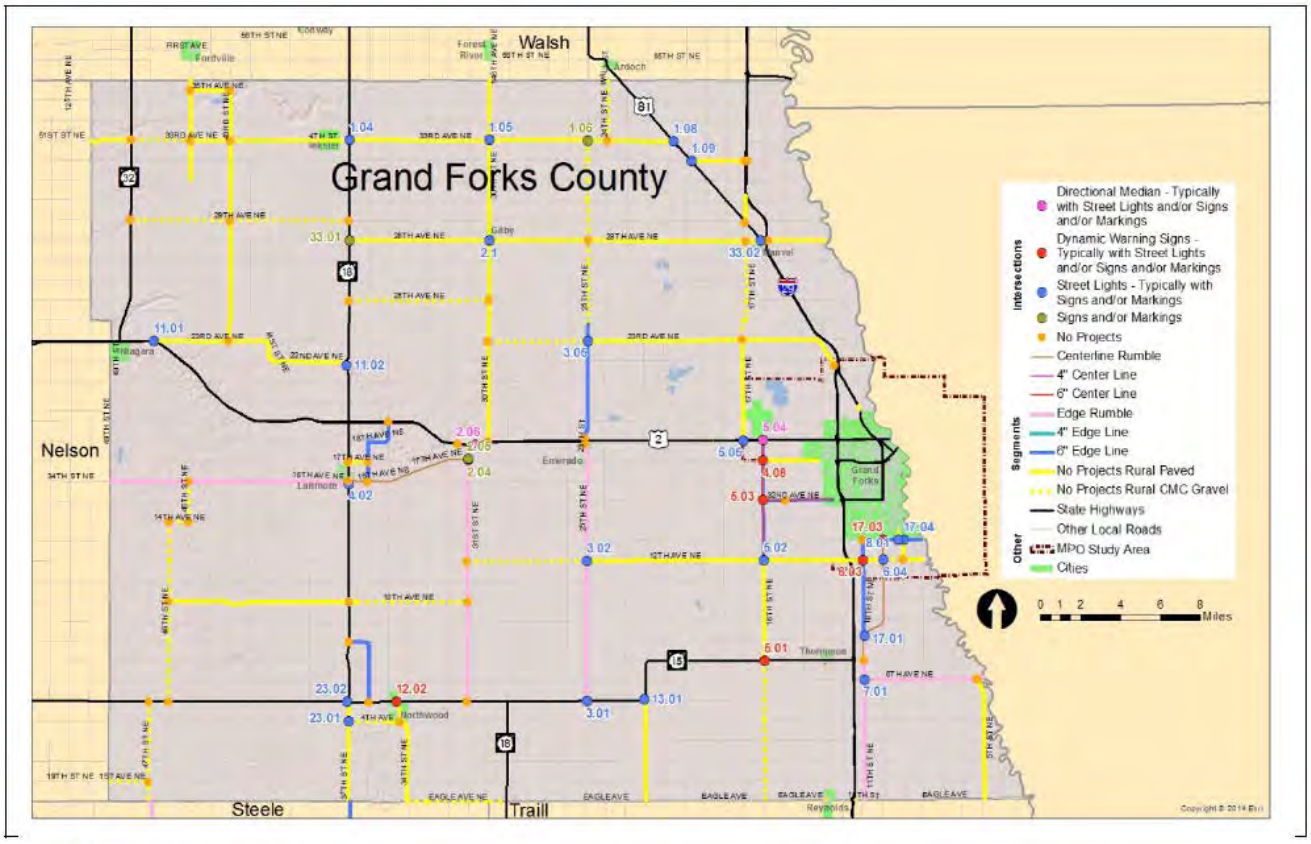
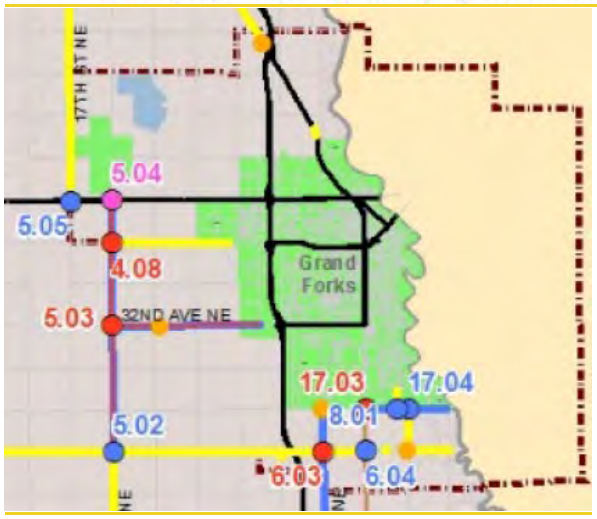


FIGURE 4-8
Grand Forks County Projects Location Map—Roadway Segments and Intersection Projects



Source: North Dakota Local Road Safety Program: Grand Forks

Figure 3-27: Grand Forks County Projects Location Map – Roadway Segments and Curve Projects

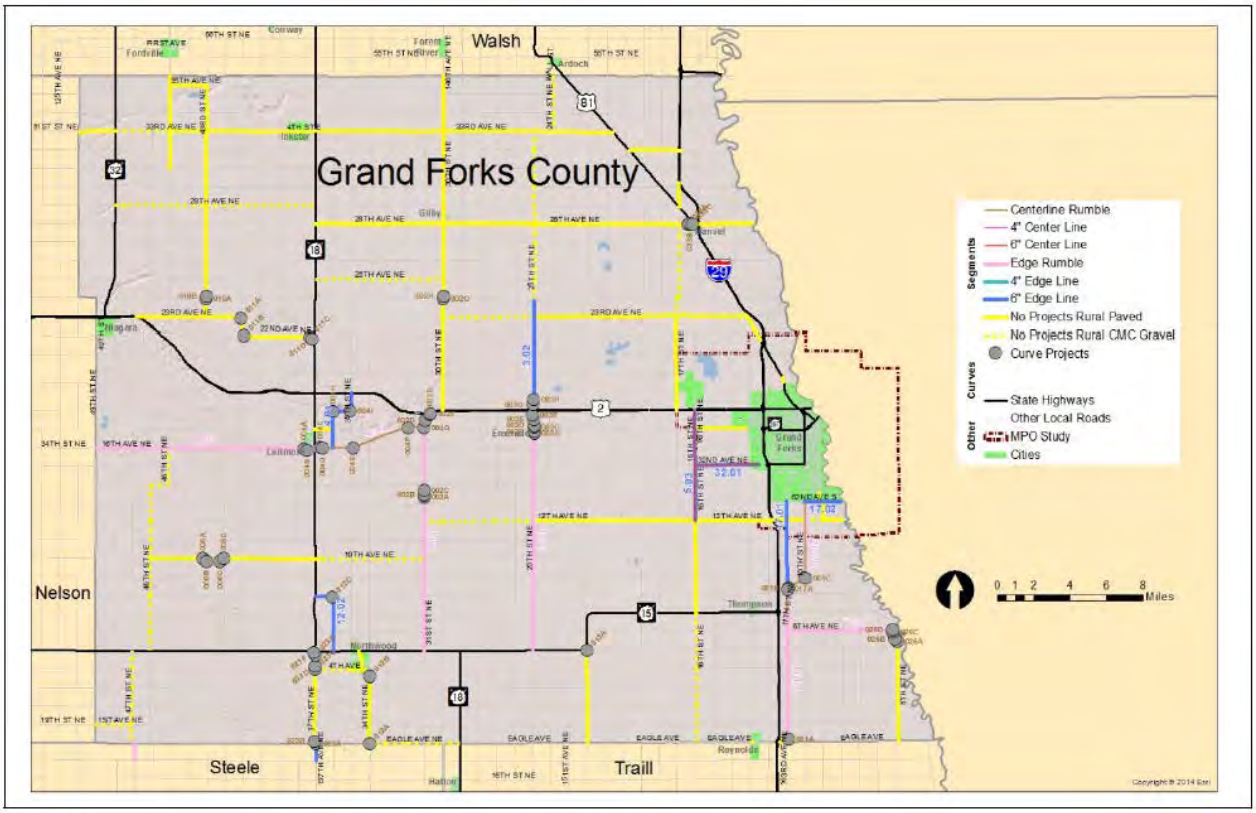


FIGURE 4-9
Grand Forks County Projects Location Map—Roadway Segments and Curve Projects



Source: North Dakota Local Road Safety Program: Grand Forks

Figure 3-28: City of Grand Forks Projects Location Map – Roadway Segments and Pedestrian and Bicycle Projects

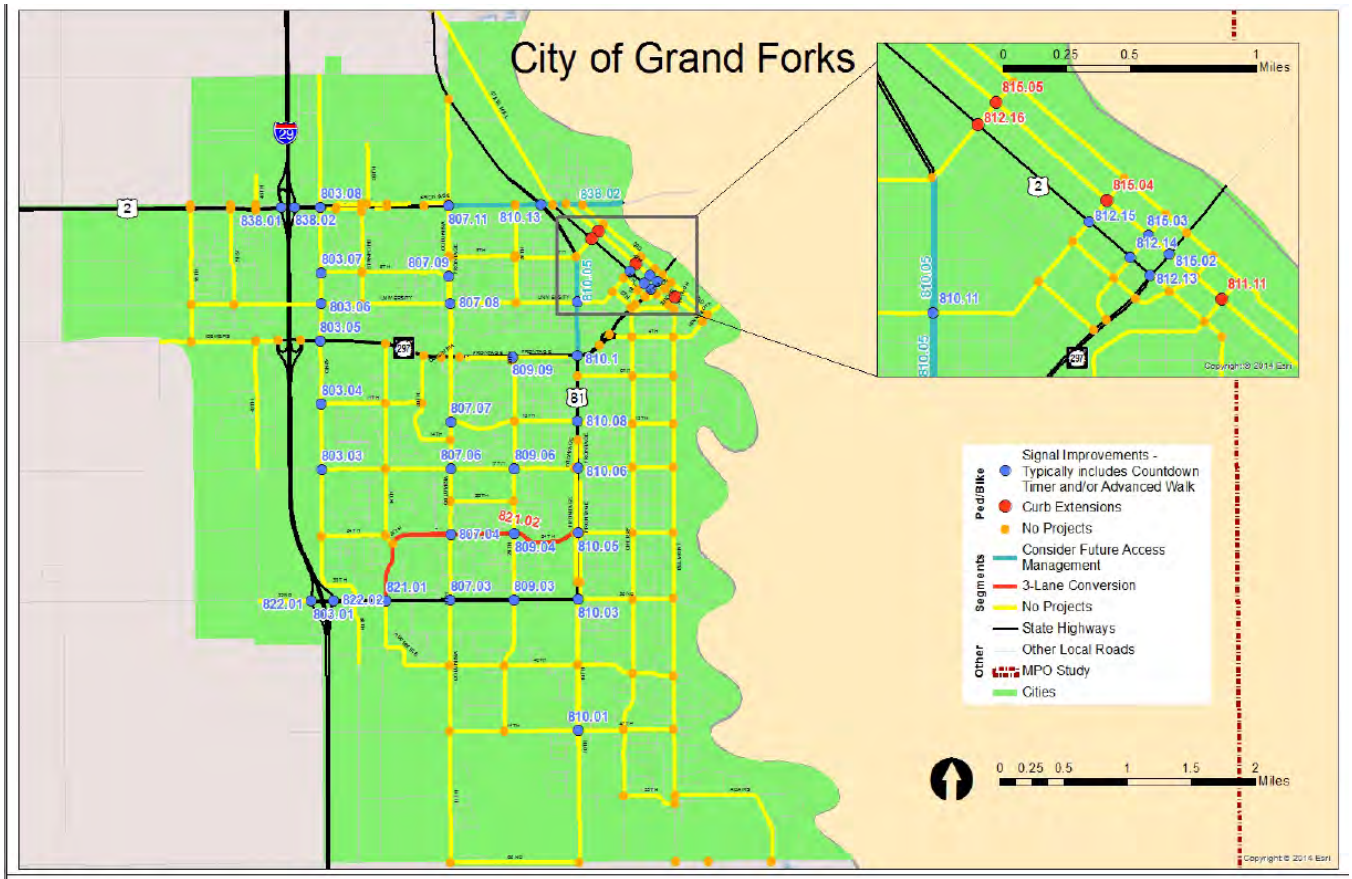


FIGURE 4-10
City of Grand Forks Projects Location Map—Roadway Segments and Pedestrian and Bicycle Projects

Source: North Dakota Local Road Safety Program: Grand Forks

Figure 3-29: City of Grand Forks Projects Location Map – Right Angle Intersection Projects

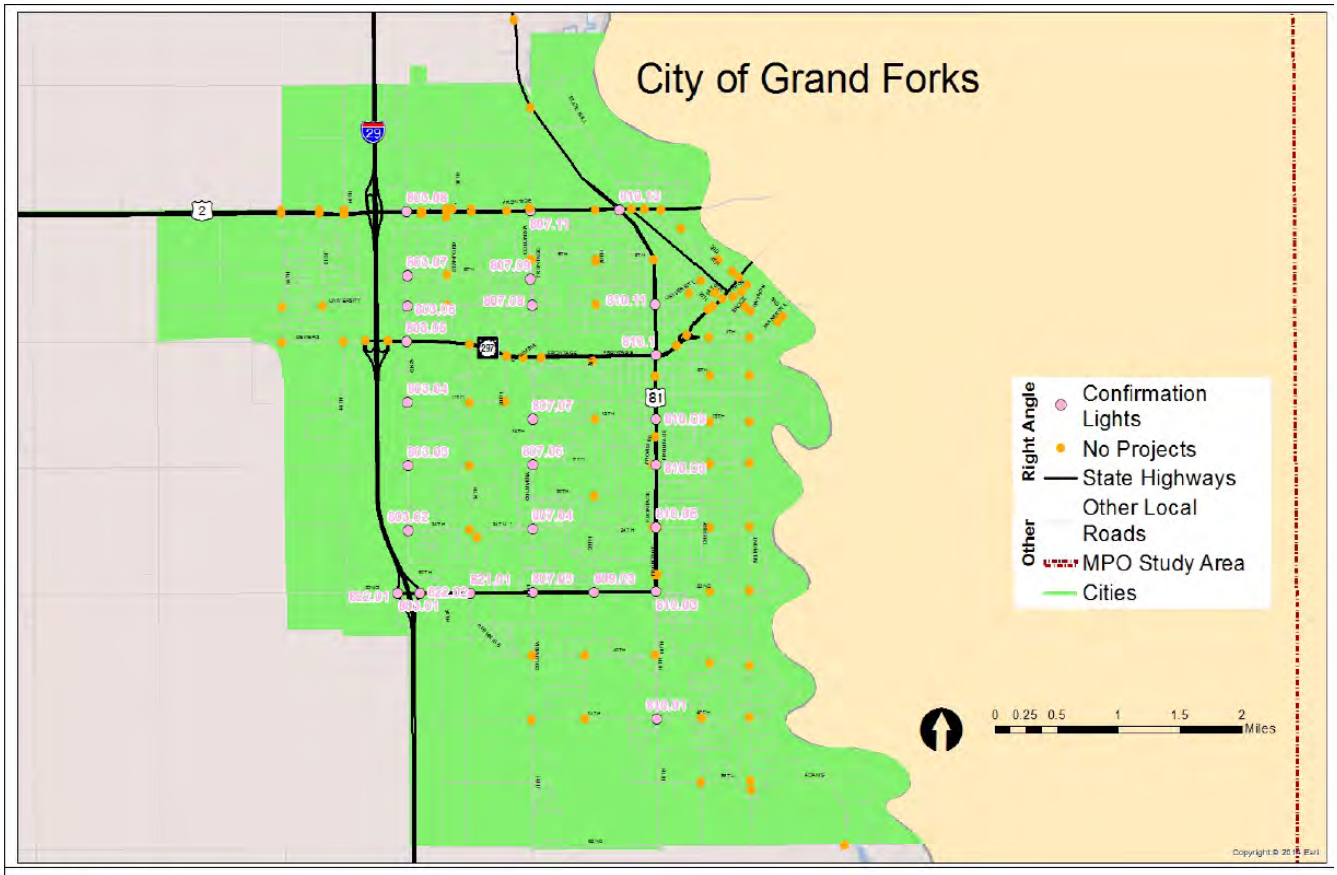


FIGURE 4-11
City of Grand Forks Projects Location Map—Right Angle Intersection Projects

Source: North Dakota Local Road Safety Program: Grand Forks

Figure 3-30: Polk County High Priority Segments

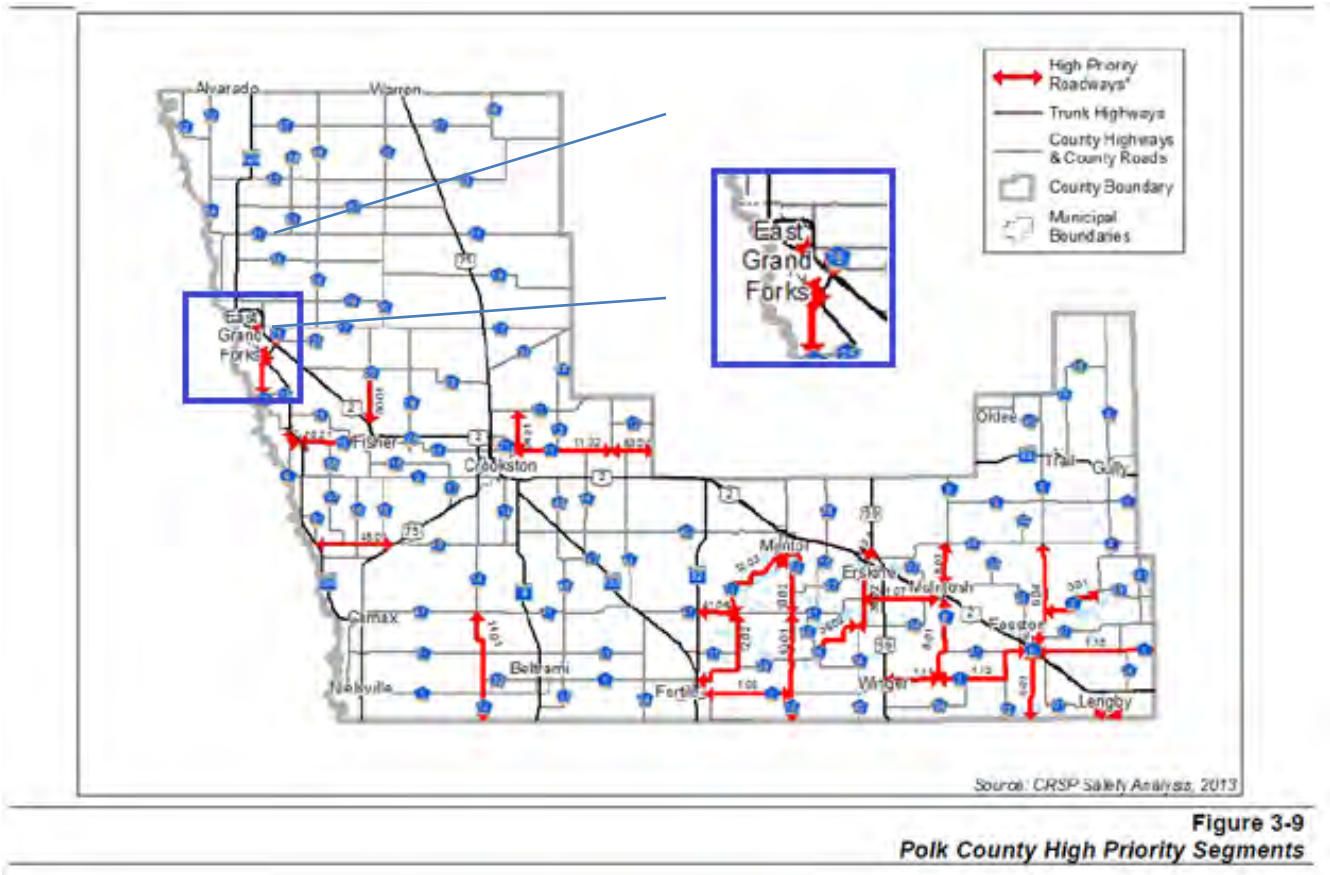


Figure 3-9
Polk County High Priority Segments

Source: Polk County Safety Plan

Figure 3-31: Polk County Curve Project Map

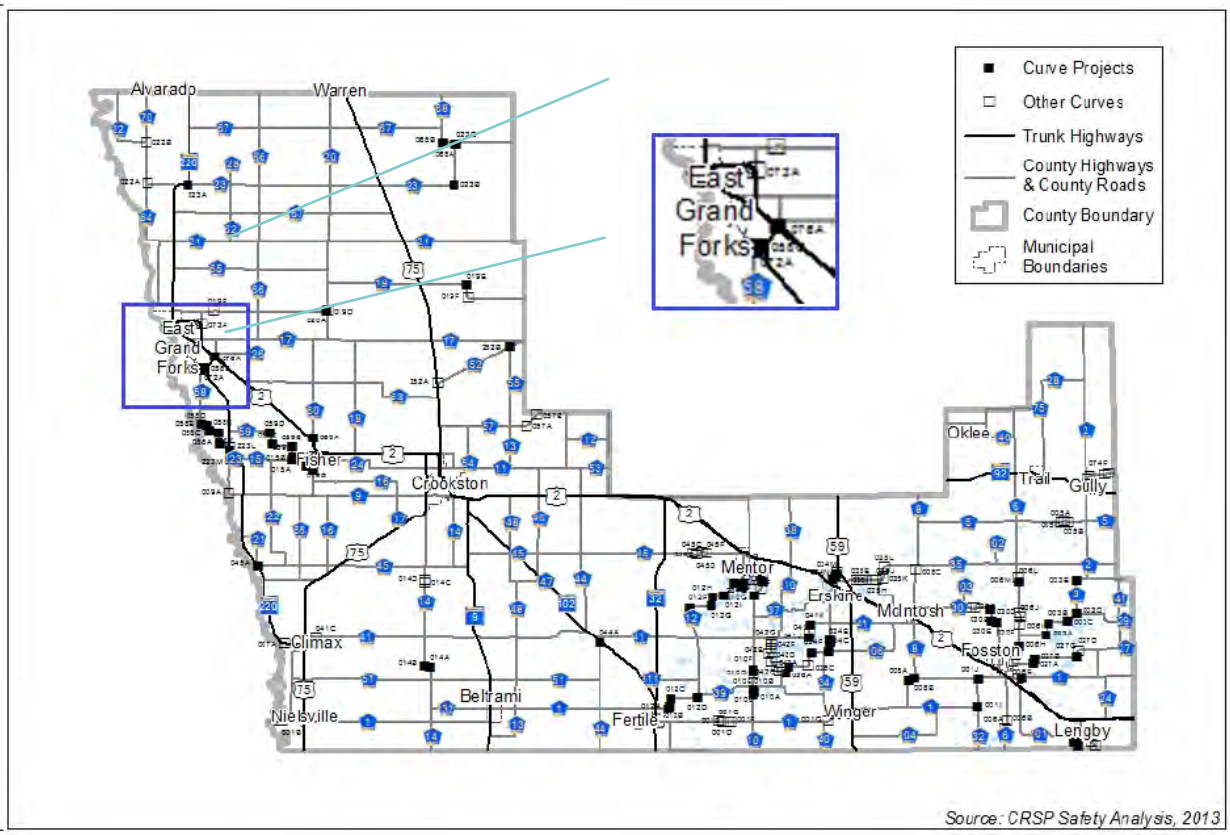


Figure 3-13
Polk County Curve Project Map

Source: Polk County Safety Plan

Figure 3-32: Polk County High Priority Intersection Map

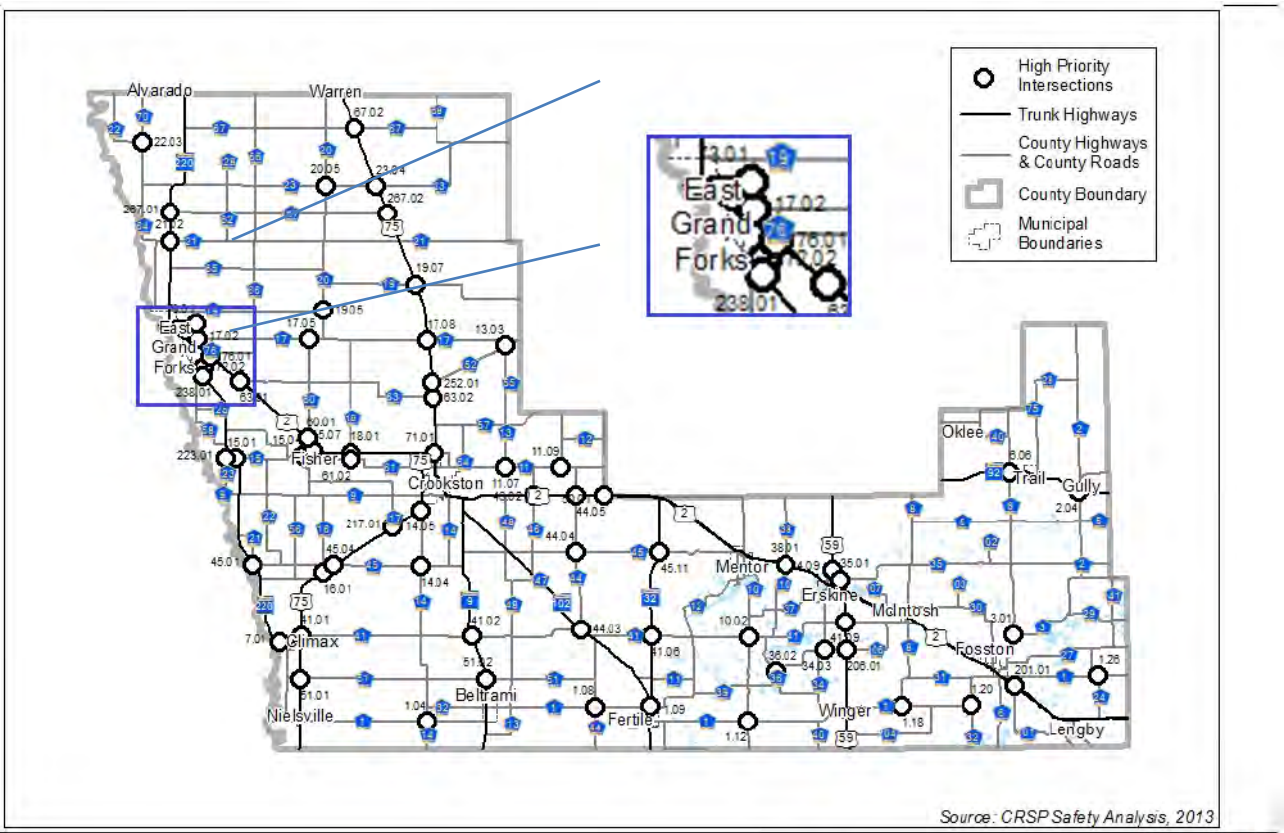


Figure 3-15
Polk County High Priority Intersection Map

Source: Polk County Safety Plan

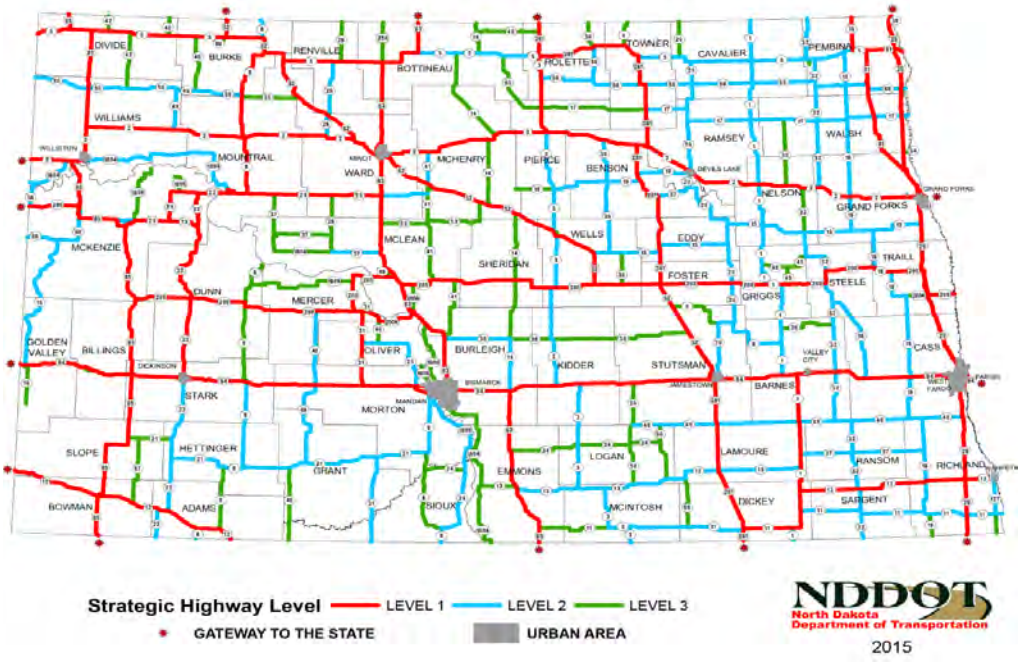
Freight

The Grand Forks-East Grand Forks MPO area includes multi-modal infrastructure for transporting goods. The street and highway network along with the Grand Forks International Airport and multiple railroad corridors connect the region to national and international transportation systems.

Key Freight Routes

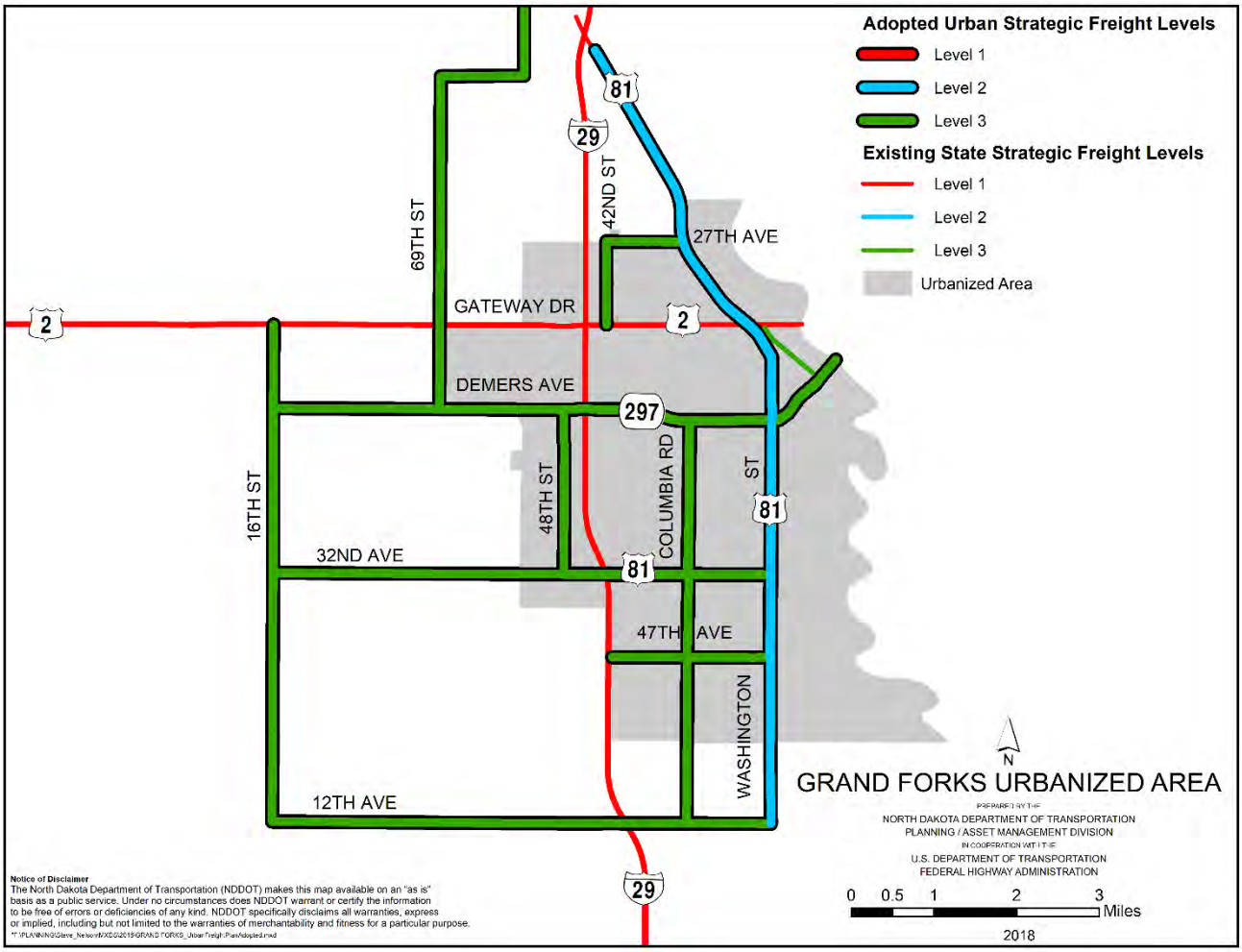
NDDOT adopted its North Dakota State Freight Transportation Plan in 2015. On the North Dakota side of the GF/EGF MPO, there are a number of roadways that serve as part of critical state and national freight routes for the movements of goods. Figure 3-33 and Figure 3-34 below illustrates NDDOT's State Strategic Freight System of Highways. As illustrated, in the Grand Forks area, Interstate I-29 and US Highway 2 are both identified as Level 1 Strategic Highways. These highways are also part of the National Freight Network and connect North Dakota with domestic and foreign markets. An extension of the National Freight Network for urban areas are Urban Critical Freight Corridors. Figure 3-35 on the following page illustrates critical urban freight corridors in the Grand Forks area including Gateway Drive, DeMers Avenue, Washington Street, Columbia Road, 32nd Avenue South, among others.

Figure 3-33: NDDOT Strategic Freight System - Highways



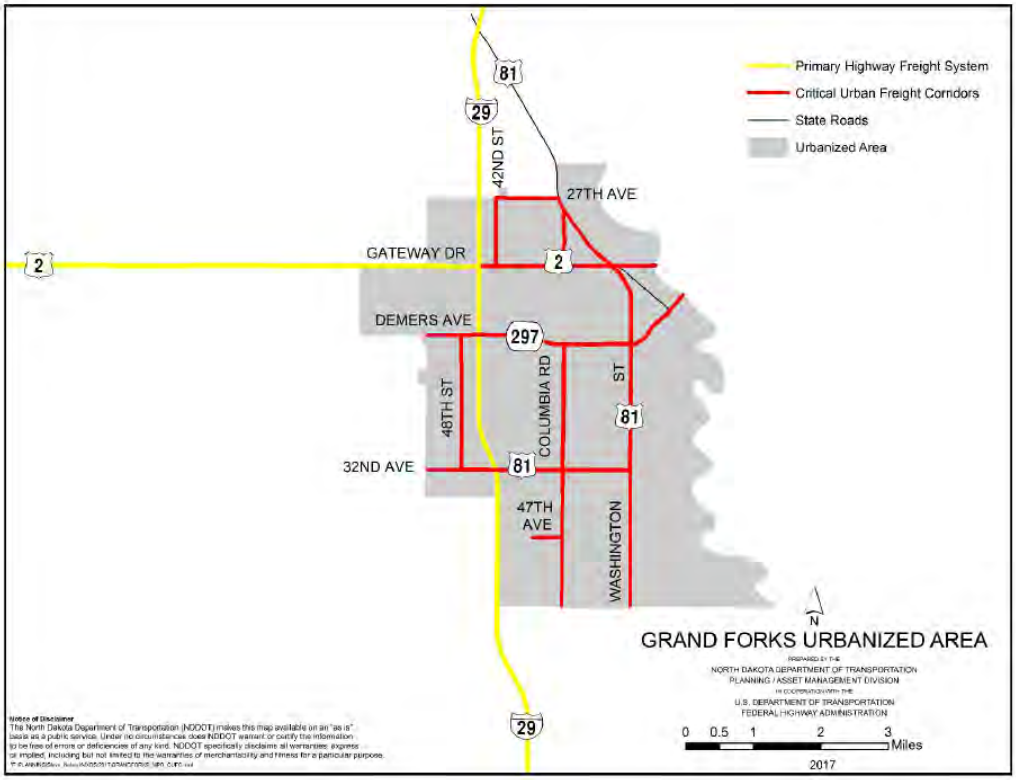
Source: NDDOT

Figure 3-34: NDDOT Strategic Freight System – Highways – Grand Forks Urbanized Area



Source: NDDOT

Figure 3-35: Critical Urban Freight Corridors - Grand Forks Urbanized Area

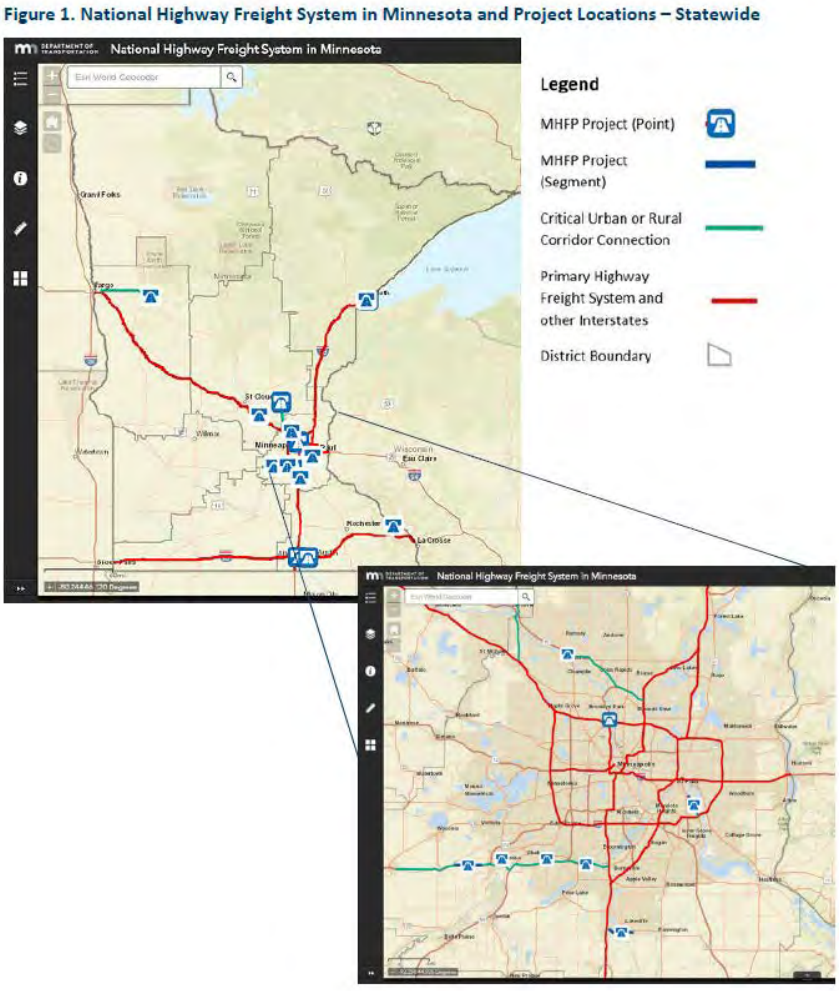


Source: NDDOT

MnDOT has developed a 2017 Minnesota State Freight Investment Plan that identifies Critical Urban Freight Corridors and Critical Rural Freight Corridors. This investment plan identifies $100 million of FAST-Act federal freight funds that will be programmed for freight projects from FY 2019 thru FY 2022. None of these funds are programmed for the GF/EGF MPO planning area. In 2018, a Minnesota Statewide Freight System Plan was also developed. Figure 3-36 on the following page illustrates the National Highway Freight System in Minnesota from the 2017 Minnesota State Freight Investment Plan. As illustrated, there are no currently designated National Freight System roadways in the East Grand Forks area. Also, MnDOT has not identified any Critical Urban Freight Corridors or Critical Rural Freight Corridors in the East Grand Forks area.

It should be noted that unlike Minnesota where there is a federal set-a-side and statewide competition for federal freight projects using FAST-Act freight funds, in North Dakota, there is not a separate federal freight project solicitation and funding process. In North Dakota, freight projects identified as part of the NDDOT Strategic Freight System or the Urban Critical Freight System must compete for and be funded through the standard state and federal funding programs available to other projects.

Figure 3-36: National Highway Freight System in Minnesota



Source: 2017 Minnesota State Freight Investment Plan

Metro Truck Routes

The movement of goods and services by truck is facilitated by designated truck routes within the metro area (see Figure 3-37). However, truck routes are designated differently between the States of North Dakota and Minnesota. In Minnesota, truck routes include any roadway designated as a Municipal State Aid (MSA) route. In North Dakota, State law allows specific designation of truck routes. In Grand Forks these special designations have been assigned to Gateway Drive, DeMers Avenue, Washington Street, 32nd Avenue South, and Mill Road. Trucks may travel on any road off the designated truck route only when they are at the intersection to their destination and then must follow the reverse route back to that intersection on the designated truck route. Grand Forks also has prohibited trucks over a certain weight from traveling on the Columbia Road overpass and the Point Bridge. For the Columbia Road overpass, the weight limit is 20,000 pounds gross weight and for the Point Bridge the weight limit is 40,000 pounds gross weight.

Metro Truck Volumes

Figure 3-38 represents year 2015 truck traffic counts taken in Grand Forks by NDDOT on certain roadways and 2012 truck traffic counts taken in East Grand Forks by MnDOT (state highways only). Truck trips are significant during harvest season in the Grand Forks-East Grand Forks region. In 2012, for example, harvest truck trips were

documented as part of turning movement counts collected along South Washington Street. This count documented a total of 316 trucks along South Washington Street and 119 of the 316, or approximately 38 percent, were beet trucks.

Metro Truck Safety

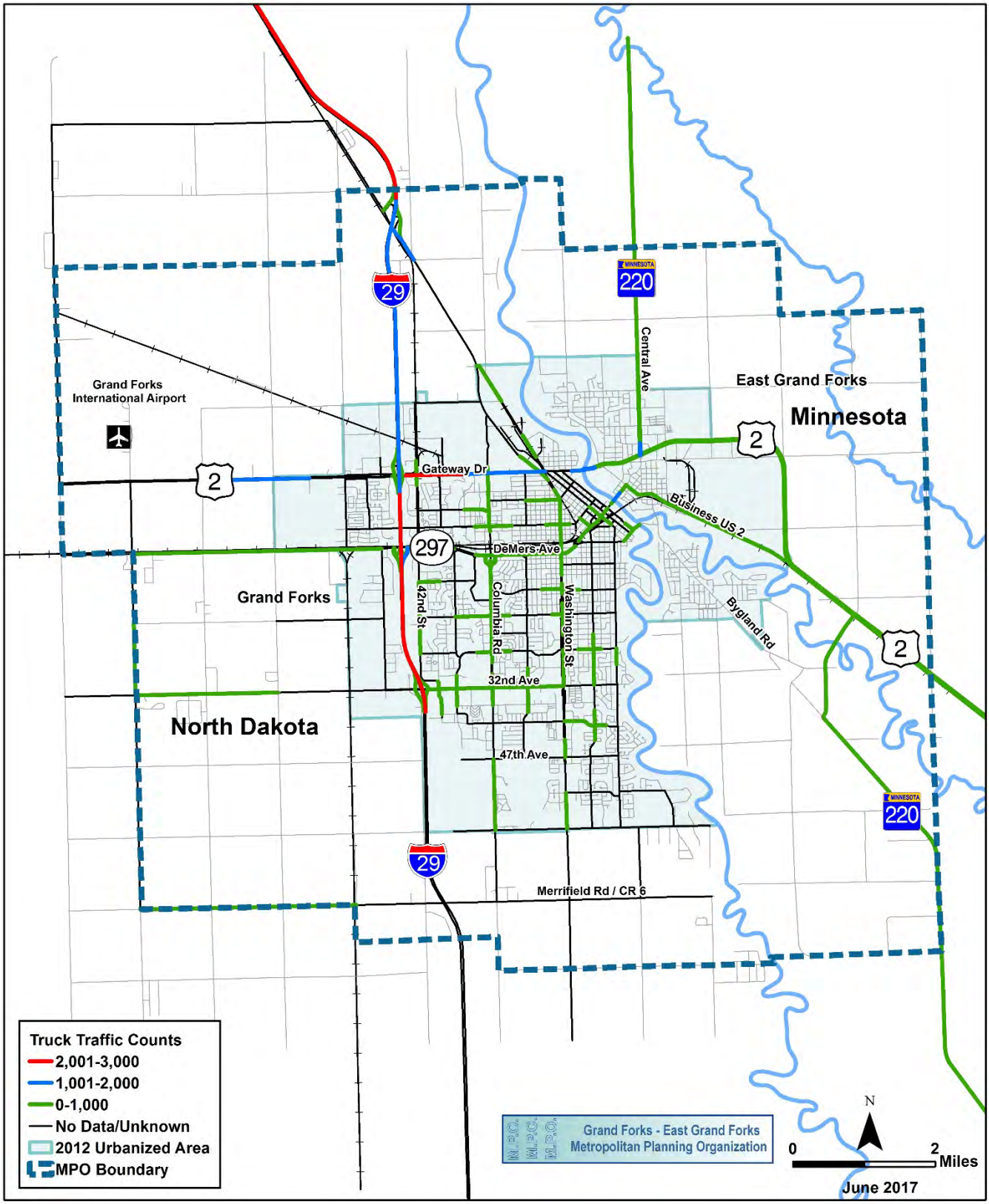
According to the US DOT, approximately 12 percent of all motor vehicle crashes in the United States involve large trucks. Comparatively, large trucks were involved in 116 of 5,425 total crashes in the Grand Forks-East Grand Forks metro area from 2012 to 2015, or approximately 2 percent of all crashes. The density and total number of truck related crashes is summarized in Figure 3-39 and Table 3-16. Most truck related crashes occurred along US Highway 2/Gateway Drive over this period-of-time.

Figure 3-37: Truck Routes



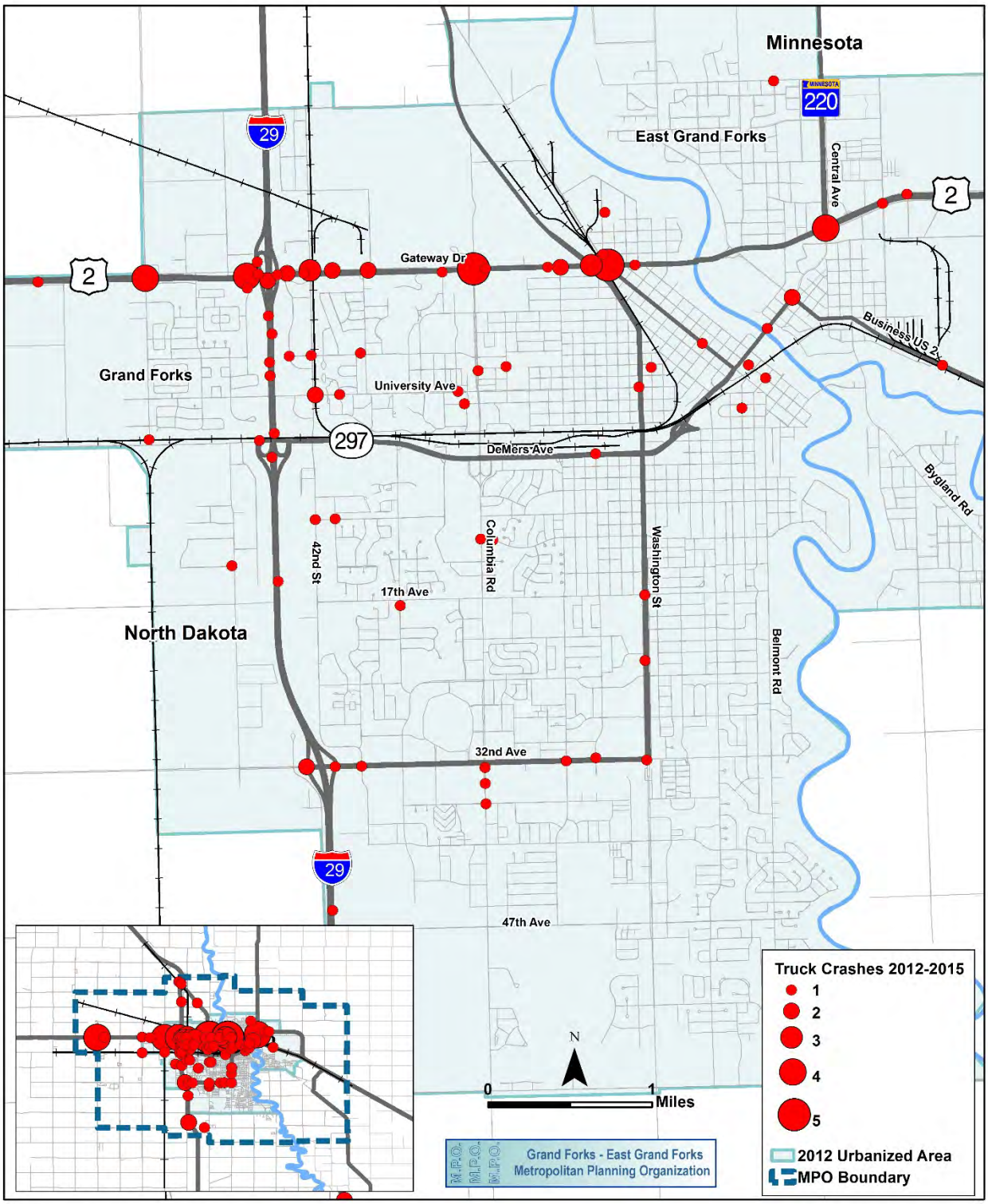
Source: Grand Forks-East Grand Forks MPO

Figure 3-38: Truck Traffic Volumes



Source: Grand Forks-East Grand Forks MPO

Figure 3-39: Truck Related Crashes



Source: NDDOT and MnDOT

Table 3-16: 2012-2015 Truck Related Crashes by Type and Severity

Truck Type	2012	2013	2014	2015	Total
Double Axle	6	1	6	2	15
Triple Axle or Greater	7	8	7	9	31
Truck Tractor with 0-3 Trailers	17	22	10	15	64
Unknown Heavy Truck	1	1	0	4	6
Total	**31**	**32**	**23**	**30**	**116**
Truck Severity Crashes					
Fatality	0	0	1	0	1
Injury	3	5	2	6	16
Property Damage Only	27	28	20	24	99

Source: NDDOT and MnDOT

Metro Rail Lines

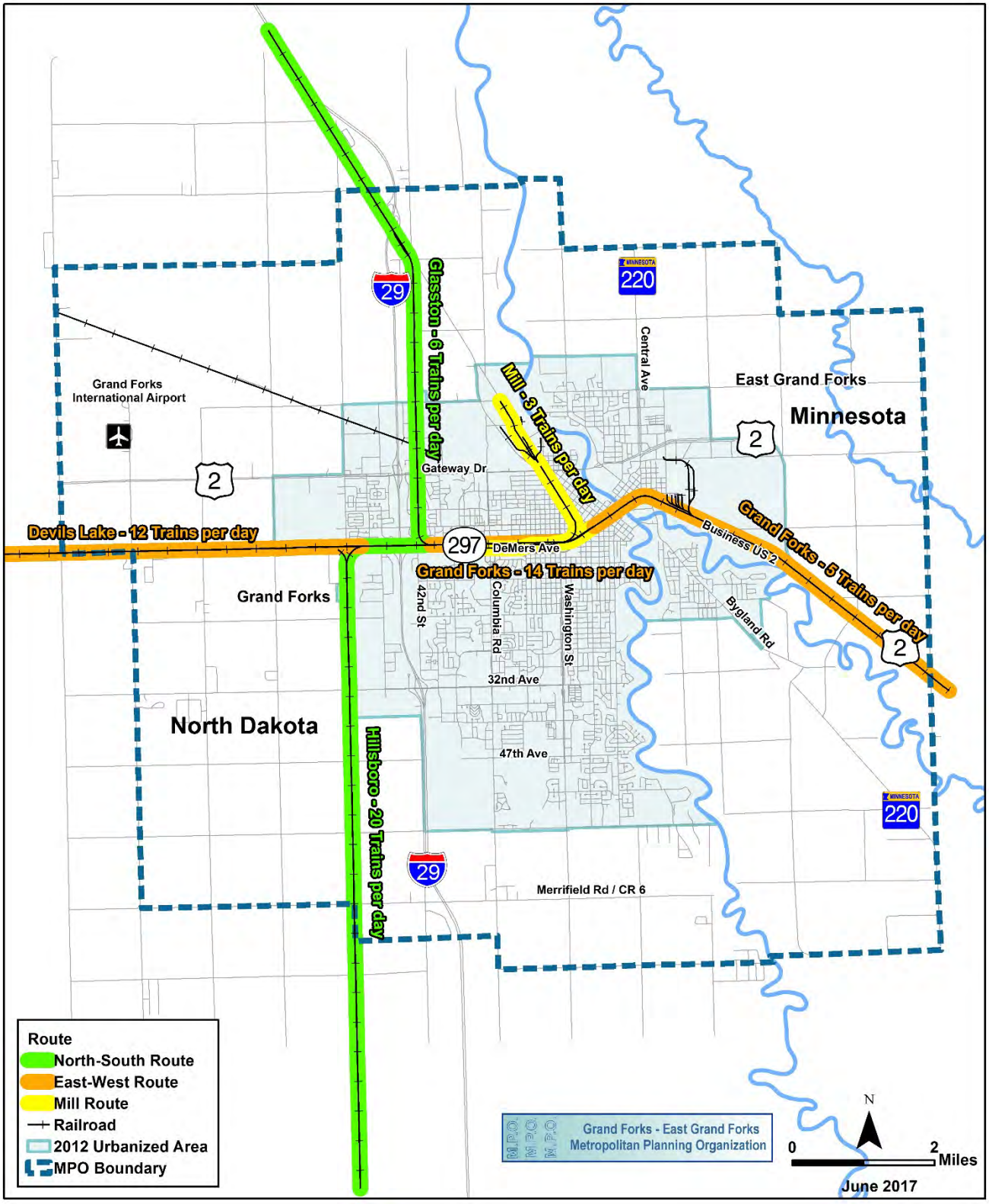
The majority of railroad tracks in the region are owned and operated by the BNSF Railway Company (BNSF). These routes provide access through North Dakota to the west coast, through Minnesota to Chicago, and south to the Gulf of Mexico. BNSF also owns and operates the DeMers railyard just north of DeMers Avenue and south of the University of North Dakota campus. It is one of the main rail yards in North Dakota. At the yard, empty cars are dropped off, and cars full of commodities are staged in sections along multiple lines of track before being heading to their destination. Additionally, the Mill Spur and other minor spur connections provide industrial rail access and link the region's industrial land uses to BNSF's national railroad network. The region's railroad network is shown in Figure 3-40. Amtrak also operates its Empire Builder line on the BNSF lines, providing daily rail passenger service to Chicago and Seattle.

Minimizing the traffic delay at rail crossings is important, especially for truck freight movement in the metro area and across the nation. FHWA reports that unexpected delays (by train blockages) can drive up the cost of freight transport by 50 to 250 percent, hindering the ability of a region's transportation system to effectively meet freight demands. The movement of various agricultural products, especially sugar beets, via trucks from field processing or transshipment points can also be disrupted by train traffic. Balancing the movement of goods and services between multiple modes of transportation is a challenging task and requires coordination and collaboration between public and private sectors. Two problematic at-grade rail crossings for truck traffic delays associated with unit train traffic and train blockages are the Glasston Subdivision crossing at US Highway 2 and the Grand Forks Subdivision crossing near the intersection of DeMers Avenue and North 42nd Street.

Metro Rail Crossings

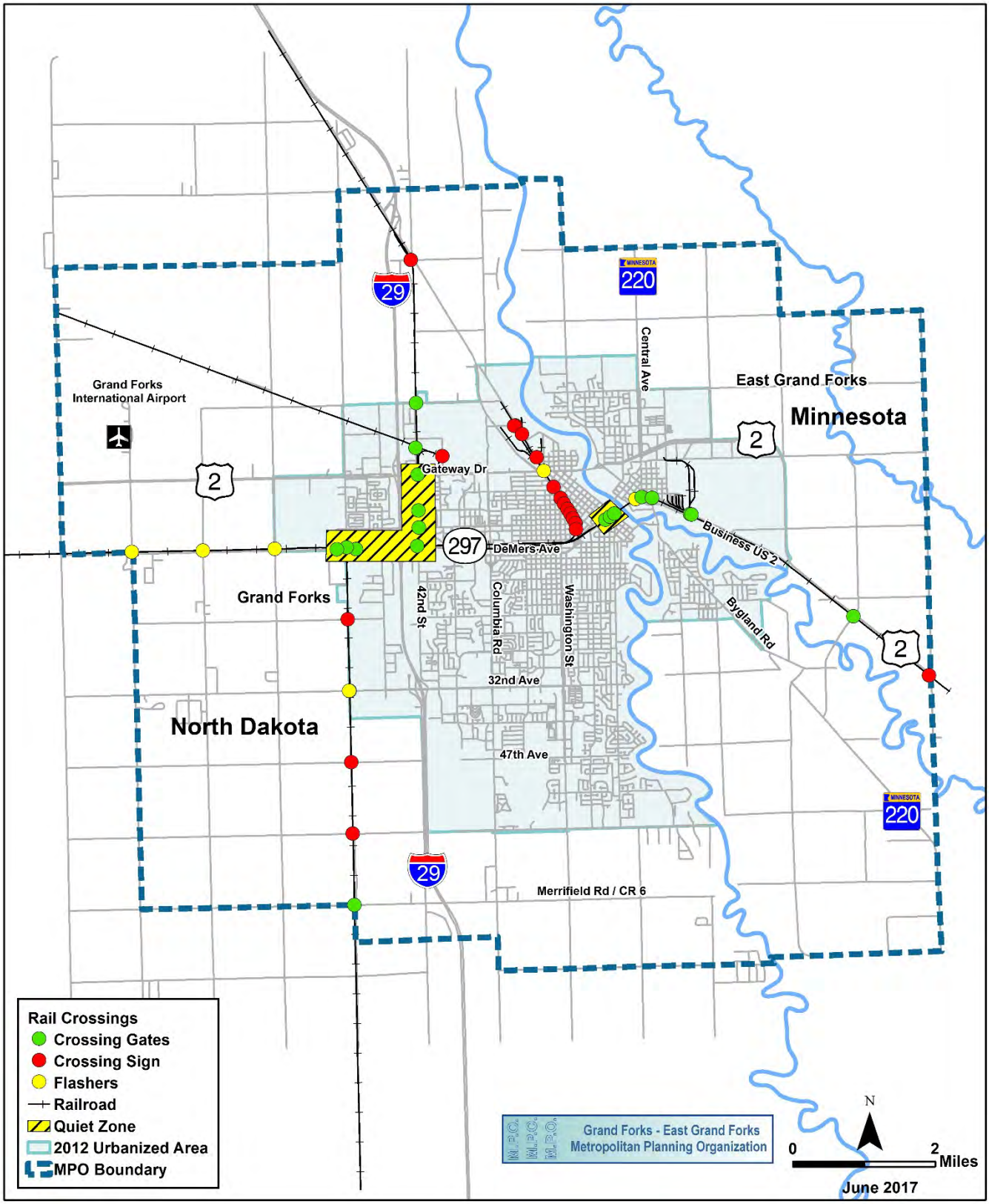
Regarding traffic operations, rail movement plays a significant role in the overall transportation system of the Grand Forks-East Grand Forks region. Currently, there are 45 at-grade railroad crossings, 20 of which have crossing signs only; 9 crossings have signs and flashers; and 16 have crossing signs flashers and gates (see Figure 3-41). In 2010, the Grand Forks-East Grand Forks MPO conducted a quiet zone assessment for the metropolitan area, which led to a recommended crossing improvement plan for 4 at-grade crossings in East Grand Forks and 11 at-grade crossings in Grand Forks. The MPO and respective cities continue to work toward implementing these quiet zones throughout the metropolitan area.

Figure 3-40: BNSF Railway Subdivisions



Source: Grand Forks-East Grand Forks MPO

Figure 3-41: Existing Railroad Crossings



Source: Grand Forks-East Grand Forks MPO

Freight Businesses

The region's economy consists of several industries, regional shopping centers, and manufacturing facilities that rely on the freight system to move goods within and out of the region. In addition, the region serves as a hub collecting agricultural commodities from northeast North Dakota and northwest Minnesota. Several large freight users are identified in Figure 3-42. Among these, the largest freight generators include American Crystal Sugar, North Dakota State Mill, and BNSF Railway.

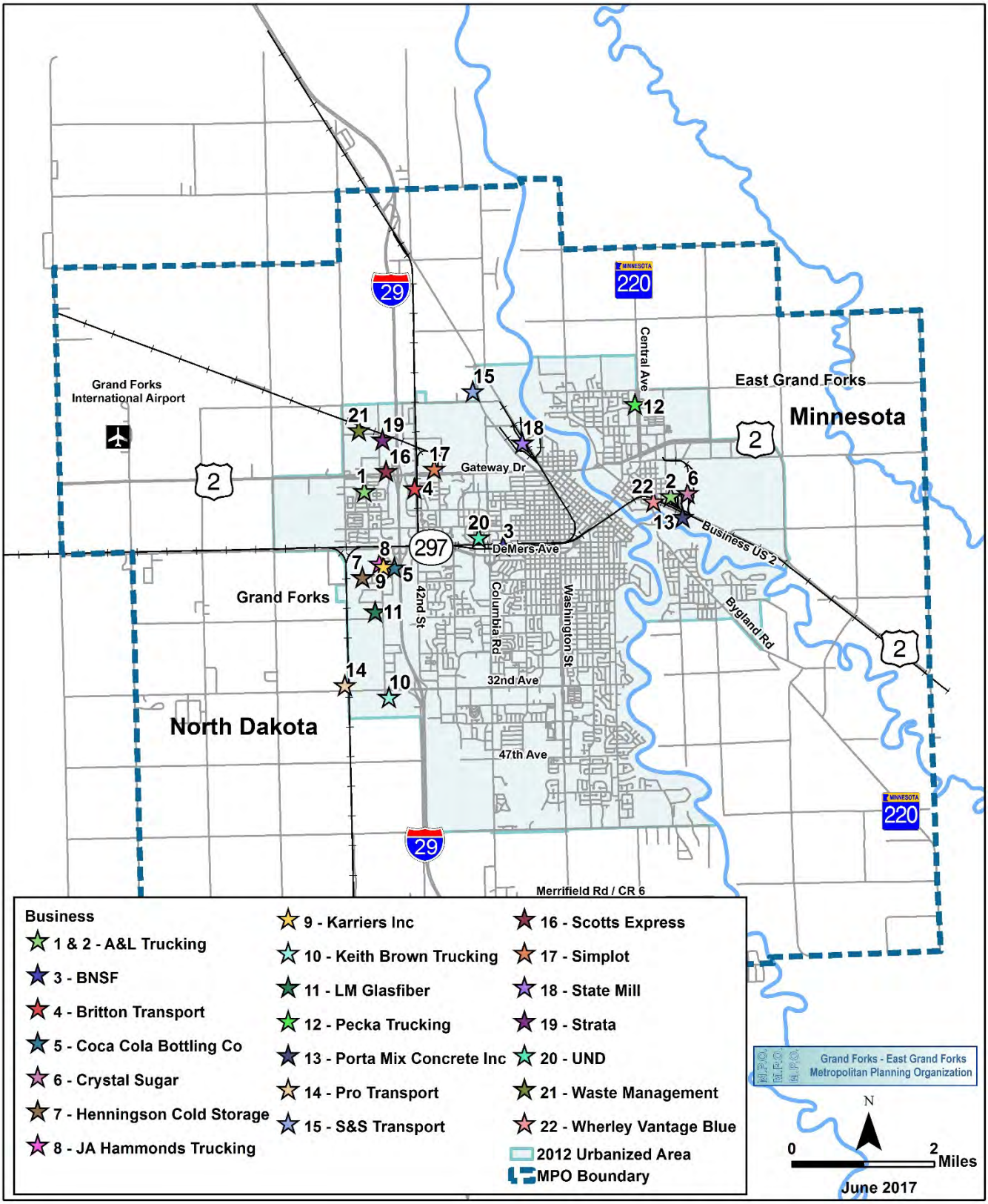
Heavy commercial vehicles are highly dependent on the US Highway 2 corridor with the unrestricted load crossing of the Red River, via Kennedy Bridge, and connections to the American Crystal Sugar plant. During the annual beet harvest, daily heavy commercial volumes can exceed 1,500 trucks per day at the intersection of US Highway 2/US Business 2 and US Highway 2/County Road 17. The geometrics of the corridor intersections need to support these vital movements to support the economics of East Grand Forks and the region. American Crystal Sugar, Bert's Truck Equipment, Todd's Trailer Sales and Lumber Mart are a few of the businesses along the US Business 2 corridor that depend on heavy commercial traffic movement.

The regional sugar beet harvest stretches from September to October of each year, generating over 4,500 heavy commercial traffic movements per day destined for the American Crystal Sugar plant. Beet deliveries are strategically timed during all hours of the day to reduce impacts to peak hour travel. The origin of these heavy commercial movements is estimated to be evenly split into thirds, with 1/3 of the trucks coming east on US Highway 2, 1/3 from the north on US Highway 2 or the east on County Road 17, and the remaining third from the south via US Highway 2. Aside from the increase in harvest season heavy commercial traffic volumes, year-round heavy commercial traffic volumes for the corridor averages nearly 10 percent of the overall traffic.

Another key freight generator is LM Wind Power, a company that produces and ships fiberglass blades for large scale wind turbines. The size of the blades being produced have recently expanded up to 184 feet, 26 feet longer than previous versions. The length of these blades impacts the delivery and shipment of these products via trucks, requiring large turning movements along key freight corridors including I-29, DeMers Avenue, and 32nd Avenue South.

The North Dakota State Mill (NDSM) is a major generator truck and for train activity in the region. Grain trucks bring commodities to the Mill and after processing much of the outputs are shipped out via rail. While there are anticipated increases in grain received at the NDSM, the most significant increase in activity is associated with a planned unit grain unloading facility with access to the Glasston Subdivision. Plans for improvements on the NDSM property are being pursued. With additional rail car storage at the North Dakota State Mill there will be the opportunity for an increase in grain received via the Mill Spur rail line. This is expected to have an impact on rail traffic to both the Mill Spur and Glasston Subdivision due to a potential rail connection, as well as the roadway network due to the increased truck traffic and additional activity at railroad crossings.

Figure 3-42: Major Freight Businesses



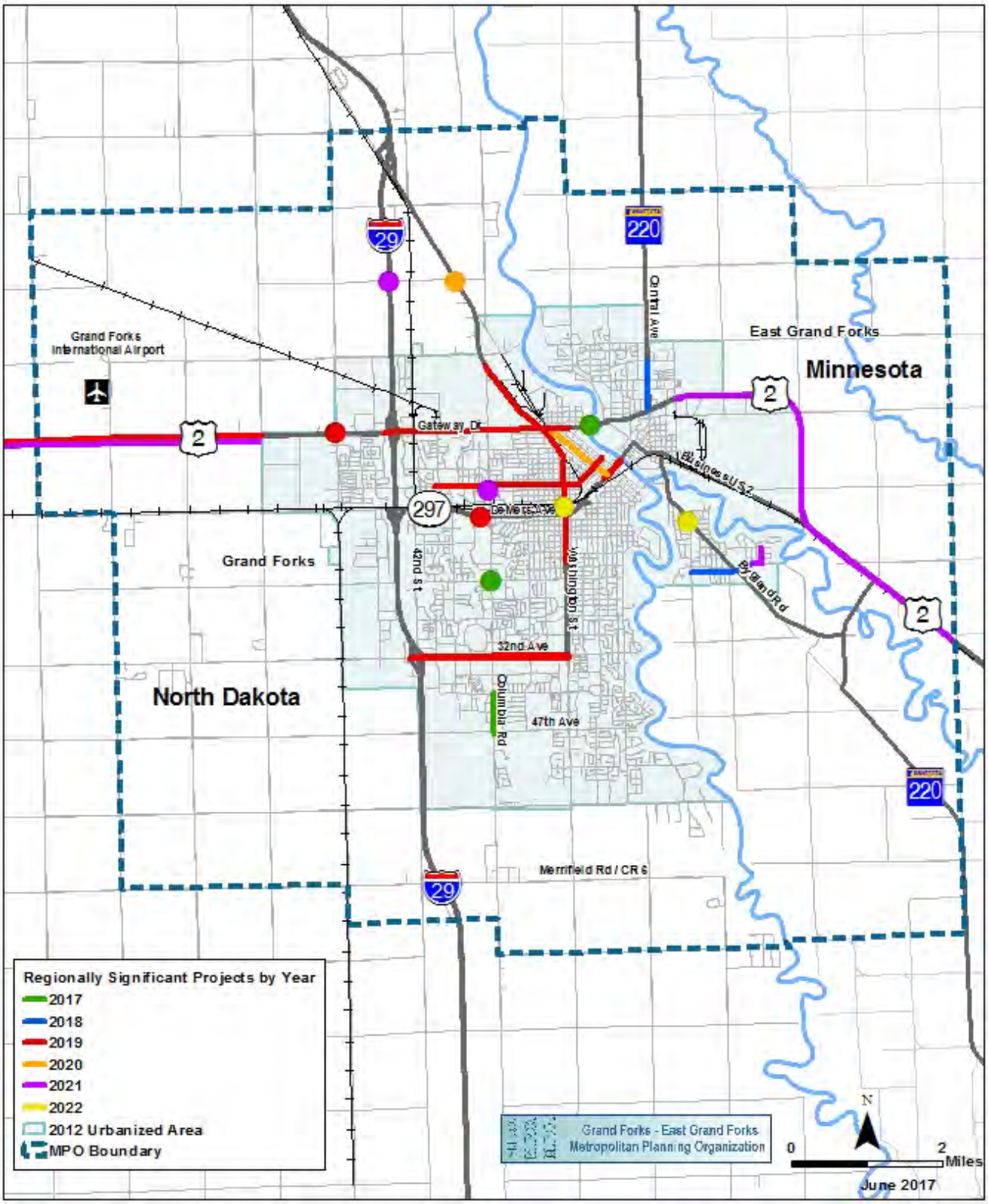
Source: Grand Forks-East Grand Forks MPO

Recent and Programmed Regionally Significant Improvements

The previous Street/Highway Plan along with state and local transportation improvement programs identify projects to be implemented and that are in the project development phase or are already prioritized for investment. These upcoming projects along with the existing conditions described in this chapter will influence future travel patterns in the region. The following includes a list of regionally significant improvements that were recently constructed or identified in the 2019-2022 Transportation Improvement Program, as further shown in Figure 3-43.

- Kennedy Bridge Rehabilitation (2017)
- South Columbia Road 2 to 5 Lane Expansion and New Signal (2017)
- South Columbia Road Turn Lanes at 17th Avenue South (2017)
- Central Avenue Multi-Use Trail (2018)
- Greenway Boulevard Reconstruction and Sidewalk (2018)
- 32nd Avenue Corridor Safety Improvements (2019)
- DeMers Avenue (Columbia Rd/30th St.) Traffic Signal/Turn Lanes (2019)
- DeMers Avenue Reconstruction/Expansion (2019)
- Gateway Drive/55th Street Traffic Signal/Turn Lanes (2020)
- US 2 Resurfacing in Grand Forks (2021)
- North Columbia Road Reconstruction (2021)
- I-29 Bridge Maintenance north of US 2 Interchange (2021)
- US 2 Resurfacing in East Grand Forks (2021)
- North Washington Street Railroad Underpass Reconstruction (2022)
- Bygland Road and Rhinehart Drive Intersection Reconstruction (2022)

Figure 3-43: Recent and Programmed Regionally Significant Projects by Year



Source: Grand Forks-East Grand Forks MPO

Recent Studies

Since the 2040 Street/Highway Element was adopted, several corridor studies were completed providing new recommendations that, if implemented, would affect the functionality of the overall roadway network. The recent studies and key findings are summarized below:

I-29 Traffic Operations Study (2017, Grand Forks)

The I-29 Traffic Operations Study examined the current and future needs and opportunities for this important regional corridor. The study provided several recommendations and implementation strategies as summarized below and in Figure 3-44.

The study found that without improvements, existing interchanges at Gateway Drive/US 2, DeMers Avenue, and 32nd Avenue South will experience significant delays and backups onto I-29 based on 2040 forecasts. New Red River crossings at 32nd Avenue South and Merrifield Road were found to provide great benefit to the region but did little to improve forecasted congestion on I-29. Grade separations (over/underpasses) were studied at 17th Avenue South, 47th Avenue South, and 62nd Avenue South; however, the cost of these improvements outweighed the benefits in the near term and were not carried forward.

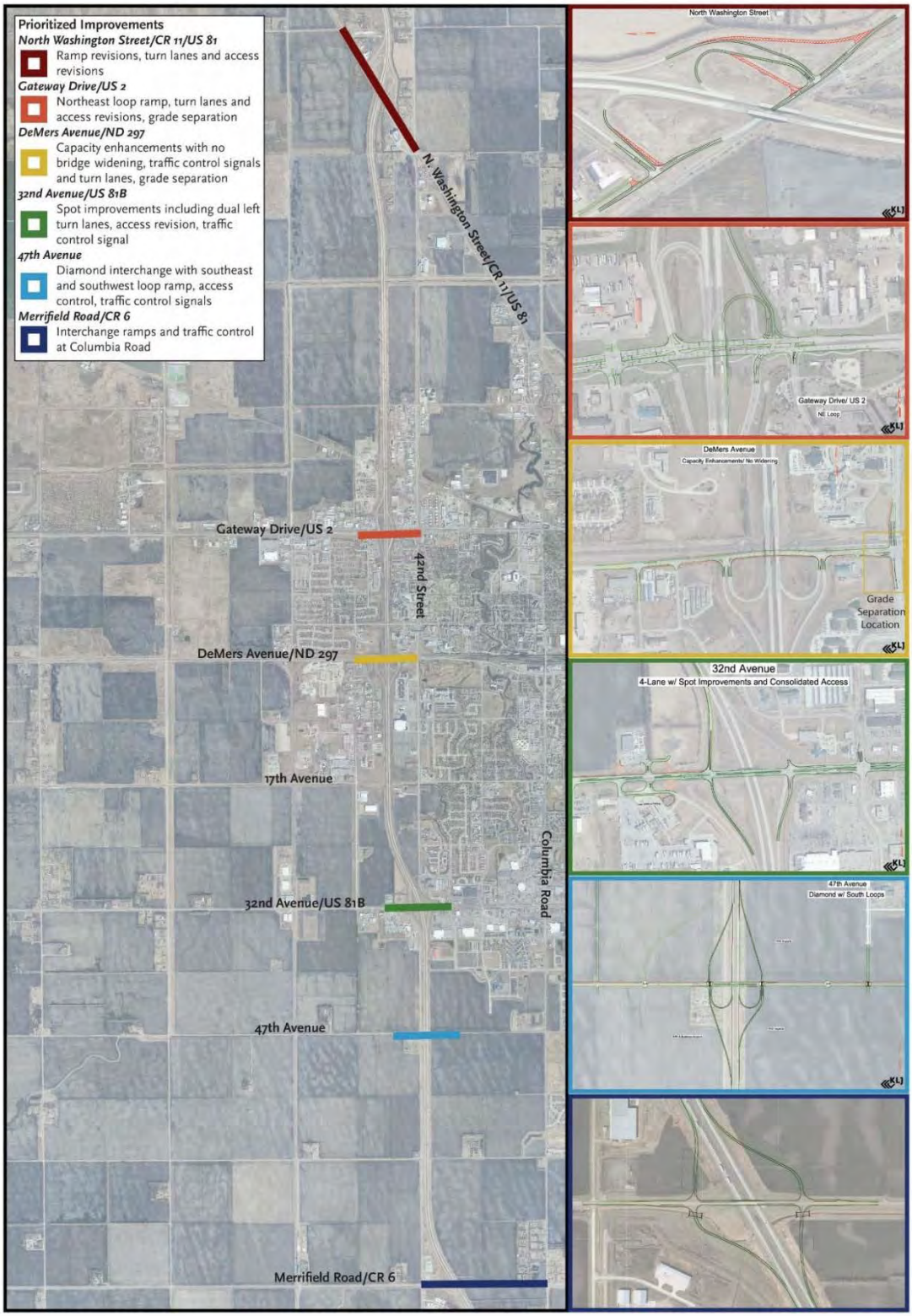
Other findings include:

- Based on 2040 forecasts, the 32nd Avenue South interchange traffic operations cannot be satisfactorily improved without an interchange at 47th Avenue South
- The Gateway Drive/US 2 interchange would benefit from the Northeast Loop Alternative, as recommended from the US 2 Study, and also grade separation of the Glasston Railroad east of 42nd Street along Gateway Drive/US 2
- The DeMers Avenue interchange would benefit from traffic control and lane configuration improvements. Also, DeMers Avenue would benefit from the 42nd Street railroad grade separation just north of DeMers Avenue. This railroad grade separation would also mitigate additional significant infrastructure improvements along I-29.
- New interchanges at 47th Avenue South and Merrifield Road/County Road 6 were found to provide significant improvement and value to the region
- A 47th Avenue South interchange with an additional travel lane on I-29 between 32nd Avenue South and 47th Avenue South was found to reduce congestion along 32nd Avenue South to the point of mitigating $16 million worth of improvements at the existing 32nd Avenue South interchange
- A Merrifield Road interchange provided a major reduction to regional vehicle miles of traveled. This interchange could be implemented with only adding ramps to the existing bridge.
- No significant problems were identified along I-29 after bottlenecks at the key interchanges of Gateway Drive, DeMers Avenue and 32nd Avenue South were relieved

I-29 Interchange Implementation Plan and Project Costs:

- I-29/North Washington Street Interchange improvements estimated at $5.98 million, no immediate need, improvements could be incorporated into 2030 NDDOT I-29 concrete pavement repair project
- I-29/Gateway Drive (US 2) Interchange improvements estimated at $6.62 million (northeast loop 2031-2040+) and US 2 railroad grade separation estimated at $28.3 million (planning evaluation 2026-2030)
- I-29/DeMers Avenue (ND 297) Interchange improvements estimated at $7.4 million (planning evaluation before 2025) and 42nd Street railroad grade separation estimated at $40 million (planning evaluation before 2025)
- I-29/32nd Avenue South Interchange improvements estimated at $915,000 (2017-2030) and 47th Avenue South Interchange estimated at $28.5 million (mid-term planning horizon, 2026-2030)
- I-29/Merrifield Road Interchange Ramps and traffic control at South Columbia Road ($16.8 to $18.1 million)

Figure 3-44: I-29 Study - Prioritized Improvements



Source: Grand Forks-East Grand Forks MPO I-29 Traffic Operations Study, 2017

US 2 and US 2 Business Study (2017, East Grand Forks)

The primary goal of this study was to evaluate alternatives for improvements to the US Highway 2 and US Business 2 intersection to ensure safe and efficient operation for all modes of transportation. There is a long history of discussed improvements to the US Highway 2 and US Business 2 intersection based on historic crashes, heavy commercial truck movements, truck storage, and roadway grades, among others. MnDOT has scheduled a resurfacing project for the westbound lanes of US Highway 2 in 2021 and has allotted safety funding that may be utilized for improvements to this intersection. As a result of this potential funding, the intersection, along with five others in the area, were reviewed to quantify issues and identify potential opportunities.

Several intersection alternatives were evaluated based on 31 criteria. Three alternatives (Alternatives 2A turn lane improvements, 3A modified R-Cut and acceleration lane, and 3B modified R-Cut) received the highest cumulative score, and are all recommended solutions for improvements for the US Highway 2 and US Business 2 intersection. This recommendation is a result of the alternative evaluation and input received from the public and corridor stakeholders throughout the process. Further analysis during project development and NEPA evaluation should be used to determine a preferred solution for the intersection to be included in the 2021 resurfacing project.

Bygland Road Study (2016, East Grand Forks)

This study evaluated the 2.5-mile segment of Bygland Road from the Red Lake River to the southeastern East Grand Forks city limits. The goals of this study were to: evaluate feasibility, design options and desire to provide an on street bike facility along Bygland Road; examine traffic operations at key intersections, specifically 5th Avenue, Rhinehart Drive, and 13th Street and potential options to improve mobility, access, and safety; improve pedestrian crossing opportunities and safety at key locations along the corridor; and examine Cities Area Transit (CAT) and school bus stops and routes within the study area and potential to improve the modal connections.

The outcomes of the study included a recommended transportation plan showing future infrastructure improvements, capital improvement programming costs and an implementation plan. Recommendations included:

- Pedestrian and bicycle improvements from 1st Street Southeast to 13th Street Southeast (south East Grand Forks City limits), estimated costs of $215,000-$543,000 (2016-2020)
- Reroute “Route 11” to Bygland Road and Rhinehart Drive concurrent with roundabout construction currently programmed for 2022
- Pedestrian school crossing improvements programmed for 2018
- Roundabout construction at Bygland Road and 13th Street, estimated costs of $3.5 million (long-term improvements 2026-2040)
- Roundabout construction at Bygland Road and 5th Avenue, estimated costs of $1.875 million (long-term improvements 2026-2040)

Glasston Railroad Crossing Study (2016, Grand Forks)

The purpose of the study was to develop strategies to minimize at-grade conflicts of train traffic in northern Grand Forks. The north-south BNSF Railway Glasston Subdivision currently has six trains per day at a maximum speed of 25 MPH and is forecasted to increase to twelve trains per day by 2040. Gateway Drive/US 2 is an NHS/Super Haul/Expanded Envelop Corridor[4] serving international trade from Canada. Gateway Drive/US 2 is currently congested and expected to become increasingly congested in the future. Operations along the Glasston Subdivision can result in trains currently blocking traffic on Gateway Drive/US 2 for 5 minutes at a time.

[4] For the purposes of permitting over-sized, over-weight loads on Trunk Highways in Minnesota, MnDOT has explored identifying super haul corridors. Superload Corridors can accommodate a loaded vehicle with a 14- foot height limit, a 10-foot width limit, a 110-foot length limit, and an 80,000 pound weight limit. Expanded Envelope Corridors are routes that can be permitted for a loaded vehicle that is 16-feet high, 16-feet wide, and 130-feet long with a weight of 235,000 pounds.

The Mill Spur Rail Line is east of the Glasston Subdivision, just west of the Red River and the Grand Forks Downtown, currently has a total of thirteen at-grade crossings, including University Avenue, 8th Avenue, and Gateway Drive/US 2. The Mill Spur does not currently connect to the Glasston Subdivision.

The study recommends rerouting the Mill Spur north of Grand Forks near 27th Avenue and continuing west to the Glasston Subdivision to remove thirteen existing at-grade railroad crossings just west of the downtown area. The study also recommends grade separation of Glasston Subdivision at Gateway Drive/US 2.

In June 2017, it was announced that ND State Mill is seeking City approval to receive unit trains using the Mill Spur Line.

North 42nd Street Traffic Operations Study (2016, Grand Forks)

The existing three-lane corridor has adequate capacity for existing and forecasted traffic. An upgraded signal, driveway consolidation, right and left-turn lane improvements, and bicycle facility improvements are recommended in the study. The reconstruction of North 42nd Street from University Avenue to Gateway Drive is programmed for 2018 at an estimated cost of $6.9 million. The proposed project will include reconstructing the roadway into a four-lane urban roadway south of 6th Avenue and a three-lane urban roadway north of 6th Avenue. In addition this project would also include a 10-foot wide shared use path connecting with the existing path along Gateway Drive and the path along University Avenue.

32nd Avenue Safety Audit Review / 32nd Avenue Signal Coordination Plan Update (2016, Grand Forks)

This study was prepared by NDDOT. The study recommends a variety of turn lane, signal, and pedestrian related improvements along 32nd Avenue from the Interstate 29 interchange to Washington Street. Turn lane, signal, and pedestrian related improvements are also recommended along Columbia Road, 20th Street, and Washington Street, near 32nd Avenue. Also, signal timing and operational improvements along 32nd Avenue from I-29 to Washington Street and along Columbia Road from 6th Avenue North to 40th Avenue South were recommended. Improvements are currently programmed for 2019.

US 2 Access Study (2015, Grand Forks)

US 2 is a designated truck route and carries over half of North Dakota's 85 million tons of freight. The study highlighted improvements to six major focus areas: Airport Drive intersection, I-29 interchange area, traffic control, access management, the proposed Northern Plains Nitrogen (NPN) Plant site, turn lanes, and bicyclist/pedestrian facilities. Recommended improvements included:

- A staggered T-Intersection configuration and ITS improvements at Airport Drive
- A new northeast quadrant loop ramp along with turn lane improvements and new access restrictions at the I-29 interchange
- New signals at 55th Street and 69th Street
- NDDOT prefers 1 mile spacing of signals in rural areas and ½ mile spacing is acceptable in urban areas
- Future turn lanes at 51st Street, 55th Street, 58th Street and 69th Street
- The corridor was divided into built-out urban, urbanizing, and rural areas for access management purposes
- No access management improvements were recommended for the build-out urban area
- A frontage and backage road system was developed for the urbanizing area. The urbanizing area also includes design plans for future ½ mile full access signalized intersections with intervening ¾ access intersections.
- The rural area did not include specific plans for a frontage/backage road system, but is envisioned to accommodate a similar access spacing plan to the urbanizing area once developed

South Columbia Road Traffic Operations Study (2015, Grand Forks)

A traffic study was completed for the proposed South Columbia Road expansion project programmed for 2017. The traffic study project limits were between 36th Avenue South and 47th Avenue South. The analysis provided the following conclusions:

- The intersections along South Columbia Road at 36th Avenue South, 40th Avenue South, and 47th Avenue South and the segment from 36th Avenue South to 40th Avenue South have a crash rate higher than typical for intersections or segments with similar characteristics. 36th Avenue South and 40th Avenue South intersections have a crash rate above the critical crash rates, indicating a crash issue.
- Traffic forecasts were developed for future year 2040 conditions for two scenarios based on the ATAC travel demand model:
  - Year 2040 with an interchange at I-29/47th Avenue South
  - Year 2040 no interchange at I-29/47th Avenue South
- With the at I-29/47th Avenue South interchange, traffic volumes along South Columbia Road north of 47th Avenue South decrease approximately 6,000 to 7,000 vehicles per day and traffic volumes along 47th Avenue increase approximately 9,000 vehicles per day west of South Columbia Road
- Year 2040 traffic forecasts indicate that South Columbia Road will be significantly over capacity for a two-lane rural section for conditions with and without the I-29/47th Avenue South interchange. Planning level roadway capacities suggest that a five-lane (four-lane divided with turn lanes) will be needed along South Columbia Road to meet the traffic demand.
- It was recommended that South Columbia Road be expanded to a four-lane facility south of 36th Avenue South to 47th Avenue South.
- Construction will be complete in Fall 2017.

42nd Street Railroad Grade Separation Study (2014, Grand Forks)

42nd Street is a primary access north-south corridor to North Dakota State University and Alerus Center, and carries 15,000 vehicles per day. An at-grade railroad crossing currently exists on 42nd Street just north of DeMers Avenue. Train volumes are expected to increase 70 percent by 2040 and vehicle volumes expected to increase to 90 percent by 2040. It is estimated that by 2040, 41 percent of traffic would be diverted to I-29 and the railroad crossing would be blocked for ten percent of the day.

To address traffic issues, the City of Grand Forks is recommending grade separation of the railroad at this location with an estimated cost of $24 to $30 million. The project would have a benefit-cost of 1.5 and would save 500,000 hours of train delay through 2040. This project is beyond funding available over the long-term planning horizon. Additional funding opportunities including federal grants are being pursued. The recent announcement of golf course closure in southeast quadrant of DeMers Avenue/42nd Street intersection may open up discussion of alternatives previously eliminated that utilize the golf course property

Grand Forks-East Grand Forks Freight Rail Access Study (2014, Grand Forks)

This study undertook a broad stakeholder outreach effort and site viability analysis to identify properties in the GF/EGF area that are available and best suited for providing industrial/commercial access to rail services on the BNSF Railway. The study also analyzed the local street network and developed conceptual designs for rail access for a several sizes of property developments. This is the first step toward the greater inclusion of freight in the MPO planning process as well as the deliberate inclusion of freight in the broadly defining the future vision of the region. The study provided a list of recommendations for next steps in increasing rail freight access to the region.

Grand Sky Traffic Study (2013, Grand Forks)

Grand Sky is a proposal for private use of the Grand Forks Air Force Base runway for drone use/development. The development was proposed in the southwest portion of the existing Grand Forks Air Force Base along the

north side of US 2, near 27th Street, is expected to employ 3,000 people when fully developed with 70 percent of travel to and from Grand Forks/East Grand Forks. Recommended improvements to accommodate this development include:

- Construct four lane expansion of 27th Street
- Construct turn lanes and install a traffic signal at US 2 and 27th Street

The recommendations from this study have since been completed. This location is not within the MPO planning area.

Chapter 4. Identification of Issues

This chapter is intended to provide a summary of key issues and themes for the 2045 Street/Highway Plan Update identified as part of public engagement activities, stakeholder input, and in the Existing Conditions Chapter. The findings of this chapter served as the basis for developing Chapter 5. Range of Alternatives by considering both the technical analysis of the current street and highway network with the input received from Technical Advisory Committee (TAC) stakeholder meetings, public meetings, and on-line surveys and engagement.

Existing Conditions Summary

The Existing Conditions Chapter provides a summary of the Grand Forks-East Grand Forks Metropolitan Planning Organization (MPO) area street and highway system. Several topics were discussed including roadway functional classification and jurisdiction, pavement and bridge condition, traffic and safety patterns, and summaries of recent study recommendations. The following is a summary of key issues and themes identified in the chapter.

- Balancing the need to maintain existing pavement conditions with the need to expand roadways to support additional traffic continues to be an issue given current funding levels.
- Three east-west corridors (US 2/Gateway Drive, DeMers Avenue, and 32nd Avenue South) and two north-south corridors (Columbia Road and Washington Street) continue to experience the highest daily traffic volumes.
- Overall, the system's intersections generally operate within acceptable traffic Level of Service (LOS) A-C conditions. There are four intersections where a LOS D was recorded (South Columbia Road & 17th Avenue South, South Columbia Road & 32nd Avenue South, South Washington Street & DeMers Avenue, and North 42nd Street & University Avenue when trains are present). No intersections were recorded with a LOS E or F.
- The roadway segment traffic analysis identified three road segments experiencing LOS of D (South Columbia Road between 11th Avenue South and DeMers Avenue, South Columbia Road between 17th Avenue South and Knight Drive, and South Washington Street between 8th Avenue South and DeMers Avenue). There were no segments that were identified as a LOS E or F as part of this analysis.
- A total of 26 intersections were found to have crash rates above the expected crash rates. Three intersections experienced over 50 crashes during this timeframe. They were: S. 34th Street & 32nd Avenue S. (64), N. 42nd Street North & DeMers Avenue (60), and S. 31st Street & 32nd Avenue S (52).
- There were no fatal incidents reported in any of the high crash rate intersections from 2012-2015. 31 percent of the total crashes that occurred at the high crash rate intersections involved injury related crashes.
- Minimizing traffic delays at rail crossings is important, especially for truck freight movement. Two problematic at-grade rail crossings for truck traffic delays associated with unit train traffic and train blockages are the Glasston Subdivision crossing at US Highway 2 and the Grand Forks Subdivision crossing near the intersection of DeMers Avenue and North 42nd Street.
- The I-29 Traffic Operations Study (2017) found that without improvements, existing interchanges at Gateway Drive/US 2, DeMers Avenue, and 32nd Avenue South will experience significant delays and backups onto I-29 based on 2040 forecasts. New Red River crossings at 32nd Avenue South and Merrifield Road were found to provide great benefit to the region but did little to improve forecasted congestion on I-29. Grade separations (over/underpasses) were studied at 17th Avenue South, 47th Avenue South, and 62nd Avenue South; however, the cost of these improvements outweighed the benefits in the near term and were not carried forward.
- The Bygland Road Study (2016) includes a recommended transportation plan with near term improvements including: pedestrian, bicycle and school crossing improvements; reroute of "Route 11" to Bygland Road and Rhinehart Drive; roundabout construction at Bygland Road and 13th Street; and roundabout construction at Bygland Road and 5th Avenue.

- The Glasston Railroad Crossing Study (2016) recommends rerouting the Mill Spur north of Grand Forks near 27th Avenue and continuing west to the Glasston Subdivision to remove thirteen existing at-grade railroad crossings just west of the downtown area. The study also recommends grade separation of Glasston Subdivision at Gateway Drive/US 2.
- NDDOT completed a safety audit review and signal coordination plan in 2016 for 32nd Avenue from I-29 to Washington Street. The study recommends a variety of turn lane, signal, and pedestrian related
- Improvements and signal timing and operational improvements. Improvements are currently programmed for 2019.
- A grade separation of the railroad at 42nd Street is recommended by the City of Grand Forks to address traffic issues. However, this project is currently beyond funding available over the long-term planning horizon.
- The US 2 Access Study (2015) highlighted several improvements to six major focus areas: Airport Drive intersection, I-29 interchange area, traffic control, access management, the proposed Northern Plains Nitrogen (NPN) Plant site, turn lanes, and bicyclist/pedestrian facilities. The corridor was divided into built-out urban, urbanizing, and rural areas for access management purposes. No access management improvements were recommended for the build-out urban area. A frontage and backage road system was developed for the urbanizing area. The urbanizing area also includes design plans for future ½ mile full access signalized intersections with intervening ¾ access intersections. The rural area did not include specific plans for a frontage/backage road system, but is envisioned to accommodate a similar access spacing plan to the urbanizing area once developed.

Summary of Public and Stakeholder Engagement

As part of the 2045 Street/Highway Plan Update, several outreach and engagement opportunities have been utilized to help the public learn about the plan and provide input regarding the street and highway system in the MPO area. Both in person and web-based opportunities were used to ensure that people could participate in ways that work best for their schedule and preferred communication style. The following list describes the various public engagement opportunities used through the planning process.

- Public meetings and open houses
- Project website (www.theforksstreets2045.org) combined with interactive online mapping, surveys, and comment forms. The project website was used as the primary resource for posting information related to the planning process.
- MPO Facebook updates and postings
- MPO website updates
- Agency and stakeholder meetings
- Local media press releases and interviews with MPO staff

Public Meetings

Four public meetings have been held to date. The materials presented at the meetings were also posted on the study website immediately following the meetings. More information is available in Appendix B.

Public Meeting #1

The first public meeting was held on August 30, 2017, at the Empire Arts Center in Grand Forks. A formal presentation was provided during a portion of the event, and the remainder of the event was set up in an open house format. The purpose of this public meeting was to introduce the Street and Highway Plan Update to the public, present the 2045 Long-Range Transportation Plan (LRTP) vision statement and draft goals, and provide information on existing conditions and planned land use in the MPO area. Attendees were also asked to provide feedback on the condition of streets and highways in the MPO area to help guide the process for prioritizing projects in the Street and Highway Plan Update. Display boards were available that provided an overview of the LRTP and Street and Highway Plan Update, the schedule, the 2045 LRTP vision statement and draft goals,

existing conditions, and planned land use. An interactive mapping activity was also available on a display board and as an interactive map on the project website.

Twenty-two attendees signed in at the open house. Two written comments were received. One was a safety concern at a specific location and the other comment noted a preference to keep performance measures to only those that are required. The project website was accessed by more than 130 users in the two weeks before and after the public meeting.

Public Meeting #2

The second public meeting was held on December 14, 2017, at the East Grand Forks City Hall. The meeting was set up in an open house format (no formal presentation provided). The purpose of the meeting was to discuss the existing plus future transportation network and the transportation issues that have been identified so far. Additionally, the meeting was meant to explore the concept of a financially constrained transportation plan; this discussion was aided by an interactive financial planning activity, which collected input on attendees' public investment preferences. Finally, more detailed information on goals, objectives, and performance measures for the Street and Highway Plan Update were presented.

Display boards were available that provided information on the LRTP and Street and Highway Plan Update, the draft universe of alternatives, existing traffic volumes, forecast traffic volumes, planned land use, issues identified through the last public meeting and interactive mapping activity, the 2045 LRTP vision statement and draft goals, performance-based planning, financial plans, and the project schedule.

For the financial planning activity, each attendee was given ten stickers and a worksheet. Participants were asked to place the stickers, representing public funds, on their worksheets to indicate their investment priorities. On online version of this activity was also available on the project website.

Some of the key issues that were presented at the public meeting included:

- Costs are rising faster than federal and state revenues
- Developing reasonably expected revenue estimates for new sources (ND HSIP, ND Main Street Program, Grand Forks sales tax)
- Identifying and positioning projects to successfully compete for grants
- Maintenance and operations costs are a significant part of overall costs
- Need for additional river crossing to improve local traffic and connectivity

Seven attendees signed in on the meeting sign-in sheets. Three written comments were received. One comment asked that all railroad tracks south of Gateway Drive, Grand Forks, be removed, and that new tracks be laid north of Grand Forks and East Grand Forks. Another comment expressed that a new bridge and street improvements should be a first priority for public funding. A third comment expressed the desire for more bicycle and pedestrian infrastructure. This comment explained that east and west flowing bike traffic is very difficult and dangerous, and asked that bike facilities on University Avenue be improved. The project website was accessed by more than 100 users in the two weeks before and after the public meeting.

Public Meeting #3

The third public meeting was held on April 18, 2018, at Choice Health & Fitness in Grand Forks. The purpose of this meeting was to present the range of alternatives, discuss how the alternatives will be evaluated, and share the public input received on funding priorities. Display boards were available that provided information on the LRTP and Street and Highway Plan Update, the project schedule, forecast average daily traffic, forecast volume to capacity ratios, issues identified through the first public meeting and interactive mapping activity, the 2045 LRTP vision statement and draft goals, performance-based planning, the financial plan, input received from the second public meeting and an interactive activity on funding priorities, the range of alternatives, the alternatives evaluation framework, and the river crossing analysis. This information was also presented through a formal presentation during the public meeting.

Fourteen attendees signed in on the meeting sign-in sheets. No written comment forms were submitted at the public meeting. The project website was accessed by nearly 80 users in the two weeks before and after the public meeting.

Public Meeting #4

The fourth public meeting was held on September 12, 2018, at the Alerus Center in Grand Forks. The purpose of this meeting was to present information about available street/highway funding and share the street/highway projects that match the funding available. Results from the analysis of new river crossing options were also shared. Display boards were available that provided information on the LRTP and Street and Highway Plan Update; the project schedule; the 2045 LRTP vision statement, goals, and performance measures and targets; performance goals, measures, and targets for safety, system preservation, and accessibility and mobility; the financial plan; input issues areas and investment priorities; the alternatives evaluation framework; the proposed investment scenario; and potential discretionary projects. Display boards were also available on the river crossing analysis, including information on the scope of work, traffic analysis, and benefit-cost analysis. This information was also presented through a formal presentation during the public meeting.

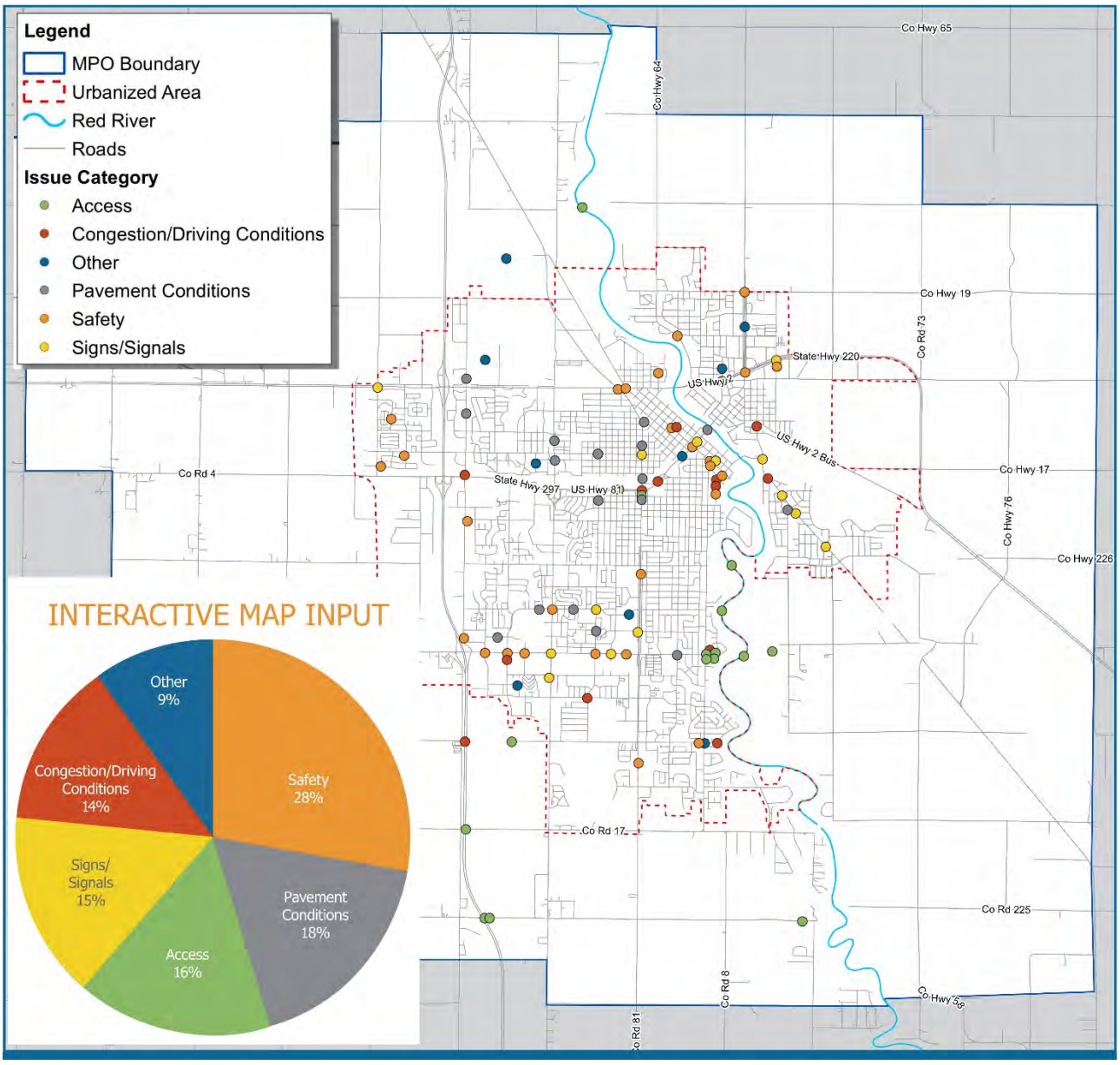
Eighteen attendees signed in on the meeting sign-in sheets. One written comment was received. It noted the commenter's opposition to the 24th Avenue S river crossing option due to the impact to the historical society's grounds and recommended pursuing a crossing further south. The project website was accessed by more than 250 users in the two weeks before and after the public meeting.

Online Engagement

A key public outreach component was the use of on-line resources to engage residents in the Street and Highway Plan Update process. The project website (www.theforksstreets2045.org) was used as the primary resource for posting information related to the study, announcements, and providing opportunities for on-line engagement activities. Between July 2017 and December 2018, the project website was accessed more than 2,000 times by more than 1,500 users. In addition, the MPO posted announcements on its Facebook page.

In coordination with Public Meeting #1, an on-line mapping activity was used to collect input on the existing street and highway network. Accessed through the project website, participants were able to post geographically specific comments related to access, congestion/driving conditions, pavement conditions, safety, signs/signals, and other. A total of 97 comments were posted. Figure 4-1 displays the related location for these comments and the general comment type.

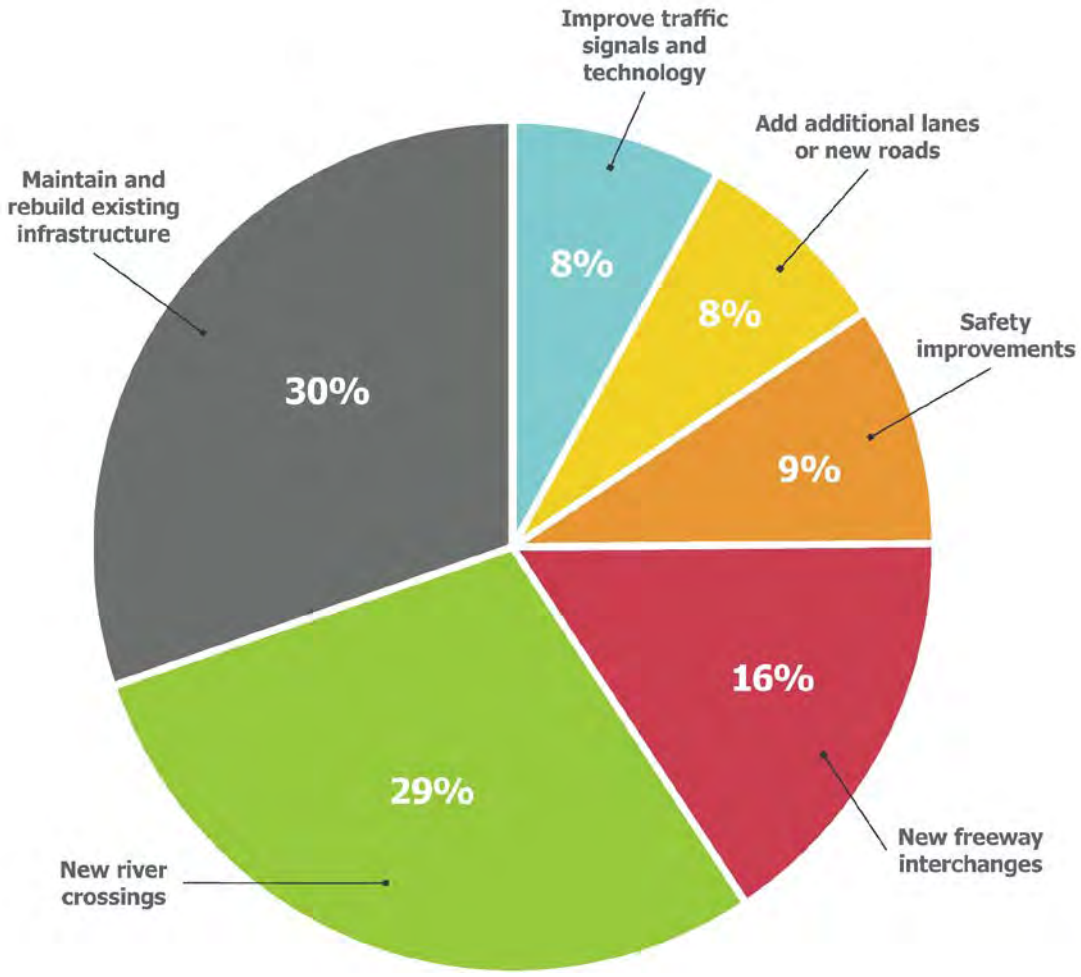
Figure 4-1: On-Line Mapping Results



The second on-line engagement activity was coordinated with Public Meeting #2 to help identify investment priorities to inform the financial plan analysis. Via the project website, participants were asked how they would allocate $100 between the six investment categories listed below. The more money allocated to a category indicates a higher priority for the participant. A total of 69 interactions were posted. The results of the exercise are illustrated in Figure 4-2 and included the following:

- Maintain and rebuild existing infrastructure: **30%**
- Safety improvements (ex: lighting): **9%**
- Improve traffic signals and technology: **8%**
- New freeway interchanges: **16%**
- New river crossings: **29%**
- Add additional lanes or new roads: **8%**

Figure 4-2: December 2017 Open House Results - How Would You Invest $100?



Stakeholder Engagement

The following stakeholders have been identified in the Streets and Highway Plan Update planning process:

- North Dakota Department of Transportation
- Minnesota Department of Transportation
- City of Grand Forks
- City of East Grand Forks
- Grand Forks County
- Polk County
- Federal Highway Administration
- Federal Transit Administration
- Residents and other stakeholders

The Technical Advisory Committee (TAC) served as a primary group to collect input from the various partner agency stakeholders. The TAC is composed of various modal staff from the GF/EGF MPO's cities and counties, as well as technical staff from the North Dakota Department of Transportation (NDDOT), the Minnesota Department of Transportation (MnDOT), Federal Transit Administration (FTA) and the Federal Highway Administration (FHWA). Study meetings were held on approximately a monthly basis throughout the planning process.

One of the key issues discussed by the TAC included the need for an additional crossing over the Red River for the southern portion of the MPO area. TAC representatives noted that this issue has been discussed in previous Streets and Highway plans, and continues to be a need to address local traffic and connectivity for an expanding population.

Summary of Issues, Needs and Opportunities

A summary of issues and opportunities collected from the public and stakeholder engagement activities is provided in Figure 4-3. Some of the key issues include:

- Additional southern Red River crossing
- 32nd Avenue South
- Proposed interchange improvements along I-29
- Bygland Road
- Columbia Road
- Washington Avenue
- Belmont Road
- Proposed railroad grade separations at DeMers Avenue and US Highway 2
- US Highway 2
- Demers Avenue through the Grand Forks and East Grand Forks downtowns
- Minnesota TH 220

Figure 4-3: Issues Map



Chapter 5. Range of Alternatives

This chapter provides a summary of the process used to develop various street and highway improvements needed to improve the overall street and highway transportation system and address identified existing, 2030, and 2045 street and highway goals, objectives, standards, performance measures and targets, and issues for the Grand Forks-East Grand Forks (GF/EGF) Metropolitan Planning Organization (MPO) area. The Range of Alternatives process is intended to develop a comprehensive list of potential projects for consideration in various financially constrained alternative scenarios. The process for developing the range of alternatives included reviewing existing transportation improvement programs and recent studies to document expected and anticipated improvements. Previously unidentified improvements were considered to address unmet needs based on the results of the technical analysis and traffic modeling from the overall Street/Highway Plan Update process. Public input and partner agency feedback also contributed to the development of the list of projects for evaluation.

2040 Street/Highway Plan Improvements

Projects identified by the previous 2040 Street/Highway Plan Update were compiled to summarize known and documented transportation improvement needs. Previously completed projects since adoption of the 2040 Street/Highway Plan Updated were removed from the inventory.

Programmed Improvements

Programmed roadway improvements as identified by local, regional, and state agencies were inventoried for the GF/EGF MPO area. All roadway projects currently listed in the GF/EGF MPO's transportation improvement program (TIP) and the North Dakota and Minnesota statewide transportation improvement programs (STIP)s were compiled to the range of alternatives list. This information also provided valuable data on project scopes, cost, funding sources and program year.

The Grand Forks 6-year capital improvement program (CIP) and the East Grand Forks 5-year CIP were also reviewed to add locally programmed roadway projects to the list. It was through this process that costs, scopes, funding sources and year of improvements for many local projects were identified and/or refined.

In addition, the recently adopted Grand Forks Infrastructure Sales Tax project list was reviewed. Any projects not previously identified were added to the list. The following list identifies the source of all programmed roadway improvements that were included in the Range of Alternatives:

- NDDOT Statewide Transportation Improvement Program 2018-2021 and 2019-2022
- MnDOT Statewide Transportation Improvement Program 2018-2021 and 2019-2022
- Grand Forks-East Grand Forks MPO Transportation Improvement Program 2018-2021 and 2019-2022
- Grand Forks Capital Improvement Program (2018-2023)
- East Grand Forks Capital Improvement Program (2018-2022)
- Grand Forks Infrastructure Sales Tax Project List

Recently Completed Studies

Several recent studies that identified or recommended roadway improvements with the GF/EGF MPO planning area were compiled and reviewed. It was through this step that additional recommended roadway improvements were identified for inclusion on the expanded range of alternatives list. These studies also provided valuable technical analysis and costs estimates for such improvements.

Safety Plans & Operational Analysis

A list of safety issues and needs were identified as part of the Plan's detailed technical analysis. These issues and needs were evaluated during the development of the range of alternatives by the TAC and GF/EGF MPO staff to determine possible project improvements that will address safety needs. A detailed summary of the safety issues are identified in the Existing Conditions Chapter. A variety of safety related projects eligible for Highway Safety Improvement Program (HSIP) federal funding are also included.

- North Dakota Local Road Safety Plan
- Polk County Safety Plan
- MnDOT District 2 Safety Plan

As discussed in the Existing Conditions Chapter, existing intersection Level of Service (LOS) was also conducted at individual intersection locations within the GF/EGF MPO planning area in an effort to identify intersection operational deficiencies and possible project investments to improve these deficiencies. Additionally, as part of the Red River Crossing forecasted 2045 LOS analysis that was done in conjunction with this Street and Highway Plan at select intersections in the immediate vicinity of the crossings. This analysis, which can be found in Appendix C, was considered in the identification of future operational deficiencies and intersection operational improvement projects.

2030/2045 Capacity Analysis

Year 2030/2045 Average Daily Traffic (ADT) forecasts were prepared by the GF/EGF MPO regional travel demand forecast model. As a part of the Street and Highway Plan update, staff from the Advanced Traffic Analysis Center (ATAC) worked in coordination with GF/EGF MPO staff to update the travel demand model.

The travel demand model update included the most recent state-of-practice techniques to improve the model's ability to correctly replicate local travel patterns. Details about specific updates to the model can be found in Appendix D. Other updates included, but were not limited to, revised 2045 land use and transportation network assumptions to represent a 2015 base year 2030 and year 2045 conditions.

Average Daily Traffic (ADT) forecasts for year 2030 and 2045 were developed after the incorporation of the "Existing + Committed" transportation system which included the existing roadway network plus all roadway improvement projects that currently programmed in the GF/EGF MPO's 2018-2022 Transportation Improvement Program (TIP). After the model was calibrated and verified for an acceptable level of accuracy, 2030/2045 traffic forecasts were produced and mapped. Figure 5-1 and Figure 5-3 illustrate the resulting forecasted 2030 and 2045 ADTs respectively.

2030/2045 ADT forecasts developed through the travel demand modeling process provided the basis for the future Level of Service (LOS) deficiency analysis. This analysis was completed using volume to capacity (V/C) ratios to estimate future levels of congestion. Figure 5-1 illustrates the V/C thresholds used for the LOS deficiency analysis.

The purpose of the LOS analysis was to identify future 2030/2045 congestion for various roadway corridors throughout the GF/EGF MPO planning area, so that mobility improvement projects could be scoped and considered that could mitigate future operational issues. Locations anticipated to exhibit congestion issues (i.e., LOS D or worse) by year 2030 or 2045 were identified through this process and then discussed with the TAC to assess if existing programmed projects were already identified to address the deficiency or if a new Street and Highway Plan project should be proposed. Figure 5-1 and Figure 5-4 illustrate the resulting LOS for 2030 and 2045 respectively.

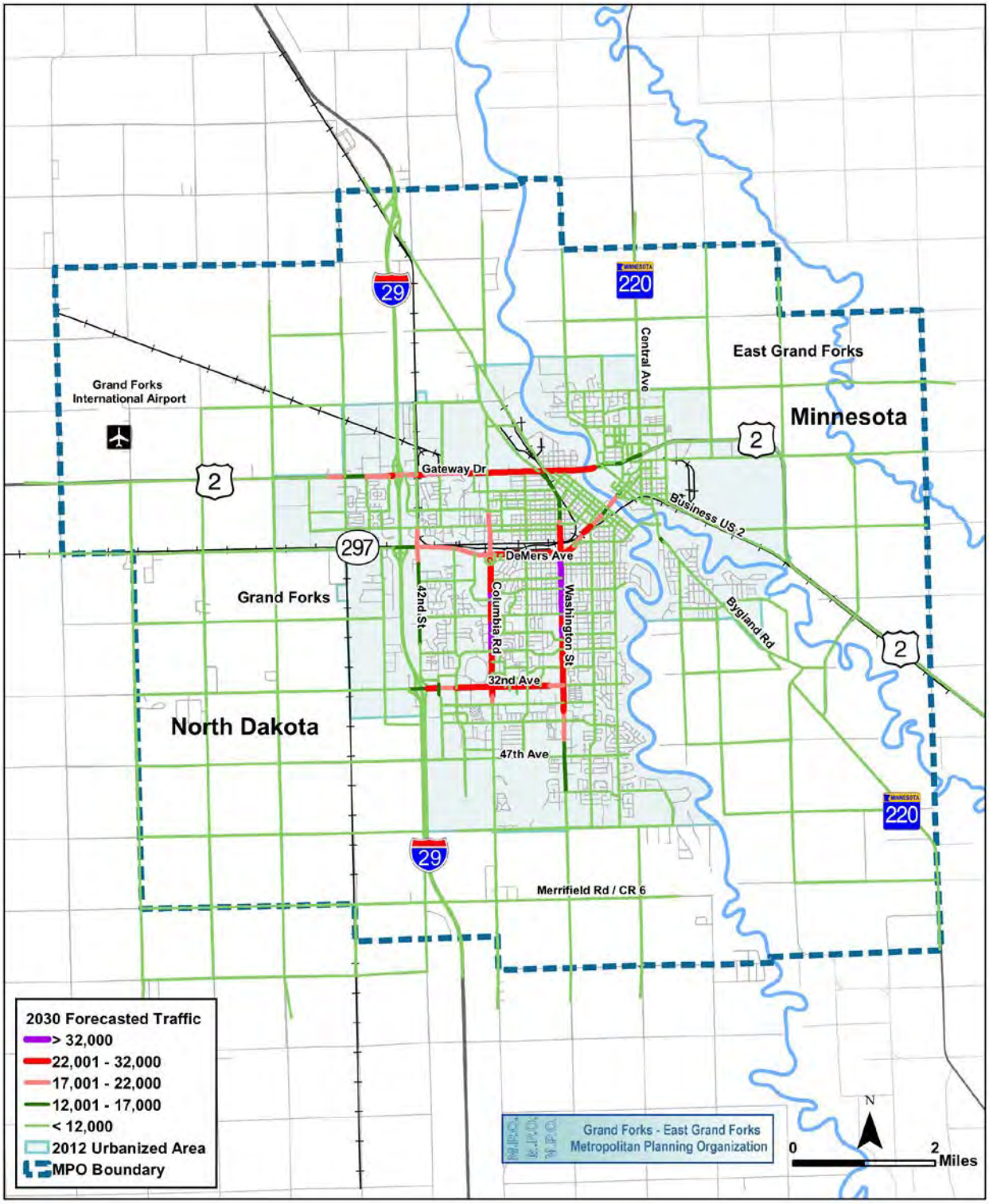
As part of the regional modeling task, an analysis of various Red River Crossings extending from 17th Avenue South to Merrifield Road were also analyzed. Appendix C provides a detailed narrative and summary of this analysis and associated recommendations and conclusions.

Table 5-1: Volume to Capacity Ratio Thresholds

Level of Service (LOS)	Volume to Capacity (V/C) Ratio
LOS A	< 0.6
LOS B	0.6 - 0.7
LOS C	0.7 - 0.8
LOS D	0.8 - 0.85
LOS D-	0.85 - 0.9
LOS E	0.9 - 1.0
LOS F	> 1.0

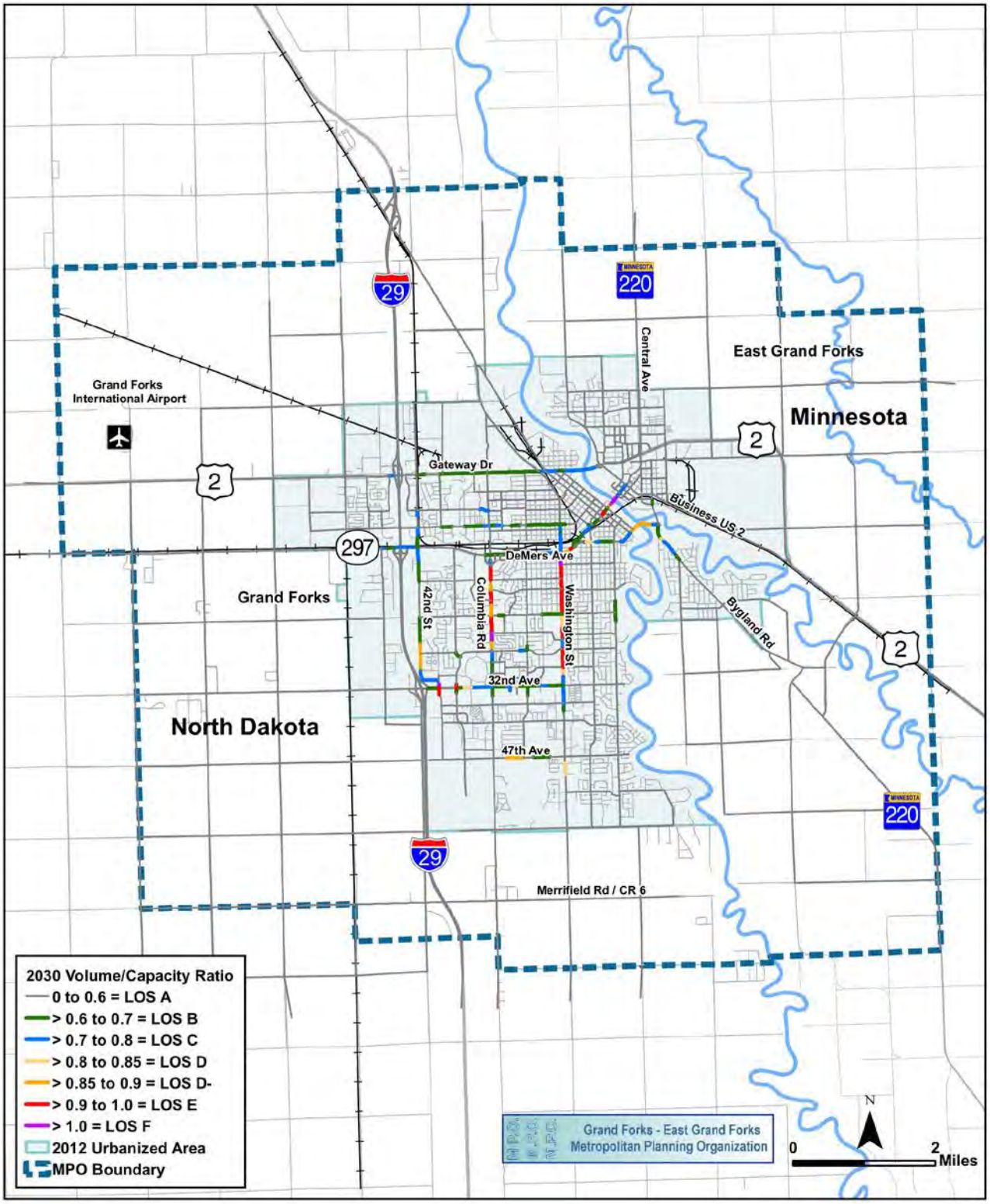
Source: ATAC

Figure 5-1: 2030 Forecasted Average Daily Traffic Volumes



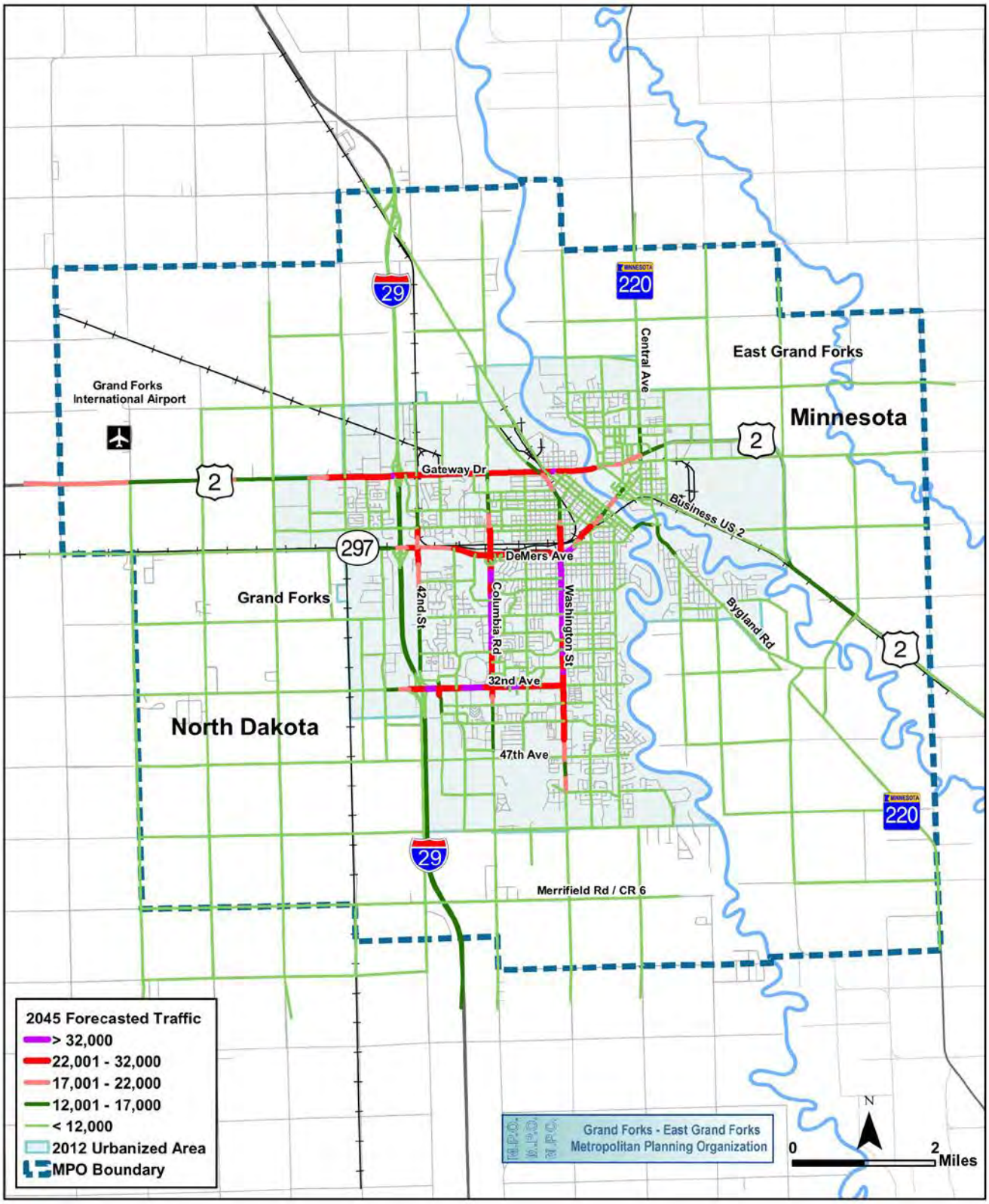
Source: GF/EGF MPO

Figure 5-2: 2030 Volume to Capacity Ratios



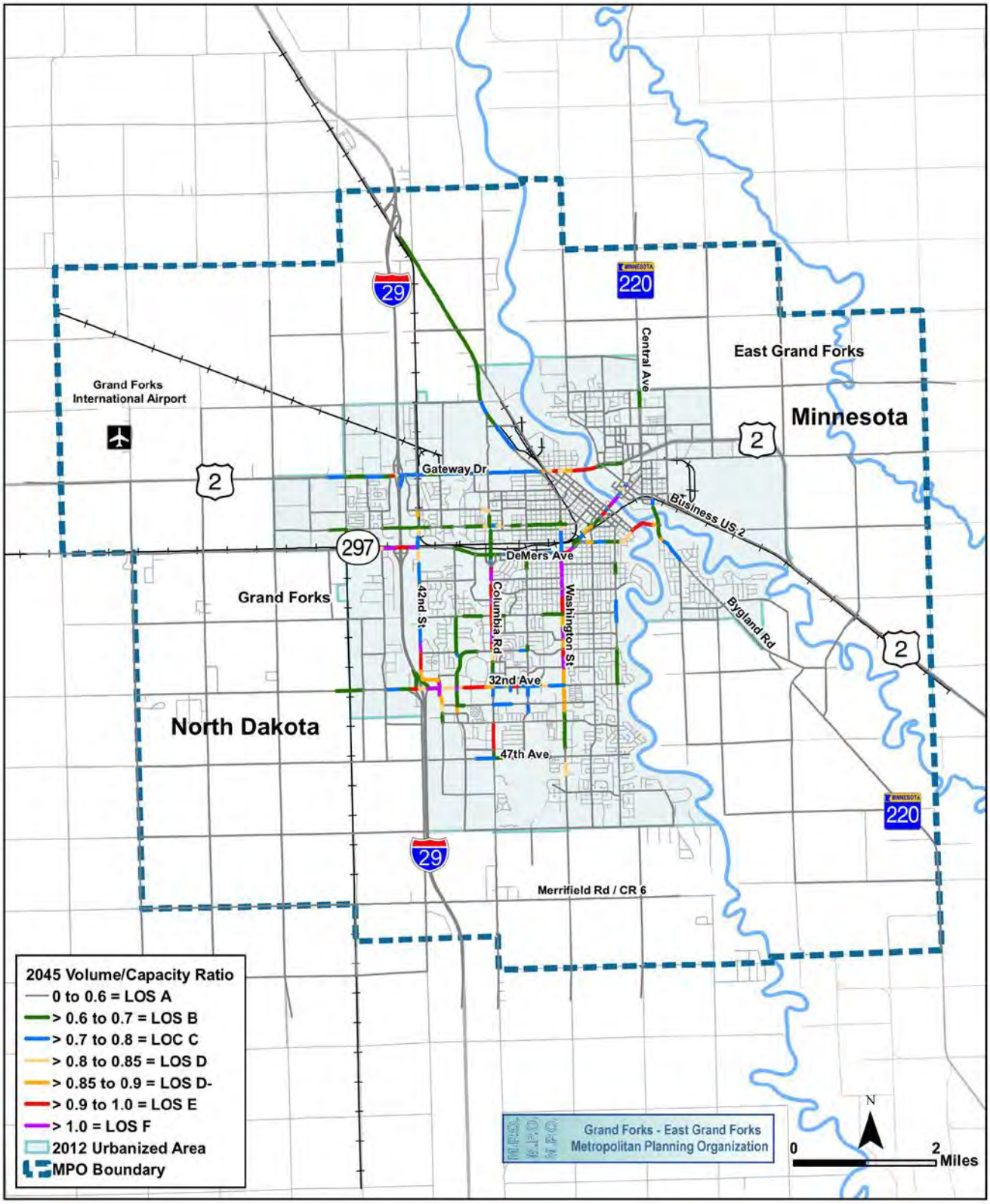
Source: GF/EGF MPO

Figure 5-3: 2045 Forecasted Average Daily Traffic Volumes



Source: GF/EGF MPO

Figure 5-4: 2045 Volume to Capacity Ratios



Source: GF/EGF MPO

North Dakota Mainstreet Projects

North Dakota Mainstreet projects were identified within the urban core of the City of Grand Forks. These projects are eligible for a special federal set-a-side established by NDDOT to revitalize existing urban core areas. Projects identified for this program included bicycle/pedestrian improvements, transit improvements, decorative streetlighting, benches, planters, street signs and other streetscape amenities.

State of Good Repair Projects

State of Good Repair (SOGR) projects were identified by NDDOT, MnDOT, the City of Grand Forks, the City of East Grand Forks, Grand Forks County and Polk County based on these agencies assessment of current and anticipated future pavement and bridge conditions.

When considering State of Good Repair projects, efforts were made to group investments within the same roadway corridor that typically would occur in a sequence within the short-range, mid-range and long-range time periods of the transportation plan. These State of Good Repair investments, when done in the right sequence and the right time intervals, have been proven to maximize the useful life of pavements and bridges. These improvements generally include the following:

- Pavement Chip Seal/Bridge Painting
- Pavement Mill and Overlay/Resurfacing/Bridge Redecking
- Major Pavement/Bridge Rehabilitation
- Full Roadway/Bridge Reconstruction/Replacement

Range of Alternatives Project List

The range of alternatives project list represents the entire "universe of projects" that have been evaluated and screened through the planning process. The range of alternatives was focused on addressing the GF/EGF MPO area's issues, needs and deficiencies. Appendix F and Appendix G provide a detailed summary of each project included in the entire range of alternatives projects list. This list divides projects into six categories, which include:

- MPO 2019-2022 TIP: Included in current regional TIP. Each of these projects is included as part of this metropolitan transportation plan.
- Existing + Committed (E + C) Network: Projects expected to be completed using Non-Federal/Non-State funds.
- Safety/Operations - HSIP: Projects that will improve the safety and operation of the existing system.
- Multimodal, Streetscape, Studies: Projects emphasizing multimodal or streetscape improvements or studies.
- State of Good Repair: Projects related to maintenance and preservation of the existing system.
- Discretionary: All remaining projects not listed previously.

Chapter 6. Financial Plan

Introduction

This section examines the sources of funding that will be available for transportation investments within the region in the coming years and the general areas of expenditure for those revenues. This section presents the revenues that can reasonably be expected to be available and investment spending that will occur under what is known as the "Current Revenue Scenario".

As identified in past Street/Highway Plans, an inadequate level of transportation funding continues to be a major issue facing the region. Under the Current Revenue Scenario, expectations are that highway system pavement and bridge conditions will continue to decline, and that highway congestion will continue to grow.

This chapter summarizes the revenue forecasting methodology and results, and demonstrates how available revenues align with the investments identified in this plan.

It should be noted that funds were identified for 2023 to 2045 only. Projects identified as existing and committed are constrained based on funds identified for those projects in the 2019-2022 Transportation Improvement Program (TIP).

Fiscal Constraint & Revenue Forecasting Requirements

Since the passage of the Intermodal Surface Transportation Efficiency Act (ISTEA) in 1991, the long-range transportation planning process in metropolitan areas was transformed away from "needs" based analyses, with little-to-no consideration given to the transportation funding amounts, to a financially-constrained project / program planning approach. Fiscally-constrained means that anticipated investments are equal to or less than forecast revenues.

The fiscal evaluation element of the MPO planning process has continued to evolve. Subsequent congressional re-authorizations of TEA-21 in 1998, SAFETEA-LU in 2005, and MAP-21 in 2012 have required an increased level of financial analysis, so that MPOs clearly demonstrate that projects and program activities included in their transportation plan were reasonably fundable for both the near- and long-term.

This remains even truer today. The Fixing America's Surface Transportation Act (FAST Act) passed in 2015 places an even stronger emphasis on-performance-based planning, preserving the National Highway System (NHS), and documenting that sufficient funding is available to address "state of good repair" (preservation projects) before expansion or discretionary projects are programmed. State and local policy also emphasize that street and highway preservation needs are critical and should be considered a primary investment.

Revenue Forecast Methodology

The methodology for developing future funding estimates was developed by the Grand Forks-East Grand Forks MPO in cooperation with state DOTs and local counties and cities. Federal and state policy allow for development of region-specific methodology, which is summarized below. All state and local partners accepted the resulting revenue forecasts.

Step 1: Establish Historical Transportation Improvement Funding Programs and Amounts

The GF/EGF MPO worked with the state DOTs and local agencies to review past Transportation Improvement Program (TIP) funding and future revenue forecasts, when available, to establish a "reasonable" baseline for forecasting future revenue streams. The TIP assessment considered past obligated dollars for expansion and preservation projects that occurred on the federal aid system (e.g., functionally classified roadways) dating back to 2013. The assessment also considered projects programmed in the 2019-2022 Transportation Improvement

Program (TIP) for the Minnesota and North Dakota sides of the GF/EGF MPO, and projects planned in the MnDOT 10-Year Capital Highway Investment Plan 2019-2028.

The revenue data was further screened to evaluate if past funding sources could reasonably be expected to continue into this Plan's time horizon. Many sources are expected to continue including:

- Federal assistance to each State DOT
- Various federal funding pass through programs to local governments, e.g., Urban Program (North Dakota), Highway Safety Improvement Program, and the Area Transportation Partnership programs (Minnesota)
- State funding sources, e.g., gas tax and license tab fees
- Local revenue streams, e.g., property tax and sales tax.

Special revenue streams were not included, such as bonds, special assessments, or grants (e.g., Safe Routes to School, Local Road Improvement Board Grant), because they are not considered reasonably consistent future revenue streams.

The baseline revenue for federal, state, and local programs is presented in Table 6-1 for North Dakota and Minnesota. This information supplements the revenue forecast in the 2019-2022 Transportation Improvement Program and establishes the base forecast.

Table 6-1: Annual Anticipated GF/EGF MPO Revenues from Historic Sources – Annual (2018 Dollars except where noted)

Funding Program	North Dakota	Minnesota
Highway Safety Improvement Program	$530,500	$25,500
Interstate Program	$320,000	None
Urban Regional Program	$2,800,000	Not applicable
Urban Roads Program	$2,458,000	Not applicable
Statewide Performance Program (SPP)	Not applicable	Varies by project $3.2 million to $13.6 million (year of expenditure dollars)
MN District Risk Management Program	Not applicable	Varies by project $720,000 to $3.2 million (year of expenditure dollars)
East Grand Forks City Sub-Target of Federal Funding	Not applicable	$860,000 every fourth year starting in 2018
State Match	$390,000	Varies by project $180,000 to $3 million (year of expenditure dollars)
Federal Allocation to Grand Forks County	$80,000	Not applicable
Grand Forks County Match	$25,000	Not applicable
City of Grand Forks Existing Revenues	$2,550,000	Not applicable
East Grand Forks State Aid	Not applicable	$315,000
Polk County, MN State Aid	Not applicable	$100,000

Step 2: Establish New Transportation Improvement Funding Programs and Amounts

The 2045 Street/Highway plan includes two new revenue sources identified by MPO partners, the federally-funded Urban Grant (Main Street) program and a new City of Grand Forks sales tax. These sources are summarized in Table 6-2.

The Main Street program is a new competitive grant program administered by the North Dakota DOT and funded by Federal Highway Administration, with the intent of spurring investment in already developed areas. In coordination with NDDOT, the GF/EGF MPO estimated the MPO area will receive a portion of the annual program funding available in North Dakota, equal to its share of the North Dakota urban population. For the purposes of this plan, NDDOT directed the GF/EGF MPO to include Watford in the state's total urban population. Grand Forks made up 13 percent of the 2016 American Community Survey 5-year Estimated North Dakota urban population, and the GF/EGF MPO estimated it will receive the equivalent of $600,000 annually, which is 13 percent of the annual $4,600,000 program funding.

The City of Grand Forks also passed a new sales tax in November 2017 to fund public works projects, including Streets and Highways. The new sales tax supplements the existing City of Grand Forks streets/highway revenues and is set to sunset in the year 2037. For the purposes of this plan, the GF/EGF assumed the equivalent of $2,350,000 annually (2018 dollars).

Table 6-2: Annual Anticipated GF/EGF MPO Revenues from New Sources – Annual (2018 Dollars)

Funding Program	North Dakota	Minnesota
Main Street Program	$600,000	Not applicable
City of Grand Forks Sales Tax	$2,350,000	Not applicable

Step 3: Establish Revenue Growth Rates

The GF/EGF MPO worked with the state DOTs and the local agencies to establish inflation rates for each revenue source. These are summarized in Table 6-3.

Table 6-3: GF/EGF MPO Revenue Inflation Assumptions – Annual

Inflation Rate by Funding Program	North Dakota	Minnesota
Federal Funding (includes State Match)	2.0%	2.2%
State Funding (non-federal match)	2.0%	1.9%
Local Funding	2.0%	1.9%

Step 4: Identify Future Available Revenues

The GF/EGF MPO inflated each revenue stream annually through the program sunset year or 2045-planning horizon, whichever year came first. This information provided year-by-year revenue forecasts for 2023-2045 for each side of the GF/EGF MPO that are presented in Appendix E. Funds forecast at the federal, state, and local levels assume reauthorization or otherwise continued collection and disbursement of the source revenue (gas tax, property tax, sales tax, etc.).

The Street and Highway Plan incorporates the following revenue assumptions and State policies:

- The 2019-2022 Transportation Improvement Program for the Grand Forks-East Grand Forks metropolitan area
- The Minnesota Department of Transportation prepares their own revenue forecasts and disbursements by MPO area

- Area Transportation Partnership (Minnesota) generally provides funds to East Grand Forks project every four years. The Minnesota revenue forecasts account for this allocation starting in 2018, and includes a state match corresponding to 20 percent.

Revenue Estimates

Based on these revenue assumptions, the GF/EGF MPO can reasonably anticipate approximately $425 million dollars of revenue over the 23-year planning horizon. Table 6-4 shows the forecast funds by timeband--short-range (2023 – 2027), mid-range (2028-2037), and long-range (2038-2045)—which form the base for the fiscal constraint analysis in Chapter 7.These revenues are in addition to those forecast in the Grand Forks-East Grand Forks 2019-2022 Transportation Improvement Program.

Table 6-4: Funding Estimates by Timeband in Year of Expenditure Dollars

Timeband	North Dakota	Minnesota	TOTAL
2019-2022 Transportation Improvement Program	$62,640,000*	$12,308,000	$74,948,000
Short-Range (2023-2027)	$69,969,000	$15,805,000	$85,774,000
Mid-Range (2028-2037)	$162,543,000	$18,910,000	$181,452,000
Long-Range (2038-2045)	$125,340,000	$32,857,000	$158,197,000
TOTAL (2023-2045)	$357,851,000	$67,572,000	$425,423,000

*Includes $1.3 million in federal funding available through the NDDOT Urban Main Street program in years 2021-2022

Chapter 7. Future Network and Implementation

Background and Overall Approach

The previous Range of Alternatives Chapter provides a summary of how the "Universe of Projects" list was developed, which encompasses all projects that could potentially be included in the Current Revenue Scenario of the financially constrained 2045 Street and Highway Plan. This Future Network and Implementation Chapter provides an outline of the methodology, assumptions and underlying approach used to narrow down the "Universe of Projects" list to a smaller subset of street and highway projects that have been identified as the financially constrained 2045 Street and Highway Plan (i.e. Current Revenue Scenario). Projects identified in the Current Revenue Scenario are eligible to compete for federal transportation funding through the GF/EGF MPO's Transportation Improvement Program (TIP) process. The following pages provide further background of how these Current Revenue Scenario projects were selected.

Projects identified in this section supplement those identified in the 2019-2022 Transportation Improvement Program (TIP).

Goals, Objectives, Performance Measures

The fundamental starting point for reviewing the "Universe of Projects" list and considering projects for inclusion in the Current Revenue Scenario was to consider the overall vision, goals, objectives, standards, performance measures and targets established for the 2045 Street and Highway Plan. The policy framework outlined in the 2045 Plan includes specific federal performance target requirements from the FAST Act combined with State and local standards established by NDDOT, MnDOT and the MPO regarding how the overall transportation system should perform today and through the year 2045.

The Grand Forks-East Grand Forks MPO has established ten overarching goal areas in this Plan related to the regional transportation system. Federal performance measures through the FAST Act have also been established for safety, state of good repair, mobility and environment. Safety and state of good repair are identified as the top federal investment priority in the FAST Act. These federal investment priorities have been carried out by NDDOT and MNDOT and are also the primary investment focus of this Grand Forks-East Grand Forks MPO 2045 Street and Highway Plan.

Specific targets have been established by NDDOT and MnDOT to carry out State of Good Repair requirements for the National Highway System (NHS). Maintaining roadway pavements and bridges in a State of Good Repair consistent with these targets for NHS Interstate Principal Arterials and Non-NHS Minor Arterials was the number one priority of the MPO and its planning partners when identifying fiscally constrained projects in the Current Revenue Scenario. Table 2-15 of the Vision, Goals, Objectives, Standards, Performance Measures and Targets Chapter outlines the specific State of Good Repair performance targets established by NDDOT and MnDOT to satisfy this FAST Act State of Good Repair mandate. The Grand Forks East Grand Forks MPO has adopted these same NDDOT and MnDOT standards for pavement quality and bridge condition. Figure 7-1 provides an illustration of how the overall 2045 Street and Highway Plan vision, goals, objectives, standards, performance measures and targets relate to each other as part of the overall planning process.

Figure 7-1: Vision, Goals, Objectives, Standards and Performance Measures



Financial Forecast

As discussed in the Financial Forecast Chapter, Federal law requires that Current Revenue Scenario projects be financially constrained to only include projects that can reasonably be expected to be funded within the 2045 planning horizon. For the 2045 Street and Highway Plan Current Revenue Scenario, separate financially constrained project lists were prepared based on the following 2045 forecasted highway revenue sources outlined in Table 7-1.

Table 7-1: 2045 Highway Revenue Forecast (2023-2045)

Funding Source	Total Forecasted Revenue (2023-2045)*
Safety	$17.7
North Dakota Main Street	$19.1**
Interstate	$10.2
State	$20.3
Other Federal	$218
Local	$139.9
Total	**$425 Million**

**An additional $75 million is forecast to be available in the 2019-2022 Transportation Improvement Program

*An additional $1.3 million in federal funding is available through the NDDOT Main Street program in years 2021-2022

Using the above referenced revenue forecasts, revenues for each funding source were then broken up further into the following time periods so projects could be grouped and financially constrained into logical implementation periods.

Table 7-2: 2045 Street/Highway Plan Time Periods

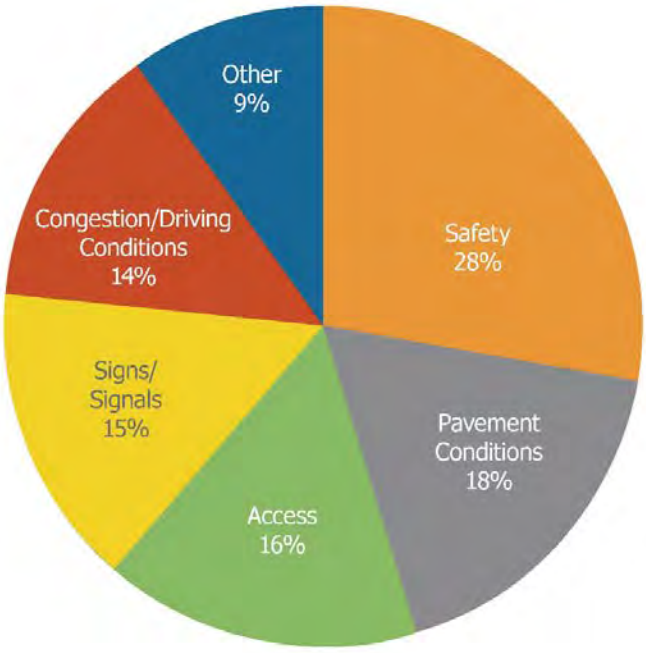
Transportation Improvement Program	2019-2022	▪ Adopted MPO Transportation Improvement Program
Short-Range	2023 to 2027	▪ Starts at end of adopted 2019-2022 MPO Transportation Improvement Program
Mid-Range	2028 to 2037	▪ End coincides with expiration of City of Grand Forks 2018-2037 sales tax
Long-Range	2038 to 2045	▪ Remaining years in planning horizon

Projects that could not be financially constrained within these time periods and the overall 2045 planning horizon were identified as "Illustrative." Illustrative projects are projects that have a regional transportation purpose and need, however, based on the financial forecast and established project priorities, it is not reasonable to assume that the project can be funded within the 2045 planning horizon.

Public Input

Another important consideration in selecting projects from the Universe of Projects list for inclusion in the Current Revenue Scenario was collecting public input. Early in the study process, during the summer of 2017, citizens had an opportunity to provide input about general transportation issues they experience in the Grand Forks-East Grand Forks Metro Area via an interactive on-line "Wiki Maps" tool. General transportation issue areas identified through the "Wiki Maps" exercise are summarized in Figure 7-2.

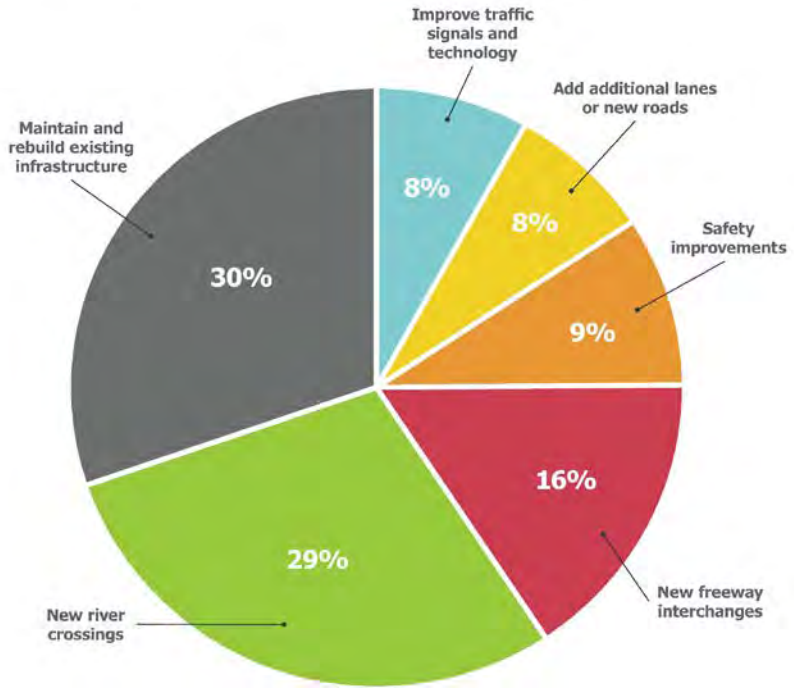
Figure 7-2: 2017 On-line Wiki Map Survey: What are your transportation issues?



In late 2017, residents had an opportunity to provide input about investment priorities for the area's street and highway system. Residents could provide input at the December 2017 Open House and online through the plan

website. Figure 7-3 summarizes investment preference responses. As shown in Figure 7-2 and Figure 7-3, existing transportation system preservation and safety are high priorities for Grand Forks-East Grand Forks residents, along with a new river crossing.

Figure 7-3: January 2018 Open House: How would you invest between the above referenced choices?



Prioritization Tool

In addition to overall transportation plan goals and objectives, the 2045 revenue forecast, and public input, another important resource used to identify Current Revenue Scenario projects from the Universe of Projects list was a Prioritization Tool that helped score and rank projects based on how well they addressed each of the following ten goal areas:

1. Economic Vitality
2. Security
3. Accessibility and Mobility
4. Environmental/Energy/Quality of Life
5. Integration and Connectivity
6. Efficient System Management
7. System Preservation
8. Safety
9. Resiliency
10. Tourism

Using the above referenced general goal areas and more detailed objectives associated with each goal as a reference, staff then used the prioritization tool to assign points to each project on the Universe of Projects list as one consideration in the project screening process. Projects that did not clearly improve a given goal area and its associated objectives received 0 points for that goal. Projects that clearly improved a given goal area and its associated objectives receive 1 point for that goal.

Projects were prioritized into the following federal project categories:

- State of Good Repair
- Safety
- North Dakota Urban Grant (Main Street) Program
- Illustrative

Other Considerations

In addition to the considerations outlined above, a variety of other factors also contributed to the overall conversation and ultimate decision of what projects to include in the Current Revenue Scenario. The following provides an overview of these considerations.

NHS and Functional Classification

State of Good Repair pavement and bridge projects on the federally designated National Highway System (NHS)/Principal Arterial system, including Interstate 29, US Highway 2, DeMers Avenue, Columbia Road, Washington Street and 32nd Avenue South were given the priority for inclusion in the Current Revenue Scenario. Secondarily, Non-NHS Minor Arterial State of Good Repair pavement and bridge projects were also funded to the extent possible.

Pavement and Bridge Life Cycle

When considering State of Good Repair projects, efforts were made to group investments within the same roadway corridor that typically would occur in a sequence within the short-range, mid-range and long-range time periods of the transportation plan. These State of Good Repair investments, when done in the right sequence and the right time intervals, have been proven to maximize the useful life of pavements and bridges. These improvements generally include the following:

- Pavement
  - Reconstruction by rebuilding the roadway, including soil and infrastructure beneath the pavement
  - Rehabilitation by performing mill and overlay
  - Preservation by applying chip seal
- Bridge
  - Reconstruction by rebuilding the bridge, including approach roadways
  - Rehabilitation by replacing the bridge deck
  - Preservation by repainting the surface of the bridge

Existing Investment Programs

Existing short-, mid-, and long-range investment programs developed by MnDOT, NDDOT, the City of Grand Forks, the City of East Grand Forks, Grand Forks County and Polk County tied to known revenue sources were used as a starting point to identify individual agency investment priorities. These individual agency investment programs were integrated into the overall Current Revenue Scenario to the maximum extent possible within the framework of other factors outlined in this chapter.

The North Dakota Urban Grant (Main Street) Program was introduced in 2017. The program funds transportation improvements that directly support a community's urban core and central business district. It is also intended to leverage funding administered by other state agencies. Urban Grant Program objectives include: preserving existing assets; ensuring safety of all users of the transportation system; improvement of multi-modal transportation options such as walking, bicycling and public transit; supporting economically sustainable growth; lessening the need for outward expansion of community transportation infrastructure; and enhancing the economic vitality of the area by providing transportation assets.

Project Cost Estimates and Inflation

Current project cost estimates were provided by NDDOT, MnDOT, City of Grand Forks, City of East Grand Forks, Polk County and Grand Forks County or were taken from recent corridor studies. In limited cases, current cost

estimates were made based on similar projects in the Grand Forks/East-Grand Forks area. Each project was assigned to a time period in the plan, and its cost was inflated to the mid-year of the time period. The assumed annual inflation rates were 4 percent per year in North Dakota, and 4.4 percent per year in Minnesota. The inflation factors for each time period for North Dakota and Minnesota projects are:

NDDOT/City of Grand Forks/Grand Forks County Inflation Rates (4% compounded annually)

Short-Range: 2023 to 2027 (1.316)
Mid-Range: 2028 to 2037 (1.801)
Long-Range: 2038 to 2045 (2.563)

MnDOT/City of East Grand Forks/Polk County Inflation Rates (4.4% compounded annually)

Short-Range: 2023 to 2027 (1.352)
Mid-Range: 2028 to 2037 (1.908)
Long-Range: 2038 to 2045 (2.811)

Local Knowledge

In addition to the above referenced considerations, the final tool used to identify Current Revenue Projects from the Universe of Projects list was to consider local staff and elected official knowledge. Various local knowledge considerations such as project readiness, coordination with other scheduled projects, neighborhood and community support, elected official support, etc., were all considered in the Current Revenue Scenario project selection process.

Current Revenue Scenario Planned Investments

Current Revenue Scenario investments for 2023-2045 are summarized in Table 7-3 and Figure 7-4. The majority of funding goes toward maintaining a state of good repair for the non-Interstate National Highway System. This investment direction advances the direction first established in the 2040 Streets and Highway plan and reflected in the 2019-2022 Transportation Improvement Program.

The $267 million in investments is less than the $425 million in forecast revenues largely because the revenue forecast includes the transportation portion of the recent increase in City of Grand Forks sales tax. The City of Grand Forks sales tax increase for transportation was included to ensure the local match and local cost components of federally funded projects could be shown as fiscally constrained. Revenues from the City of Grand Forks sales tax for transportation exceed the amount required for federal project local match and local components. Consistent with City policy, these remaining revenues can serve purposes beyond paying for costs related to federally funded transportation projects, including repairing or expanding local roads.

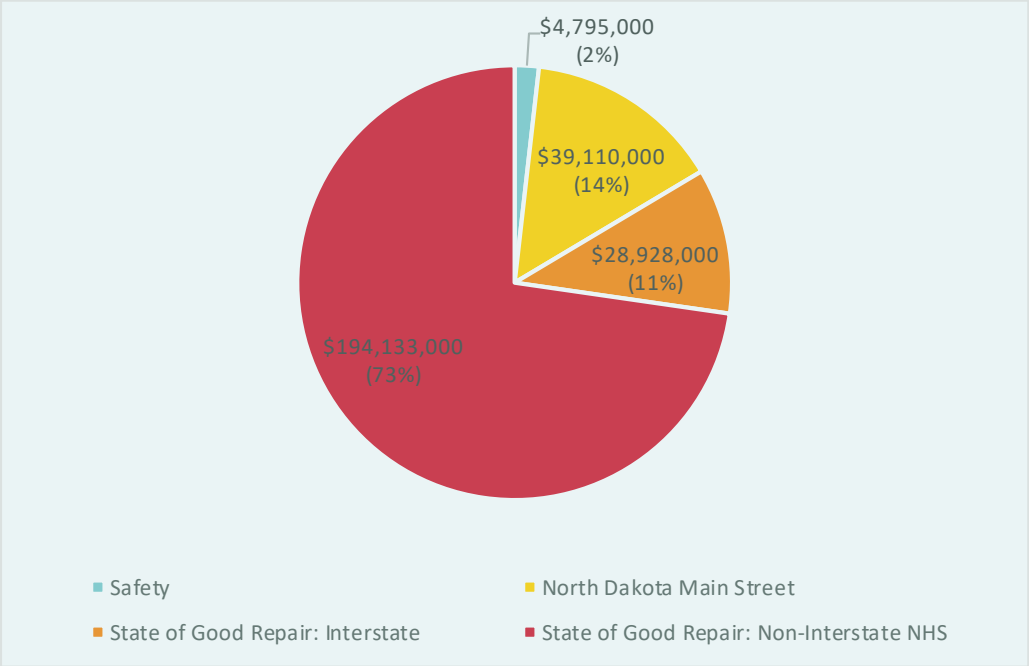
The City of Grand Forks local projects will be identified by the City Council. Any project being financed locally and needing federal approval must be amended into this fiscally constrained Current Revenue Scenario.

Table 7-3: Current Revenue Scenario Project Type Investment Amounts for 2023-2045*

Project Type	Investment Amounts	Share
Safety	$4.8 million	2%
North Dakota Main Street	$39.1 million	14%
State of Good Repair: Interstate	$28.9 million	11%
State of Good Repair: Non-Interstate NHS	$194.1 million	73%
Total	**$267 million**	**100%**

*An additional $75 million is programmed for investment through the 2019-2022 Transportation Improvement Program.

Figure 7-4: Current Revenue Scenario Investment Amounts



North Dakota Current Revenue Scenario Projects

NDDOT Planned State of Good Repair

NDDOT State of Good Repair projects were identified by NDDOT from their existing Capital Improvement Program and incorporated in their entirety within the Current Revenue Scenario. Roadways that have been targeted for State of Good Repair Investments by NDDOT are along the Interstate and NHS Principal Arterial system including Interstate 29, US Highway 2 (Gateway Drive), US 81 Business (Washington Street/32nd Avenue) and State Highway 297 (DeMers Avenue). Table 7-4 provides a summary of NDDOT State of Good Repair projects by time period. State of Good Repair project types included in the Current Revenue Scenario include chip seal, CPR and grind, mill and overlay, full reconstruction, painting the Kennedy and Sorlie Bridges in conjunction with MnDOT, as well as regional traffic signal upgrades.

Table 7-4: NDDOT State of Good Repair Planned Investments

Time Period	Federal/ State Match	City Match	YOE Total
Short-Range	$20,181,000	$1,440,000	$21,620,000
Mid-Range	$50,485,000	$4,732,000	$55,217,000
Long-Range	$44,150,000	$2,412,000	$46,561,000
Total	**$114,816,000**	**$8,584,000**	**$123,398,000**

Source: GF/EGF MPO, 2018

City of Grand Forks Planned State of Good Repair

City of Grand Forks federally funded State of Good Repair projects included in the Current Revenue Scenario focused on the NHS Principal Arterial system. These projects addressed pavement needs on roadways such as University Avenue, 4th Avenue South, Minnesota Avenue, South 48th Street, Columbia Road, 17th Avenue South and Washington Street. A project is also included in conjunction with the City of East Grand Forks to rehabilitate the Point Bridge. Specific project types include maintenance and operations, Concrete Pavement Rehabilitation

(CPR), rehabilitation, reconstruction as well as traffic signal or roundabout improvements. Table 7-5 provides a summary of the City of Grand Forks federally funded State of Good Repair projects by time period.

Table 7-5: City of Grand Forks State of Good Repair Planned Investments (Federally Funded)

Time Period	Federal/City Match	Additional City Funds	YOE Total
Short-Range	$18,568,000	$4,744,000	$23,312,000
Mid-Range	$42,138,000	$13,906,000	$56,044,000
Long-Range	$40,117,000	$13,238,000	$53,355,000
Total	**$100,823,000**	**$31,888,000**	**$132,711,000**

Source: GF/EGF MPO, 2018

The City of Grand Forks identified additional locally funded projects to bring segments of the federal aid system into state of good repair. A prioritized list of Illustrative projects by agency, identifying relative importance to one another, is available in Appendix G.

City of Grand Forks Planned Main Street

The City of Grand Forks has identified a series of streetscape, bicycle/pedestrian, transit and downtown revitalization projects as potential "Main Street" program investments to compete for this recently established federal set-a-side available through NDDOT. The focus of these projects is to improve multimodal transportation options in the urban core of Grand Forks while also investing in decorative streetlighting, benches, planters, street signs and other streetscape amenities. Revitalization projects have been identified for east, west, north and south quadrants of the downtown, as well as reconstruction along North and South sections of 3rd Street and 4th Street. Table 7-6 provides a summary of City of Grand Forks Main Street projects by time period.

Table 7-6: City of Grand Forks Main Street Planned Investments

Time Period	YOE Total Federal/City Match
Short-Range	$6,330,000*
Mid-Range	$8,293,000
Long-Range	$24,488,000
Total	**$39,111,000**

***One** or more of the short-range Main Street projects may be completed in 2021-2022.

Source: GF/EGF MPO, 2018

Grand Forks County Planned State of Good Repair

Grand Forks County has identified State of Good Repair mill and overlay projects along their federal-aid eligible roadway network in the MPO planning area along County Road 6, CR 5, CR 17 and 32nd Avenue west of Interstate 29. The County has also identified various chip seal projects throughout the County roadway network. Table 7-7 summarizes these projects by time period.

Table 7-7: Grand Forks County State of Good Repair Planned Investments

Time Period	Federal/County Match	County Only Funds	YOE Total
Short-Range	$1,316,000	$618,000	$1,934,000
Mid-Range	$2,702,000	$1,162,000	$3,864,000
Long-Range	$3,845,000	$1,459,000	$5,304,000
Total	**$7,863,000**	**$3,239,000**	**$11,102,000**

Source: GF/EGF MPO, 2018

Safety (North Dakota Portion of MPO)

Safety projects included in the Current Revenue Scenario were derived from the North Dakota Local Road Safety Plan, recent studies and local capital improvement programs. It is important to note that this Plan is in need of updating and efforts should be made in the future to include a short-term listing of projects that can be implemented. Safety projects will be funded through the Highway Safety Improvement Program (HSIP) and include miscellaneous intersection safety upgrades along with more significant investments. More significant investments include intersection improvements at Gateway Drive and Airport Drive and realignment of Stanford Road at Gateway Drive. Table 7-8 provides a summary of all safety/operation projects within the North Dakota portion of the MPO by time period.

Two projects are included in the Illustrative Projects list that respond to the higher than expected crash rates identified in Chapter 3 Existing Conditions. These projects are interchange improvements in the NE loop at Interstate 29 and Gateway Drive and intersection improvements at the Ralph Engelstad Arena entrance at Gateway Drive; they would cost about $19 million if constructed in the mid-range time period of this plan.

Table 7-8: Safety Projects (North Dakota Portion of MPO*

Time Period	YOE Total Federal/City Match
Short-Range	$3,479,000
Mid-Range	$1,316,000
Long-Range	$0
Total	**$4,795,000**

*Note: Short-range projects are from the North Dakota Local Road Safety Plan. Mid-range projects are candidates identified in recent studies and capital improvement programs and should be prioritized for funding through updates to the North Dakota Local Road Safety Plan and North Dakota Strategic Highway Safety Plan.

Source: GF/EGF MPO, 2018

Planned "Projects of Significance" (North Dakota Portion of MPO)

Table 7-9 outlines planned "Projects of Significance" on the North Dakota side of the MPO planning area. Projects of $5 million or more are identified for NDDOT and the City of Grand Forks. Grand Forks County did not have any projects identified in the Current Revenue Scenario that met this criterion.

Table 7-9: Planned "Projects of Significance" (North Dakota Portion of MPO) (>/= $5 Million)

Project Type	Roadway	Lead Agency	Termini	Time Period	Improvement	Investment
State of Good Repair	**US 81 Business**	NDDOT	Grand Forks - South Washington Street (Hammerling to 8th Avenue South)	Short-Range	Reconstruct	$5,922,000
State of Good Repair	**Various**	NDDOT	Various	Short-Range	Regional Traffic Signal Upgrade	$7,238,000
State of Good Repair	**Columbia Road**	City of Grand Forks	Columbia Road Railroad Overpass North of DeMers Ave.	Short-Range	Overpass	$7,481,000

Project Type	Roadway	Lead Agency	Termini	Time Period	Improvement	Investment
State of Good Repair	**North Columbia Road**	City of Grand Forks	8th Avenue North to US 2 (Gateway Drive)	Short-Range	Reconstruct	$10,632,000
State of Good Repair	**US 81 Business**	NDDOT	I-29 to South Washington Street	Mid-Range	Reconstruct	$30,798,000
State of Good Repair	**North Washington Street (US 81 Business)**	NDDOT	Dyke Avenue to .05 Mi South of 8th Avenue	Mid-Range	Reconstruct	$9,450,000
State of Good Repair	**North Columbia Road**	City of Grand Forks	University Avenue to 8th Avenue North	Mid-Range	Reconstruct	$12,933,000
State of Good Repair	**South Washington Street**	City of Grand Forks	32nd Avenue South to 47th Avenue South	Mid-Range	CPR	$11,209,000
State of Good Repair	**South Columbia Road**	City of Grand Forks	17th Avenue South to 32nd Avenue South	Mid-Range	CPR	$11,425,000
State of Good Repair	**South Columbia Road**	City of Grand Forks	DeMers Avenue to 17th Avenue South	Mid-Range	CPR	$9,484,000
State of Good Repair	**Various**	NDDOT	Various	Long-Range	Regional Traffic Signal Upgrade	$17,480,100
State of Good Repair	**Columbia Road****	City of Grand Forks	47th - 62nd and Washington SED - 62nd	Long-Range	Maintenance & Operations	$9,107,000
State of Good Repair	**Columbia Road**	City of Grand Forks	32nd Avenue South to 47th Avenue South	Long-Range	CPR	$15,645,000
State of Good Repair	**Various**	City of Grand Forks	Various	Long-Range	Traffic Signal Upgrade	$11,886,000
State of Good Repair	**32nd Avenue South**	City of Grand Forks	Cherry Street to Belmont Road	Long-Range	Reconstruct	$5,215,000

Source: GF/EGF MPO, 2018

**Columbia Road project includes two separate sets of termini. These projects being packaged together by the City of Grand Forks for a future NDDOT Urban Roads Program grant funding request.

Minnesota Current Revenue Scenario Projects

MnDOT Planned State of Good Repair

MnDOT's 20-year Minnesota Highway Investment Plan (MnSHIP) and 10-year Highway Investment Plan (HIP) communicate MnDOT's capital investment priorities and fiscally constrained project commitments. MnDOT's State of Good Repair projects in these Plans for the East Grand Forks/Polk County portion of the MPO planning area include painting the Kennedy and Sorlie bridges in conjunction with NDDOT, replacing the US Highway 2 Bridge

over River Road NW, rehabilitating the Sorlie Bridge, along with a variety of mill and overlay, resurfacing and concrete rehabilitation projects along US Highway 2, US Highway 2 Business and Minnesota State Trunk Highway 220. As noted in Table 7-10, these State of Good Repair improvements total $39,500,000 through the 2045 planning horizon.

Table 7-10: MnDOT State of Good Repair Planned Investments

Time Period	YOE Total Federal/State Match
Short-Range	$10,300,000
Mid-Range	$9,000,000
Long-Range	$20,600,000
Total	**$39,800,000**

Source: GF/EGF MPO, 2018

City of East Grand Forks Planned State of Good Repair

City of East Grand Forks State of Good Repair projects were identified by the City for its federal-aid eligible roadways including Bygland Road, Rhinehart Drive, 10th Street NE, 5th Avenue NW, and 8th Avenue NW. Project types include rehabilitation and full reconstruction. Additionally, the City of East Grand Forks has a rehabilitation project planned for the Point Bridge in the short-range time period in cooperation with the City of Grand Forks. A summary of these investments is provided in Table 7-11.

Table 7-11: City of East Grand Forks State of Good Repair Planned Investments

Time Period	YOE Total Federal/City Match
Short-Range	$2,738,000
Mid-Range	$6,392,000
Long-Range	$6,803,000
Total	**$15,933,000**

Source: GF/EGF MPO, 2018

Polk County Planned State of Good Repair

Planning efforts were coordinated with Polk County to identify State of Good Repair projects, which has led to identification of mill and overlay projects along CSAH 72, CSAH 73 and CSAH 76. The CSAH 72 project is planned for the short-range time period and the CSAH 73 and CSAH 76 projects are planned for the mid-range time period. Table 7-12 below provides a summary of these investments.

Table 7-12: Polk County State of Good Repair Planned Investments

Time Period	YOE Total Federal/County Match
Short-Range	$203,000
Mid-Range	$638,000
Long-Range	$0
Total	**$841,000**

Source: GF/EGF MPO, 2018

Safety (Minnesota Portion of MPO)

The Current Revenue Scenario does not yet identify fiscally constrained safety projects in the Minnesota portion of the metropolitan area. Regional partners will work together to quickly identify projects to be funded using Highway Safety Improvement Program (HSIP) funds.

The Illustrative Projects list includes more than $18 million in potential safety projects derived from the MnDOT District 2 Safety Plan, the Polk County Safety Plan, and a recent corridor study along Bygland Road. Examples of larger investments include signal and turn lane upgrades along US 2 and roundabout upgrades along Bygland Road at 13th Avenue and also 5th Avenue. Table 7-13 provides a summary of all safety/operation projects within the Minnesota portion of the MPO by time period.

Table 7-13: Safety (Minnesota Portion of MPO)

Time Period	YOE Total Federal/City/County Match
Short-Range	$0
Mid-Range	$0
Long-Range	$0
Total	**$0**

Source: GF/EGF MPO, 2018

Planned "Projects of Significance" (Minnesota Portion of MPO)

Table 7-14 outlines planned "Projects of Significance" on the Minnesota side of the MPO planning area. Projects of 5 million dollars or more are identified for MnDOT and the City of East Grand Forks. and Polk County.

Table 7-14: Planned "Projects of Significance" (Minnesota Portion of MPO) (>/= $5 Million)

Project Type	Roadway	Agency	Termini	Time Period	Improvement	Inflated Cost
State of Good Repair	**US 2**	MnDOT	Over River Road NW	Short-Range	Replace Bridge	$5,600,000
State of Good Repair	**US 2**	MnDOT	WB from 0.5 miles W of the W JCT of MN 220 (East Grand Forks) to 0.3 miles E of Polk CSAH 15 (Fisher)	Long-Range	Resurfacing	$15,000,000

Source: GF/EGF MPO, 2018

Fiscally Constrained Program of Projects

The following provides a summary of the financially constrained implementation plan based upon the GF/EGF MPO's forecasted local, state and federal revenues and inflation adjusted expenditures by short-range (2023-2027), mid-range (2028-2037) and long-range (2038-2045) time period. Expenditures are financially constrained by Main Street, Safety and State of Good Repair eligible funding program and associated local match forecasts from 2023 through 2045. Project expenditures are also constrained within each individual funding program and within each time period.

As a result of the FAST Act required emphasis on State of Good Repair and safety investments and the NDDOT, MnDOT and MPO reinforcement of this emphasis, all of the fiscally constrained program of projects in this Plan through 2045 are State of Good Repair, Safety and Main Street investments.

Expected Revenue and Expenditure Estimates

The fiscally-constrained program of projects (Current Revenue Scenario) represents the financial balancing of the Grand Forks/East Grand Forks 2045 Street and Highway Plan recognized federally eligible project investment needs and corresponding revenues that are "reasonably expected to be available" over the 2023 to 2045 planning

horizon. As discussed earlier in this chapter and in various other locations of this Plan, the FAST Act requires that system preservation and maintenance needs for pavements and bridges and Safety needs be addressed before other discretionary transportation system needs are funded. This investment philosophy is also supported by NDDOT, MnDOT and the GF/EGF MPO.

Table 7-15 summarizes the GF/EGF MPO expenditures and revenues for the North Dakota portion of the MPO planning area. Table 7-16 summarizes the GF/EGF MPO expenditures and revenues for the Minnesota portion of the MPO planning area. During development of the fiscally constrained plan, a threshold tolerance of +/-8 percent was established for the purposes of balancing revenues and expenditures by time period.

Table 7-15: Fiscally Constrained Program for North Dakota Portion of Grand Forks-East Grand Forks MPO*

Time Period	Planned Expenditures			Forecast Revenue		Balance
	NDDOT	City of Grand Forks	Grand Forks County	State and Federal	City/County	
Short-Range (2023-2027)	$20,951,000	$13,902,000**	$3,253,000	$41,671,000	$28,297,000	+$32 million
Mid-Range (2028-2037)	$50,485,000	$28,247,000	$3,864,000	$96,805,000	$65,737,000	+$80 million
Long-Range (2038-2045)	$44,150,000	$40,137,000	$5,304,000	$92,499,000	$32,841,000	+$35.8 million
Subtotal	**$115,586,000**	**$82,286,000**	**$12,421,000**	**$230,975,000**	**$126,875,000**	

*The 2019-2022 Transportation Improvement program includes an additional $63 million in forecast revenues and planned expenditures for the North Dakota portion of the MPO area.

**One or more of the short-range Main Street projects may be completed in 2021-2022, when there is an additional $1.3 million in federal funding available.

Source: GF/EGF MPO, 2018

Table 7-16: Fiscally Constrained Program for Minnesota Portion of Grand Forks-East Grand Forks MPO*

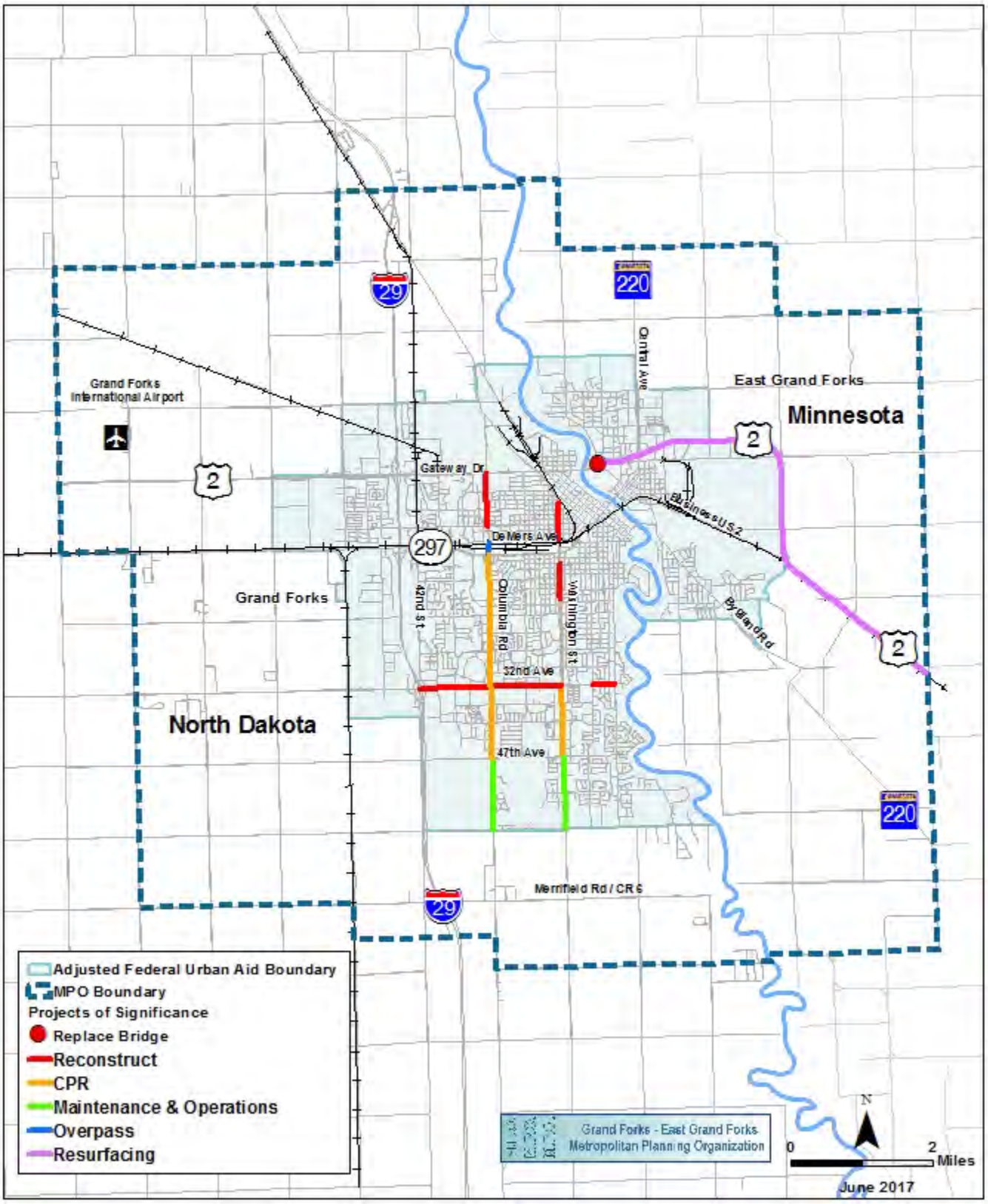
Time Period	Planned Expenditures			Forecasted Revenue		Balance
	MnDOT	City of East Grand Forks	Polk County	State and Federal	City/County	
Short-Range (2023-2027)	$10,300,000	$2,738,000	$203,000	$11,060,000	$2,365,000	+$0.2 million
Mid-Range (2028-2037)	$9,000,000	$6,392,000	$638,000	$11,657,000	$5,453,000	+$1.1 Million
Long-Range (2038-2045)	$20,600,000	$6,803,000	$0	$23,592,000	$5,165,000	+$1.4 million
Subtotal	**$39,800,000**	**$15,933,000**	**$841,000**	**$46,309,000**	**$12,983,000**	

*The 2019-2022 Transportation Improvement Program includes an additional $12 million in forecast revenues and planned expenditures for the Minnesota portion of the MPO area.

Source: GF/EGF MPO, 2018

A complete listing of fiscally constrained Current Revenue Scenario projects by agency and funding program can be found in Appendix F. Figure 7-5 also highlights Current Revenue Scenario "Projects of Significance" equal to or greater than $5 million, as summarized earlier in this chapter in Table 7-9 and Table 7-14.

Figure 7-5: Current Revenue Scenario "Projects of Significance"



Illustrative Projects

After going through the project prioritization and vetting process described in this chapter, a variety of projects were not included in the Current Revenue Scenario. These illustrative projects have had an identified regionally significant transportation purpose and need, however, at this point in time, forecasted federal, state and local revenues are not available for construction through 2045. A prioritized list of Illustrative projects by agency, identifying relative importance to one another, is available in Appendix G. A summary of some of the highest ranked illustrative projects from the prioritization tool are outlined in Table 7-17 and in Figure 7-6.

The Red River crossing projects, 32nd Avenue S and Merrifield Road, shown on the bottom of the table are included on the list as a result of policy direction from the GF/EGF MPO Board that was made considering input from this planning process and public input. The river crossing projects will provide regional connectivity across the Red River, supplementing the three existing river crossings that are forecast to operate with significant congestion in 2045. The 2040 Plan also included the same crossings as Illustrative "Projects of Significance" although the 2040 plan prioritized Merrifield Road over 32nd Avenue S. As a part of this plan they have not been prioritized for the following reasons:

- There has been interest in the community in these two river crossing locations for "local traffic" and "bypass" since the late 1990s.
- The current analysis again showed that the Merrifield Road river crossing served "bypass" traffic and the 32nd Avenue S river crossing served "local" traffic. There are different transportation benefits for each crossing location.
- The Merrifield Road and 32nd Avenue S. river crossings would be led by different agencies. Merrifield Road would be a Grand Forks County and Polk County led project. The 32nd Avenue S crossing would be a City of Grand Forks and City of East Grand Forks led project.
- Both projects had a benefit-cost ratio over 1 based on the planning analysis completed, indicating both projects are anticipated to benefit the community when compared to cost of construction.
- Since both river crossing locations would benefit the region and funding would come from different sources, including both crossing as illustrative "Projects of Significance" provides some flexibility if one crossing is successful in obtaining funding.

Important activities that will be necessary to make a river crossing a success include the following:

- Continue to explore for additional funding sources for a river crossing.
- Political leaders in North Dakota and Minnesota should work collaboratively to communicate the need for funding to state and federal political leaders.
- Local land use authorities should take steps to preserve corridor right-of-way for public use.
- Lead transportation authorities should complete required environmental documentation when possible.

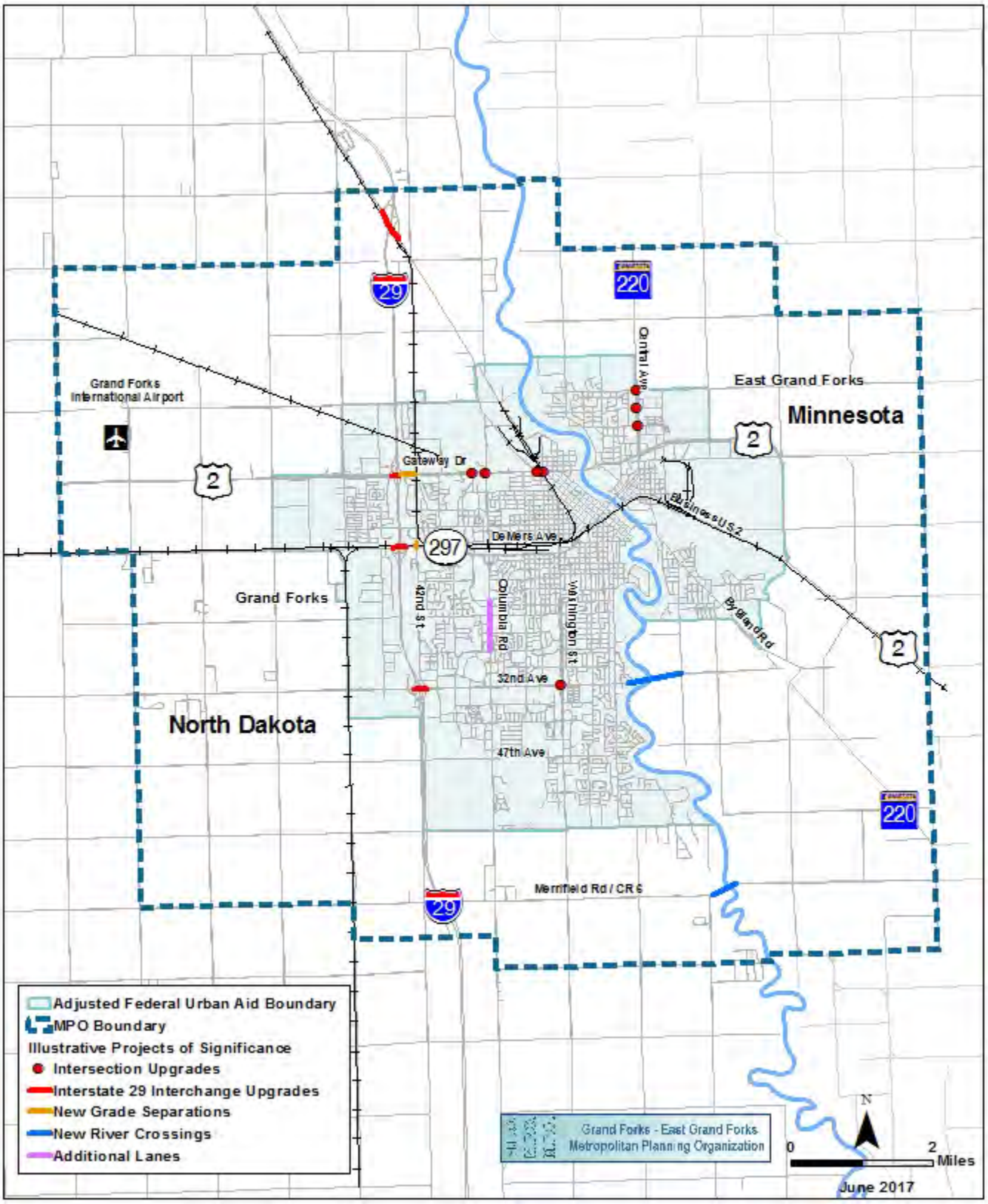
More information regarding the river crossings and how they impact the overall regional transportation network is available in Appendix C.

Table 7-17: Illustrative "Projects of Significance"

Project Type	Project Description
State of Good Repair	Non-NHS Federal Aid Eligible Streets/Highways
Intersections	32nd Avenue/South Washington Street Central Avenue: 17th Street to 23rd Street US 2 (Gateway Drive): Washington Street to Mill Road US 2 (Gateway Drive): Cambridge Street to Columbia Road
Additional Lanes	Columbia Road: 14th Avenue S. to 24th Avenue S.
Interstate 29 Interchange Upgrades	North Washington

Project Type	Project Description
	US 2 (Gateway Drive) DeMers Avenue 32nd Avenue
New Grade Separations	US 2 (Gateway Drive) east of Interstate 29 42nd Street: North of DeMers Avenue
New River Crossings	32nd Avenue Merrifield Road

Figure 7-6: Summary of Illustrative Projects of Significance



Right-of-Way and Corridor Preservation

Right-of-way for future transportation infrastructure is a valuable asset and difficult to obtain. As the Grand Forks-East Grand Forks area continues to grow and develop, local partners should work together to preserve right-of-way for public use when project locations become certain and property becomes available. Local government can help preserve right-of-way by identifying transportation right-of-way needs in local comprehensive and zoning plans in coordination with transportation providers. Other strategies include advanced purchase, subdivision techniques, official mapping, and corridor signing; these strategies should be carefully implemented in coordination with project development and environmental documentation. Preserving right-of-way can reduce project costs and streamline project development.

In addition to preserving right-of-way, local partners should work together to preserve corridor capacity. Local government can preserve corridors by adopting and implementing access management guidelines that can be implemented through the development review process.

Environmental Mitigation Considerations

The GF/EGF MPO's transportation planning activities are performed at the regional level and projects identified in this plan require more detailed scoping and design analysis in order to adequately determine social, economic, and environmental impacts. Environmentally-sensitive areas, including wetlands, species of concern, and identified cultural sites are shown in Figure 7-7. Many of these sensitive areas require a project-level analysis to determine potential impacts and mitigation activities. Some areas are yet to be identified and will only become known once a project-level analysis is completed. When a programmed project is ready for project implementation, the project sponsor will be responsible for conducting the necessary analyses as required by state and federal regulations to determine the type, location, and impact to environmentally sensitive areas within the project study area.

As part of long-range transportation plans, MPOs are required to consult with Federal, State, and Tribal land management, wildlife, and regulatory agencies on possible environmental mitigation activities that may be appropriate for the types of system improvement projects identified in the plan. The GF/EGF MPO solicited input from several regional agencies as part of this plan update. Agencies were notified via a letter and requested to provide input on the projects and proposed environmental mitigation activities identified during the planning process. There were 50 different agencies from which comments were solicited.

Environmental Mitigation Activities

The GF/EGF MPO and its jurisdictional partners are committed to minimizing and mitigating the negative effects of transportation projects on the natural and built environments. Not every project will require the same amount of review or mitigation. For example, preservation or State of Good Repair projects typically have no or limited impacts as they are located within previously disturbed or built environments. New roadways or expansion projects have a greater likelihood for impacts as the areas of disturbance are greater in size and may extend beyond current road right of ways. The GF/EGF MPO and its planning partners understand that project specific mitigation efforts will depend on how severe the impact on environmentally sensitive areas is expected to be.

Considerations should be made during the project design phase to avoid environmentally-sensitive areas, where feasible. If avoidance is not possible, strategies to minimize off-site disturbance in sensitive areas should be strongly considered, to preserve air and water quality, to limit tree removal, to minimize grading and other earth disturbance, to incorporate Best Management Practices (BMP) for erosion and sediment control, and limit noise and vibration impacts. Impacts that cannot be avoided or minimized should be mitigated. The mitigation planning process should solicit public input and offer alternative designs or alignments and mitigation strategies for comment by the GF/EGF MPO, state and local governments.

For major construction projects, such as new roadways, or for projects that may have a metropolitan-wide environmental impact, context sensitive solutions should be considered. This process should include considerable public participation and alternative design solutions are used to lessen the impact of the project.

The following three steps process will be used by the GF/EGF MPO and its planning partners to determine the type of mitigation strategy to apply for any given project, as it advanced from the planning stage:

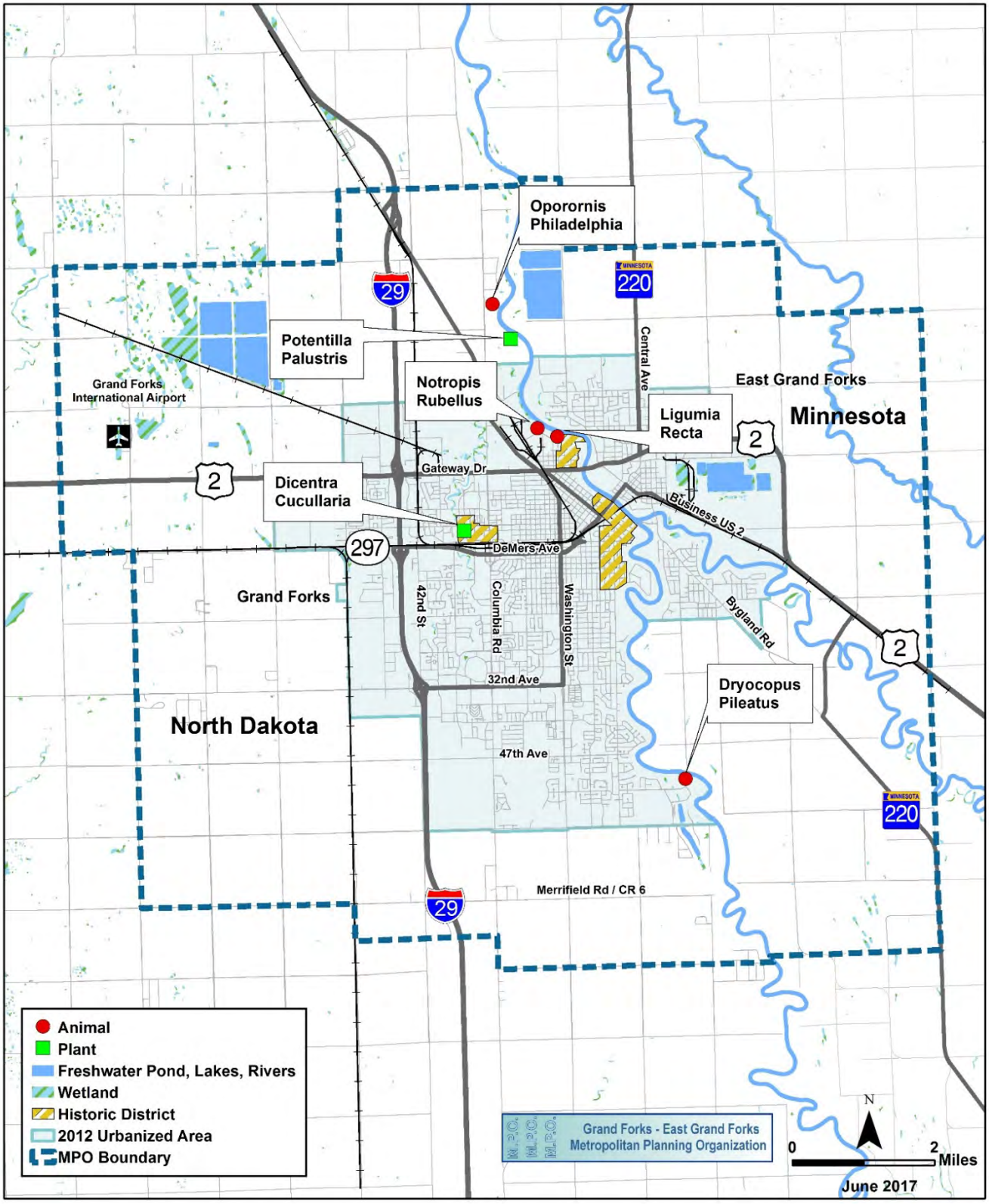
1. Identify environmentally sensitive areas throughout the project study area.
2. Determine how and to what extent the project will impact these environmentally-sensitive areas.
3. Develop appropriate mitigation strategies to lessen the impact these projects have on the environmentally-sensitive areas.

Table 7-18 details mitigation activities that will be considered by the GF/EGF MPO as projects move through the project development process. Sensitive environmental features identified in Figure 7-7 will need to be considered as Current Revenue Scenario projects identified in Appendix F move forward through future environmental review and project development processes.

Table 7-18: Environmental Mitigation Activities

Environmental Concern	Potential Mitigation Activities
Wetlands or Water Resources	Mitigation sequencing requirements involving avoidance, minimization, compensation (could include preservation, creation, restoration, in lieu fees, riparian buffers); design exceptions and variances; environmental compliance monitoring
Forested and Other Natural Areas	Avoidance, minimization; replacement property for open space easements to be of equal fair market value and of equivalent usefulness; design exceptions and variances; environmental compliance monitoring
Agricultural Areas	Avoidance, minimization; design exceptions and variances; environmental compliance monitoring
Endangered and Threatened Species	Avoidance, minimization; time of year restrictions; construction sequencing; design exceptions and variances; species research; species fact sheets; memoranda of agreements for species management; environmental compliance monitoring
Ambient Air Quality	Transportation control measures, transportation emission reduction measures
Neighborhoods, Communities, Homes, and Businesses	Impact avoidance or minimization; context sensitive solutions for communities (appropriate functional and / or aesthetic design features)
Environmental Justice (EJ)	Avoidance, minimization; engage EJ populations in the planning process; follow procedures in MPO's Environmental Justice Program Manual
Cultural Resources (historical properties, cemeteries, cultural areas, etc.)	Avoidance, minimization; landscaping for historic properties; preservation in place or excavation for archeological sites; Memoranda of Agreement with the State Historical Society of North Dakota and the Minnesota Historical Society; design exceptions and variances; environmental compliance monitoring
Parks and Recreation Areas	Avoidance, minimization, mitigation; design exceptions and variances; environmental compliance monitoring

Figure 7-7: Sensitive Environmental Features



Source: Grand Forks-East Grand Forks MPO

Environmental Justice

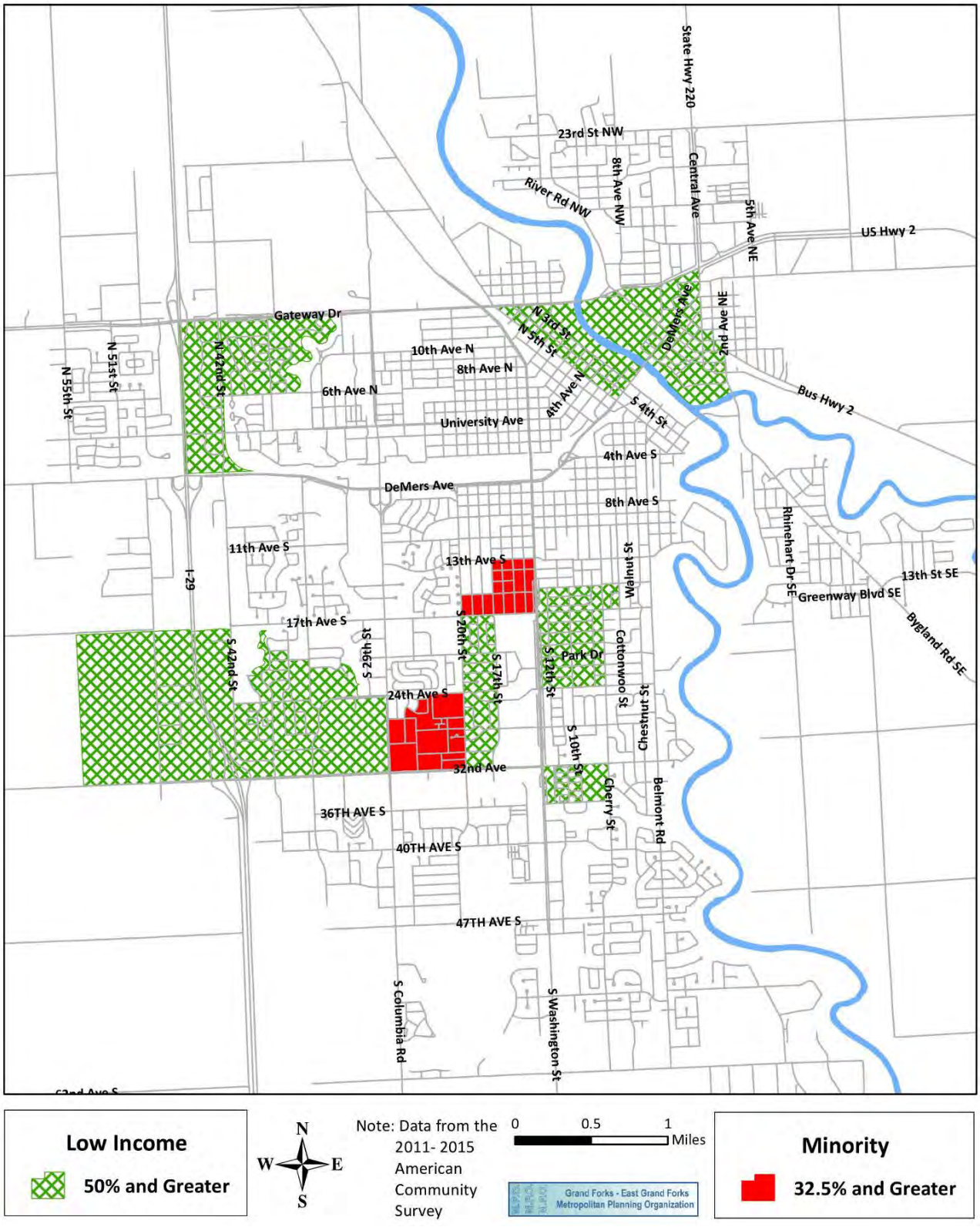
Executive Order 12898 directs Federal agencies to take appropriate and necessary steps to identify and address disproportionately high and adverse effects of Federal projects, including the transportation planning process, on the health or environment of minority and low-income populations to the greatest extent practical and permitted by law. USDOT Order 5610.2(a) sets forth the USDOT policy to consider environmental justice (EJ) principles in all (USDOT) programs, policies, and activities. It describes how the objectives of EJ will be integrated into planning and programming, rulemaking, and policy formulation. The Order sets forth steps to prevent disproportionately high and adverse effects to minority or low-income populations through Title VI analyses and EJ analyses conducted as part of Federal transportation planning and NEPA provisions. Disproportionate is defined in two ways: the impact is predominantly borne by the minority or low-income population group, or the impact is appreciably more severe than that experienced by non-minority or non-low-income populations.

The MPO addresses Environmental Justice to ensure non-discrimination concerning enacted transportation-related laws, regulations, and policies. The MPO has developed an Environmental Justice Program Manual designed to provide guidance in meeting EJ mandates and structuring a public participation plan at the project or study level. To certify compliance with, and to address environmental justice, the MPO:

- Identifies residential, employment, and transportation patterns of low-income and minority populations so that their needs can be identified and addressed, and the benefits and burdens of transportation investments can be fairly distributed.
- Ensures that the long-range transportation plan and the transportation improvement program (TIP) comply with the tenets of Environmental Justice.
- Utilizes public involvement processes to eliminate participation barriers and engage minority and low-income populations in transportation decision making.

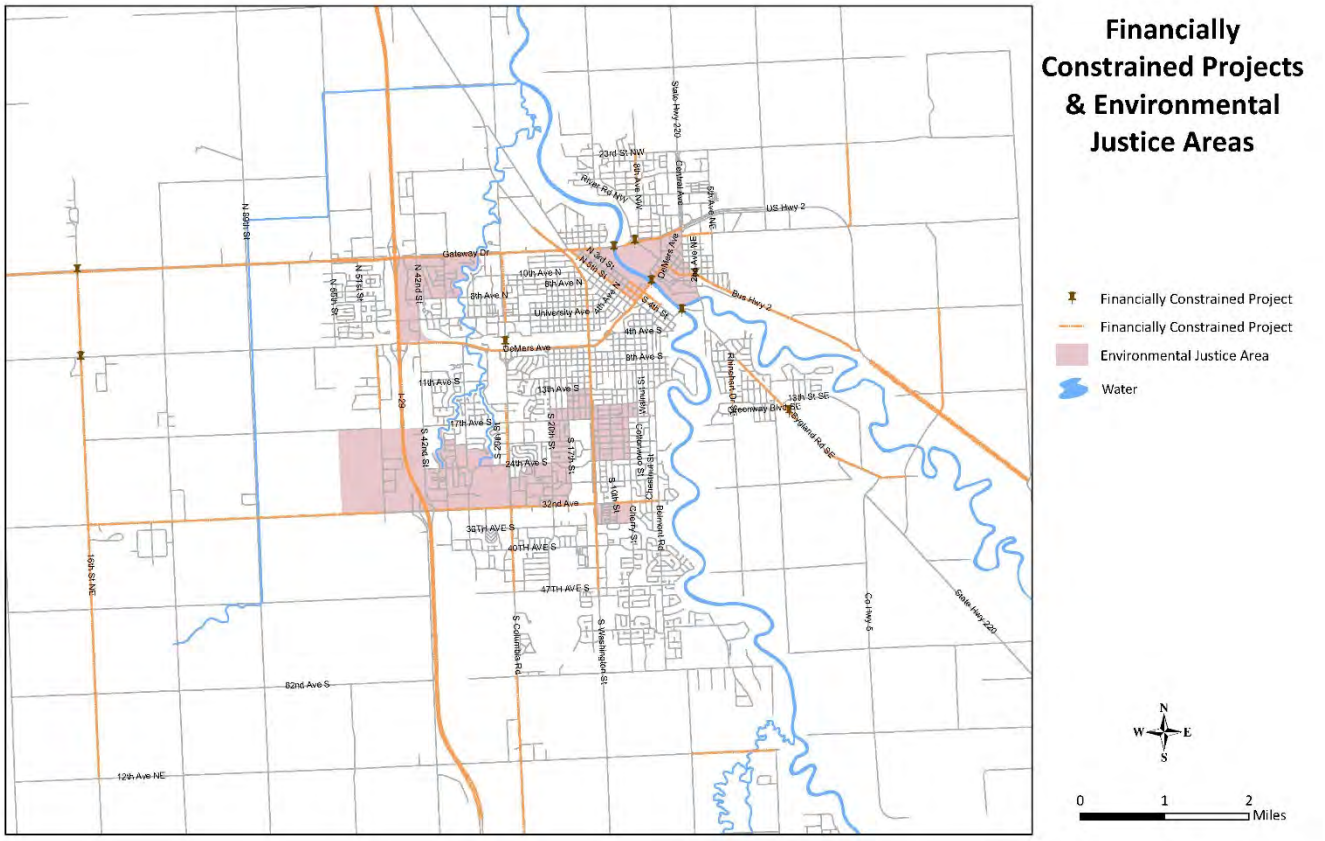
According to the most recent Environmental Justice Program Manual, minority populations in Grand Forks were most concentrated east of Columbia Mall between 24th Avenue South and 32nd Avenue South and north of Grand Cities Mall between 13th Avenue South and 17th Avenue South. As illustrated in Figure 7-8, concentrations of poverty greater than 50 percent are also located near the two shopping centers, as well as near both downtown areas. As illustrated in Figure 7-9, the fiscally constrained, Current Revenue Scenario projects are not concentrated in environmental justice communities. These areas will be evaluated further during the future project development process for the Current Revenue Scenario projects identified in Figure 7-9 and Appendix F.

Figure 7-8: Environmental Justice Populations



Source: Grand Forks-East Grand Forks MPO

Figure 7-9: Environmental Justice Populations



Source: Grand Forks-East Grand Forks MPO Performance Based Planning

MAP-21 and FAST Act requires incorporation of performance based planning in the development of the Grand Forks – East Grand Forks MPO metropolitan transportation plan. The requirement in these US Laws defined that the Plan shall include, to the maximum extent practicable, a description of the anticipated effect of the Plan toward achieving the performance measures by linking them with the investment priorities.

Performance-based planning is an approach to applying performance management principles to transportation system policy and investment decisions. This approach provides a link between short-term management and long-range decisions about policies and investments that an agency makes for its transportation system. Performance-based planning is a system-level, data-driven process to identify strategies and investments. For MPOs, performance measures provide a nuanced means of assessing progress toward meeting the intent of the Plan.

MAP-21 and FAST Act place increased emphasis on performance management within the Federal Aid highway program, including development of national performance measures with targets set by State DOTs and MPOs. The Grand Forks-East Grand Forks MPO performance measures and targets are discussed in Chapter 3.

The 2045 Street/Highway Plan implements the now promulgated required national performance measures. The Plan integrates the safety plans developed by partner agencies, including each state's Strategic Highway Safety Plan and more localized strategic highway safety plans that apply state-level emphasis areas and strategies consistent with local context and intent to implement. The 2045 Plan also identifies projects for Highway Safety

Improvement Program (HSIP) funding (see Table 7-8 and Table 7-13). These projects are expected to have a positive impact toward meeting safety targets in North Dakota.

This plan also acknowledges the need to update plans that prioritize safety-related projects for HSIP funding. A concern with these safety plans, particularly on the Minnesota side, has been the lack of MPO inclusion in the safety planning process. The most recent Minnesota Strategic Highway Safety Plan greatly improved MPO engagement, but this practice has not carried forward with each respective District and/or County Safety plan update. Further, the Minnesota process for programming funds from the Highway Safety Improvement Program has historically neglected the active engagement of MPOs. Routinely, MnDOT solicits, vets and programs projects without involvement from Greater Minnesota MPOs. This plan recommends improvements to the HSIP project solicitation process, and efforts are underway to improve it.

The MPO regularly completes corridor specific studies. Safety is often one of the leading issues that create the need for the more in-depth analysis of the corridors transportation system. As a standard operating practice, the MPO conducts these studies through the lens of the needs of all users regardless of mode dominance. Lately, some specific studies on the Minnesota has led to adopting future improvement projects that should be prioritized for investment and amended into this Plan.

The MPO conducted a project identification and selection process to assist it in planning for projects that help the region meet its performance targets. Each possible project was reviewed through criteria pertinent to the project's likely funding source. Safety is also considered.

The 2045 Street/Highway Plan emphasizes projects that support State of Good Repair for pavement and bridges on the Interstate, non-Interstate National Highway System, and Federal Aid-Eligible System in North Dakota and Minnesota (see Table 7-4, Table 7-5, Table 7-6, Table 7-7, Table 7-10, Table 7-11, and Table 7-12). These projects are expected to have a positive impact toward meeting pavement and bridge condition targets in North Dakota and Minnesota.

The Grand Forks-East Grand Forks MPO understands it is in the early stages of developing a fully compliant, performance-based MTP. As multiple years of data is collected for the performance measures and their targets, the MPO will monitor performance and evaluate if trends are moving toward meeting the targets. The Grand Forks-East Grand Forks MPO commits to making adjustments to planning strategies to meet the performance targets if the desired results are not being met.

Appendix A

Grand Forks-East Grand Forks Metropolitan Transportation Plan Linkage to NDDOT and MnDOT Plans

Appendix A. Grand Forks-East Grand Forks Metropolitan Transportation Plan Linkage to NDDOT and MnDOT Plans

Table 1: Linkage between Grand Forks-East Grand Forks Metropolitan Transportation Plan and North Dakota DOT Statewide Strategic Transportation Plan Goals

Grand Forks-East Grand Forks Metropolitan Transportation Plan Goal	NDDOT Statewide Strategic Transportation Plan Goals				
	Goal 1: Safe and Secure Transportation The importance of safe and secure transportation includes both personal and freight mobility, it extends to transportation infrastructure and services.	**Goal 2: Sustainable and Reliable Mobility** Personal mobility includes going to work, accessing health care, attending school and social functions, running errands and many other trip purposes. Personal mobility in rural and urbanized areas is viewed differently in terms of trip time and congestion. Freight mobility encompasses transporting bulk grain, crude oil transloaded from trucks to rail and pipelines, in bound raw materials for manufacturing, and a host of other movements.	**Goal 3: Diversified and Sufficient Funding for Transportation Priorities** For funding to be sufficient, it must be tied to system goals and priorities. To achieve sufficiency, transportation revenues must be derived from multiple sources that are reliable, equitable, diversified, flexible, timely, and adequate.	**Goal 4: Communication and Cooperation** Effective communication is a two-way process that results in a common perception. Common perception results in cooperation that leads to collaborative outcomes.	**Goal 5: Strong Economic Growth with Consideration of Environmental, Cultural and Social Impacts** The transportation system, consisting of both infrastructure and services, exists to move people and goods. The movement of goods supports economic activity, which supports our quality of life. Important to sustaining our quality of life is the appropriate consideration of transportation impacts on our environmental, cultural, and social resources. Understanding the relationship of land use and the generation of traffic, particularly truck traffic, is key to the development of a sustainable transportation system.
Economic Vitality Support the economic vitality through enhancing the economic competitiveness of the metropolitan area by giving people access to jobs, and education services as well as giving business access to markets.		Link			Link
Security Increase security of the transportation system for motorized and non-motorized uses.	Link				
Accessibility and Mobility Increase the accessibility and mobility options for people and freight by providing more transportation choices.		Link			
Environmental/ Energy/Quality of Life Protect and enhance the environment, promote energy conservation, and improve quality of life by valuing the unique qualities of all communities – whether urban, suburban, or rural.					Link
Integration and Connectivity Enhance the integration and connectivity of the transportation system, across and between modes for people and freight, and housing, particularly affordable housing located close to transit.		Link			Link
Efficient System Management Promote efficient system management and operation by increasing collaboration among federal, state, local government to better target investments and improve accountability.				Link	
System Preservation Emphasize the preservation of the existing transportation system by first targeting federal funds towards existing infrastructure to spur revitalization, promote urban landscapes and protect rural landscapes.			Link		
Safety Increase safety of the transportation system for motorized and non-motorized uses.	Link				

Grand Forks-East Grand Forks Metropolitan Transportation Plan Goal	NDDOT Statewide Strategic Transportation Plan Goals				
	Goal 1: Safe and Secure Transportation The importance of safe and secure transportation includes both personal and freight mobility, it extends to transportation infrastructure and services.	**Goal 2: Sustainable and Reliable Mobility** Personal mobility includes going to work, accessing health care, attending school and social functions, running errands and many other trip purposes. Personal mobility in rural and urbanized areas is viewed differently in terms of trip time and congestion. Freight mobility encompasses transporting bulk grain, crude oil transloaded from trucks to rail and pipelines, in bound raw materials for manufacturing, and a host of other movements.	**Goal 3: Diversified and Sufficient Funding for Transportation Priorities** For funding to be sufficient, it must be tied to system goals and priorities. To achieve sufficiency, transportation revenues must be derived from multiple sources that are reliable, equitable, diversified, flexible, timely, and adequate.	**Goal 4: Communication and Cooperation** Effective communication is a two-way process that results in a common perception. Common perception results in cooperation that leads to collaborative outcomes.	**Goal 5: Strong Economic Growth with Consideration of Environmental, Cultural and Social Impacts** The transportation system, consisting of both infrastructure and services, exists to move people and goods. The movement of goods supports economic activity, which supports our quality of life. Important to sustaining our quality of life is the appropriate consideration of transportation impacts on our environmental, cultural, and social resources. Understanding the relationship of land use and the generation of traffic, particularly truck traffic, is key to the development of a sustainable transportation system.
Resiliency Improve resiliency and reliability of the transportation system and reduce or mitigate stormwater impacts of surface transportation.	Link				
Tourism Enhance travel and tourism.		Link			

Table 2: Linkage between Grand Forks-East Grand Forks Metropolitan Transportation Plan and MnDOT Statewide Multimodal Transportation Plan Objectives

Grand Forks-East Grand Forks Metropolitan Transportation Plan Goal	MnDOT Multimodal Transportation Plan Objectives				
	Open Decision-Making Make transportation system decisions through processes that are inclusive, engaging and supported by data and analysis. Provide for and support coordination, collaboration and innovation. Ensure efficient and effective use of resources.	**Transportation Safety** Safeguard transportation users as well as the communities the systems travel through. Apply proven strategies to reduce fatalities and serious injuries for all modes. Foster a culture of transportation safety in Minnesota.	**Critical Connections** Maintain and improve multimodal transportation connections essential for Minnesotans' prosperity and quality of life. Strategically consider new connections that help meet performance targets and maximize social, economic and environmental benefits.	**System Stewardship** Strategically build, manage, maintain and operate all transportation assets. Rely on system data and analysis, performance measures and targets, agency and partners' needs, and public expectations to inform decisions. Use technology and innovation to get the most out of investments and maintain system performance. Increase the resiliency of the transportation system and adapt to changing needs.	**Healthy Communities** Make fiscally-responsible decisions that respect and complement the natural, cultural, social and economic context. Integrate land uses and transportation systems to leverage public and private investments.
Economic Vitality Support the economic vitality through enhancing the economic competitiveness of the metropolitan area by giving people access to jobs, and education services as well as giving business access to markets.			Link	Link	Link
Security Increase security of the transportation system for motorized and non-motorized uses.		Link		Link	
Accessibility and Mobility Increase the accessibility and mobility options for people and freight by providing more transportation choices.			Link	Link	Link
Environmental/ Energy/Quality of Life Protect and enhance the environment, promote energy conservation, and improve quality of life by valuing the unique qualities of all communities – whether urban, suburban, or rural.	Link			Link	Link
Integration and Connectivity Enhance the integration and connectivity of the transportation system, across and between modes for people and freight, and housing, particularly affordable housing located close to transit.			Link		Link
Efficient System Management Promote efficient system management and operation by increasing collaboration among federal, state, local government to better target investments and improve accountability.	Link			Link	
System Preservation Emphasize the preservation of the existing transportation system by first targeting federal funds towards existing infrastructure to spur revitalization, promote urban landscapes and protect rural landscapes.				Link	
Safety Increase safety of the transportation system for motorized and non-motorized uses.		Link			Link
Resiliency Improve resiliency and reliability of the transportation system and reduce or mitigate stormwater impacts of surface transportation.				Link	
Tourism Enhance travel and tourism.			Link		Link

Appendix B

Public Engagement Materials and Results

Overcoming Barriers **Strengthening Connections**

M.P.O. M.P.O. M.P.O.

Grand Forks - East Grand Forks Metropolitan Planning Organization

Ensuring Opportunities **Planning One Community**

"A community that provides a variety of complementary transportation choices, that are fiscally constrained, for people and goods."

Public Meetings with 2045 Street/Highway Plan on Agenda

MPO Technical Advisory Committee	MPO Executive Board
June 7, 2017	June 21, 2017
July 12, 2017	
August 9, 2017	August 16, 2017
September 13, 2017	September 20, 2017
October 11, 2017	October 18, 2017
November 1, 2017	
November 8, 2017	November 15, 2017
December 13, 2017	December 20, 2017
January 10, 2018	January 17, 2018
February 14, 2018	February 21, 2018
February 20, 2018	
March 14, 2018	March 21, 2018
April 11, 2018	April 18, 2018
May 9, 2018	May 16, 2018
June 13, 2018	June 20, 2018
July 11, 2018	July 18, 2018
July 27, 2018	
August 15, 2018	August 22, 2018
September 12, 2018	September 19, 2018
October 10, 2018	October 17, 2018
November 14, 2018	November 21, 2018
December 12, 2018	December 19, 2018

Agenda/minutes posted www.theforksmpo.org

Grand Forks Planning and Zoning Commission – All video

September 6, 2017
December 6, 2018
June 6, 2018
October 3, 2018
November 7, 2018
December 5, 2018

Agenda/minutes posted www.grandforksgov.com

Public Meetings with 2045 Street/Highway Plan on Agenda

Grand Forks City Council – Meetings with ASTERISK (*) include video
- September 13, 2017 – Interconnect Advisory Board *
- November 16, 2017 – Joint MPO-City-County-State meeting
- February 22, 2018 – Joint MPO-City-County-State meeting
- March 27, 2018 – Committee of the Whole *
- June 27, 2018 – Joint MPO-City-County-State meeting
- November 13, 2018 – Committee of the Whole *
- November 19, 2018 – City Council *

Agenda/minutes posted www.grandforksgov.com

Grand Forks Council Ward Meetings
- October 10, 2018 – Ward 5 at Choice Health and Wellness
- October 15, 2018 – Ward 3 & 4 at Phoenix School

East Grand Forks Planning and Zoning Commission
- January 11, 2018 – Meeting cancelled due to weather
- February 8, 2018
- June 14, 2018
- October 11, 2018
- November 8, 2018

Agenda/minutes posted www.egf.mn

East Grand Forks City Council – Meetings with ASTERISK (*) include video
- August 22, 2017 – Working Session *
- September 13, 2018 – Interconnect Advisory Board *
- November 16, 2017 – Joint MPO-City-County-State meeting
- February 22, 2018 – Joint MPO-City-County-State meeting
- March 12, 2018 – Working Session *
- June 27, 2018 – Joint MPO-City-County-State meeting
- November 13, 2018 – Working Session *
- November 20, 2018 – City Council *

Agenda/minutes posted www.egf.mn

Grand Forks County
- August 1, 2017 – County Commission meeting
- November 16, 2017 – Joint MPO-City-County-State meeting
- December 19, 2017 – County Commission meeting
- February 22, 2018 – Joint MPO-City-County-State meeting
- June 27, 2018 – Joint MPO-City-County-State meeting
- December 4, 2018 – County Commission meeting

Agenda/minutes posted www.gfcounty.nd.gov

Polk County
- November 16, 2017 – Joint MPO-City-County-State meeting
- February 22, 2018 – Joint MPO-City-County-State meeting
- April 17, 2018 – County Commission meeting
- June 27, 2018 – Joint MPO-City-County-State meeting
- November 6, 2018 – County Commission meeting

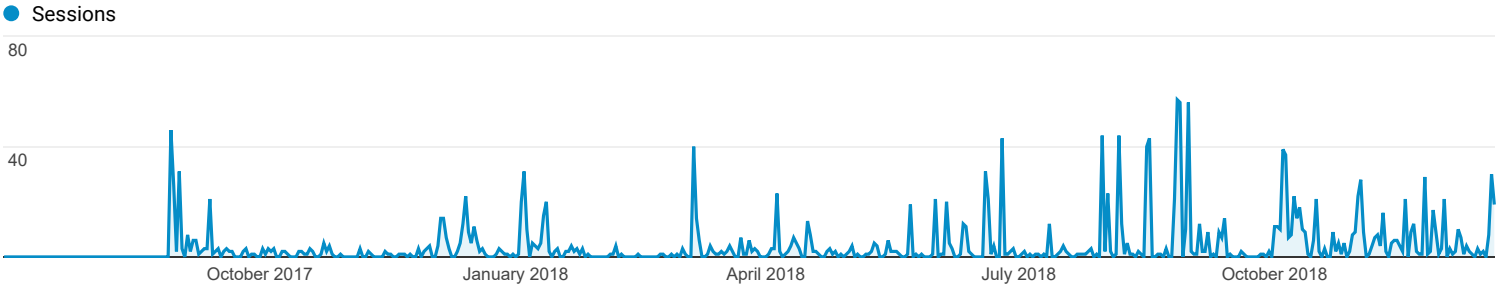
Agenda/minutes posted www.co.polk.mn.us

Audience Overview

All Users
100.00% Sessions

Jul 1, 2017 - Dec 19, 2018

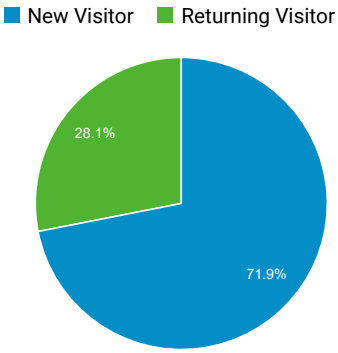
Overview



Sessions	Users	Pageviews
2,119	1,524	3,945

Pages / Session	Avg. Session Duration	Bounce Rate
1.86	00:01:51	57.34%

% New Sessions
71.92%



	Language	Sessions	% Sessions
1.	en-us	1,621	76.50%
2.	fr	309	14.58%
3.	pt-br	78	3.68%
4.	it-it	24	1.13%
5.	fr-fr	23	1.09%
6.	en-gb	8	0.38%
7.	es-es	7	0.33%
8.	pt-pt	7	0.33%
9.	es-mx	6	0.28%
10.	en-au	4	0.19%

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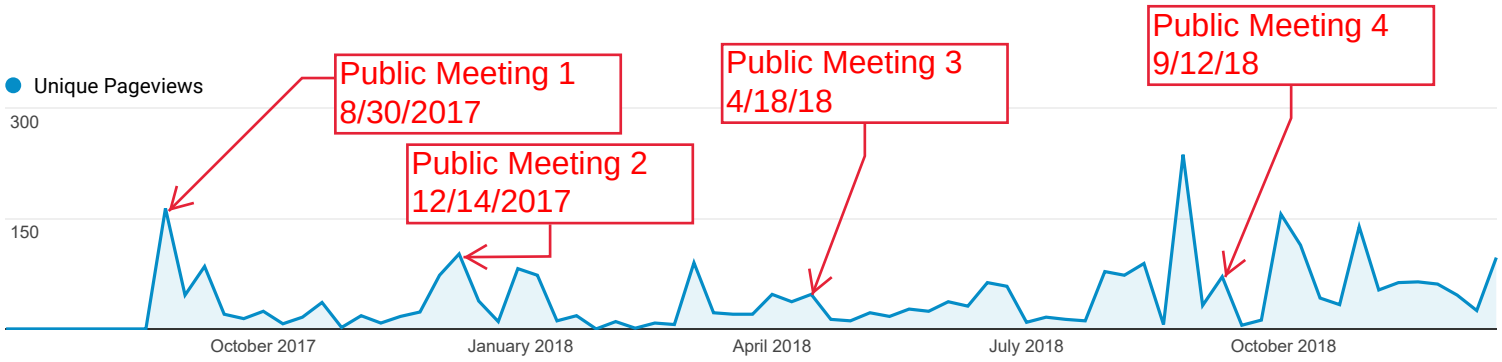
Pages

All Users
100.00% Pageviews

Jul 1, 2017 - Dec 19, 2018

Explorer



Page	Pageviews	Unique Pageviews	Avg. Time on Page	Entrances	Bounce Rate	% Exit	Page Value
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1. /	**1,669** (42.31%)	1,287 (42.29%)	00:01:36	1,224 (58.29%)	53.48%	51.41%	$0.00 (0.00%)
2. /participate/	**661** (16.76%)	447 (14.69%)	00:01:30	174 (8.29%)	55.43%	45.99%	$0.00 (0.00%)
3. /resources/	**605** (15.34%)	463 (15.22%)	00:04:25	240 (11.43%)	35.97%	56.69%	$0.00 (0.00%)
4. /draft-plan/	**256** (6.49%)	212 (6.97%)	00:07:13	105 (5.00%)	34.23%	73.44%	$0.00 (0.00%)
5. /h/4861158.html	**183** (4.64%)	182 (5.98%)	00:04:26	182 (8.67%)	99.45%	99.45%	$0.00 (0.00%)
6. /about/	**172** (4.36%)	136 (4.47%)	00:00:31	28 (1.33%)	53.57%	18.60%	$0.00 (0.00%)
7. /contact/	**143** (3.62%)	94 (3.09%)	00:02:00	17 (0.81%)	94.12%	27.97%	$0.00 (0.00%)
8. /faqs/	**105** (2.66%)	92 (3.02%)	00:00:34	15 (0.71%)	66.67%	31.43%	$0.00 (0.00%)
9. /index.html	**100** (2.53%)	100 (3.29%)	00:00:00	100 (4.76%)	100.00%	100.00%	$0.00 (0.00%)
10. /404.html?page=/resources/NEED LINK&from=https://www.theforksstreets2045.org/resources/	**20** (0.51%)	3 (0.10%)	00:01:59	0 (0.00%)	0.00%	5.00%	$0.00 (0.00%)

Rows 1 - 10 of 20

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PUBLIC INPUT MEETING

WHY?

To discuss the updating of the Street and Highway element of the Transportation Plan. The purpose of this first meeting is to inform the public that an update is taking place, to provide the schedule, to give existing conditions and to gather initial public thoughts on important issues to address.

WHEN?

August 30th, 2017
5:00 PM to 7:00 PM
Presentation at 5:45 PM

WHERE?

Empire Arts Center
415 DeMers Ave
Grand Forks, ND

OPEN HOUSE CONDUCTED BY

M.P.O. M.P.O. M.P.O.
Grand Forks - East Grand Fo
Metropolitan Planning Organiz

Representatives from the Grand Forks/ East Grand Forks Metropolitan Planning Organization (GF-EGF MPO) and Kimley-Horn/WSB Consulting Team will be on hand to answer your questions and discuss your concerns. Additional information available at www.theforksmpo.org

WRITTEN STATEMENTS or comments about this project must be mailed by September 15th, to Earl Haugen, GF-EGF MPO, PO Box 5200, Grand Forks, ND 58206
Email: info@theforksmpo.org
Note “Street and Highway” in email subject heading.

The GF-EGF MPO will consider every request for reasonable accommodation to provide:

- an accessible meeting facility or other accommodation for people with disabilities,
- language interpretation for people with limited English proficiency (LEP), and
- translations of written material necessary to access GF-EGF MPO programs and information.

Appropriate provisions will be considered when the MPO is notified at least 5 days prior to the meeting date or the date the written material translation is needed.

To request accommodations, contact Earl Haugen, at 701-746-2660 or earl.haugen@theforksmpo.org.

Public Meeting #1 Summary

Time and Location

Wednesday, August 30, 2107
5:00-7:00 p.m.
Presentation at 5:45 p.m.

Empire Arts Center
415 DeMers Avenue
Grand Forks, ND 58201

Purpose of Meeting

The purpose of this public meeting was to introduce the Street and Highway Plan Update to the public, present the 2045 Long-Range Transportation Plan (LRTP) vision statement and draft goals, and provide information on existing conditions and planned land use in the MPO area. Attendees were also asked to provide feedback on the condition of streets and highways in the MPO area to help guide the process for prioritizing projects in the Street and Highway Plan Update.

Materials

Display boards were available that provided an overview of the LRTP and Street and Highway Plan Update, the schedule, the 2045 LRTP vision statement and draft goals, existing conditions, and planned land use. An interactive mapping activity was also available on a display board and as an interactive map on the project website.

Participants

Twenty-two attendees signed in on the sign-in sheets. Of these 22, 17 completed the NDDOT Title VI Public Participation Survey. The results of this survey are summarized below.

- Sex
  - Number of respondents: 17
  - Male: 11 (65%)
  - Female: 6 (35%)
- Disability
  - Number of respondents: 17
  - Yes: 0 (0%)
  - No: 17 (100%)
- Age
  - Number of respondents: 17
  - 34 and younger: 2 (12%)
  - 35-54: 8 (47%)
  - 55 and older: 7 (41%)

- Race
  - Number of respondents: 17
  - White: 16 (94%)
  - Other: 1 (6%)
- Language most frequently spoken in your home
  - Number of respondents: 17
  - English: 17 (100%)
- Do you receive public assistance?
  - Number of respondents: 16
  - No: 16 (100%)
- Indicate how you heard about the event (note that some respondents checked more than one box)
  - Number of respondents: 17
  - Internet: 6 (35%)
  - Radio: 1 (6%)
  - Mailing: 2 (12%)
  - Newspaper: 5 (29%)
  - Other: 5 (29%)

Input Received

Comment Forms

Two written comments were received. One was a safety concern that has been incorporated into the mapping activity results summarized below. The other comment noted a preference to keep performance measures to only those that are required.

Interactive Map

The input from the mapping activity at the public meeting was added to the interactive map on the project website to compile all the feedback received. As of September 15, 2017, 97 different comments had been recorded on the interactive map.

Respondents

Eighteen respondents completed the optional demographic survey. A summary of the demographic information collected is provided below.

- What is your age?
  - Number of respondents: 18
  - 18 to 34: 8 (44%)
  - 35 to 44: 3 (17%)
  - 45 to 55: 4 (22%)
  - 55 to 64: 2 (11%)
  - 65 or older: 1 (6%)
- What is your gender?
  - Number of respondents: 18
  - Male: 9 (50%)
  - Female: 9 (50%)

- What is your race?
  - Number of respondents: 17
  - White: 17 (100%)
- What is your ethnicity?
  - Number of respondents: 15
  - Not Hispanic or Latino: 15 (100%)
- What is your home zip code?
  - Number of respondents: 18
  - 56721: 5 (28%)
  - 58201: 8 (44%)
  - 58203: 5 (28%)
- If you work or are in school, what is your work/school ZIP Code?
  - Number of respondents: 16
  - 56721: 4 (25%)
  - 58201: 4 (25%)
  - 58202: 6 (38%)
  - 58203: 2 (12%)

Comments Received

The 97 comments received were broken down into the following categories:

- Access: 19 (20%)
- Congestion/Driving Conditions: 8 (8%)
- Pavement Conditions: 10 (10%)
- Safety: 42 (44%)
- Signs/Signals: 7 (7%)
- Other: 11 (11%)

The locations of these comments are shown in Figures 1 through 6. The content of the comments will be analyzed to inform the range of alternatives developed.

Figure 1: Locations of Access Comments

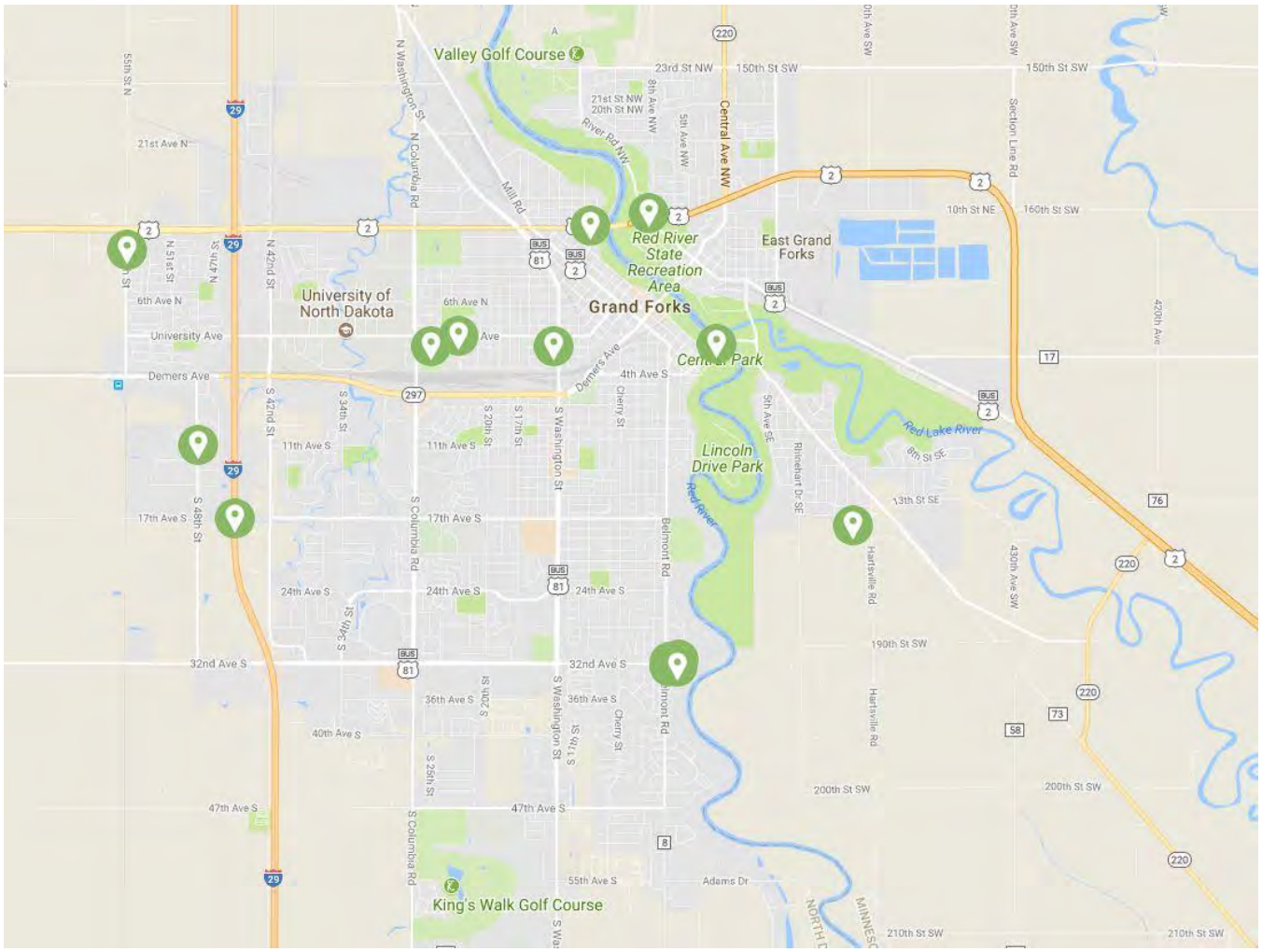


Figure 2: Locations of Congestion/Driving Conditions Comments

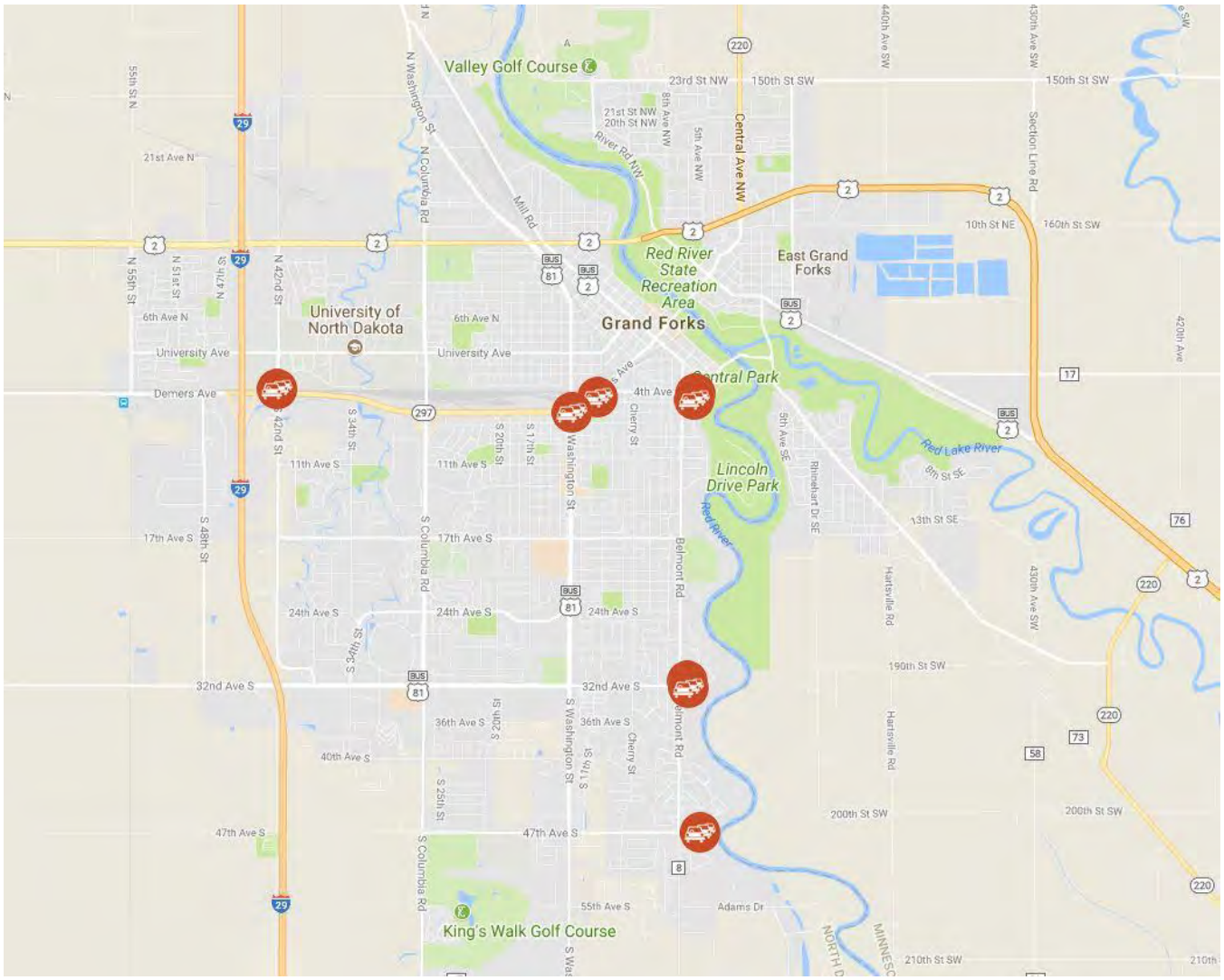


Figure 3: Locations of Pavement Conditions Comments

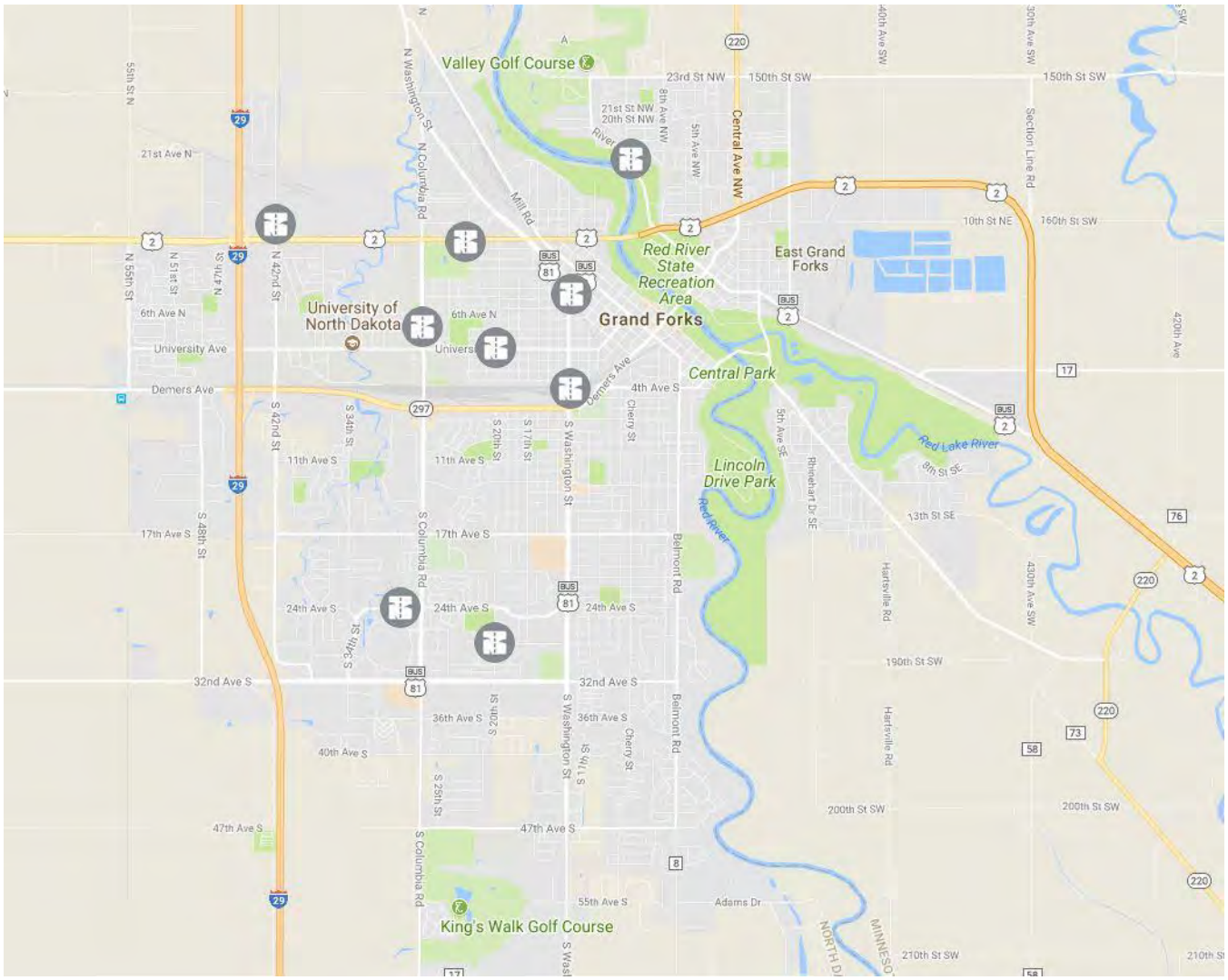


Figure 4: Locations of Safety Comments

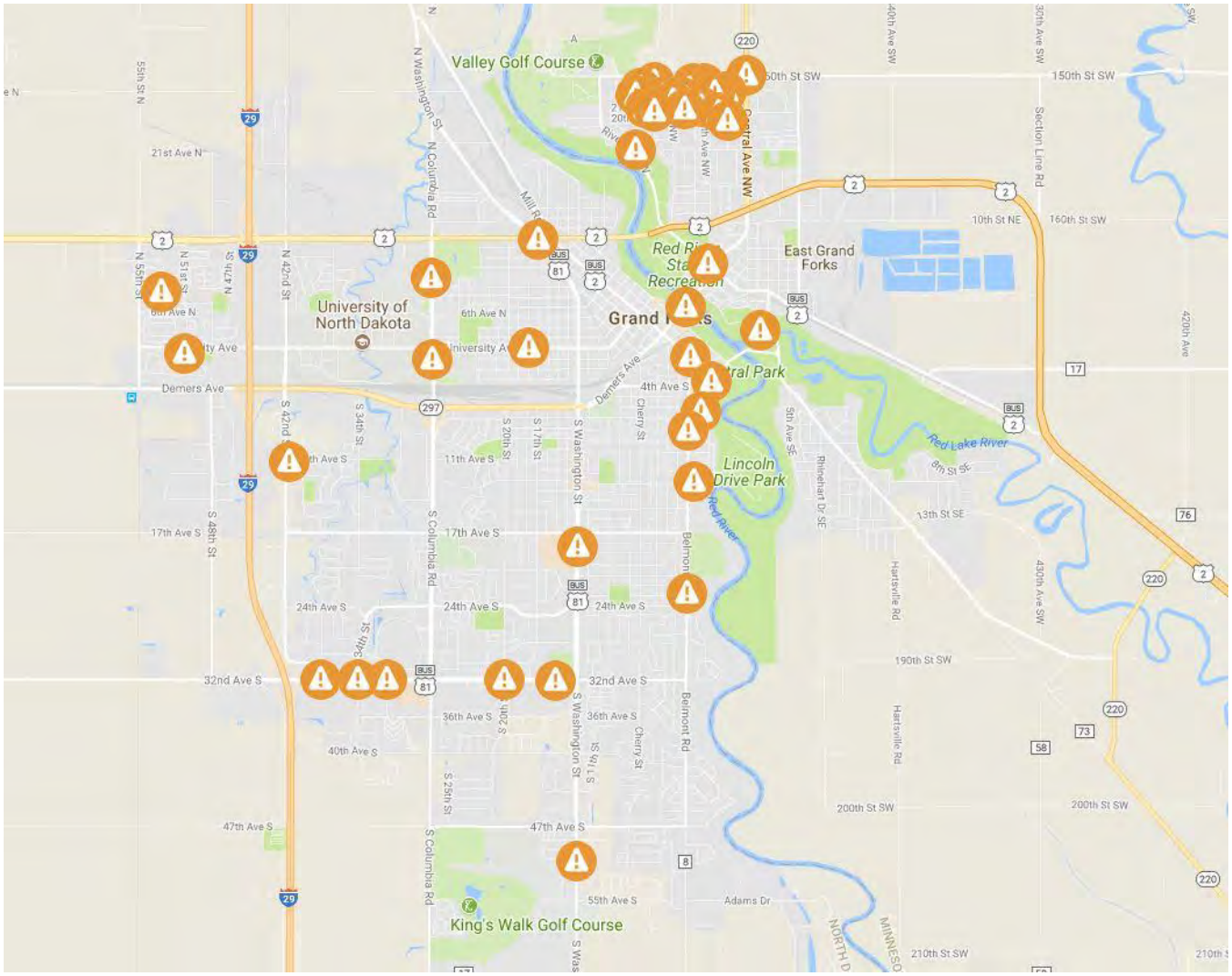


Figure 5: Locations of Signs/Signals Comments

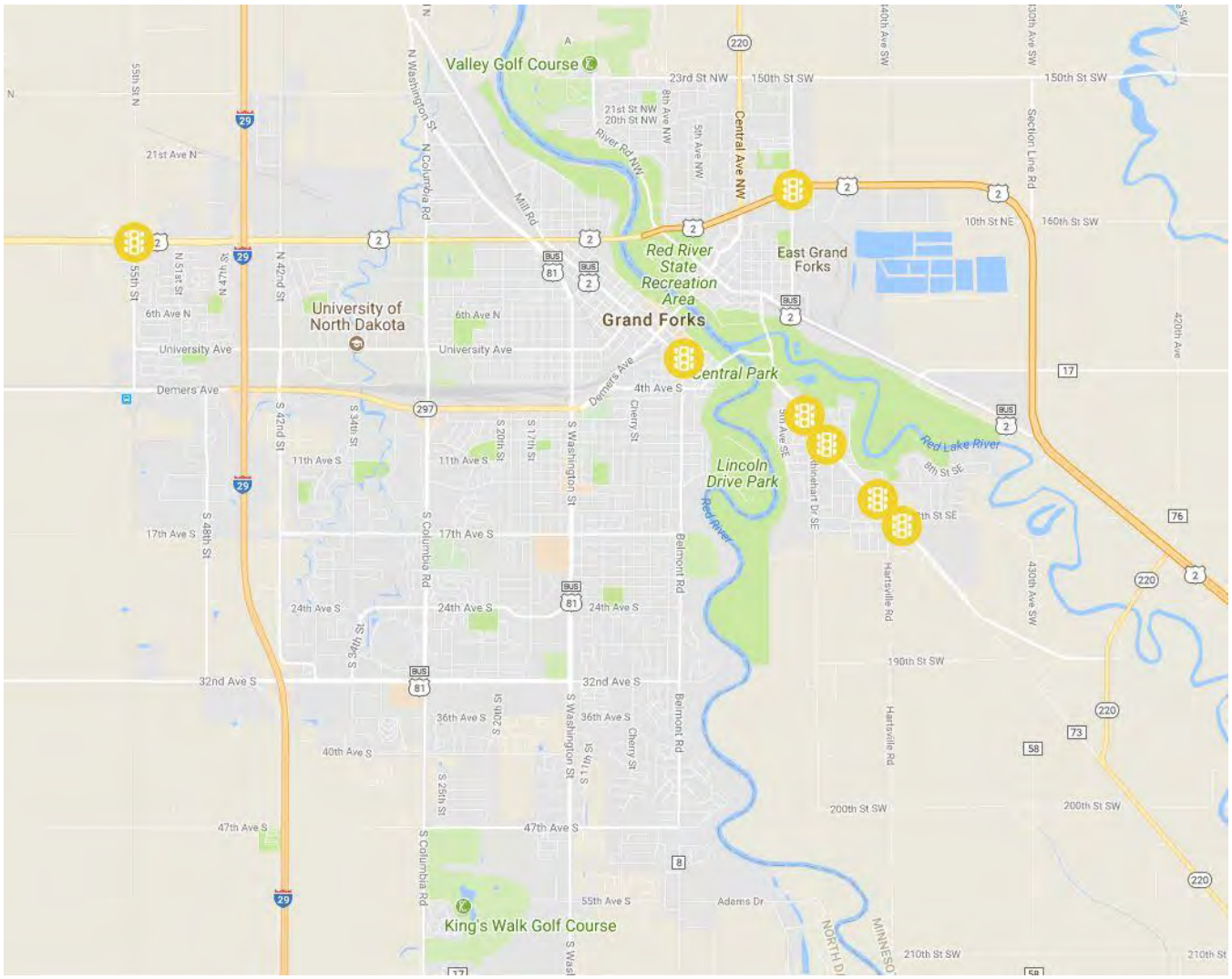
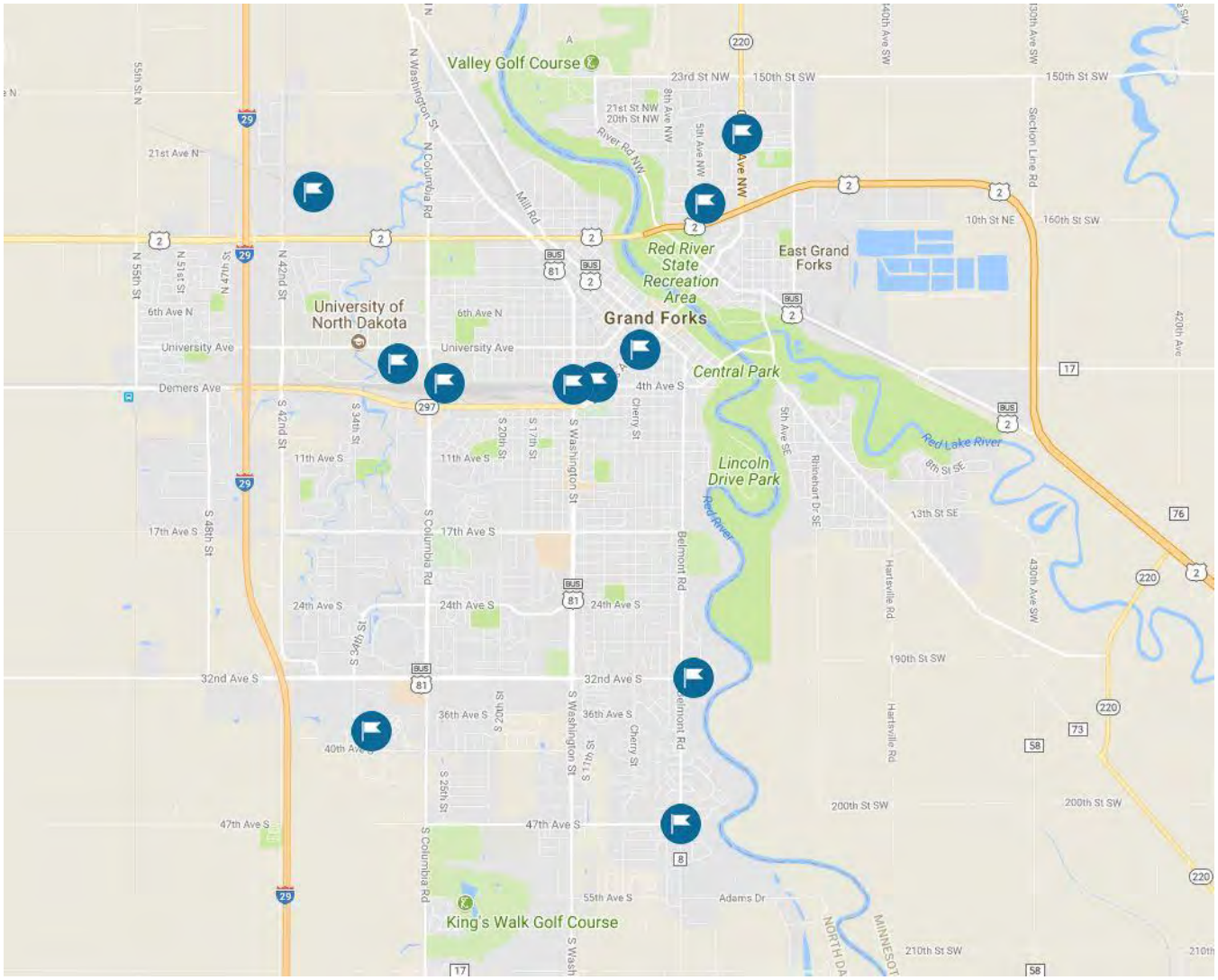


Figure 6: Locations of Other Comments



Next Steps

Public Meeting #2 is anticipated to occur in November 2017. This public meeting will include discussion on the existing plus future network and the transportation issues that have been identified. In addition, more detailed information on goals, objectives, and performance measures will also be presented, and the concept of a financially constrained transportation plan will be introduced.

Grand Forks-East Grand Forks MPO

STREET/HIGHWAY PLAN UPDATE

Welcome

Public Meeting

Grand Forks-East Grand Forks Metropolitan Planning Organization

M.P.O. M.P.O. M.P.O. Grand Forks - East Grand Forks Metropolitan Planning Organization

Kimley»Horn

WSB & Associates, Inc.

Overview

What is a Long-Range Transportation Plan (LRTP)?

- Sets a direction and strategies to help shape a region's transportation network
- Includes three elements:

Streets and highways | Transit | Pedestrians and bicycles

- The MPO is required to update its LRTP every 5 years – the last update for Grand Forks-East Grand Forks was completed in 2013

What's an MPO?

Federal law requires that all urbanized areas in the US with populations over 50,000 people establish Metropolitan Planning Organizations (MPO) responsible for area transportation planning and programming services.

What is the Street and Highway Plan Update?

- This part of the LRTP will develop a performance-based investment decision framework for the streets and highways in the MPO area that is consistent with requirements of the FAST Act

Who is Involved?

- North Dakota Department of Transportation
- Minnesota Department of Transportation
- City of Grand Forks
- City of East Grand Forks
- Grand Forks County
- Polk County
- Federal Highway Administration
- Federal Transit Administration
- Residents and regional stakeholders

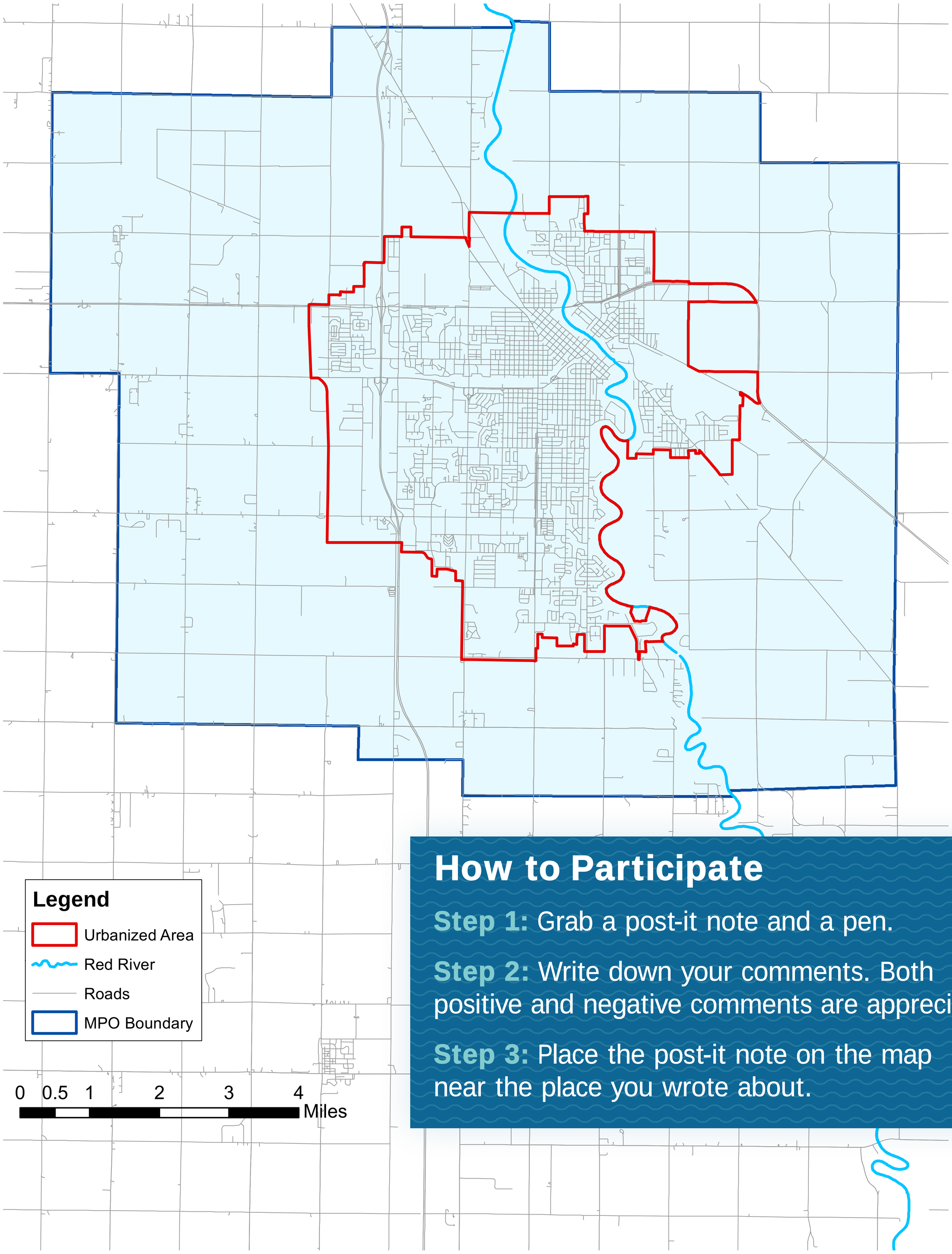
YOUR INPUT IS IMPORTANT TO US!

Schedule

	Summer 2017	Fall 2017	Winter 2017-2018	Spring 2018	Summer 2018	Fall 2018	December 2018
IN PERSON ENGAGEMENT	PUBLIC MEETING 1 August 30, 2017	PUBLIC MEETING 2 November 2017		PUBLIC MEETING 3 April 2018	PUBLIC MEETING 4 July 2018	EAST GRAND FORKS AND GRAND FORKS CITY COUNCIL MEETINGS October 2018	FINAL STREET AND HIGHWAY PLAN UPDATE
ONLINE ENGAGEMENT	PROJECT WEBSITE						
	WIKIMAP						
PLAN UPDATE PROCESS	DEVELOP GOALS, OBJECTIVES AND PERFORMANCE MEASURES			PREPARE RECOMMENDATIONS AND IMPLEMENTATION REPORT			
	IDENTIFY ISSUES AND ALTERNATIVES						
	ANALYZE EXISTING AND FUTURE CONDITIONS						

Map Activity

We want to hear your thoughts on the condition of streets and highways in the Grand Forks-East Grand Forks MPO area. Consider characteristics such as pavement condition, sight lines, congestion, and other related topics. This feedback will help guide the process for prioritizing projects in the Streets and Highway Plan Update.



How to Participate

Step 1: Grab a post-it note and a pen.

Step 2: Write down your comments. Both positive and negative comments are appreciated!

Step 3: Place the post-it note on the map near the place you wrote about.

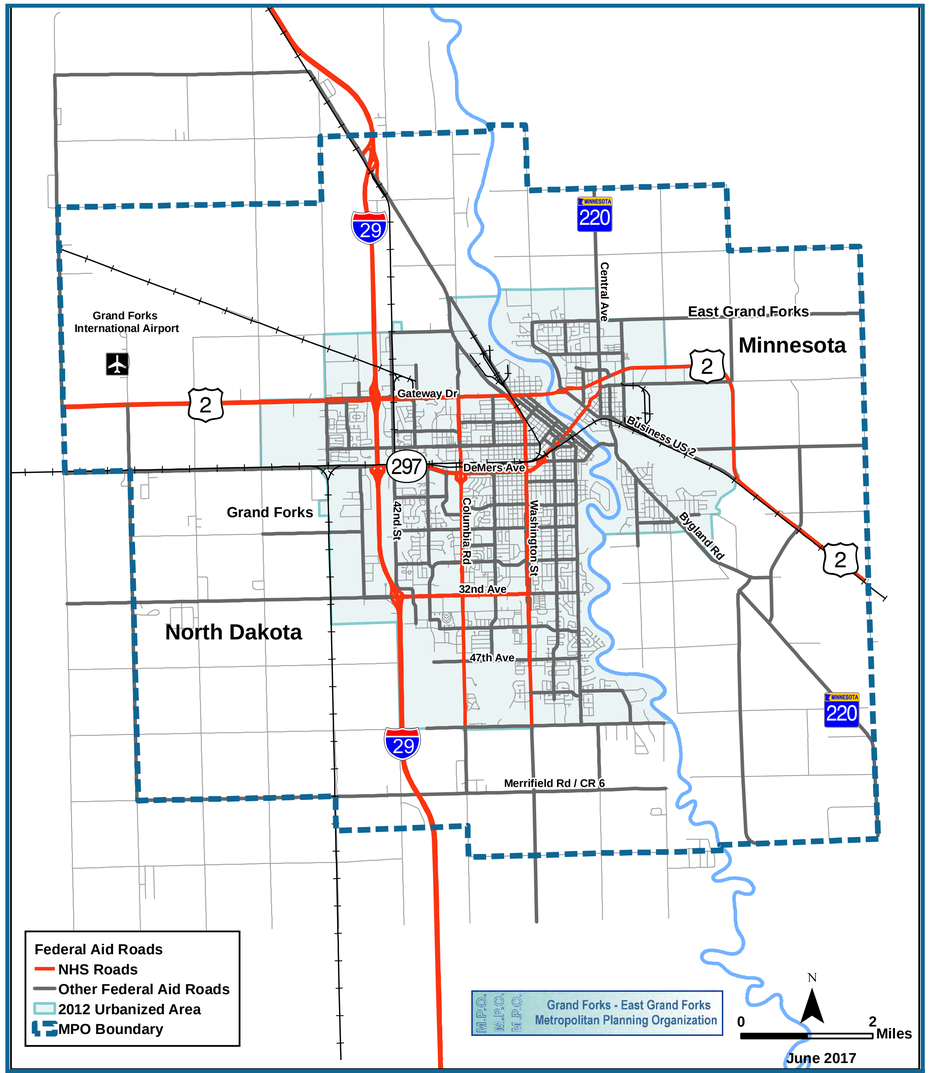
2045 LRTP Vision Statement and Draft Goals

Vision Statement: The Grand Forks-East Grand Forks Long Range Transportation Plan (LRTP) envisions a community that provides a variety of complementary transportation choices for people and goods that is fiscally constrained.

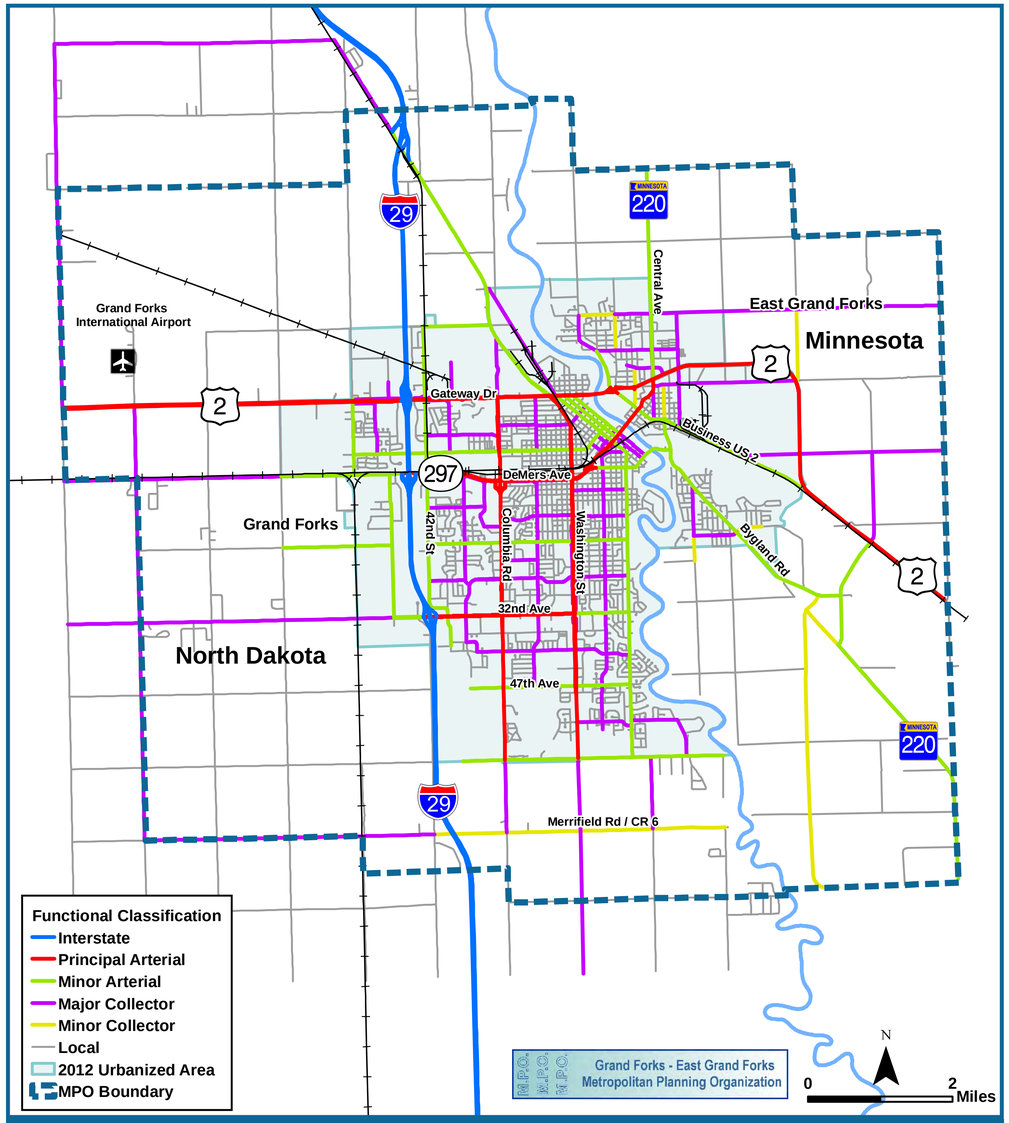
GOAL		DESCRIPTION
1	**Economic Vitality**	Support the economic vitality through enhancing the economic competitiveness of the metropolitan area by giving people access to jobs and education services as well as giving business access to markets
2	**Security**	Increase the security of the transportation system for motorized and non-motorized uses
3	**Accessibility and Mobility**	Increase the accessibility and mobility options for people and freight by providing more transportation choices
4	**Environmental/ Energy/Quality of Life**	Protect and enhance the environment, promote energy conservation, and improve quality of life by valuing the unique qualities of all communities – whether urban, suburban, or rural
5	**Integration and Connectivity**	Enhance the integration and connectivity of the transportation system across and between modes for people, freight, and housing, particularly affordable housing located close to transit
6	**Efficient System Management**	Promote efficient system management and operation by increasing collaboration among federal, state, and local government to better target investments and improve accountability
7	**System Preservation**	Emphasize the preservation of the existing transportation system by first targeting federal funds towards existing infrastructure to spur revitalization, promote urban landscapes, and protect rural landscapes
8	**Safety**	Increase safety of the transportation system for motorized and non-motorized uses.
9	**Resiliency***	Improve resiliency and reliability of the transportation system and reduce or mitigate storm water impacts of surface transportation
10	**Tourism***	Enhance travel and tourism

* A new goal for the 2045 LRTP (not included in 2040 LRTP)

Existing Conditions

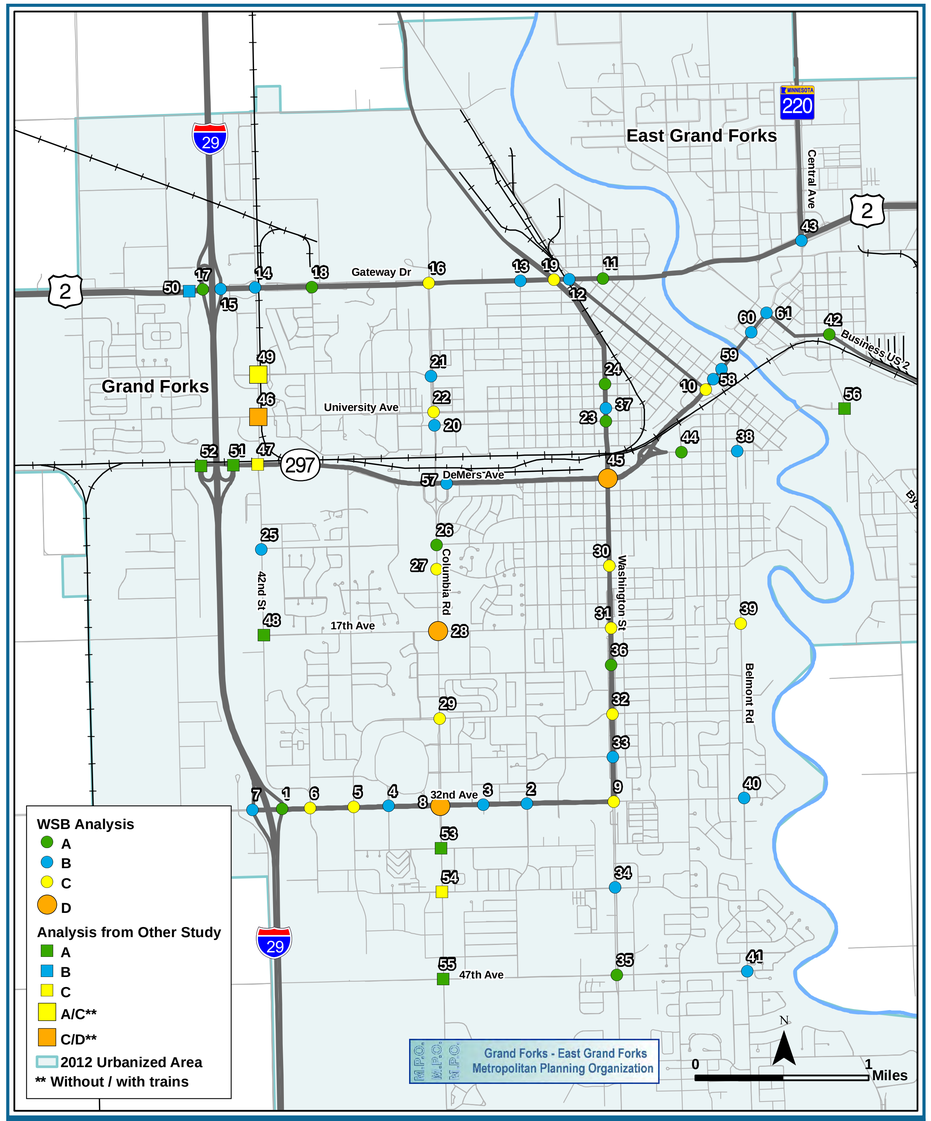


National Highway System (NHS) and Other Federal-Aid Roads

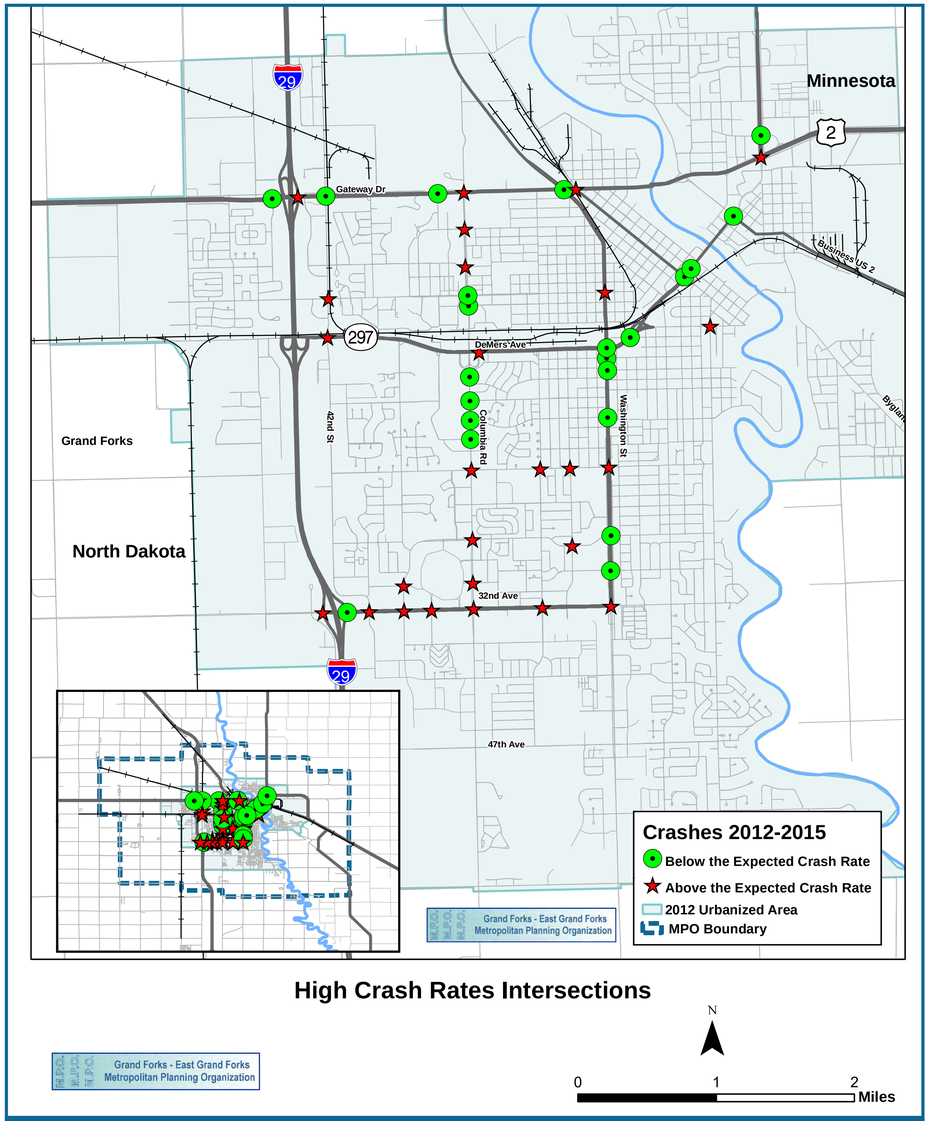


Functional Classification

Existing Conditions



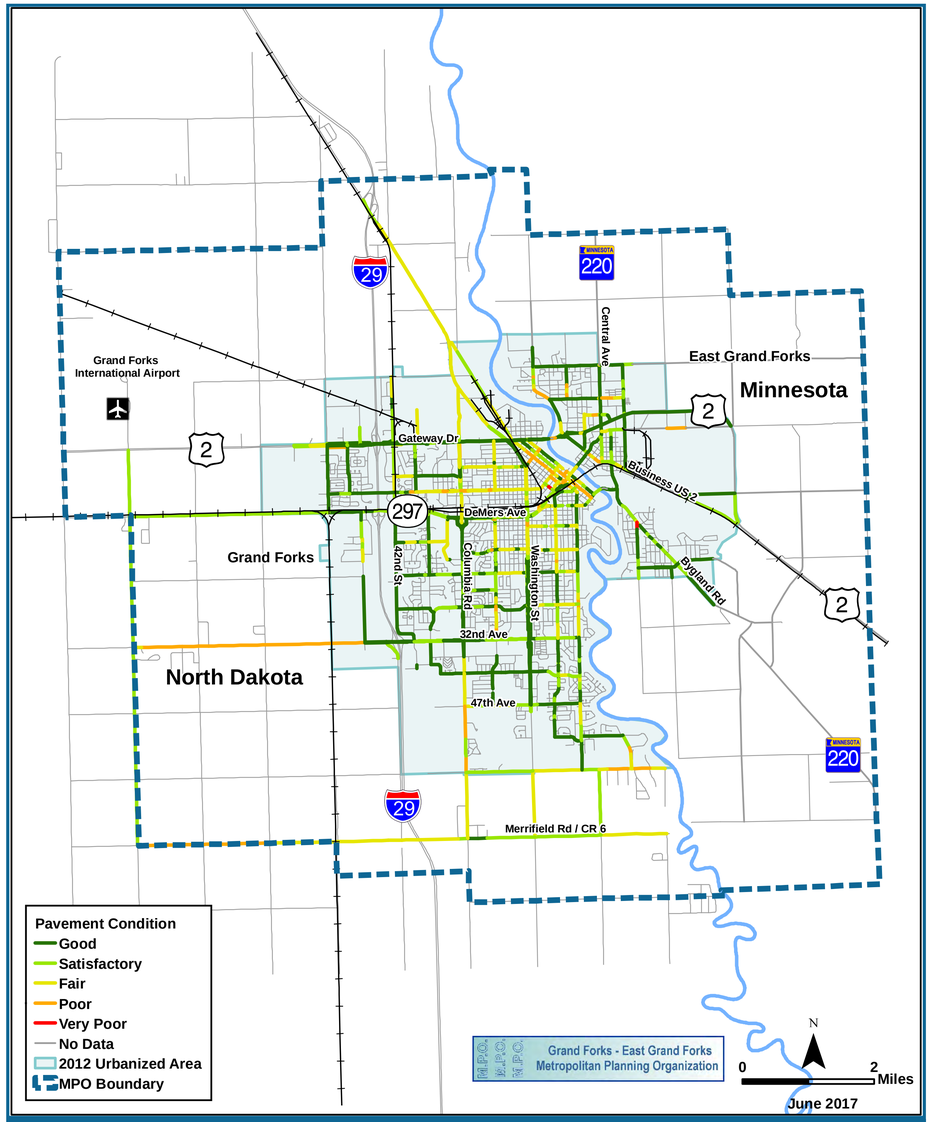
Intersection Level of Service



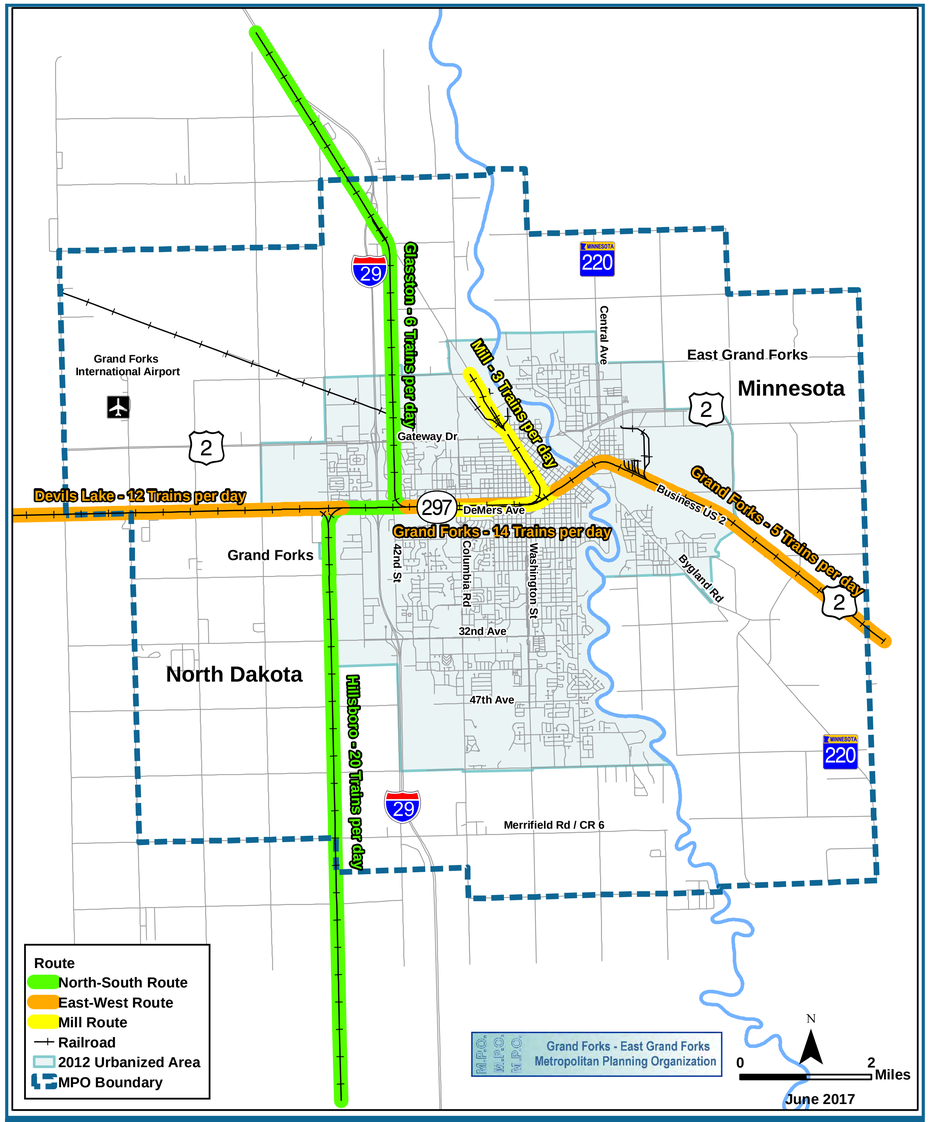
High Crash Rates Intersections

Crash Rates (2012-2015)

Existing Conditions

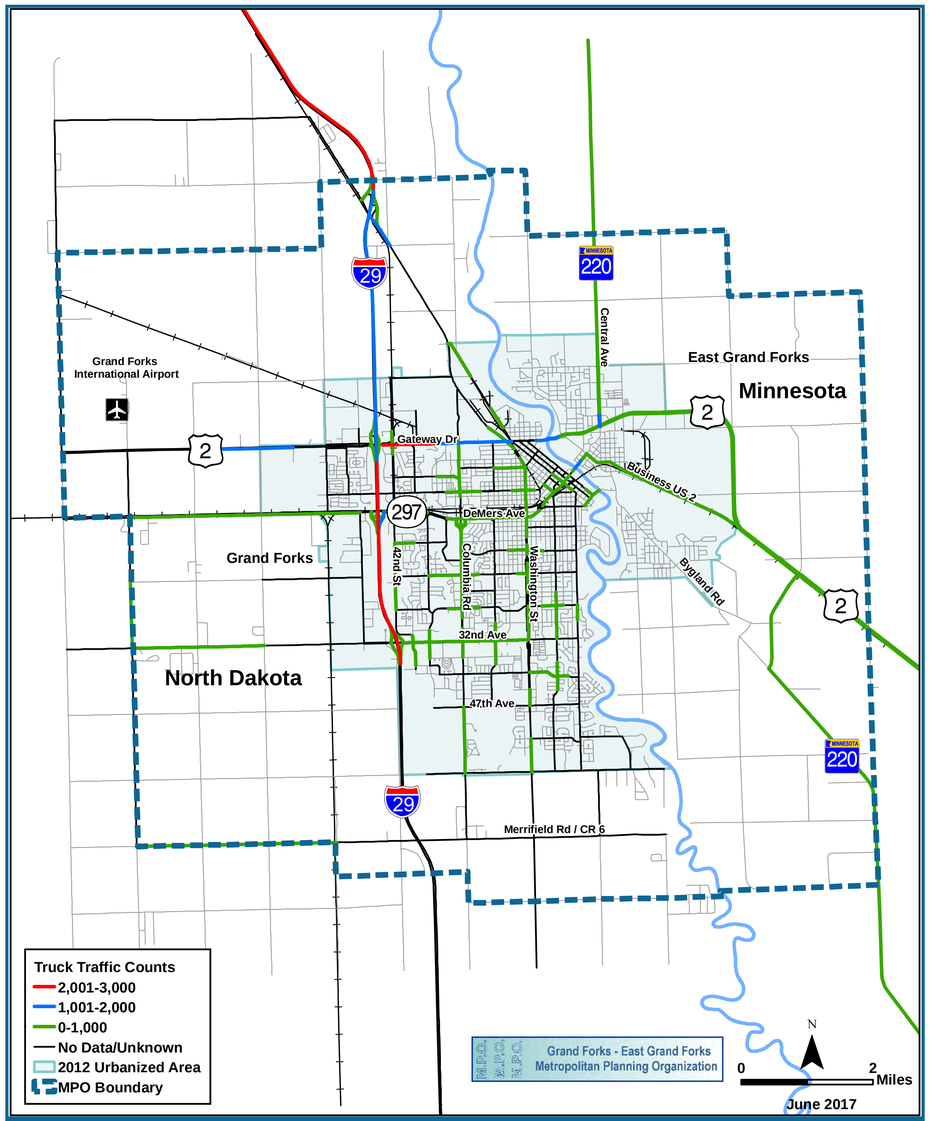


Pavement Conditions

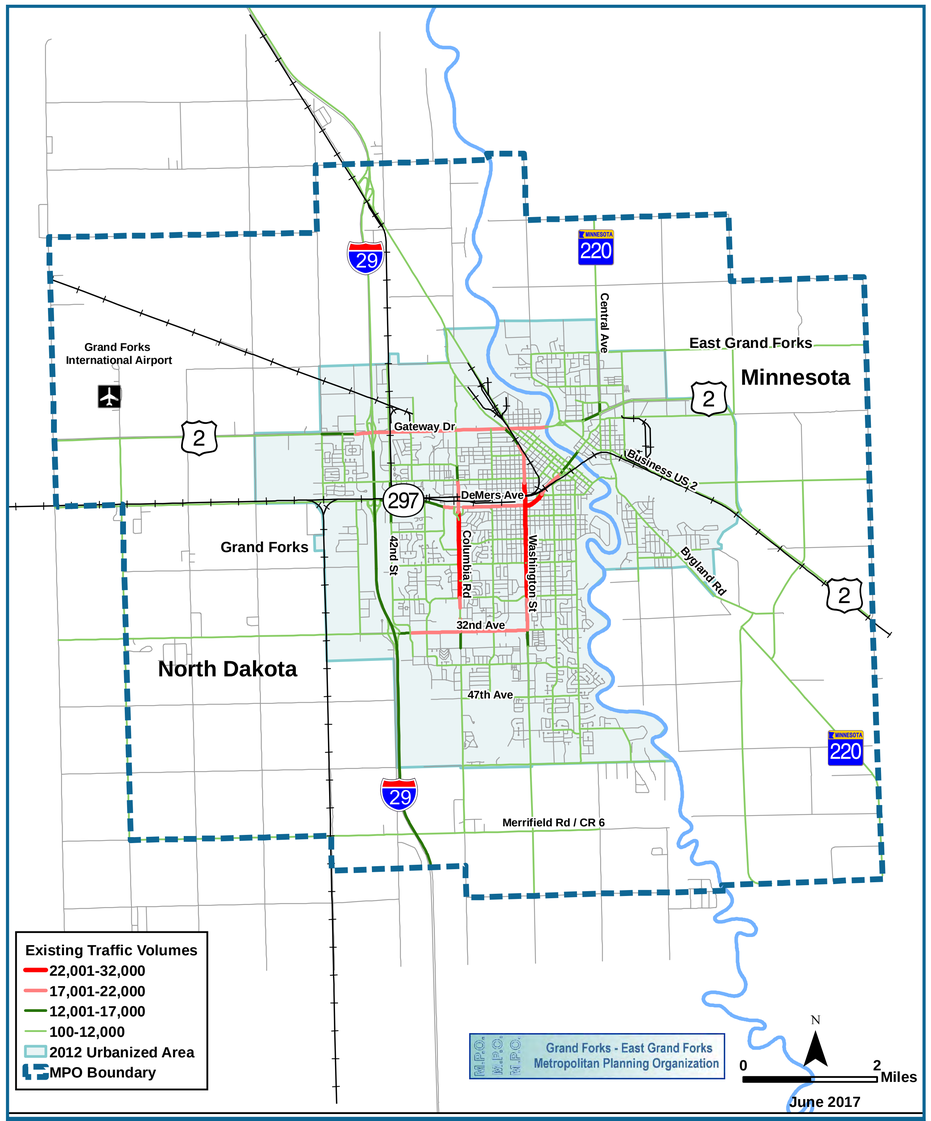


BNSF Trackage

Existing Conditions

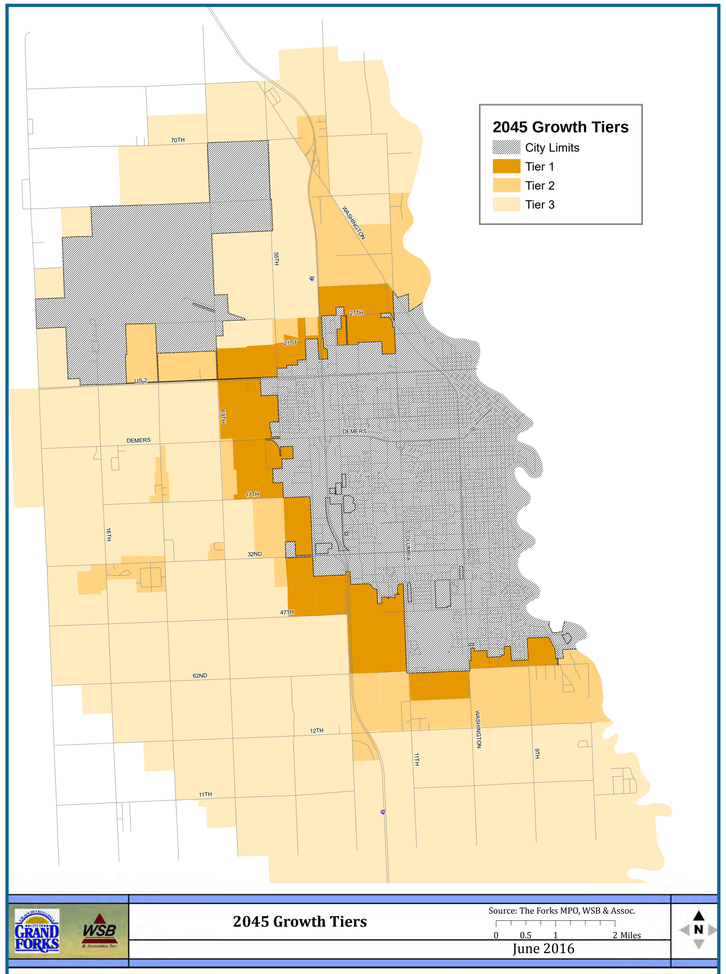


Truck Traffic Volumes



Traffic Volumes

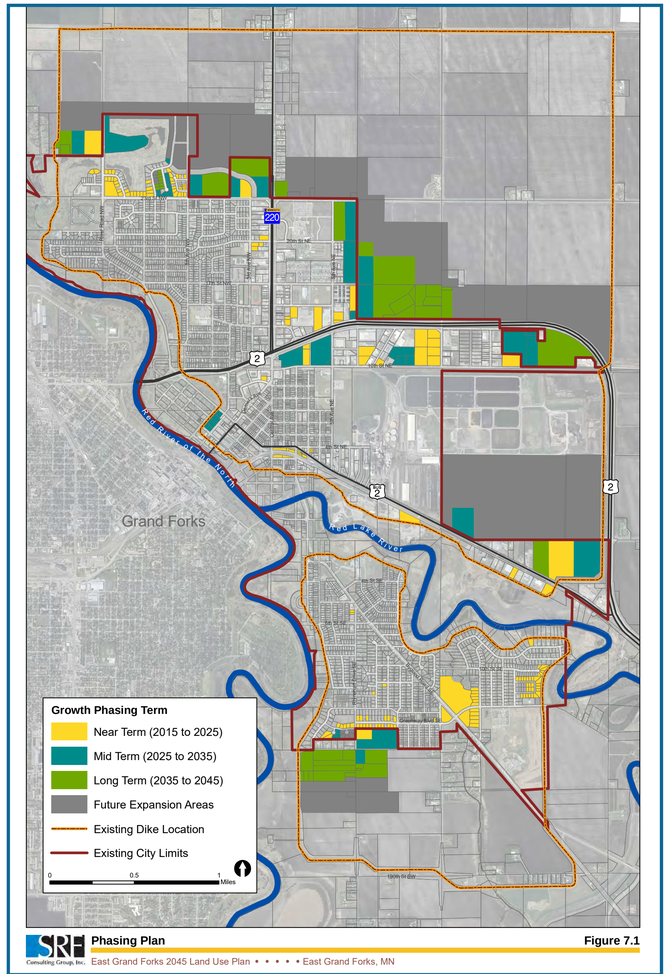
2045 Conditions



2045 Land Use Plan
Grand Forks

The 2045 Grand Forks Future Land Use Plan focuses on more compact development and uses a three-tier system for managing timing and sequencing of growth:

- **TIER 1** – includes existing city limits and is the area where all projected growth within the 2045 planning horizon will be accommodated
- **TIER 2** – Urban Reserve Area that only allows residential development on existing platted lots and only if no other Tier 1 land is available
- **TIER 3** – agricultural preservation area



2045 Land Use Plan
East Grand Forks

The East Grand Forks 2045 Land Use Plan:

- Promotes compact, infill development and responsible greenfield development
- Utilizes the existing flood protection system as an interim growth boundary, with phased land available to accommodate anticipated growth within the 2045 planning horizon

Street/Highway Plan Update

Open House

August 30, 2017

Earl Haugen, MPO Executive Director
Brandon Bourdon, Kimley-Horn

GRAND FORKS-EAST GRAND FORKS MPO

STREET/HIGHWAY PLAN UPDATE

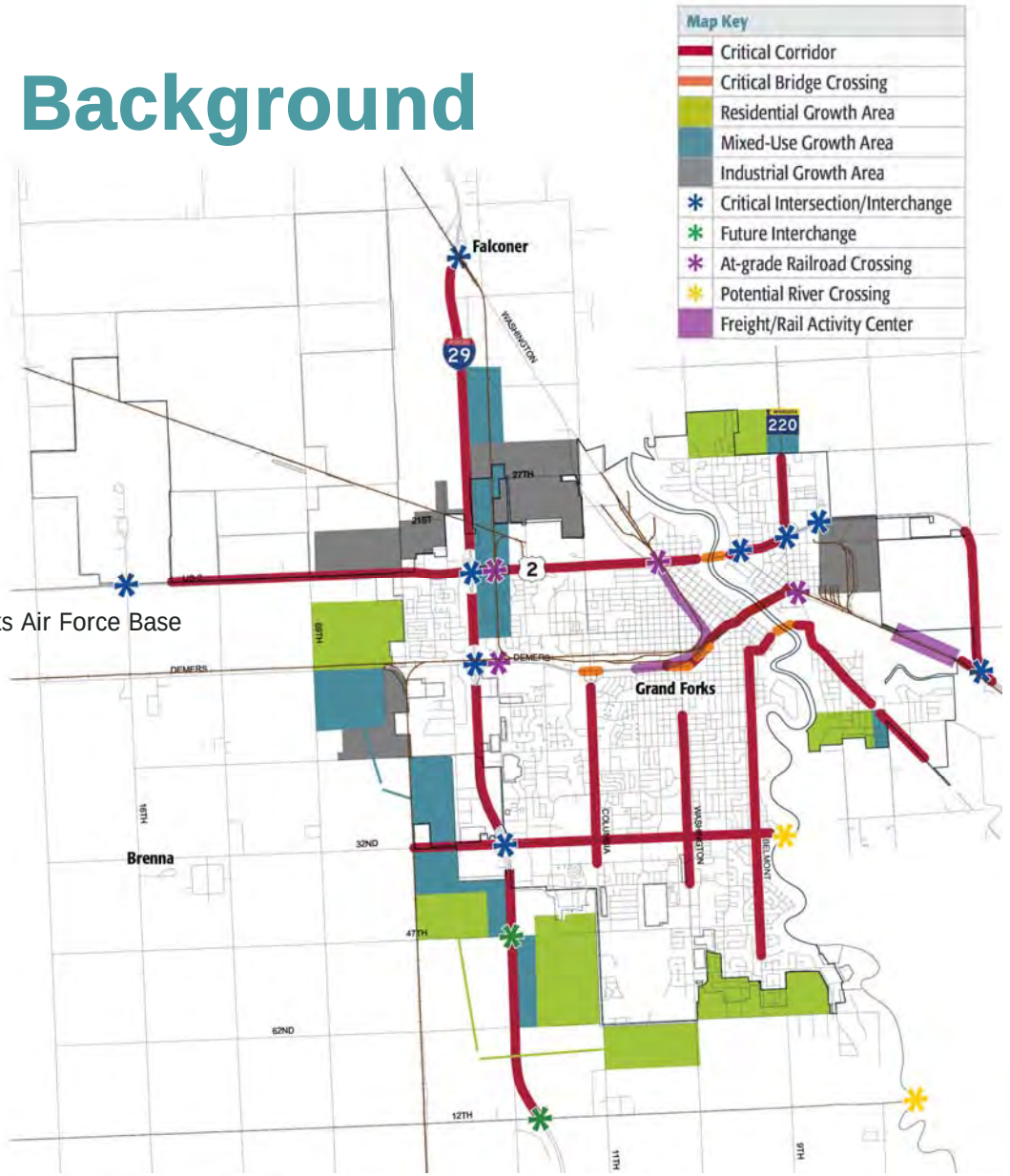
2045 METROPOLITAN TRANSPORTATION PLAN

Agenda

- Plan Overview
  - Background
  - Purpose
  - Organizational Chart
- Plan Outcomes
- Open House Overview
- Plan Engagement
  - Ways to Stay Involved
- Wrap-Up
  - Next Steps
  - Questions

Plan Overview: Background

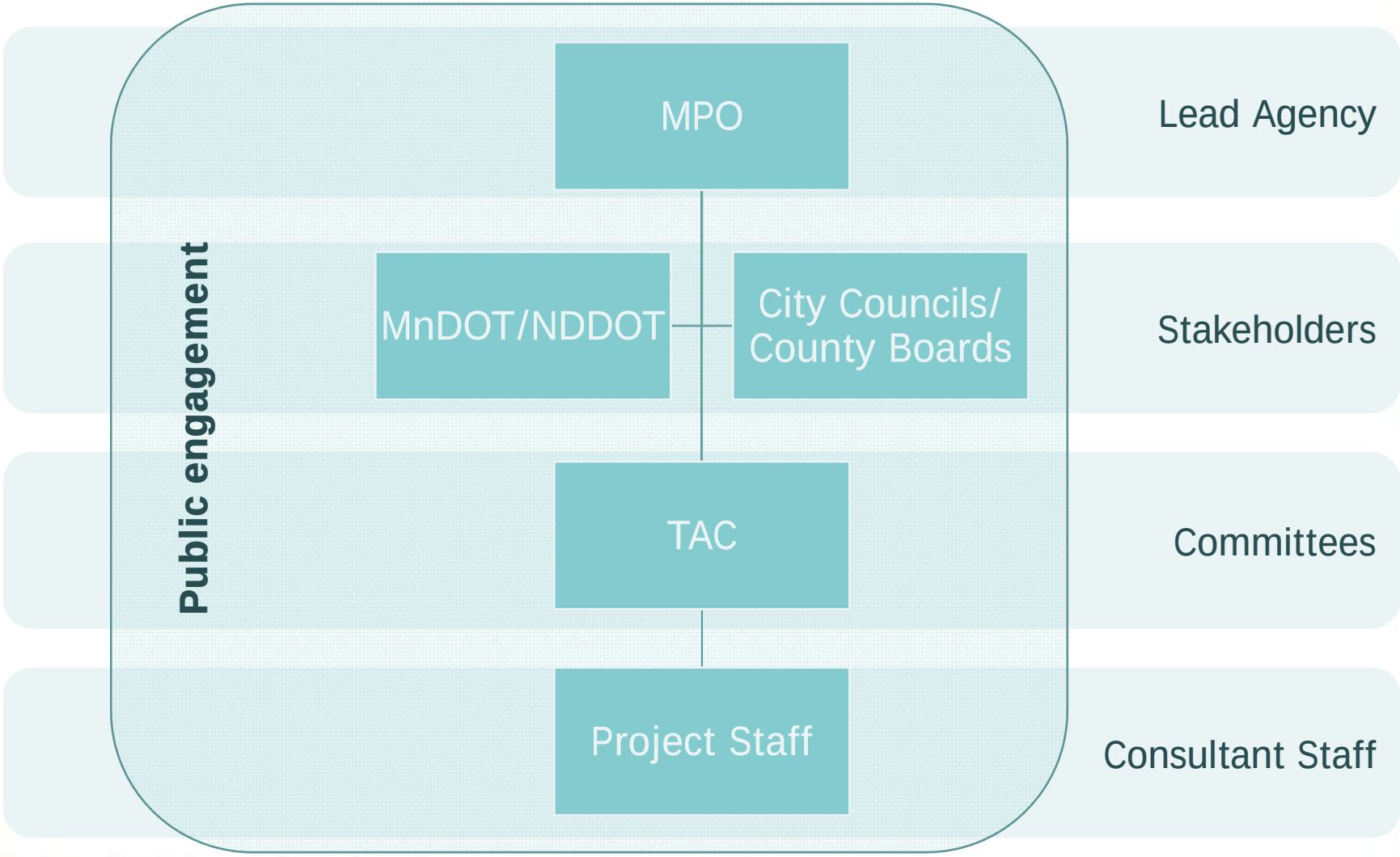
- Project Area Issues Map



Plan Overview: Purpose

- Update street/highway element of the 2040 plan
  - Communicate local investment **needs** and **priorities**
  - Address federal regulations in the **FAST Act**
  - Required to **update every five years**

Plan Overview: Organizational Chart



Plan Outcomes

1. Update or establish **vision, goals, objectives, performance measures and performance targets**
2. Understand **existing conditions and issues**
3. Identify and evaluate **planned projects and potential alternatives**
   - Apply updated performance measures and targets
4. Establish **financial plan**
5. Identify **future network recommendations**
6. Establish **implementation priorities**

Open House Overview:
Performance Measures, Metrics and Targets

Element	Description
Performance Measure	An expression of a trend or desired trend that is used to establish a metric and target.
Performance Metric	The specific dataset or information used to track a given performance measure.
Performance Target	Maximum and minimum thresholds for success and/or failure.

Open House Overview:
Existing Conditions

- National Highway System (NHS) and other federal-aid roads
- Functional classification
- Intersection level of service
- Crash rates
- Pavement condition
- BNSF trackage
- Truck traffic volumes
- General traffic volumes

Open House Overview:
Key Projects in MPO 2017-2020 Transportation Improvement Program (TIP)

2017

- Kennedy Bridge Rehabilitation
- South Columbia Road 2 to 5 Lane Expansion and New Signal
- South Columbia Road Turn Lanes at 17th Avenue South

2018

- 42nd St Reconstruction (University to US2)
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- Rhinehart St Reconstruction
- EGF Point Bridge Mill & Overlay

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- Demers Avenue (Columbia Rd/30th St.) Traffic Signal/Turn Lanes
- Downtown GF Demers Avenue Reconstruction/Mill & Overlay

2020

- Gateway Drive/55th Street Traffic Signal/Turn Lanes
- University Avenue Mill & Overlay

Open House Overview:
Key Projects in MPO 2021 TIP
Under Consideration

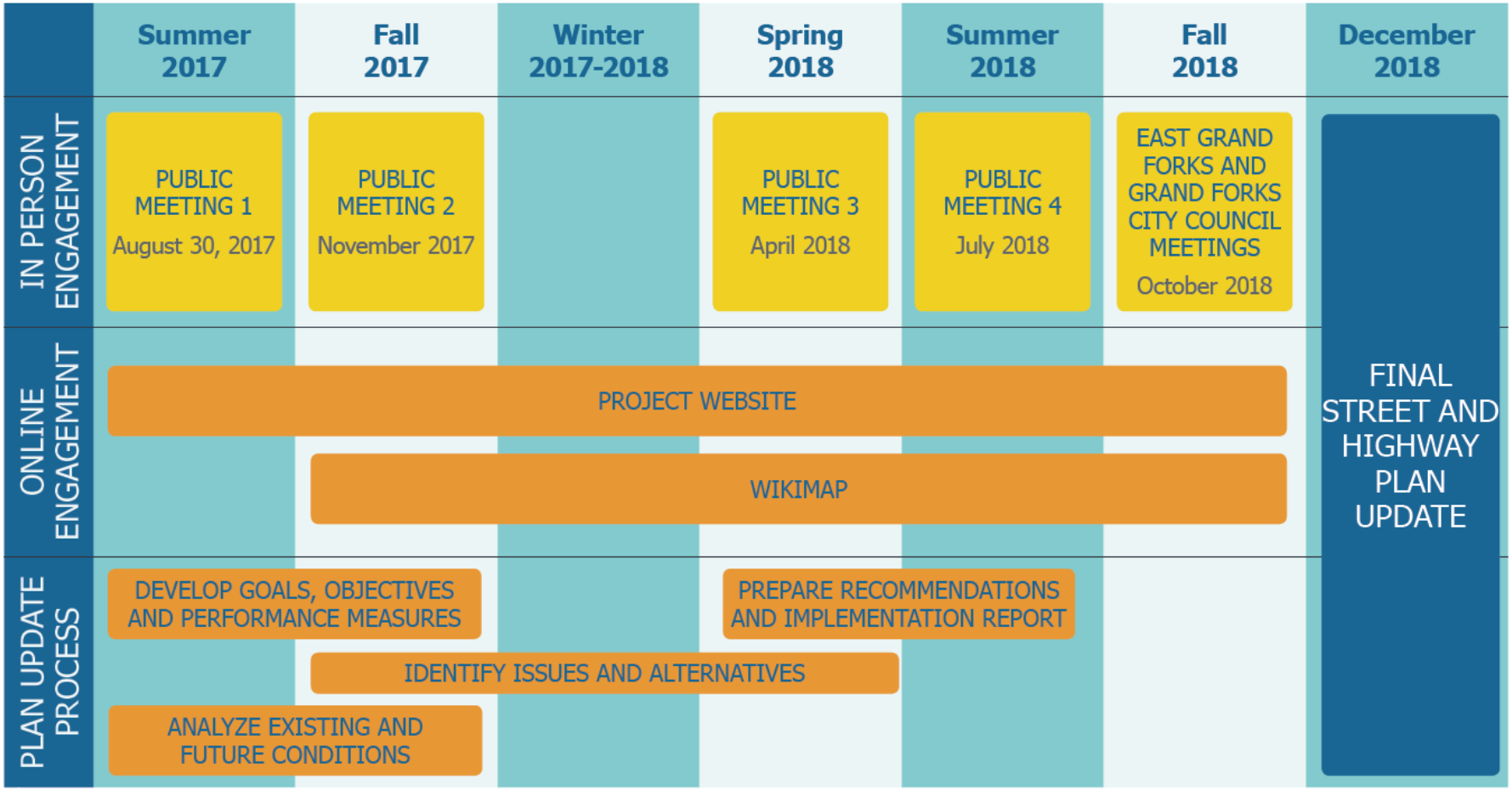
Minnesota

- US 2 and US Bus 2 Intersection Improvements
  - Funds are programmed, final project scope being set

North Dakota

- Washington St Underpass Reconstruction
- N. Columbia Rd Reconstruction (2nd St thru University Ave)

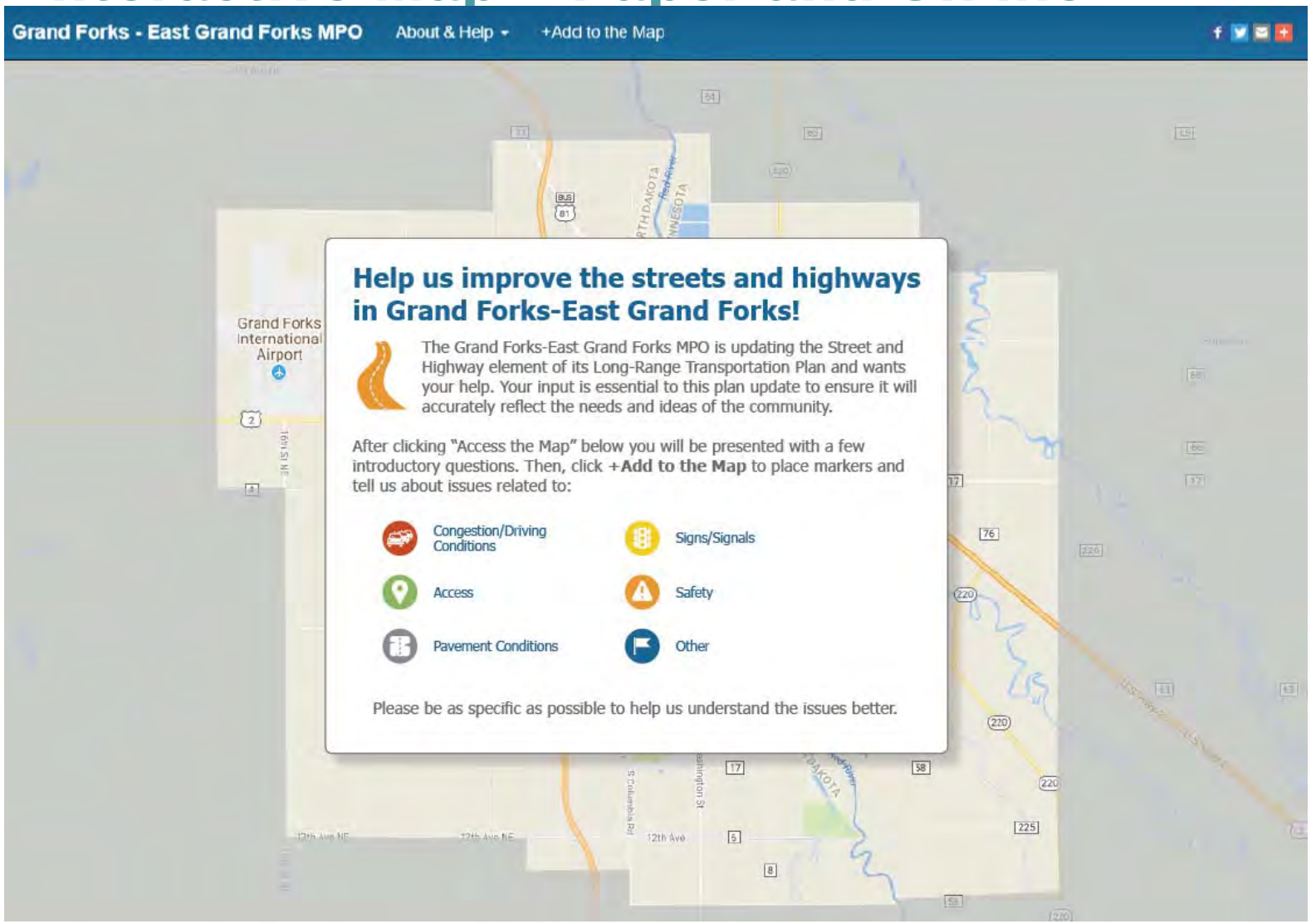
Plan Public Engagement



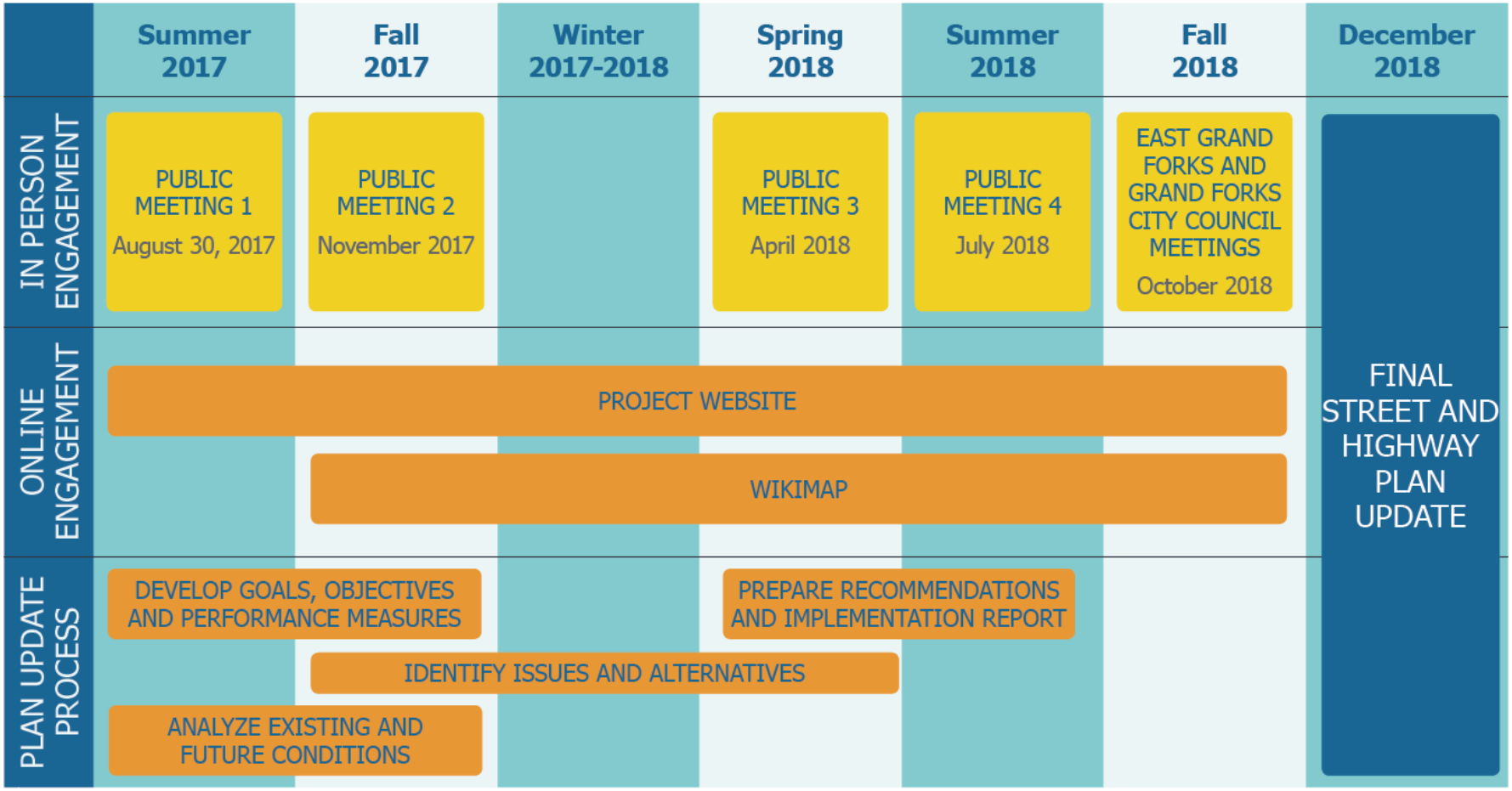
Plan Public Engagement:
Ways To Stay Involved

- Public meetings
  - Attend the open houses – *there will be four*
- Online
  - Project website – *get interactive with online mapping*
  - Facebook page – *help us spread the word*
- Stay in touch
  - Provide your contact information to stay informed
- Provide feedback on comment forms
- *Got other ideas? Tell us what works for you*

Plan Public Engagement:
Interactive Map – Paper and Online



Wrap Up: Next Steps

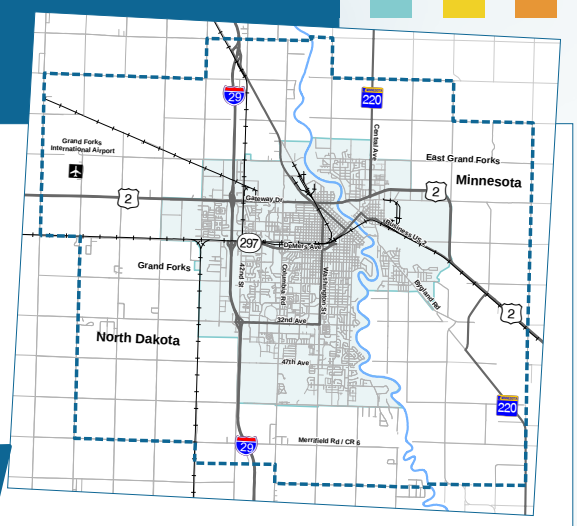


Wrap Up: Questions

Earl Haugen, MPO Executive Director
(218) 399-3370
(701) 746-2660
Earl.Haugen@theforksmpo.org

www.theforksstreets2045.org

Grand Forks-East Grand Forks MPO
STREET/HIGHWAY PLAN UPDATE



What is the purpose of the street/highway plan update?

The purpose of this project is to update the **street and highway** element of the Grand Forks-East Grand Forks Metropolitan Planning Organization's (MPO) Long-Range Transportation Plan (LRTP). The MPO is required to update its LRTP every five years, and the last update for Grand Forks-East Grand Forks was in 2013.

LRTPs include three elements:

- **Streets and highways**
- **Transit**
- **Pedestrians and bicycles**

This update will communicate local investment needs and priorities for **streets and highways** in the MPO area and address the federal regulations in the Fixing America's Surface Transportation (FAST) Act. The transit and pedestrian/bicycle elements are being addressed separately.

How can I engage with the plan update?

There will be multiple opportunities to learn about the project and provide input regarding the street and highway system in the MPO area, both in person and online. We'd love to hear from you!

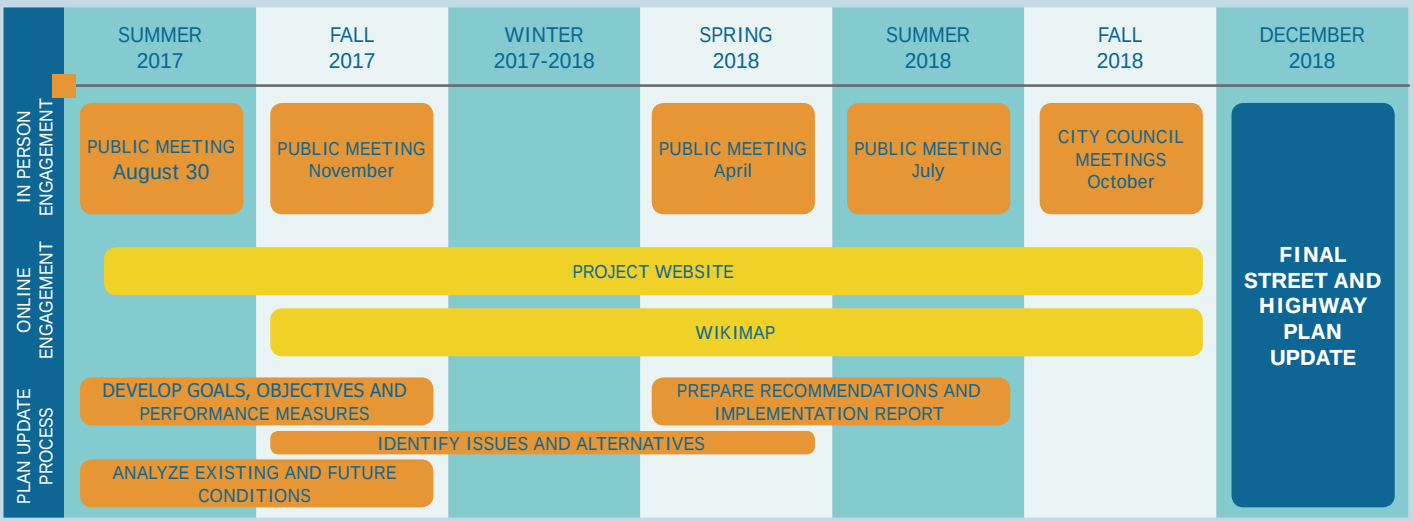
- Come talk to us at the public meetings
- Use the interactive map on the project website to provide your thoughts regarding issues with and opportunities for the streets and highways in the MPO area
- Check out the project website to see project reports and other materials and provide your comments
- Sign up for project email updates

Who is involved?

The plan update will be completed in partnership with:

- North Dakota Department of Transportation
- Minnesota Department of Transportation
- City of Grand Forks
- City of East Grand Forks
- Grand Forks County
- Polk County
- Federal Highway Administration
- Federal Transit Administration
- Residents and other stakeholders





Project website: www.theforksstreets2045.org

Grand Forks - East Grand Forks Metropolitan Planning Organization

Kimley»Horn WSB & Associates, Inc.

M.P.O. M.P.O. M.P.O.

Grand Forks - East Grand Forks Metropolitan Planning Organization



1969 Plan

32nd Ave S. Likely receive more serious consideration in future years; not officially a recommended project



1979 Plan

At 24th Ave S or 32nd Ave S with the official traffic forecast utilizing the 24th Ave S location as the future street network



1992 Plan

N. Bypass Bridge at 27th Ave N and continue study of feasibility and need for a local bridge beginning at 17th Ave S and southward.



1999/2000 Plan

No new bridges but continue seeking two new bridges with focus on either 17th Ave S or 32nd Ave S for local traffic and Merrifield Rd. for "bypass" traffic.



2004 Plan

32nd Ave S location for local traffic and Merrifield Rd for "bypass" traffic constructed within Plan horizon



2007 Plan

32nd Ave S for local traffic and Merrifield Rd for "bypass" traffic but not within fiscally constrained plan so construction not within Plan horizon



2013 Plan

32nd Ave S for local traffic and Merrifield Rd for "bypass" traffic but not within fiscally constrained plan so construction not within Plan horizon

Grand Forks-East Grand Forks MPO
STREET/HIGHWAY PLAN UPDATE

COMMENT CARD

What are your thoughts on the condition of streets and highways in Grand Forks-East Grand Forks MPO area? Provide you feedback here or on the interactive map at **www.theforksstreets2045.org/participate**

OPTIONAL

NAME

ADDRESS

PHONE

EMAIL

COMMENT Safety concern of semi & Farm traffic going through town when they could get on I-29 @ Merrifield. This would reduce traffic on 32nd & Washington. Merrifield Bridge would reduce safety concerns as well.

Grand Forks - East Grand Forks Metropolitan Planning Organization

Kimley»Horn WSB

Grand Forks-East Grand Forks MPO
STREET/HIGHWAY PLAN UPDATE

COMMENT CARD

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OPTIONAL

NAME

ADDRESS

PHONE

EMAIL

COMMENT Keep performance measures to an absolute minimum. I don't want to see a waste of tax payer dollars on unfunded mandates or going above and beyond to waste money measuring things that don't need to be measured

Grand Forks - East Grand Forks Metropolitan Planning Organization

Kimley»Horn WSB

Street/Highway Plan Update

Open House

August 30, 2017

Earl Haugen, MPO Executive Director
Brandon Bourdon, Kimley-Horn

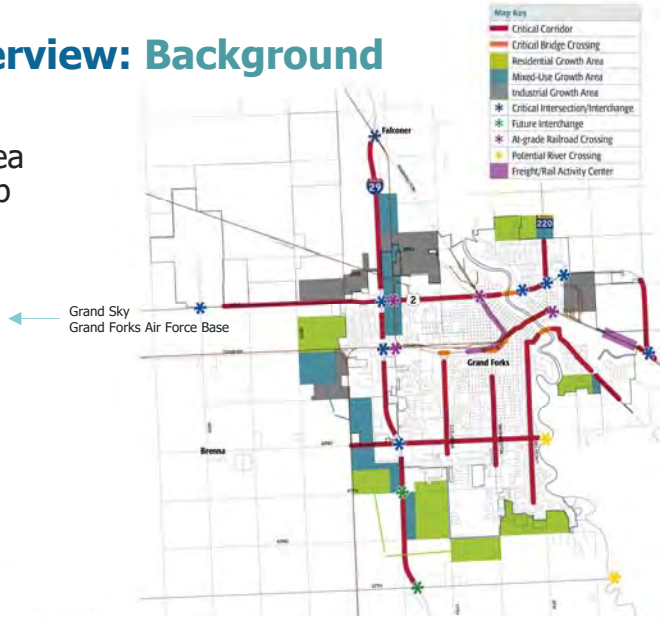
GRAND FORKS-EAST GRAND FORKS MPO
STREET/HIGHWAY PLAN UPDATE
2045 METROPOLITAN TRANSPORTATION PLAN

Agenda

- Plan Overview
  - Background
  - Purpose
  - Organizational Chart
- Plan Outcomes
- Open House Overview
- Plan Engagement
  - Ways to Stay Involved
- Wrap-Up
  - Next Steps
  - Questions

Plan Overview: Background

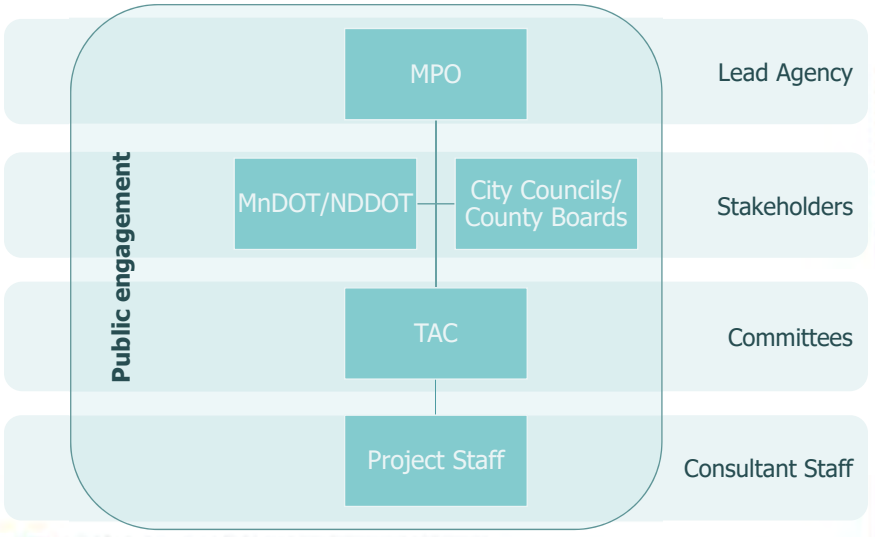
- Project Area Issues Map



Plan Overview: Purpose

- Update street/highway element of the 2040 plan
  - Communicate local investment **needs** and **priorities**
  - Address federal regulations in the **FAST Act**
  - Required to **update every five years**

Plan Overview: Organizational Chart



Plan Outcomes

1. Update or establish **vision, goals, objectives, performance measures and performance targets**
2. Understand **existing conditions and issues**
3. Identify and evaluate **planned projects and potential alternatives**
   - Apply updated performance measures and targets
4. Establish **financial plan**
5. Identify **future network recommendations**
6. Establish **implementation priorities**

Open House Overview:
Performance Measures, Metrics and Targets

Element	Description
Performance Measure	An expression of a trend or desired trend that is used to establish a metric and target.
Performance Metric	The specific dataset or information used to track a given performance measure.
Performance Target	Maximum and minimum thresholds for success and/or failure.

Open House Overview:
Existing Conditions

- National Highway System (NHS) and other federal-aid roads
- Functional classification
- Intersection level of service
- Crash rates
- Pavement condition
- BNSF trackage
- Truck traffic volumes
- General traffic volumes

Open House Overview:
Key Projects in MPO 2017-2020 Transportation Improvement Program (TIP)

2017
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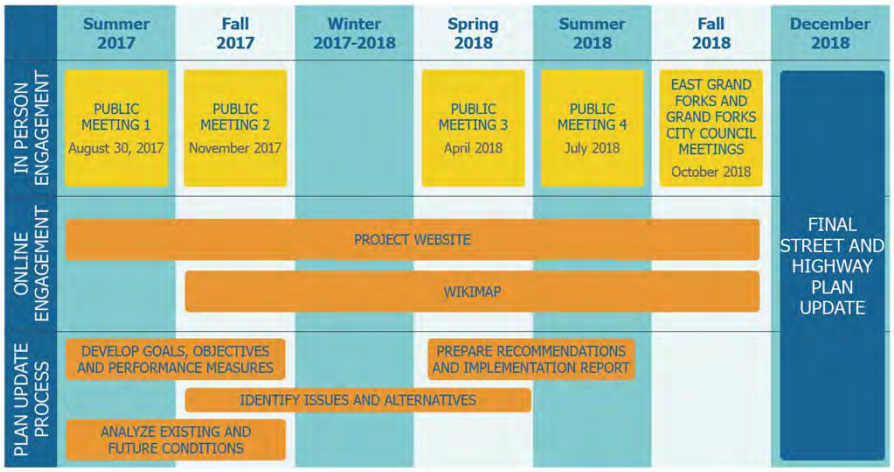
Plan Public Engagement



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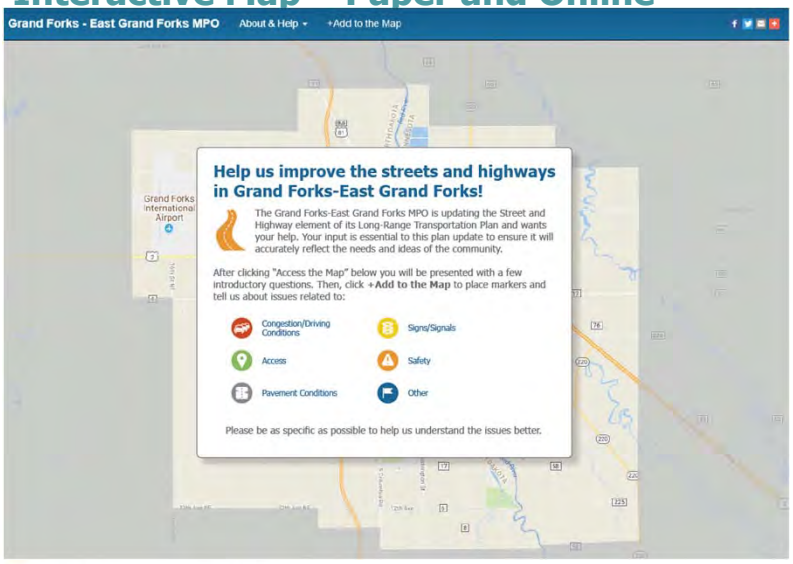
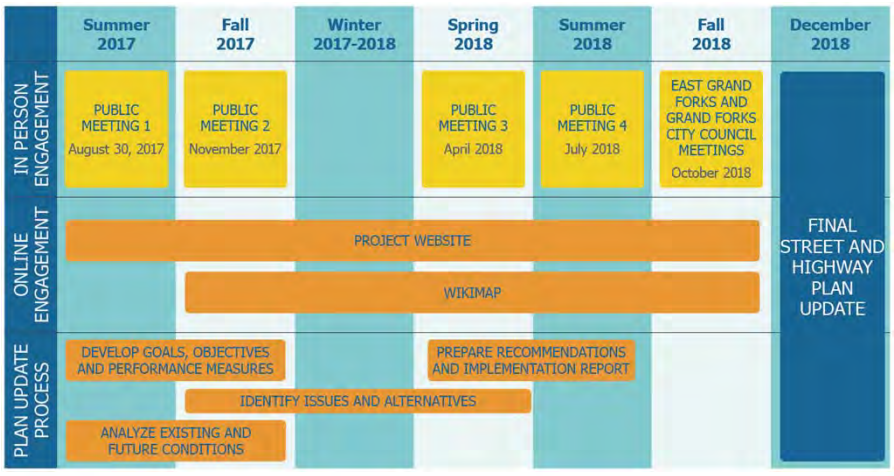
Plan Public Engagement: Interactive Map – Paper and Online



Wrap Up: Next Steps



Wrap Up: Questions

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www.theforksstreets2045.org

PUBLIC INPUT MEETING

WHY?

To discuss the updating of the Street and Highw element of the Transportation Plan. The purpos this first meeting is to inform the public on progress, to give existing conditions and to ga initial public thoughts on important issues address.

WHEN?

December 14th, 2017
5:00 PM to 7:00 PM

WHERE?

Rotunda
EGF City Hall
600 DeMers Ave
East Grand Forks, MN

OPEN HOUSE CONDUCTED BY

M.P.O. M.P.O. M.P.O. Grand Forks - East Grand Forks Metropolitan Planning Organization

Representatives from the Grand Forks/ East Grand Forks Metropolitan Planning Organization (GF-EGF MPO) and Kimley-Horn/WSB Consulting Team will be on hand to answer your questions and discuss your concerns. Additional information available at www.theforksmpo.org

WRITTEN STATEMENTS or comments about this project must be mailed by December 31st, to Earl Haugen, GF-EGF MPO, PO Box 5200, Grand Forks, ND 58206
Email: info@theforksmpo.org
Note “Street and Highway” in email subject heading.

The GF-EGF MPO will consider every request for reasonable accommodation to provide:

- an accessible meeting facility or other accommodation for people with disabilities,
- language interpretation for people with limited English proficiency (LEP), and
- translations of written material necessary to access GF-EGF MPO programs and information.

Appropriate provisions will be considered when the MPO is notified at least 5 days prior to the meeting date or the date the written material translation is needed.

To request accommodations, contact Earl Haugen, at 701-746-2660 or earl.haugen@theforksmpo.org.

Public Meeting #2 Summary

Time and Location

Thursday, December 14, 2017
5:00-7:00 p.m.

East Grand Forks City Hall
600 Demers Ave
East Grand Forks, MN 56721

Purpose of Meeting

The purpose of the second round of public engagement was to discuss the existing plus future transportation network and the transportation issues that have been identified so far. Additionally, the meeting was meant to explore the concept of a financially constrained transportation plan; this discussion was aided by an interactive financial planning activity, which collected input on attendees' public investment preferences. Finally, more detailed information on goals, objectives, and performance measures for the Street and Highway Plan Update were presented.

Materials

Display boards were available that provided information on the LRTP and Street and Highway Plan Update, the draft universe of alternatives, existing traffic volumes, forecast traffic volumes, planned land use, issues identified through the last public meeting and interactive mapping activity, the 2045 LRTP vision statement and draft goals, performance-based planning, financial plans, and the project schedule.

For the financial planning activity, each attendee was given ten stickers and a worksheet. Participants were asked to place the stickers, representing public funds, on their worksheets to indicate their investment priorities. On online version of this activity was also available on the project website.

Participants

Seven attendees signed in on the meeting sign-in sheets. Of these seven, five completed the NDDOT Title VI Public Participation Survey. The results of this survey are summarized below.

- Sex
  - Number of respondents: 5
  - Male: 5 (100%)
- Disability
  - Number of respondents: 5
  - Yes: 1 (20%)
  - No: 4 (80%)
- Age
  - Number of respondents: 5

  - 34 and younger: 1 (20%)
  - 35-54: 3 (60%)
  - 55 and older: 1 (20%)
- Race
  - Number of respondents: 5
  - White: 5 (100%)
- Language most frequently spoken in your home
  - Number of respondents: 5
  - English: 5 (100%)
- Do you receive public assistance?
  - Number of respondents: 5
  - No: 4 (80%)
  - Yes: 1 (20%)
- Indicate how you heard about the event (note that some respondents checked more than one box)
  - Number of respondents: 5
  - Internet: 2 (40%)
  - Newspaper: 1 (20%)
  - Other: 2 (40%)

Input Received

Comment Forms

Three written comments were received. One comment asked that all railroad tracks south of Gateway Drive, Grand Forks, be removed, and that new tracks be laid north of Grand Forks and East Grand Forks. Another comment expressed that a new bridge and street improvements should be a first priority for public funding. A third comment expressed the desire for more bicycle and pedestrian infrastructure. This comment explained that east and west flowing bike traffic is very difficult and dangerous, and asked that bike facilities on University Avenue be improved.

Financial Planning Activity

The financial planning activity was conducted both in-person and online. When the activity closed on January 15, 2018, input from 69 different interactions had been collected.

For the in-person activity, each attendee was given ten stickers and a worksheet showing public investment categories. Respondents were asked to place stickers, each representing ten dollars, on their worksheets to indicate their public investment priorities. With the online activity, each investment category had a slider that participants could adjust to indicate their investment priorities by setting the slider at a value between $0 and $100 in $10 increments. Input from the in-person and online interactions has been compiled in the following summary.

Responses

In the financial planning activity, participants were instructed to allocate $100 of funding across six public investment categories. There were 69 total in-person and online participant interactions. The final funds distribution is summarized below:

Table 1: Distribution of Funds by Public Investment Category

	Funding Received	Percent of Total Funding
Maintain and rebuild existing infrastructure	$2,080	30%
Safety improvements	$620	9%
Improve traffic signals and technology	$550	8%
New freeway interchanges	$1,100	16%
New river crossings	$1,970	29%
Add additional lanes or new roads	$530	8%
Total	*$6,850*	*100%*

The number of allocations for each investment category, for each funding level, is displayed in Figures 1 through 6 below. The preferences expressed through this exercise will be analyzed to inform the financial plan.

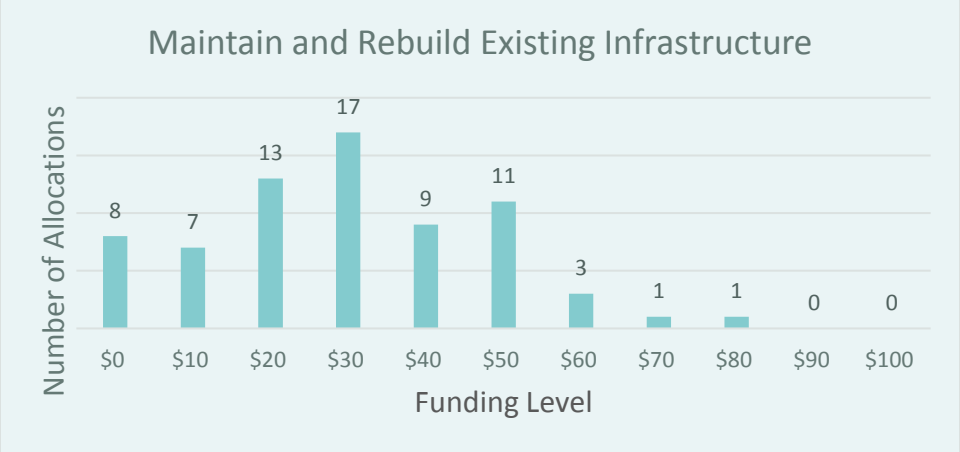


Figure 1: Number of Allocations for "Maintain and Rebuild Existing Infrastructure"

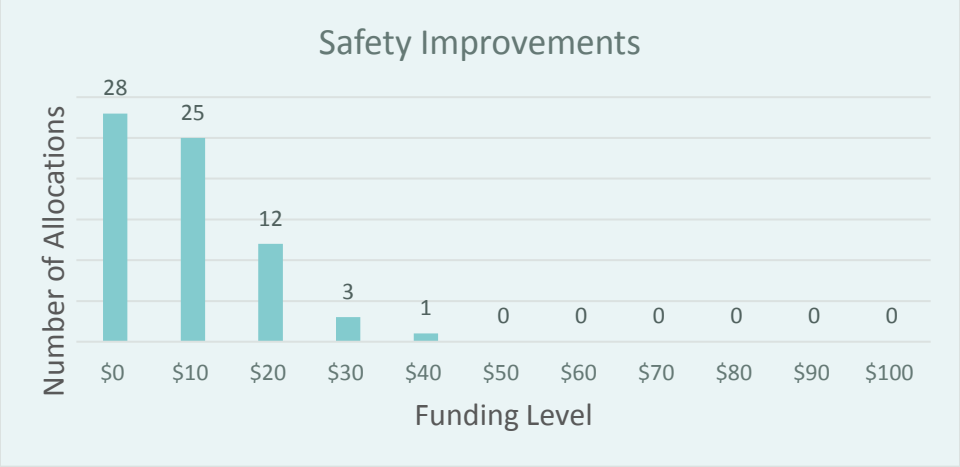


Figure 2: Number of Allocations for "Safety Improvements"

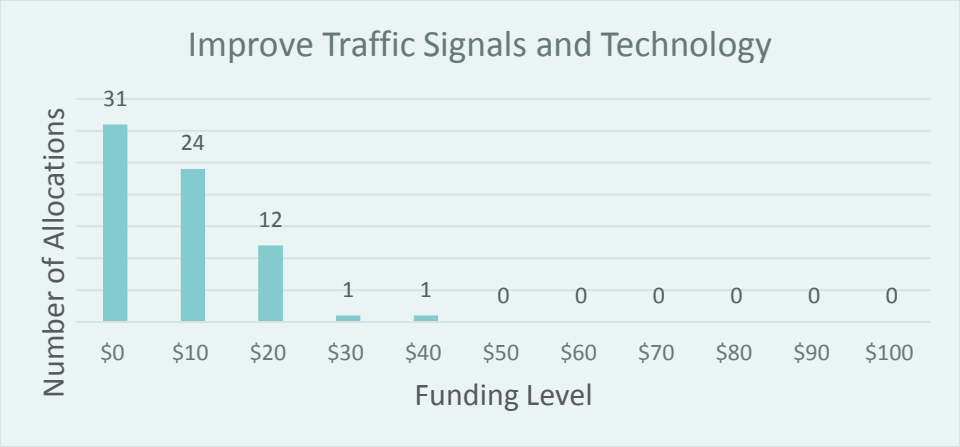


Figure 3: Number of Allocations for "Improve Traffic Signals and Technology"

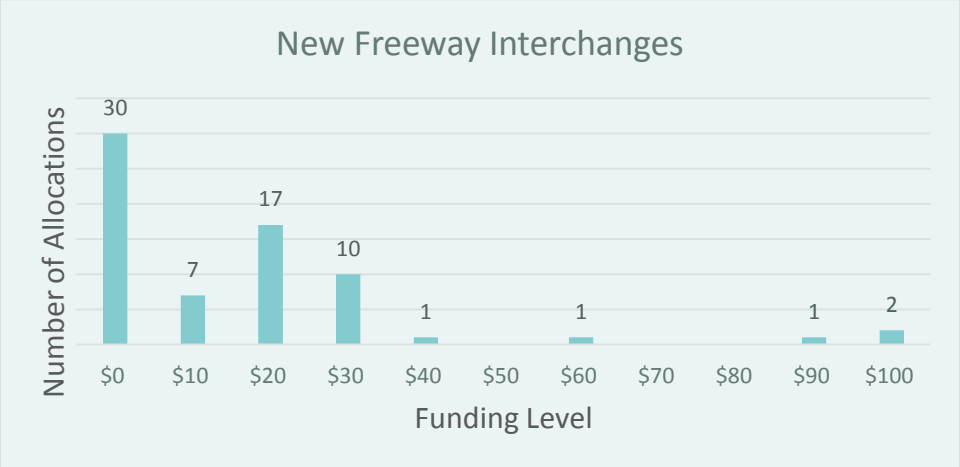


Figure 4: Number of Allocations for "New Freeway Interchanges"

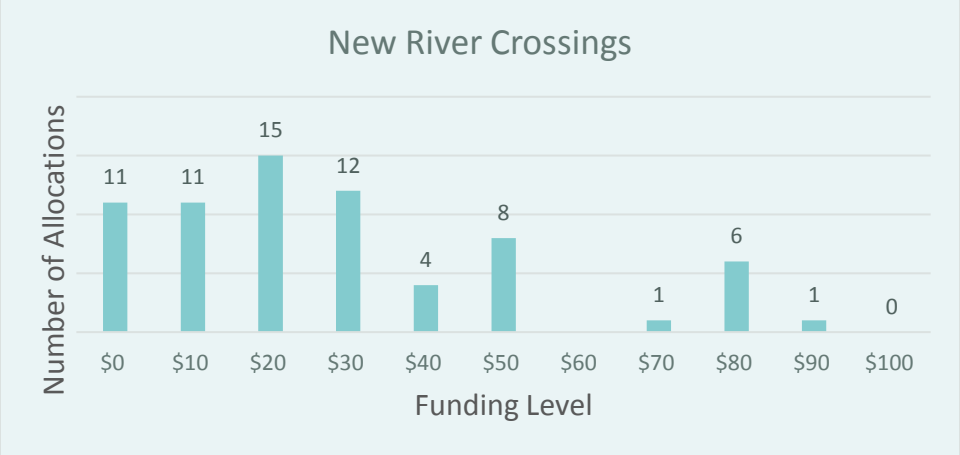


Figure 5: Number of Allocations for "New River Crossings"

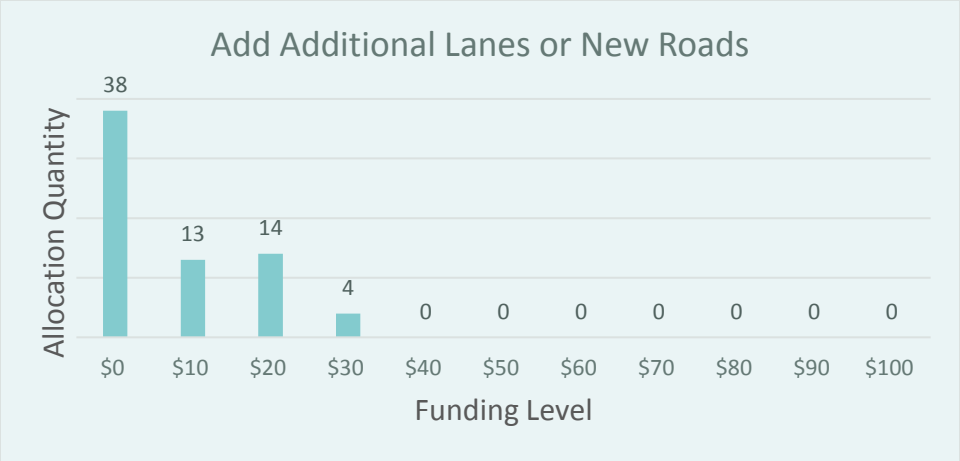


Figure 6: Number of Allocations for "Add Additional Lanes or New Roads"

Next Steps

Public Meeting #3 is anticipated to occur in April 2018. This public meeting will present a range of alternatives to address identified transportation issues and a preliminary evaluation of how these alternatives compare to each other and address identified goals, objectives, and performance measures. Tradeoffs between the various implementation packages will be discussed.

Grand Forks-East Grand Forks MPO

STREET/HIGHWAY PLAN UPDATE

Welcome

Public Meeting

Grand Forks-East Grand Forks Metropolitan Planning Organization

M.P.O. M.P.O. M.P.O. Grand Forks - East Grand Forks Metropolitan Planning Organization

Kimley»Horn

WSB & Associates, Inc.

Overview

What is a Long-Range Transportation Plan (LRTP)?

- Sets a direction and strategies to help shape a region's transportation network
- Includes three elements:

Streets and highways | Transit | Pedestrians and bicycles

- The MPO is required to update its LRTP every 5 years – the last update for Grand Forks-East Grand Forks was completed in 2013

What's an MPO?

Federal law requires that all urbanized areas in the US with populations over 50,000 people establish Metropolitan Planning Organizations (MPO) responsible for area transportation planning and programming services.

What is the Street and Highway Plan Update?

- This part of the LRTP will develop a performance-based investment decision framework for the streets and highways in the MPO area that is consistent with requirements of the FAST Act

Who is Involved?

- North Dakota Department of Transportation
- Minnesota Department of Transportation
- City of Grand Forks
- City of East Grand Forks
- Grand Forks County
- Polk County
- Federal Highway Administration
- Federal Transit Administration
- Residents and regional stakeholders

U.S. Department of Transportation Federal Highway Administration

U.S. Department of Transportation Federal Transit Administration

YOUR INPUT IS IMPORTANT TO US!

Draft Universe of Alternatives

DATA SOURCES

- MPO Transportation Improvement Program
- NDDOT and MnDOT State Transportation Improvement Programs
- City and County Capital Improvement Plans
- Existing conditions level of service
- Crash analysis
- Bridge sufficiency
- Pavement condition
- 2030/2045 traffic demand forcasts
- Interactive mapping, open house, staff and elected official input
- MPO 2040 Long-Range Transportation Plan project list
- Recent MPO corridor studies

State of Good Repair

Safety and Operations

New Interchange, New Bridge, or New Overpass

Additional Capacity/ Lane Expansion

2040 Plan Illustrative Projects

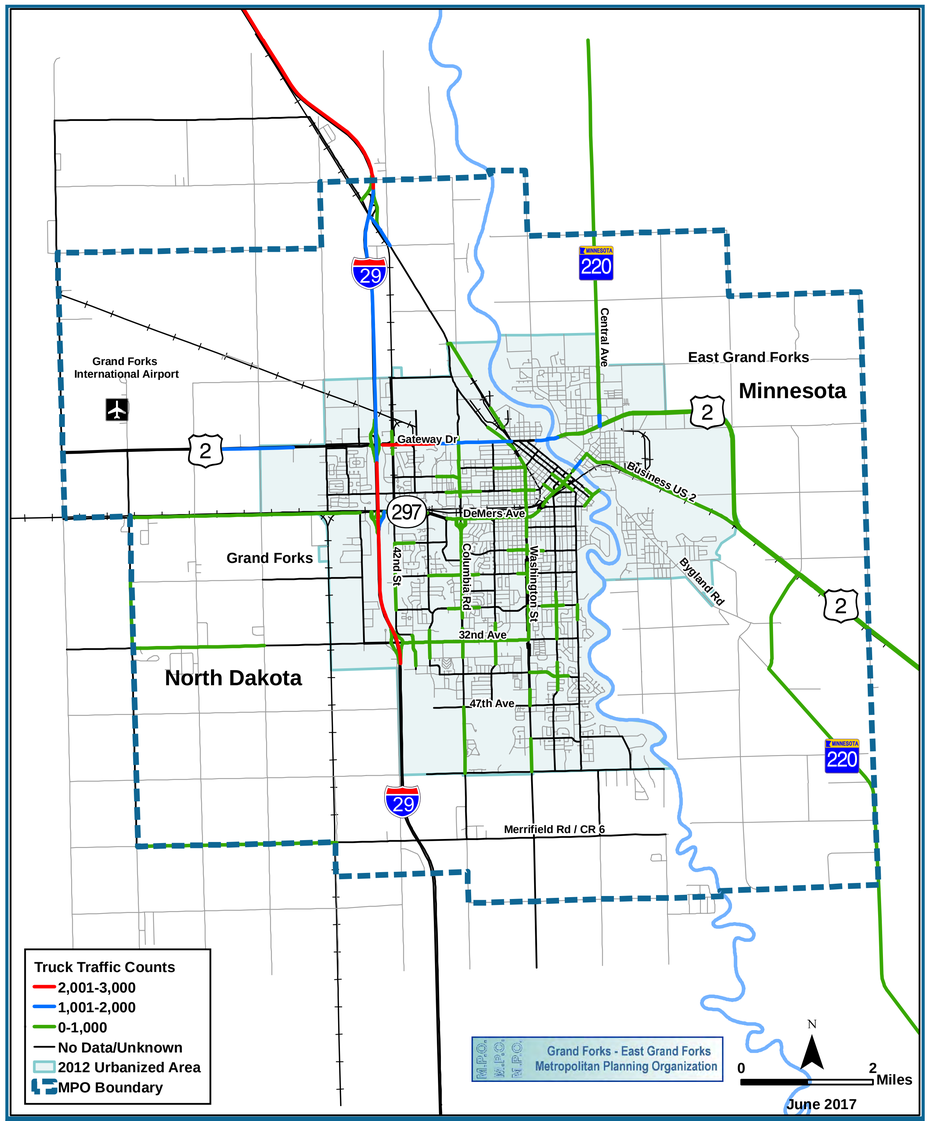
2045 PLAN

Universe of Projects Master List

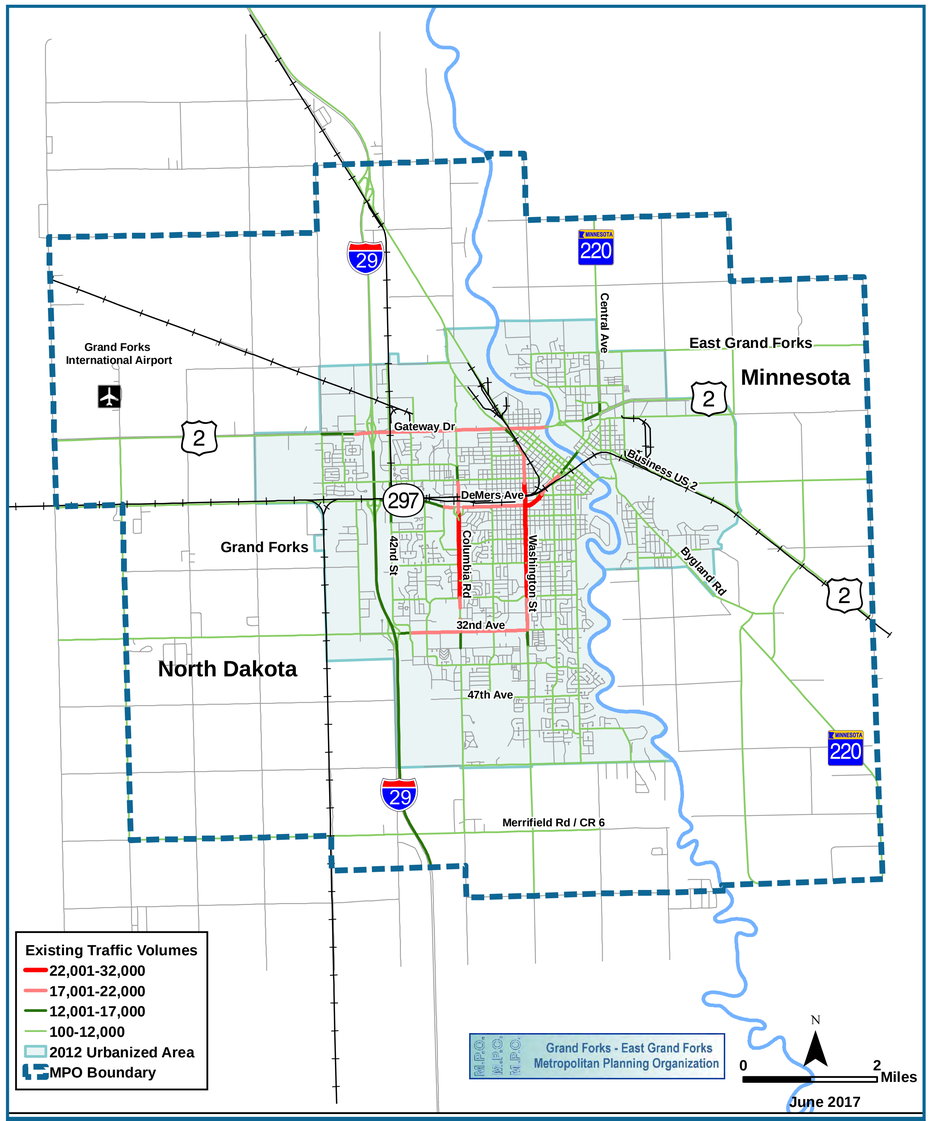
Financial Forecast of Revenue

Financially Constrained Projects

Existing Conditions

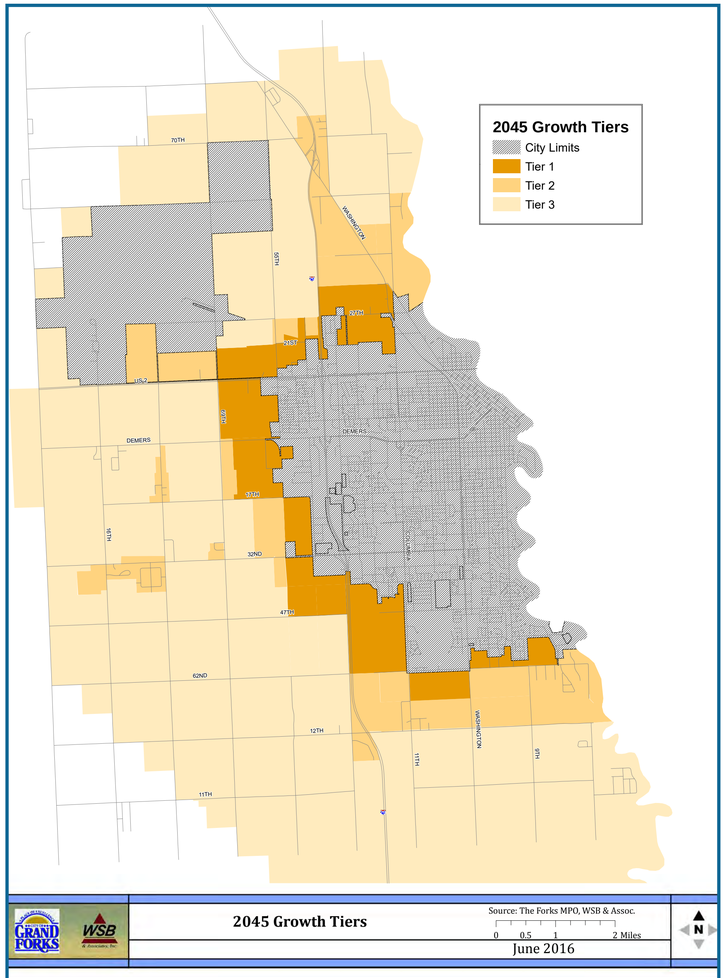


Truck Traffic Volumes



Traffic Volumes

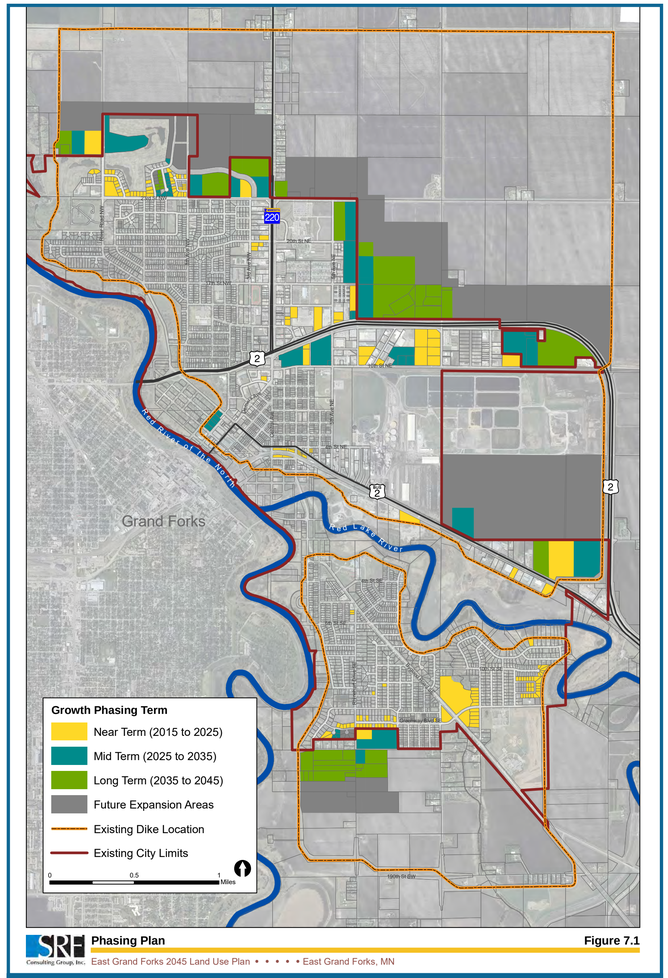
2045 Conditions



2045 Land Use Plan
Grand Forks

The 2045 Grand Forks Future Land Use Plan focuses on more compact development and uses a three-tier system for managing timing and sequencing of growth:

- **TIER 1** – includes existing city limits and is the area where all projected growth within the 2045 planning horizon will be accommodated
- **TIER 2** – Urban Reserve Area that only allows residential development on existing platted lots and only if no other Tier 1 land is available
- **TIER 3** – agricultural preservation area

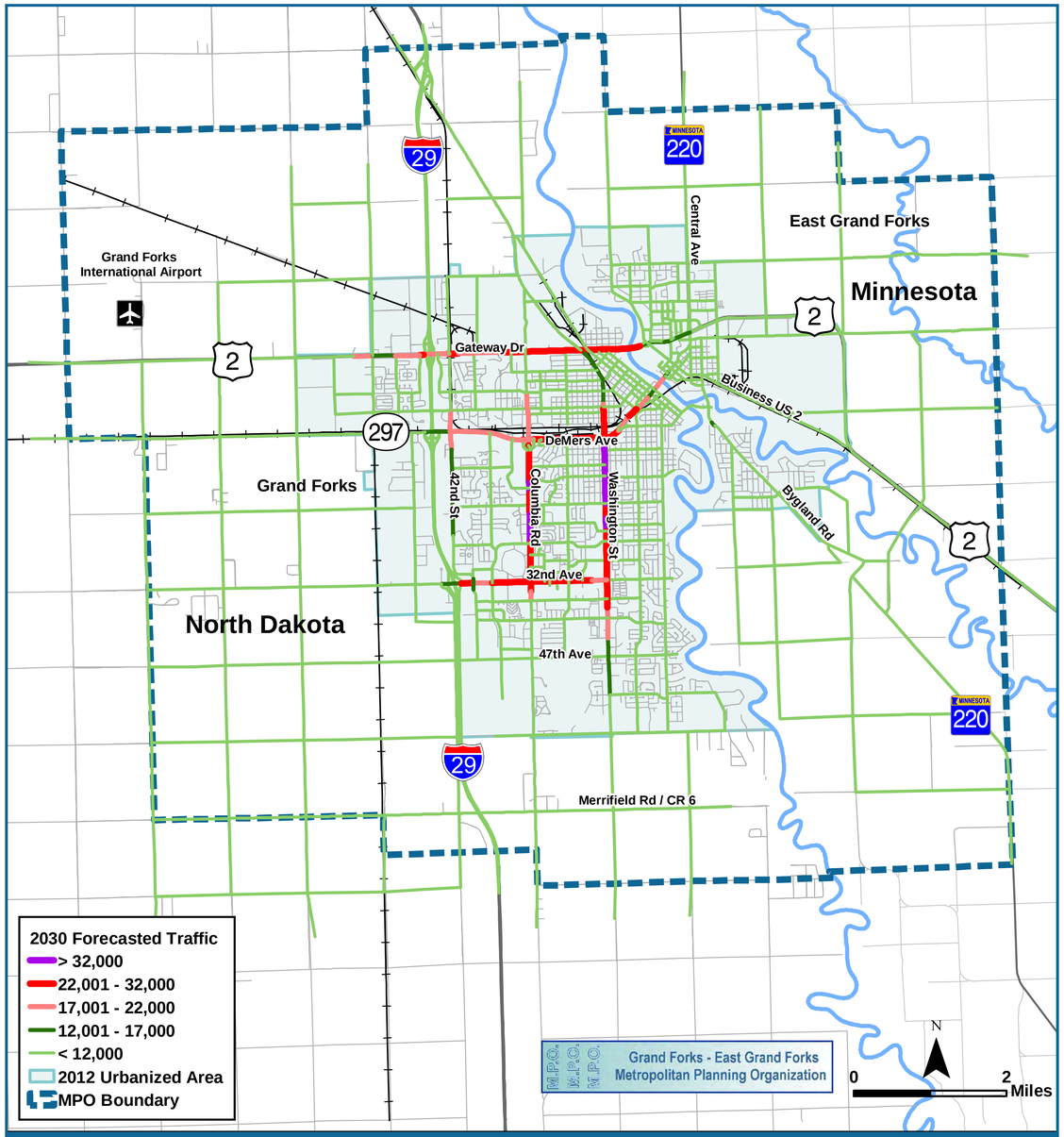


2045 Land Use Plan
East Grand Forks

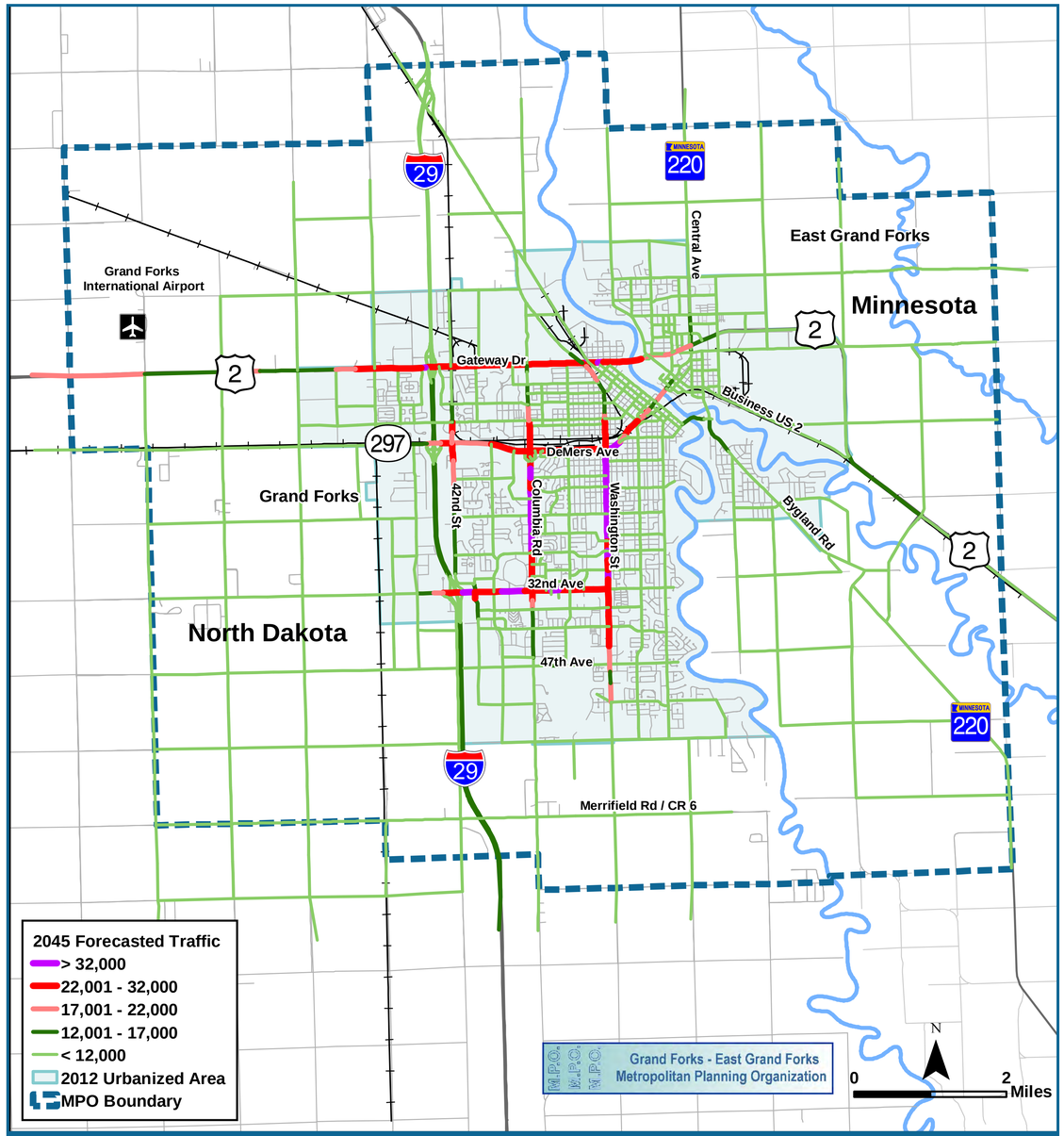
The East Grand Forks 2045 Land Use Plan:

- Promotes compact, infill development and responsible greenfield development
- Utilizes the existing flood protection system as an interim growth boundary, with phased land available to accommodate anticipated growth within the 2045 planning horizon

Forecast Average Daily Traffic

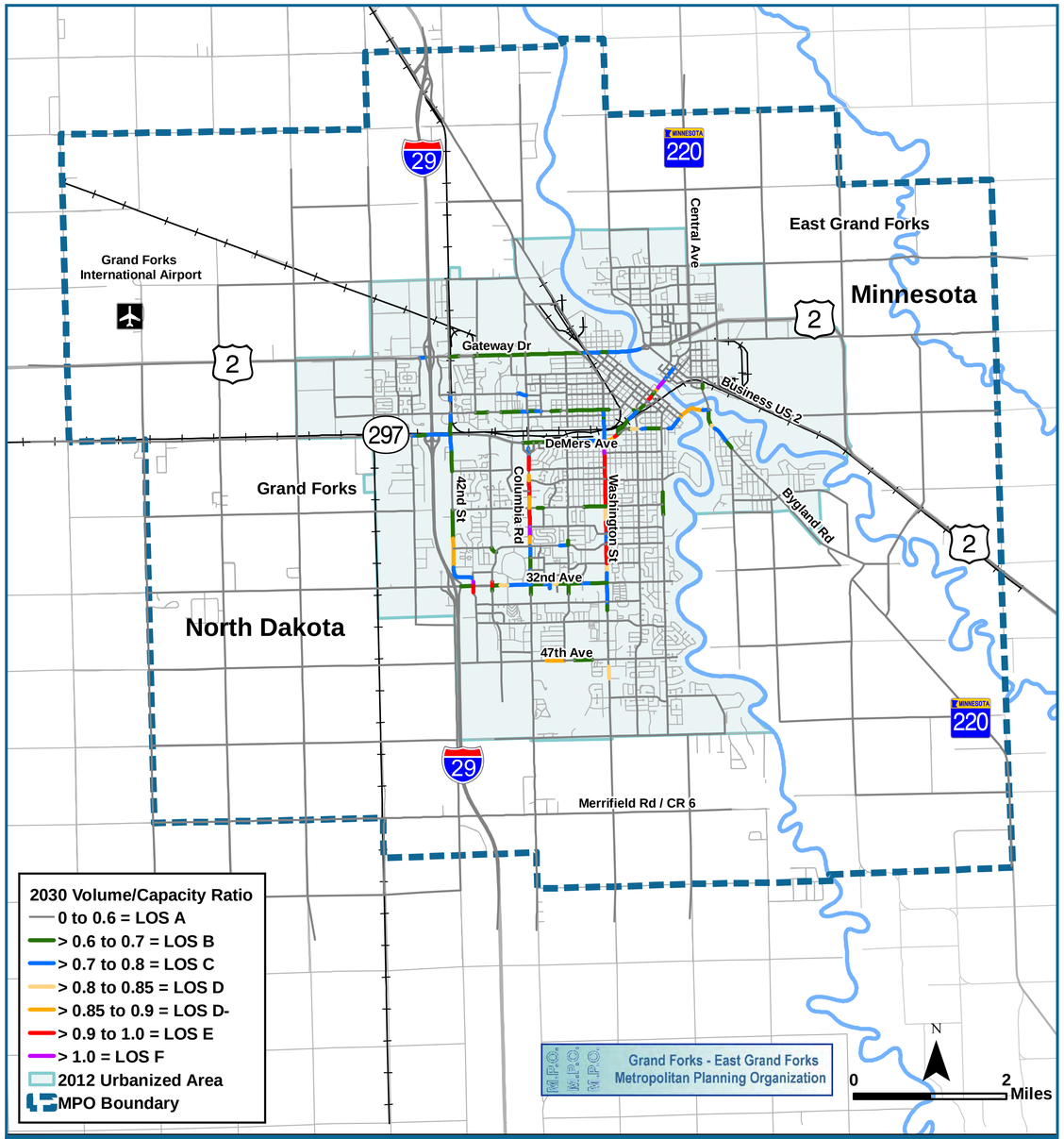


2030

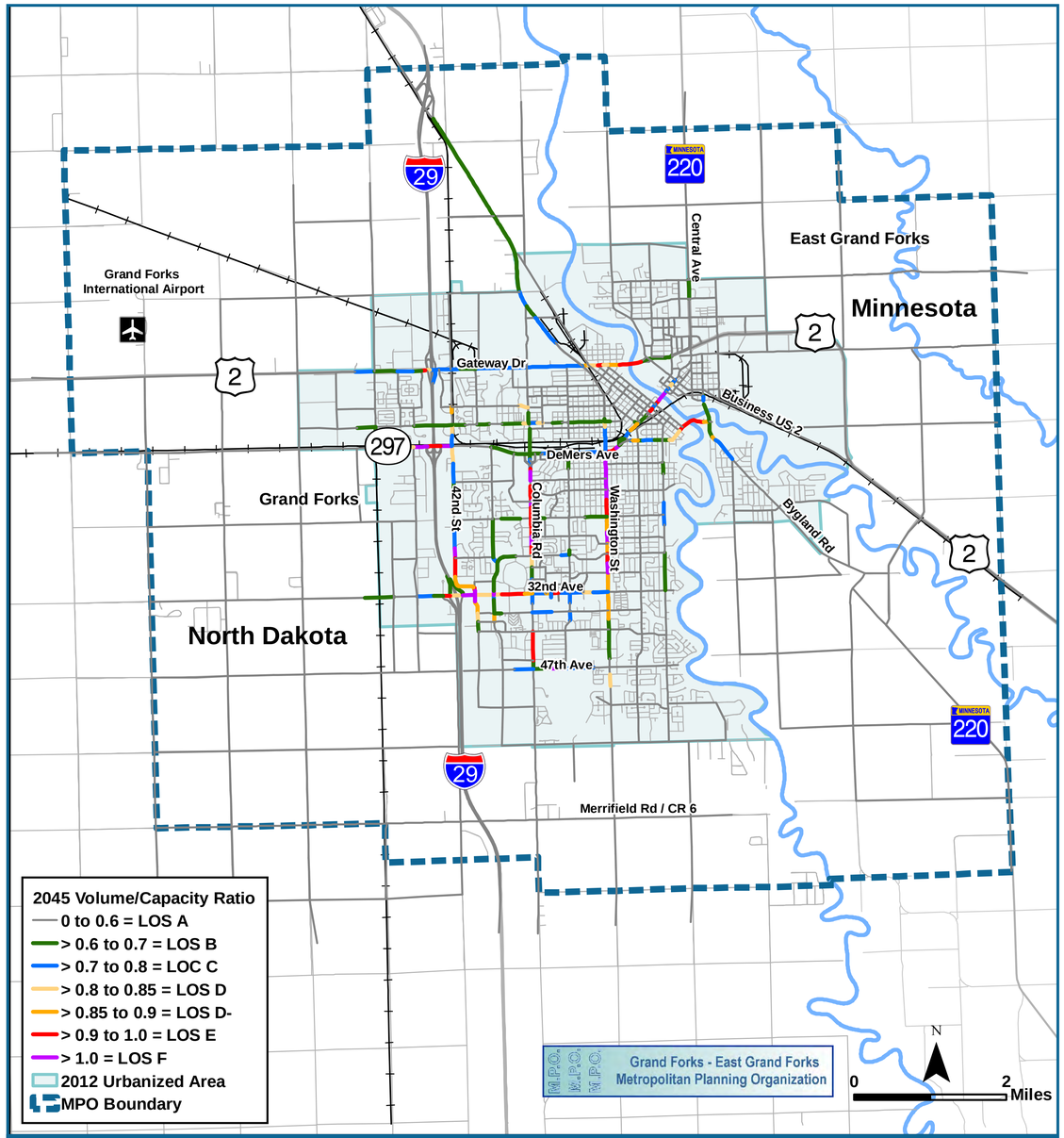


2045

Forecast Volume to Capacity Ratios

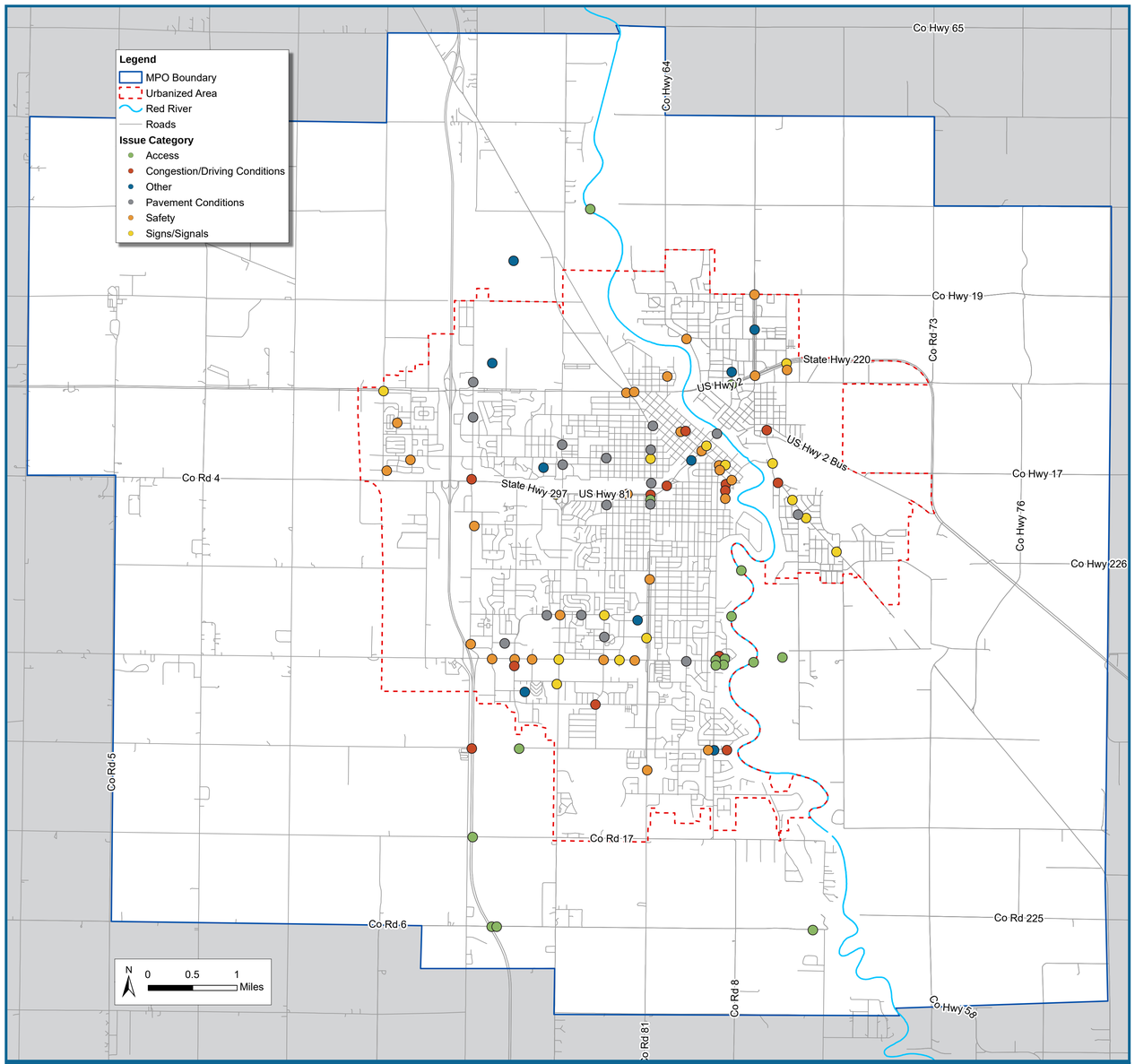


2030



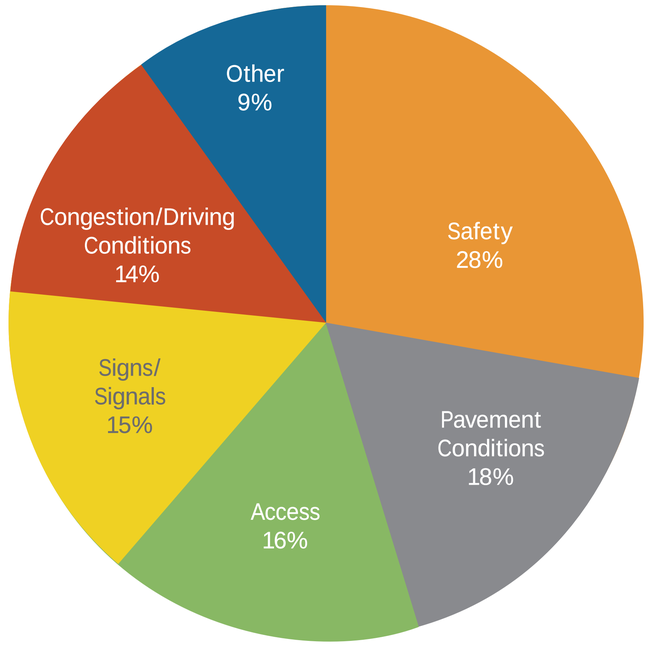
2045

Issues Identified



Your Input

INTERACTIVE MAP INPUT





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- **Performance Measure:** Things that can be measured to evaluate if a standard is working
- **Performance Target:** Data point that defines success for a performance measure

What should we add or refine?

GOAL: SAFETY

Goal Statement	Increase safety of the transportation system for motorized and non-motorized uses.
Objectives	See Handout
Standards	See Handout

Performance Measures	Number of traffic fatalities	Number of fatalities per 100 million vehicle miles traveled	Number of crash-related serious injuries	Number of serious injuries per 100 million vehicle miles traveled	Number of non-motorized fatalities and non-motorized serious injuries	Others?
						■ Number of unrestrained passenger vehicle occupant ■ Number of fatalities involving a driver or motorcycle operator with a 0.08 BAC or above ■ Number of speed-related fatalities ■ Number of fatalities involving a motorcycle operator ■ Number of unhelmeted motorcycle fatalities ■ Number of drivers age 20 and younger involved in fatal crashes ■ Number of pedestrian fatalities ■ Number of bicyclist fatalities
Performance Targets Note: the MPO can adopt the state or a local target for each category	**DRAFT Local Target** ■ 3 or fewer traffic fatalities by 2018 ■ No change in trend **STATE TARGETS** NORTH DAKOTA ■ 138 traffic fatalities or fewer statewide ■ 0.5% decline in trend MINNESOTA ■ 375 traffic fatalities or fewer statewide ■ 3% decline in trend	**DRAFT Local Target** ■ 0.673/mvmt or lower by 2018 ■ No change in trend **STATE TARGETS** NORTH DAKOTA ■ 1.336/mvmt ■ 0.5% decline in trend MINNESOTA ■ 0.62/mvmt ■ No change in trend	**DRAFT Local Target** ■ 18 or fewer serious injuries by 2018 ■ Decline in trend **STATE TARGETS** NORTH DAKOTA ■ 516 serious injuries or fewer statewide ■ No change in trend MINNESOTA ■ 1,935 serious injuries or fewer statewide ■ Decline in trend	**DRAFT Local Target** ■ 5.933/mvmt or lower by 2018 ■ Decline in trend **STATE TARGETS** NORTH DAKOTA ■ 5.088/mvmt MINNESOTA ■ 3.15/mvmt	**DRAFT Local Target** ■ 3 or fewer non-motorized fatal and serious injury crashes by 2018 ■ Decline in trend **STATE TARGETS** NORTH DAKOTA ■ 34 fatalities and serious injuries or fewer statewide ■ No change in trend MINNESOTA ■ 348 fatalities and serious injuries or fewer statewide ■ 5% decline in trend	

What Is Our Financial Plan?

A financial plan aligns revenues with eligible projects.

WHAT ARE OUR INVESTMENT PRIORITIES?

Help us update the investment priorities that will inform the financial plan.

INVESTMENT CATEGORY	Economic Vitality	Security	Accessibility and Mobility	Environmental/Energy/ Quality of Life	Integration and Connectivity	Efficient System Management	System Preservation	Safety	Resiliency	Tourism
Maintain and Rebuild Existing Infrastructure	●	●	●	●		●	●	●	●	●
Safety Improvements	●		●					●	●	●
Improve Traffic Signals and Technology	●		●	●	●	●		●	●	●
Build New Freeway Interchanges	●		●	●				●	●	●
Build New River Crossings	●		●		●			●	●	
Add General Lanes - Add Lanes or Build New Roads	●		●							●

2045 STREET AND HIGHWAY PLAN REVENUE SOURCES

FEDERAL

- Highway Safety Improvement Program (HSIP)
- Surface Transportation Block Grant Program (STPBG)
- National Highway Performance Program (NHPP)
- National Highway Freight Program
- National Discretionary Programs (INFRA, TIGER, etc.)

NORTH DAKOTA

- Urban Roads Program
- Main Street Urban Grant Program (NEW!)
- State Highways Tax Distribution Fund
- County Road Fund

MINNESOTA

- Area Transportation Partnership City Sub-Targets; County Sub-Target
- State Trunk Highway Fund
- Municipal State Aid
- Corridors of Commerce Program
- Transportation Economic Development (TED) Program

GRAND FORKS

- Sales tax (Current + NEW!)
- Special assessments
- General funds

EAST GRAND FORKS

- Special assessment
- General funds

GRAND FORKS COUNTY

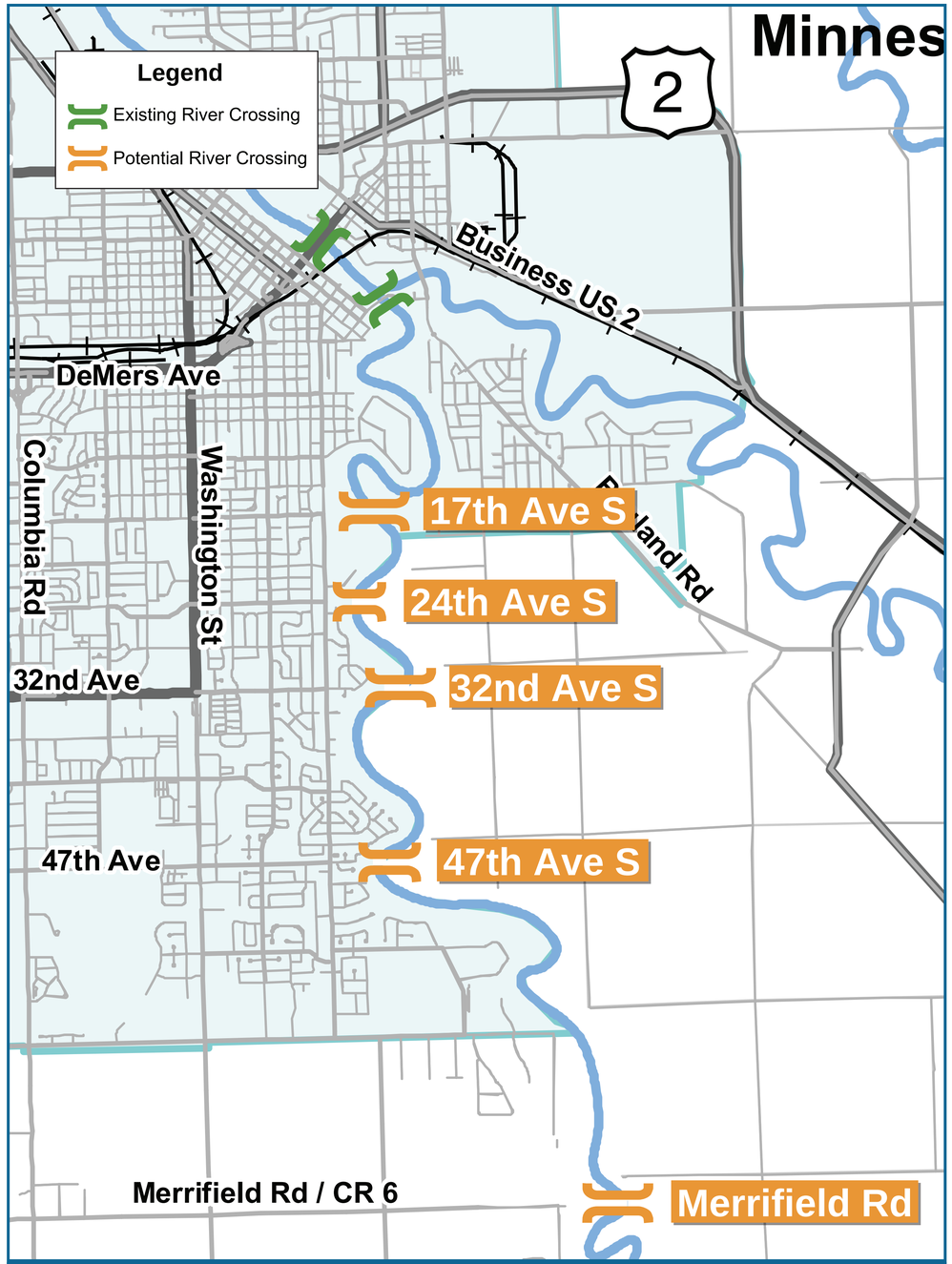
POLK COUNTY

ISSUES

- Costs are rising faster than federal and state revenues
- Developing reasonably expected revenue estimates for new sources (ND HSIP, ND Main Street Program, Grand Forks sales tax)
- Identifying and positioning projects to successfully compete for grants
- Maintenance and operations costs are a significant part of overall costs

Traffic Forecasting

- Review transportation impacts of 5 river crossing locations
- Improve local traffic and connectivity
- Use 2045 travel demand model
- Review impacts on:
  - Existing crossings
  - Neighborhoods
  - Local and regional roadway network
- Compare impacts of each crossing
- Reduce number of alternatives to analyze further



Potential River Crossing Locations

Schedule

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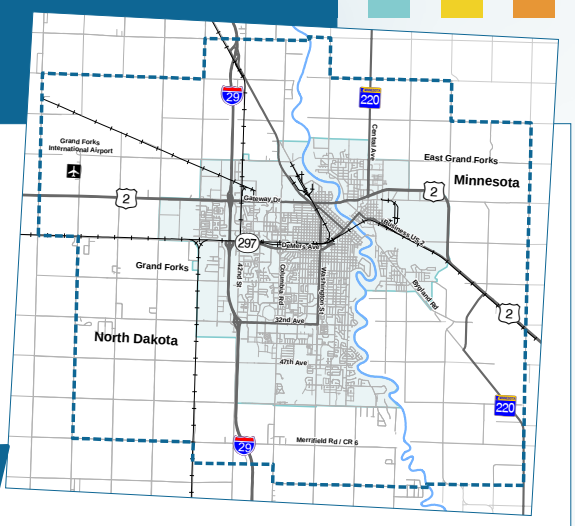
	INTERACTIVE ONLINE ACTIVITIES						
PLAN UPDATE PROCESS	DEVELOP GOALS, OBJECTIVES, AND PERFORMANCE MEASURES			PREPARE RECOMMENDATIONS AND IMPLEMENTATION REPORT			
	IDENTIFY ISSUES AND ALTERNATIVES						
	ANALYZE EXISTING AND FUTURE CONDITIONS						

Grand Forks-East Grand Forks MPO
STREET/HIGHWAY PLAN UPDATE



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LRTPs include three elements:

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- **Transit**
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This update will communicate local investment needs and priorities for **streets and highways** in the MPO area and address the federal regulations in the Fixing America's Surface Transportation (FAST) Act. The transit and pedestrian/bicycle elements are being addressed separately.

How can I engage with the plan update?

There will be multiple opportunities to learn about the project and provide input regarding the street and highway system in the MPO area, both in person and online. We'd love to hear from you!

- Come talk to us at the public meetings
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- Check out the project website to see project reports and other materials and provide your comments
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Who is involved?

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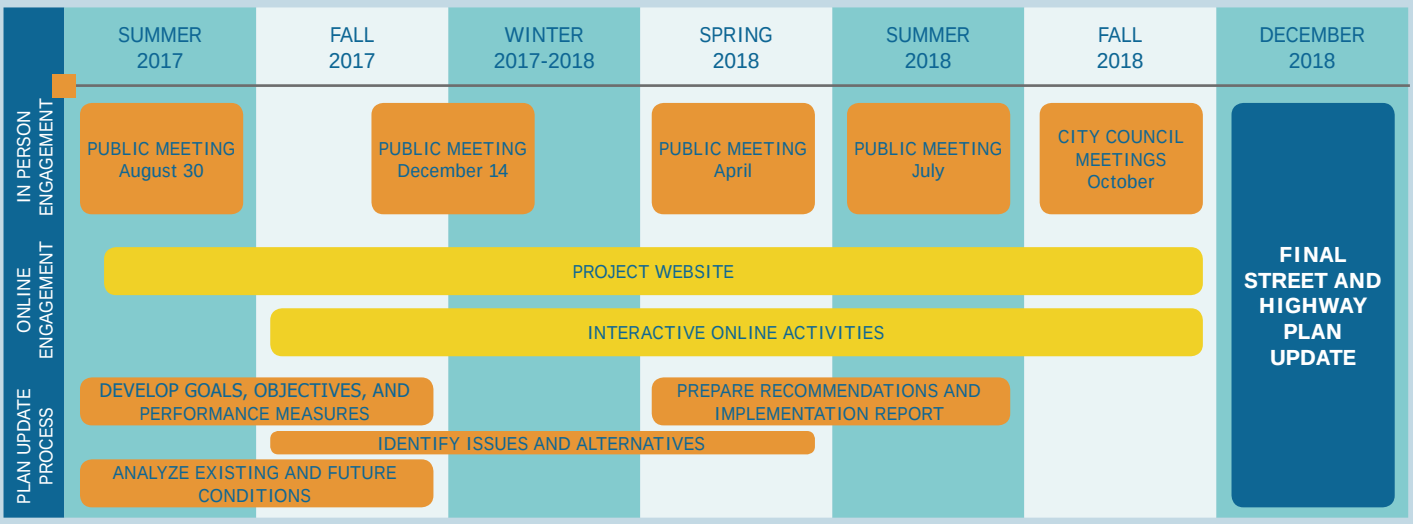
- City of Grand Forks
- City of East Grand Forks
- Grand Forks County
- Polk County
- Federal Highway Administration
- Federal Transit Administration
- Residents and other stakeholders





Project website: www.theforksstreets2045.org

Grand Forks - East Grand Forks Metropolitan Planning Organization

Kimley»Horn WSB

Grand Forks-East Grand Forks MPO
STREET/HIGHWAY PLAN UPDATE

COMMENT CARD

Please share your thoughts below or on the project website at
https://www.theforksstreets2045.org/contact

OPTIONAL

NAME A.D. René PHONE 701 270 2364

ADDRESS 2750 5TH 40TH ST ~~ST~~ EMAIL APT 319

Grand Forks, ND 58201

COMMENT #1 Remove All RR Tracks South of Gateway Drive ~~GF~~ Grand Forks ND. Run New Tracks N of GF & EGF.

Grand Forks-East Grand Forks MPO
STREET/HIGHWAY PLAN UPDATE

COMMENT CARD

Please share your thoughts below or on the project website at
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OPTIONAL

NAME _____ PHONE _____

ADDRESS _____ EMAIL _____

COMMENT A New bridge and street Improvment should be #1 on the list

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STREET/HIGHWAY PLAN UPDATE

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Please share your thoughts below or on the project website at
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OPTIONAL

NAME Eric Castle

PHONE 218-280-9050

ADDRESS 504 N. Columbia RD, 6F

EMAIL ericcastle@gmail.com

COMMENT I walk like more bike + pedestrian infrastructure. East + West flowing bike traffic is very difficult + dangerous. ~~Enhanced~~ Enhance the bike lane on University; currently it is ~~dece~~ faded and not respected by cars. Solid painted lane markers would be very nice and greatly increase the safety + usability of this bike lane

Grand Forks - East Grand Forks Metropolitan Planning Organization

Kimley»Horn WSB

PUBLIC INPUT MEETING

WHY?

Come learn about the range of alternatives, how they'll be evaluated, and the public input we received on funding priorities. We'll also share analysis of different river crossing options.

WHEN?

April 18, 2018
5:30 PM to 7:00 PM
Presentation at 6:00 PM

WHERE?

Sterling Room
Choice Health and Fitness
4401 S. 11th St.
Grand Forks, ND

OPEN HOUSE CONDUCTED BY

M.P.O. M.P.O. M.P.O.
Grand Forks - East Grand Forks
Metropolitan Planning Organization

Representatives from the Grand Forks/ East Grand Forks Metropolitan Planning Organization (GF-EGF MPO) and Kimley-Horn/WSB Consulting Team will be on hand to answer your questions and discuss your concerns. Additional information available at www.theforksmpo.org

WRITTEN STATEMENTS or comments about this project must be mailed by April 30th, to Earl Haugen, GF-EGF MPO, PO Box 5200, Grand Forks, ND 58206
Email: info@theforksmpo.org
Note "Street and Highway" in email subject heading.

The GF-EGF MPO will consider every request for reasonable accommodation to provide:

- an accessible meeting facility or other accommodation for people with disabilities,
- language interpretation for people with limited English proficiency (LEP), and
- translations of written material necessary to access GF-EGF MPO programs and information.

Appropriate provisions will be considered when the MPO is notified at least 5 days prior to the meeting date or the date the written material translation is needed.

To request accommodations, contact Earl Haugen, at 701-746-2660 or earl.haugen@theforksmpo.org.

Public Meeting #3 Summary

Time and Location

Wednesday, April 18, 2018
5:30-7:00 p.m.

Choice Health & Fitness
Sterling Meeting Room
4401 South 11th Street
Grand Forks, ND 58201

Purpose of Meeting

The purpose of the third public meeting was to present the range of alternatives, discuss how the alternatives will be evaluated, and share the public input received on funding priorities.

Materials

Display boards were available that provided information on the LRTP and Street and Highway Plan Update, the project schedule, forecast average daily traffic, forecast volume to capacity ratios, issues identified through the first public meeting and interactive mapping activity, the 2045 LRTP vision statement and draft goals, performance-based planning, the financial plan, input received from the second public meeting and an interactive activity on funding priorities, the range of alternatives, the alternatives evaluation framework, and the river crossing analysis. This information was also presented through a formal presentation during the public meeting.

Participants

Fourteen attendees signed in on the meeting sign-in sheets, and nine attendees completed the NDDOT Title VI Public Participation Survey. The results of this survey are summarized below.

- Sex
  - Number of respondents: 9
  - Male: 8 (89%)
  - Female: 1 (11%)
- Disability
  - Number of respondents: 7
  - Yes: 1 (14%)
  - No: 6 (86%)
- Age
  - Number of respondents: 7
  - 34 and younger: 1 (14%)
  - 35-54: 2 (29%)
  - 55 and older: 4 (57%)

- Race
  - Number of respondents: 9
  - White: 9 (100%)
- Language most frequently spoken in your home
  - Number of respondents: 7
  - English: 7 (100%)
- Do you receive public assistance?
  - Number of respondents: 9
  - No: 9 (100%)
- Indicate how you heard about the event (note that some respondents checked more than one box)
  - Number of respondents: 7
  - Internet: 5 (71%)
  - Radio: 2 (29%)
  - Advocacy Group: 1 (14%)
  - Mailing: 2 (29%)
  - NDDOT Contact: 1 (14%)
  - Newspaper: 2 (29%)

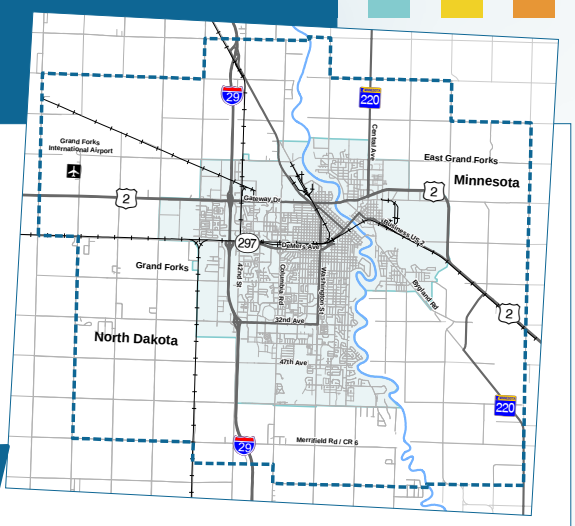
Input Received

No written comment forms were submitted at the public meeting.

Next Steps

Public Meeting #4 is anticipated to occur in summer 2018. This public meeting will present the evaluation of how the range of alternatives compare to each other and address identified goals, objectives, and performance measures. Tradeoffs between the various implementation packages will be discussed. As this will be the final public meeting, the proposed final implementation package of projects that are prioritized, financially constrained, and based on the goals, objectives, performance measures, and performance targets will be presented.

Grand Forks-East Grand Forks MPO
STREET/HIGHWAY PLAN UPDATE



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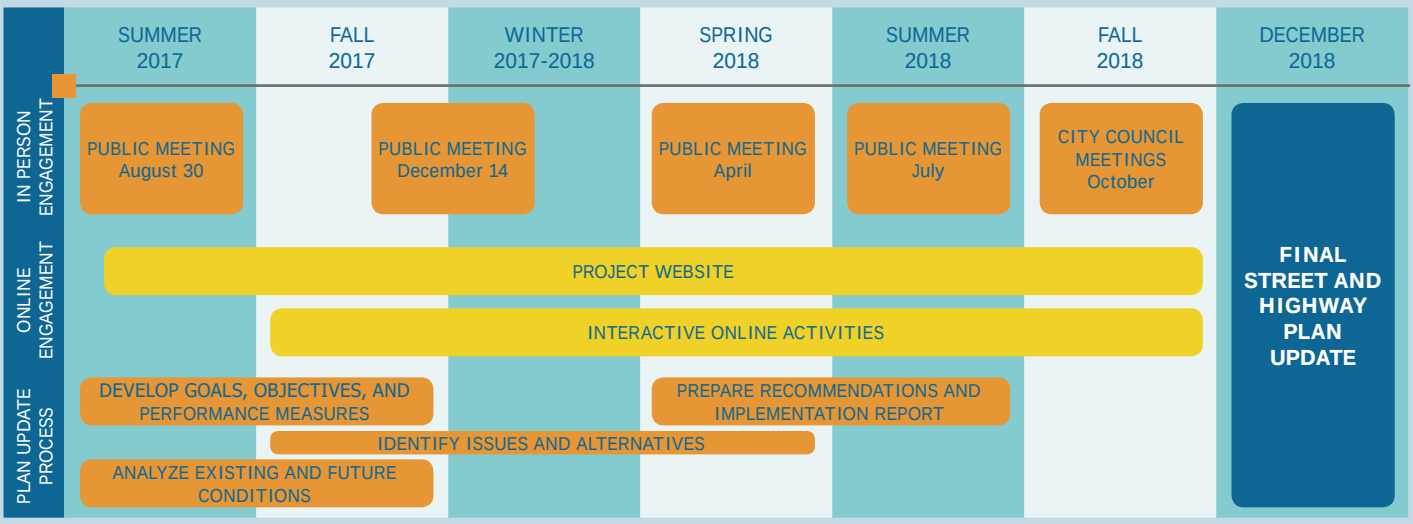

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Grand Forks - East Grand Forks Metropolitan Planning Organization

Kimley»Horn WSB

Grand Forks-East Grand Forks MPO

STREET/HIGHWAY PLAN UPDATE

Welcome

Public Meeting

Grand Forks-East Grand Forks Metropolitan Planning Organization

M.P.O. M.P.O. M.P.O. Grand Forks - East Grand Forks Metropolitan Planning Organization

Kimley»Horn

WSB & Associates, Inc.

Overview

What is a Long-Range Transportation Plan (LRTP)?

- Sets a direction and strategies to help shape a region's transportation network
- Includes three elements:

Streets and highways | Transit | Pedestrians and bicycles

- The MPO is required to update its LRTP every 5 years – the last update for Grand Forks-East Grand Forks was completed in 2013

What's an MPO?

Federal law requires that all urbanized areas in the US with populations over 50,000 people establish Metropolitan Planning Organizations (MPO) responsible for area transportation planning and programming services.

What is the Street and Highway Plan Update?

- This part of the LRTP will develop a performance-based investment decision framework for the streets and highways in the MPO area that is consistent with requirements of the FAST Act

Who is Involved?

- North Dakota Department of Transportation
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U.S. Department of Transportation Federal Highway Administration

U.S. Department of Transportation Federal Transit Administration

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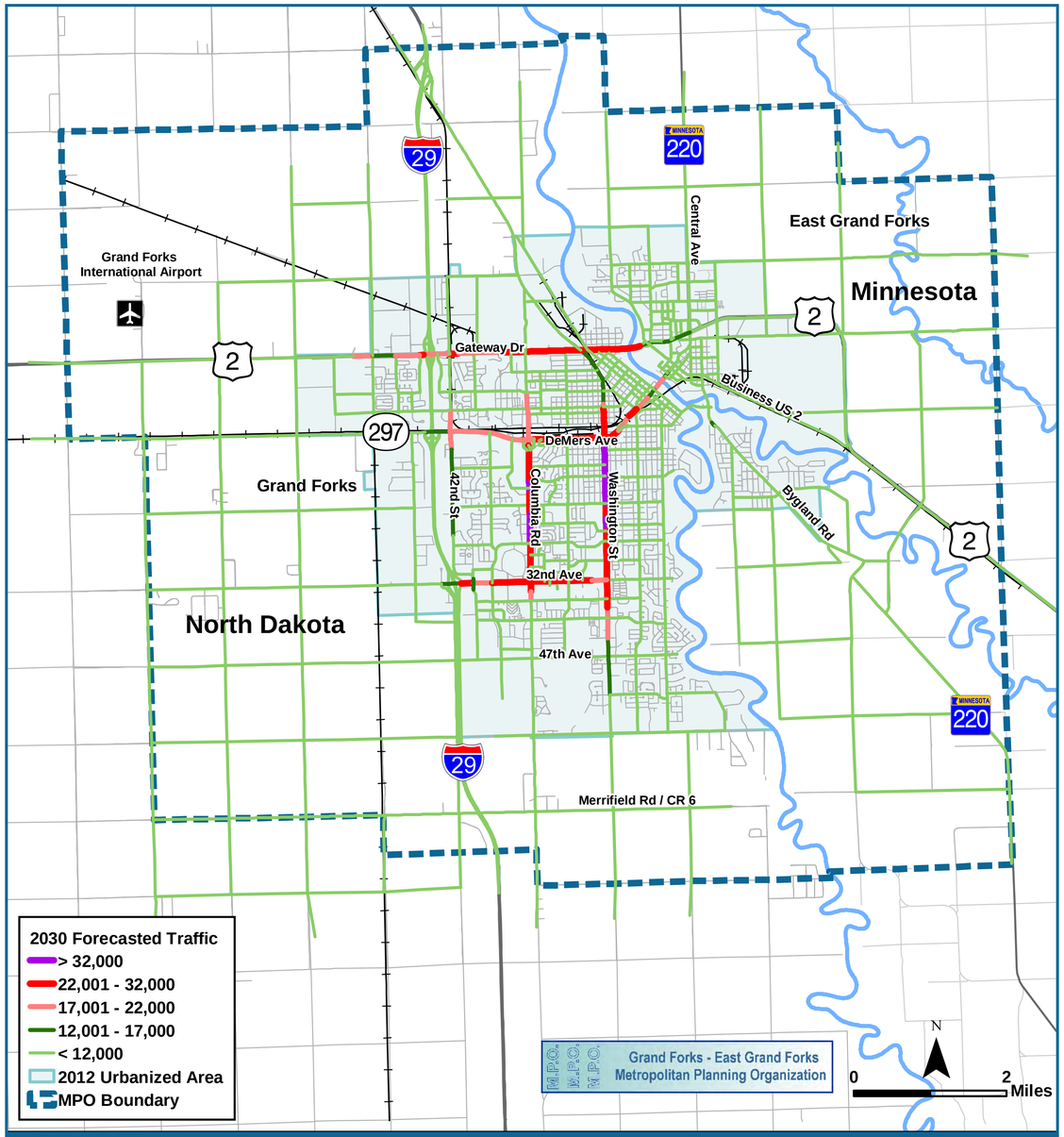
Forecast Average Daily Traffic



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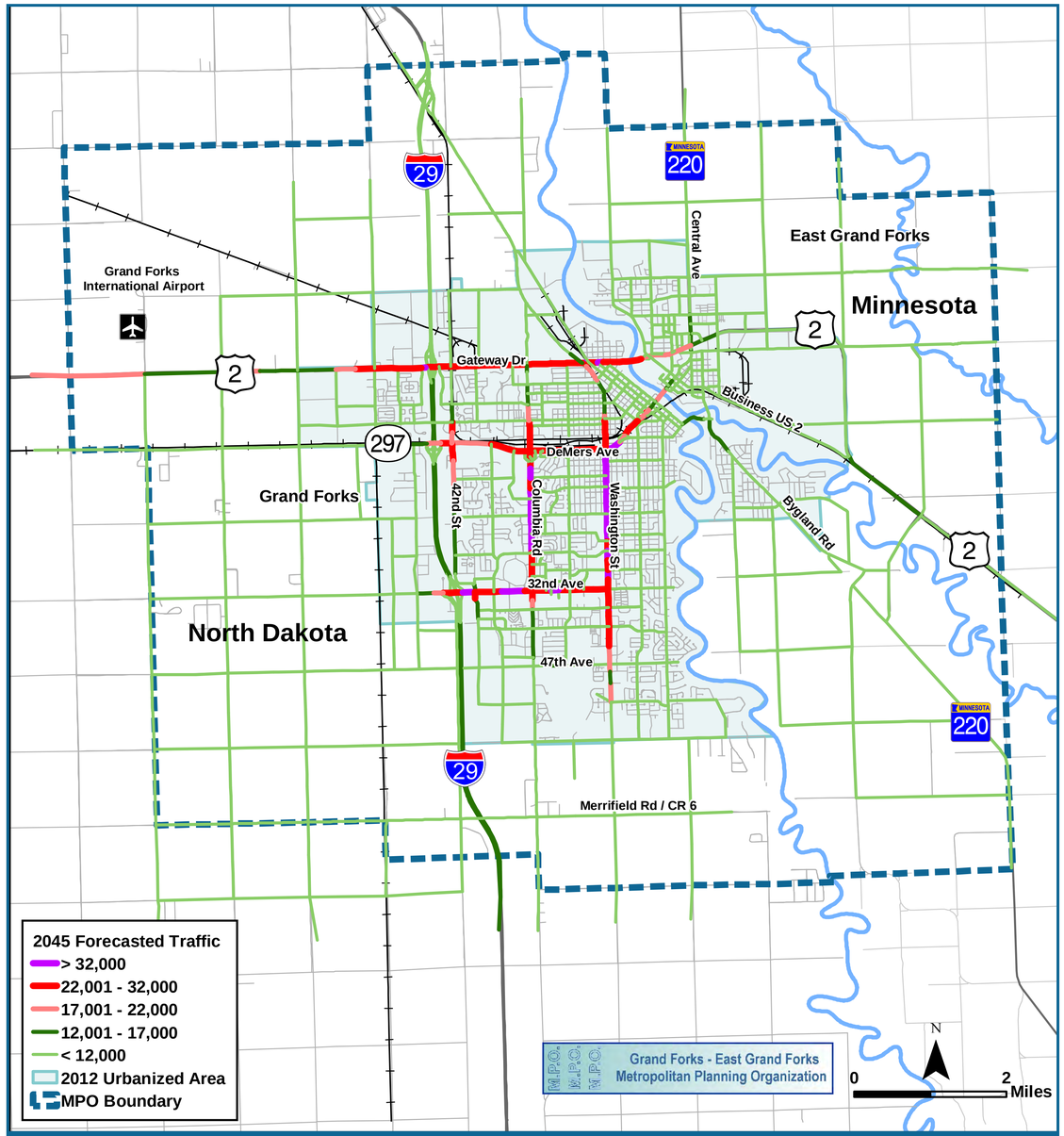
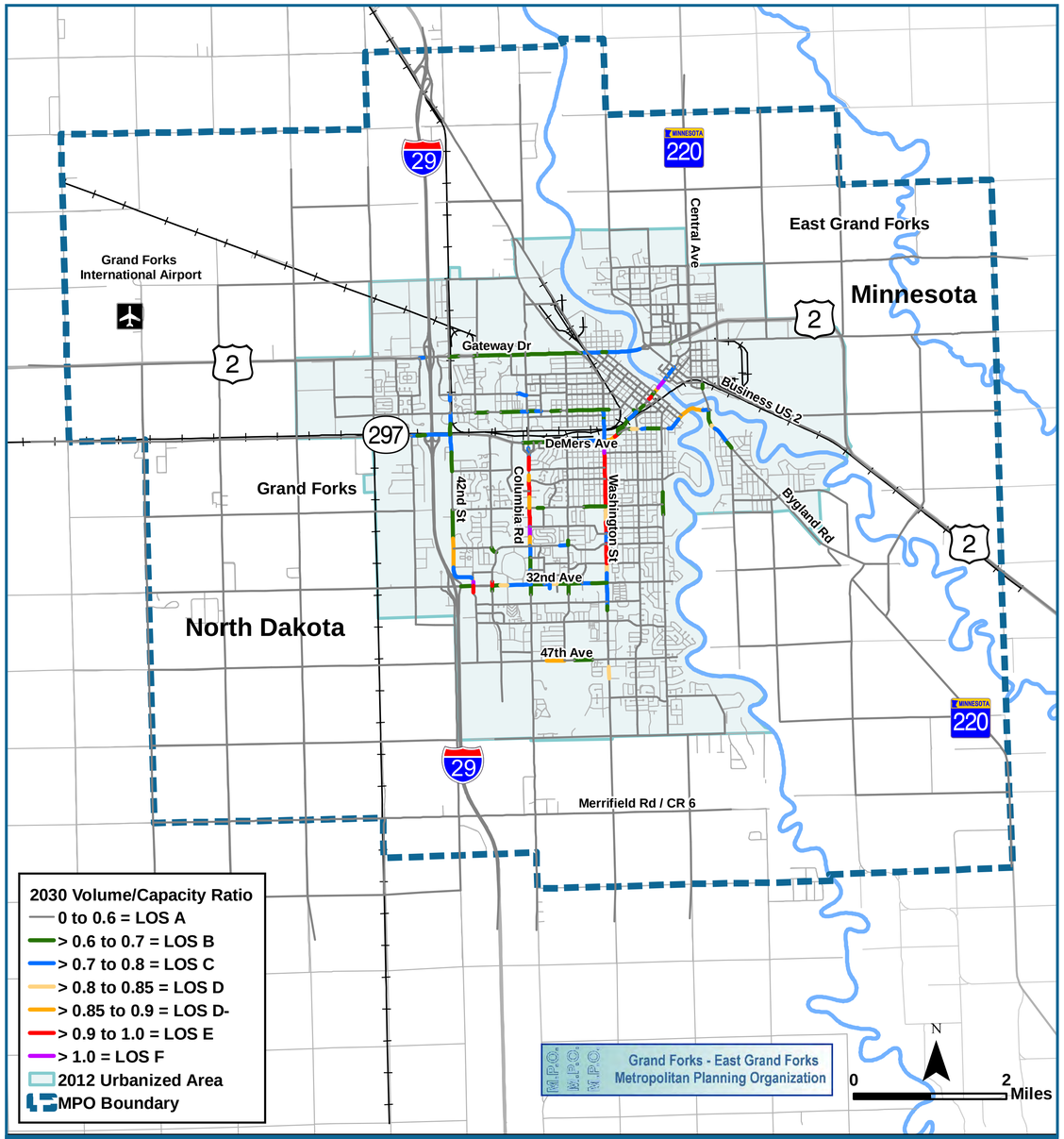


2045

Forecast Volume to Capacity Ratios



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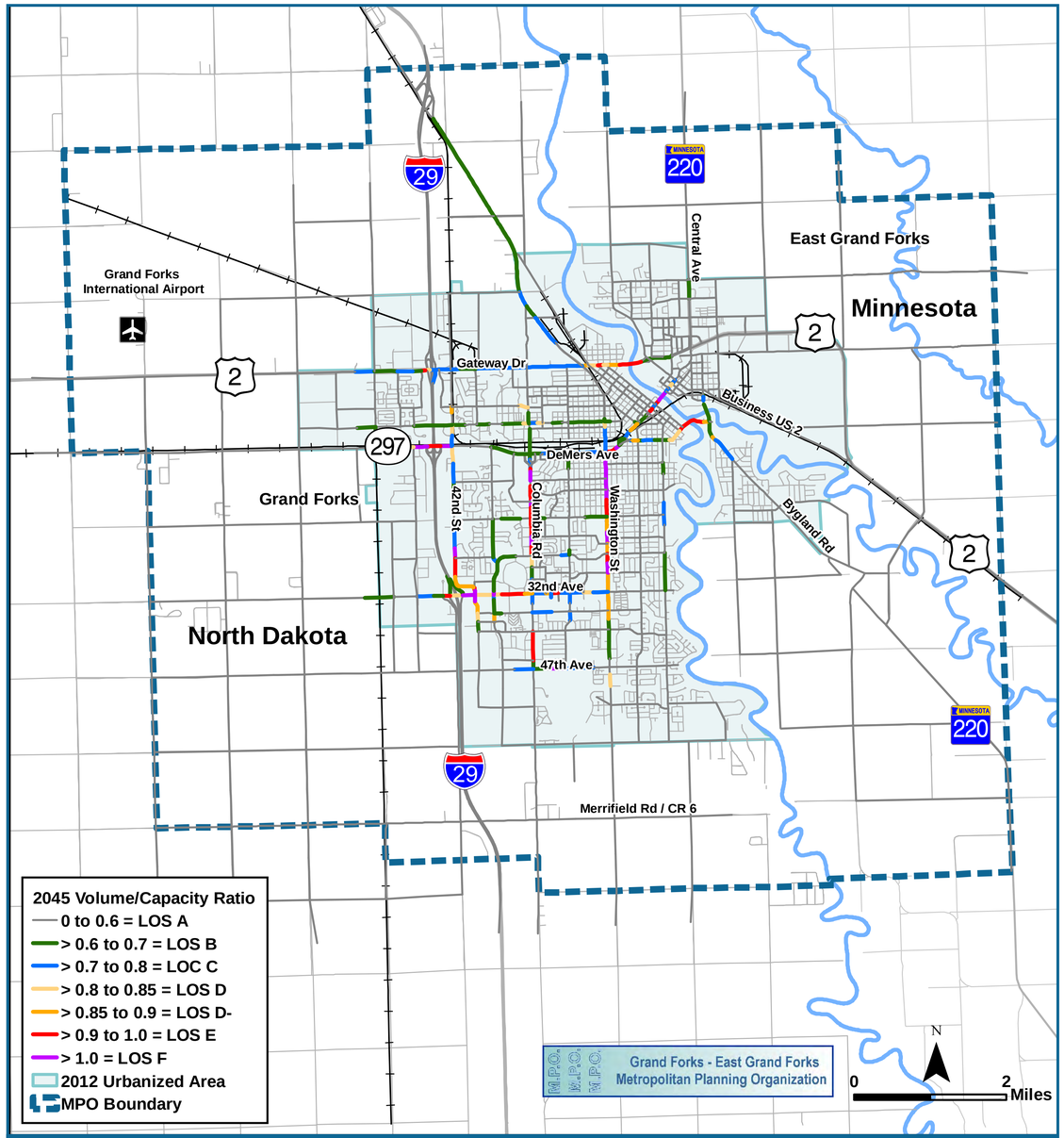

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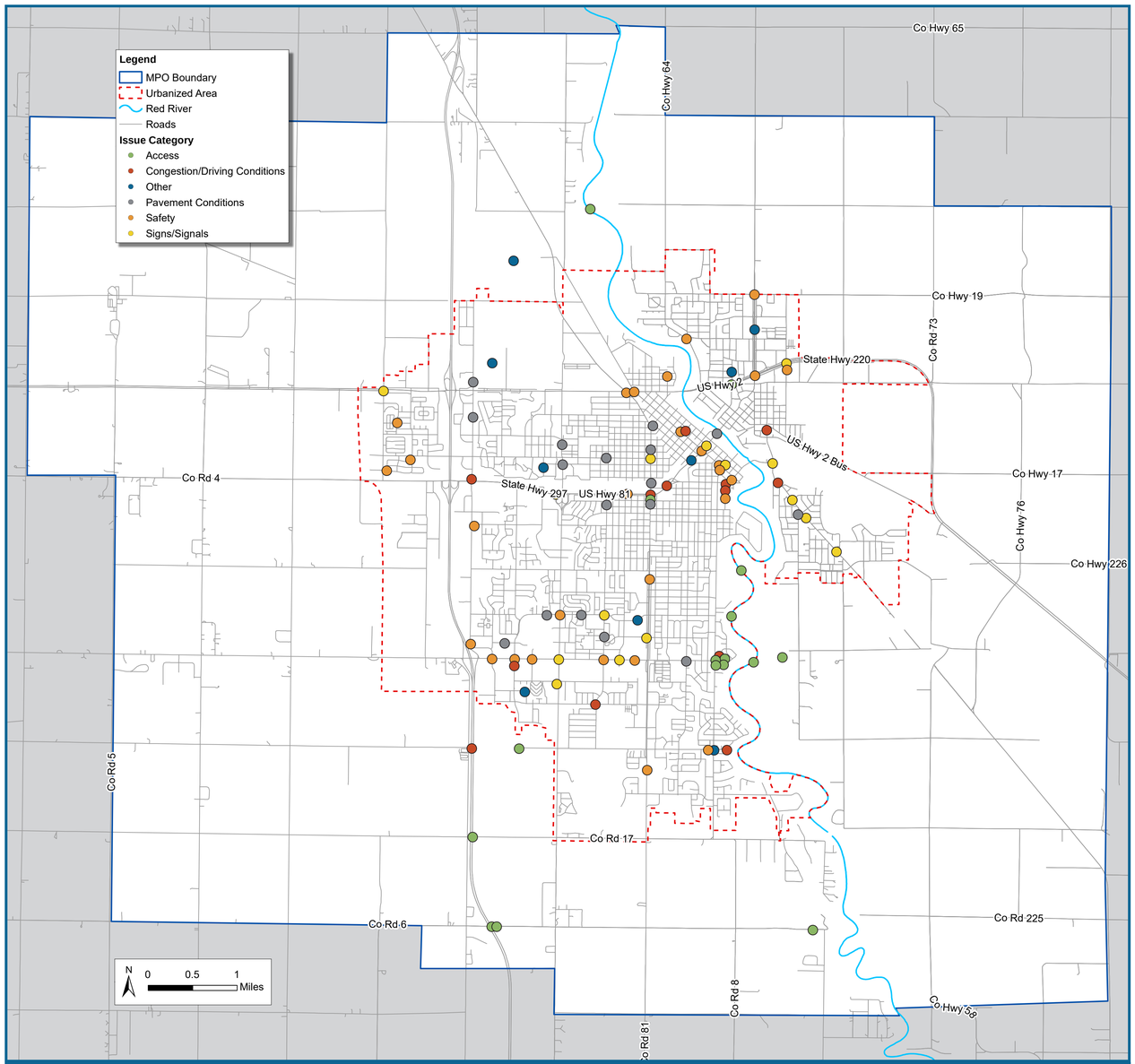

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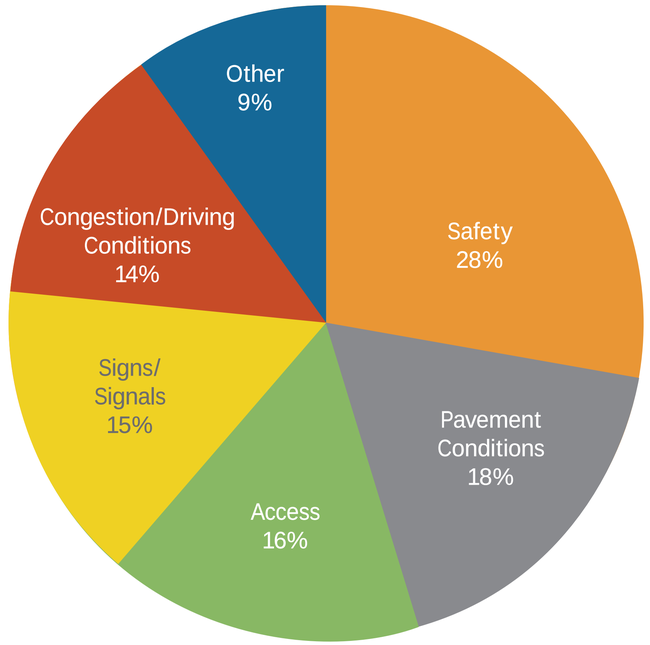



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NOTE:

The safety performance measures and targets were adopted at the February 21, 2018 MPO meeting. These targets will be reviewed and adopted annually by the MPO.

GOAL

	SAFETY				
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Objectives	See handout				
Standards	See handout				
Performance Measures	Number of traffic fatalities	Number of fatalities per 100 million vehicle miles traveled	Number of crash-related serious injuries	Number of serious injuries per 100 million vehicle miles traveled	Number of non-motorized fatalities and non-motorized serious injuries
Performance Targets	**Local Target:** ▪ 3 or fewer traffic fatalities by 2018 ▪ No change in trend	**Local Target:** ▪ 0.673/mvmt or lower by 2018 ▪ No change in trend	**Local Target:** ▪ 18 or fewer serious injuries by 2018 ▪ Decline in trend	**Local Target:** ▪ 5.933/mvmt or lower by 2018 ▪ Decline in trend	**Local Target:** ▪ 3 or fewer non-motorized fatal and serious injury crashes by 2018 ▪ Decline in trend
	State Targets: NORTH DAKOTA ▪ 138 traffic fatalities or fewer statewide ▪ 0.5% decline in trend MINNESOTA ▪ 375 traffic fatalities or fewer statewide ▪ 3% decline in trend	**State Targets:** NORTH DAKOTA ▪ 1.336/mvmt ▪ 0.5% decline in trend MINNESOTA ▪ 0.62/mvmt ▪ No change in trend	**State Targets:** NORTH DAKOTA ▪ 516 serious injuries or fewer statewide ▪ No change in trend MINNESOTA ▪ 1,935 serious injuries or fewer statewide ▪ Decline in trend	**State Targets:** NORTH DAKOTA ▪ 5.088/mvmt MINNESOTA ▪ 3.15/mvmt	**State Targets:** NORTH DAKOTA ▪ 34 fatalities and serious injuries or fewer statewide ▪ No change in trend MINNESOTA ▪ 348 fatalities and serious injuries or fewer statewide ▪ 5% decline in trend

What Is Our Financial Plan?

A financial plan aligns revenues with eligible projects.

WHAT ARE OUR INVESTMENT PRIORITIES?

Help us update the investment priorities that will inform the financial plan.

INVESTMENT CATEGORY	Economic Vitality	Security	Accessibility and Mobility	Environmental/Energy/ Quality of Life	Integration and Connectivity	Efficient System Management	System Preservation	Safety	Resiliency	Tourism
Maintain and Rebuild Existing Infrastructure	●	●	●	●		●	●	●	●	●
Safety Improvements	●		●					●	●	●
Improve Traffic Signals and Technology	●		●	●	●	●		●	●	●
Build New Freeway Interchanges	●		●	●				●	●	●
Build New River Crossings	●		●		●			●	●	
Add General Lanes - Add Lanes or Build New Roads	●		●							●

2045 STREET AND HIGHWAY PLAN REVENUE SOURCES

FEDERAL

- Highway Safety Improvement Program (HSIP)
- Surface Transportation Block Grant Program (STPBG)
- National Highway Performance Program (NHPP)
- National Highway Freight Program
- National Discretionary Programs (INFRA, TIGER, etc.)

NORTH DAKOTA

- Urban Roads Program
- Main Street Urban Grant Program (NEW!)
- State Highways Tax Distribution Fund
- County Road Fund

MINNESOTA

- Area Transportation Partnership City Sub-Targets; County Sub-Target
- State Trunk Highway Fund
- Municipal State Aid
- Corridors of Commerce Program
- Transportation Economic Development (TED) Program

GRAND FORKS

- Sales tax (Current + NEW!)
- Special assessments
- General funds

EAST GRAND FORKS

- Special assessment
- General funds

GRAND FORKS COUNTY

POLK COUNTY

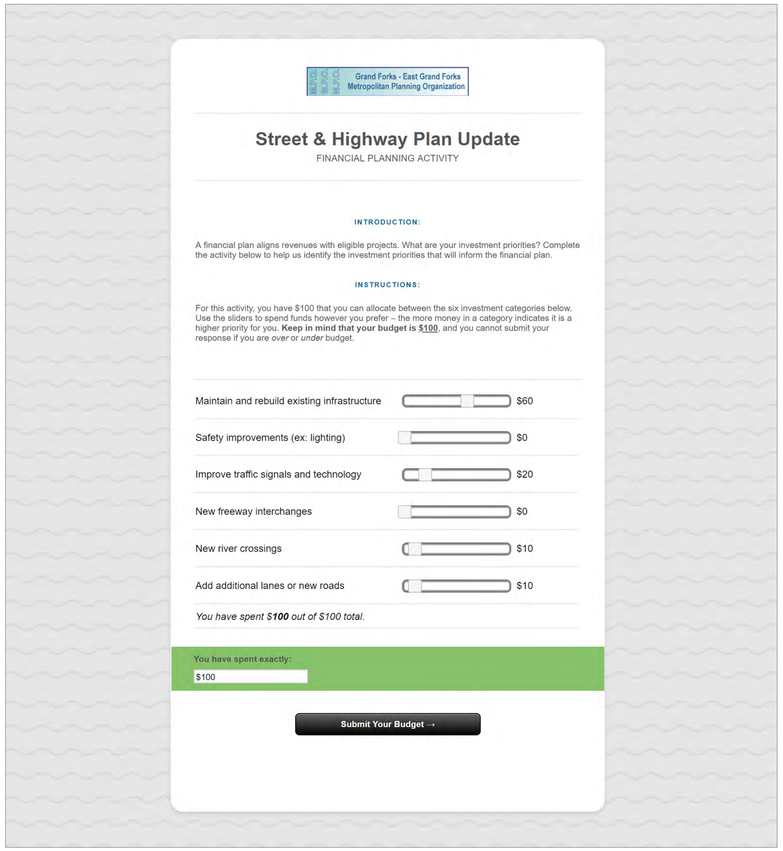
ISSUES

- Costs are rising faster than federal and state revenues
- Developing reasonably expected revenue estimates for new sources (ND HSIP, ND Main Street Program, Grand Forks sales tax)
- Identifying and positioning projects to successfully compete for grants
- Maintenance and operations costs are a significant part of overall costs

Financial Planning Activity

What We Heard:

- Participants allocated $100 between six public investment categories
- Received 69 responses in person and online



Grand Forks - East Grand Forks Metropolitan Planning Organization

Street & Highway Plan Update

FINANCIAL PLANNING ACTIVITY

INTRODUCTION:

A financial plan aligns revenues with eligible projects. What are your investment priorities? Complete the activity below to help us identify the investment priorities that will inform the financial plan.

INSTRUCTIONS:

For this activity, you have $100 that you can allocate between the six investment categories below. Use the sliders to spend funds however you prefer – the more money in a category indicates it is a higher priority for you. **Keep in mind that your budget is $100**, and you cannot submit your response if you are *over* or *under* budget.

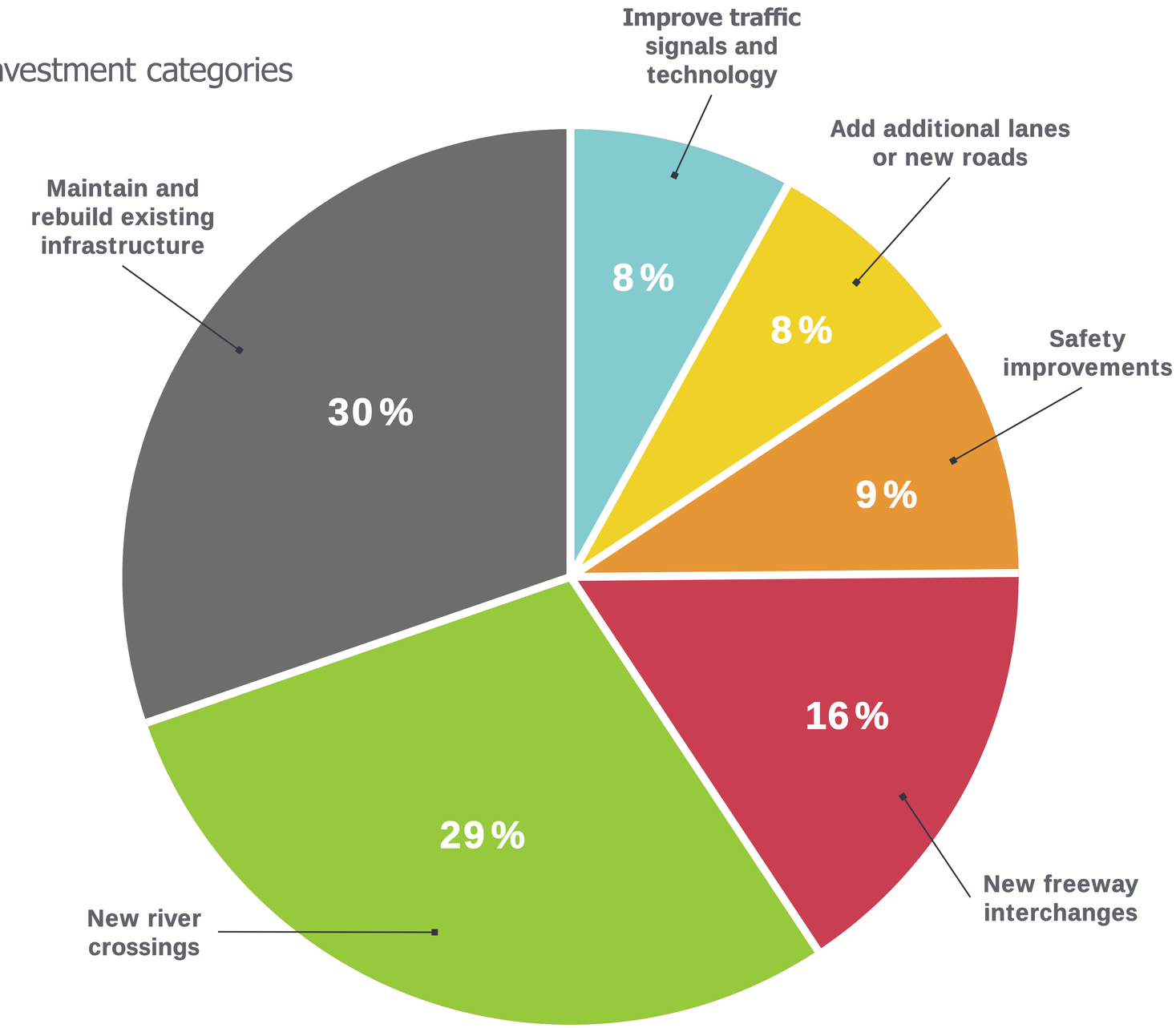
Maintain and rebuild existing infrastructure	$60
Safety improvements (ex: lighting)	$0
Improve traffic signals and technology	$20
New freeway interchanges	$0
New river crossings	$10
Add additional lanes or new roads	$10

*You have spent **$100** out of $100 total.*

You have spent exactly:

$100

Submit Your Budget →

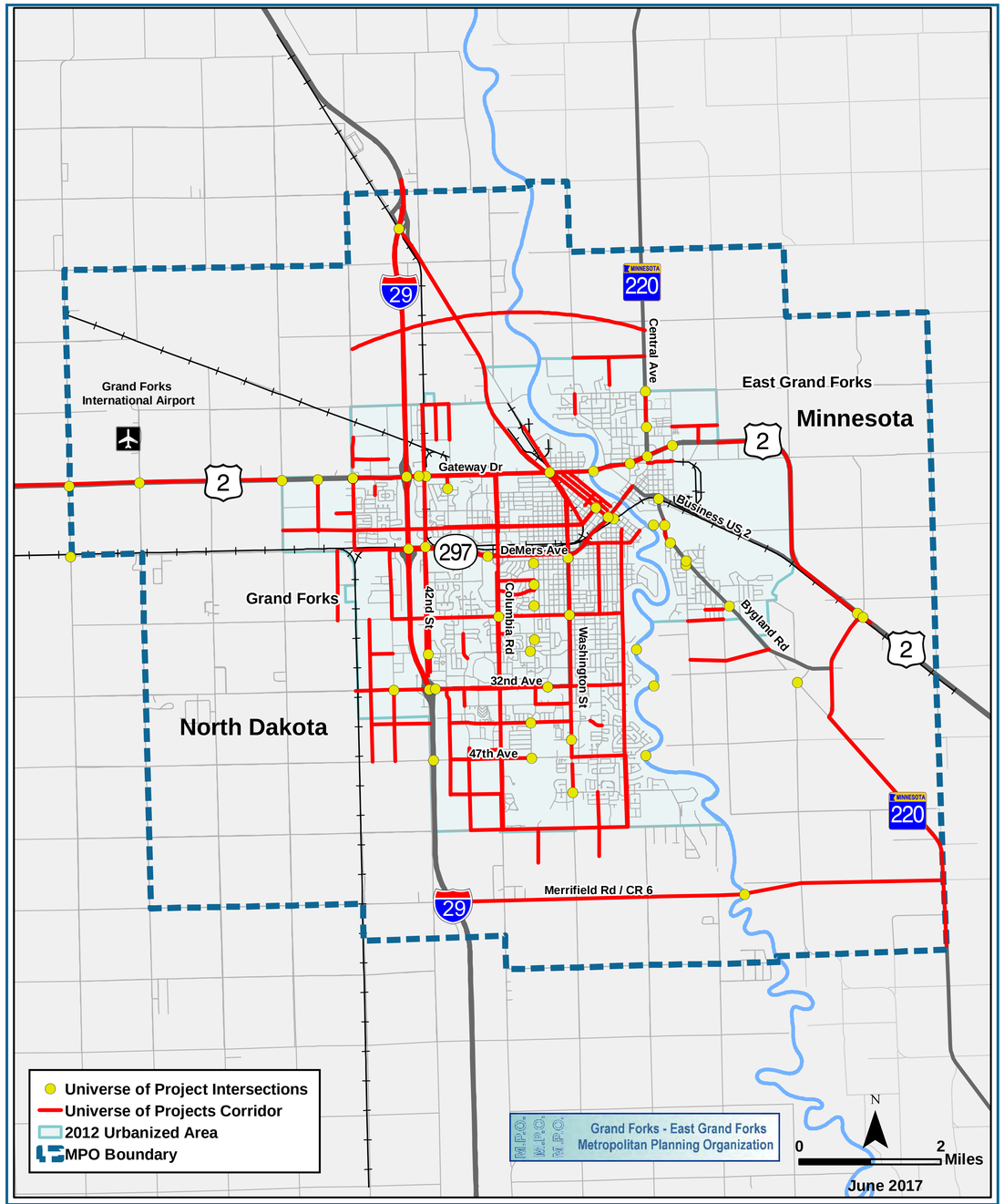


Range of Alternatives

2030/2045 Plan Universe of Project Needs:

Project Type	Current Cost	Percent of Total
MPO Transportation Improvement Program	$72,390,000	10.3%
Existing + Committed Network	$64,830,000	9.2%
Safety/Operations*	$18,910,000	2.7%
Multimodal Projects, Streetscape Projects, and Studies	$2,000,000	0.3%
State of Good Repair	$91,500,000	13.0%
Discretionary	$454,650,000	64.5%
TOTAL	$704,280,000	100%

*$14.1 million in TIP are safety/operations projects



Alternatives

Alternatives Evaluation Framework

ISSUES IDENTIFICATION

- MPO Transportation Improvement Program
- NDDOT and MnDOT State Transportation Improvement Programs
- City and County Capital Improvement Plans
- Existing conditions level of service
- Crash analysis
- Bridge sufficiency
- Pavement condition
- 2030/2045 traffic demand forecasts
- Interactive mapping, open house, staff and elected official input
- MPO 2040 Long-Range Transportation Plan project list
- Recent MPO corridor studies
- Public meetings
- Online engagement

MPO Transportation Improvement Program

Existing + Committed Network

Safety/ Operations

Multimodal Projects, Streetscape Projects, and Studies

State of Good Repair

Discretionary

Financial Forecast

Travel Demand Modeling

Public + Staff Input

Range of Alternatives

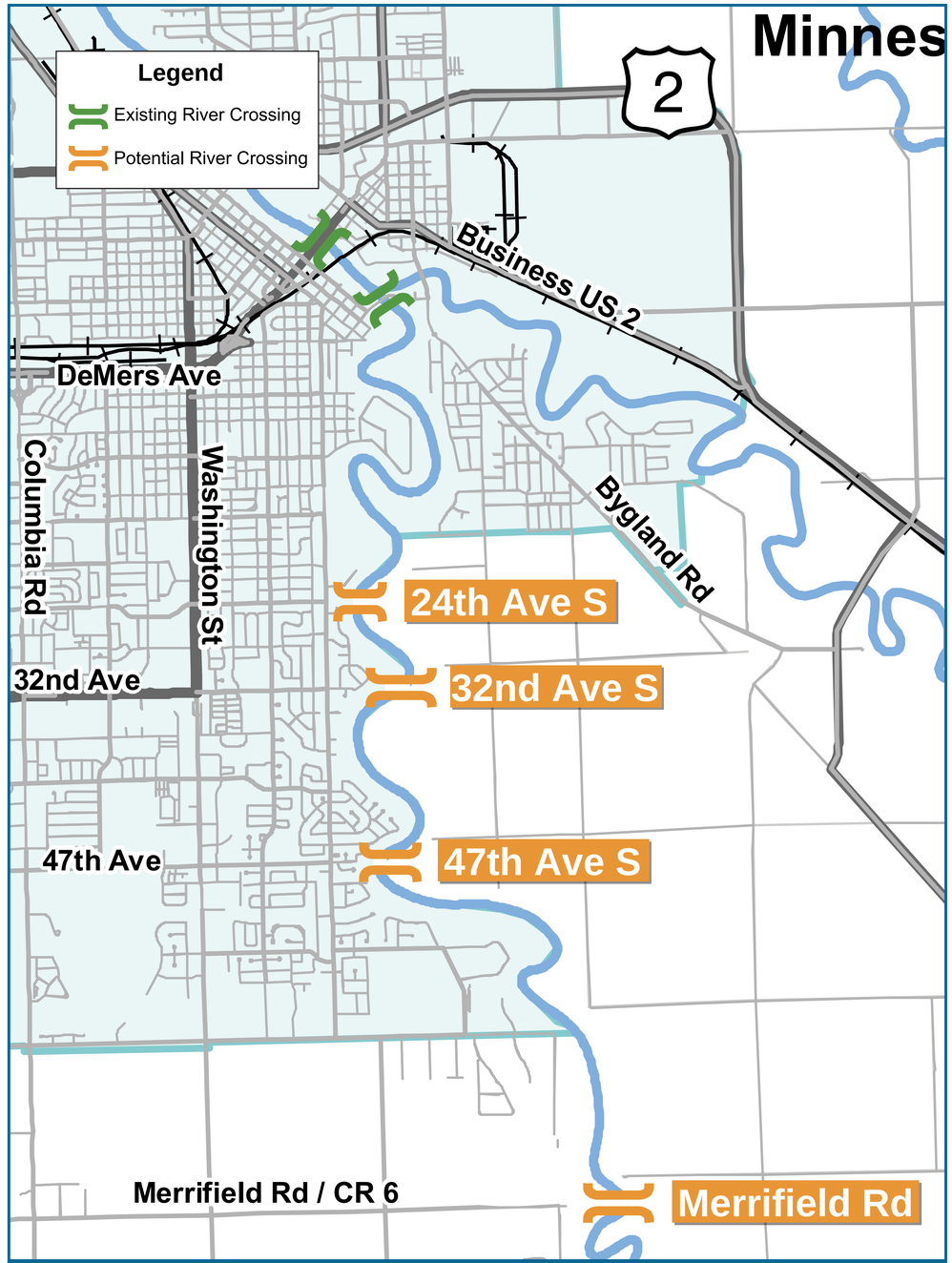
Goals, Objectives, + Performance Measures

Financially Constrained Plan

River Crossing Analysis

Scope of Work:

- Review transportation impacts of 4 river crossing locations
- Improve local traffic and connectivity
- Use 2045 travel demand model
- Review impacts on:
  - Existing crossings
  - Neighborhoods
  - Local and regional roadway network
- Compare impacts of each crossing
- Forecasts with 47th Avenue/I-29 interchange show no impact at proposed crossing

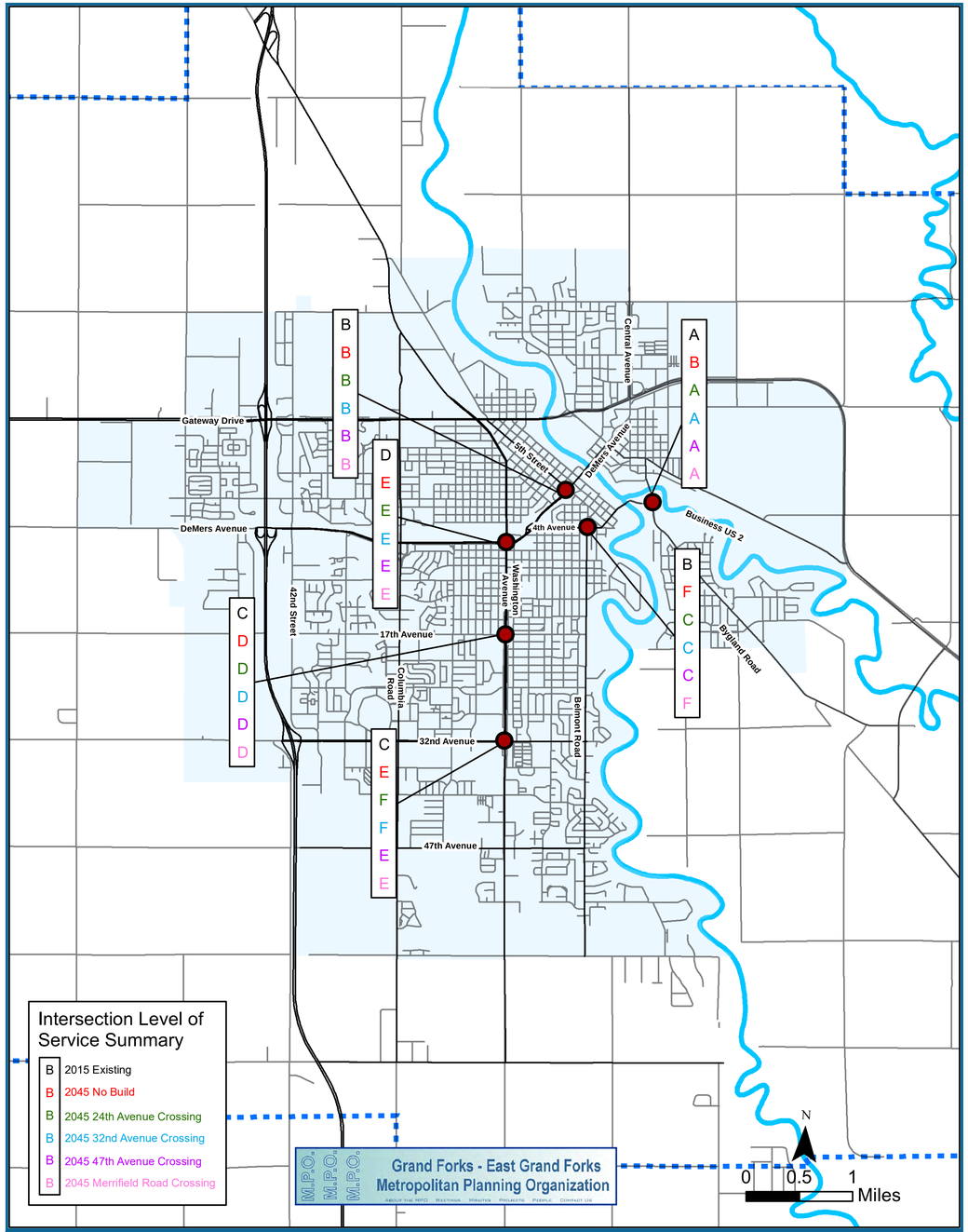


Potential River Crossing Locations

River Crossing Analysis

Intersection Level of Service:

- Most notable changes:
  - Washington Street at 32nd Avenue
  - Belmont Road at 4th Avenue



Intersection Level of Service Summary

River Crossing Analysis

Segment Level of Service and Change in Miles and Hours Traveled:

- Minnesota Avenue/ 1st Street would improve under all proposed conditions except a crossing at Merrifield Road
- Northern river crossings serve more local trips
- Southern river crossings serve more regional trips

Segment Level of Service:

RIVER CROSSING LOCATION	2045 No Build	2045 with 24th Crossing	2045 with 32nd Avenue Crossing	2045 with 47th Avenue Crossing	2045 with Merrifield Road Crossing
US 2	**E**	**D**	**D**	**D**	**E**
Demers Avenue	**F**	**F**	**F**	**F**	**F**
Minnesota Avenue / 1st Street	**E**	**B**	**B**	**C**	**D**
24th Avenue	—	**A**	—	—	—
32nd Avenue	—	—	**A**	—	—
47th Avenue	—	—	—	**A**	—
Merrifield Road	—	—	—	—	**A**

Change in Vehicle Miles Traveled and Vehicle Hours Traveled Compared to 2045 No Build:

METRIC	2045 No Build	24th Avenue River Crossing	32nd Avenue River Crossing	47th Avenue River Crossing	Merrifield Road River Crossing
Change in Daily Vehicle Miles Traveled	1,054,784	-23,535	-24,721	-13,393	-17,717
Change in Daily Vehicle Hours Traveled	59,702	-1,001	-831	174	-679

Street/Highway Plan Update
Public Meeting

April 18, 2018

Earl Haugen, MPO Executive Director
Brandon Bourdon, Kimley-Horn
Scott Marek, WSB

GRAND FORKS-EAST GRAND FORKS MPO
STREET/HIGHWAY PLAN UPDATE
2045 METROPOLITAN TRANSPORTATION PLAN

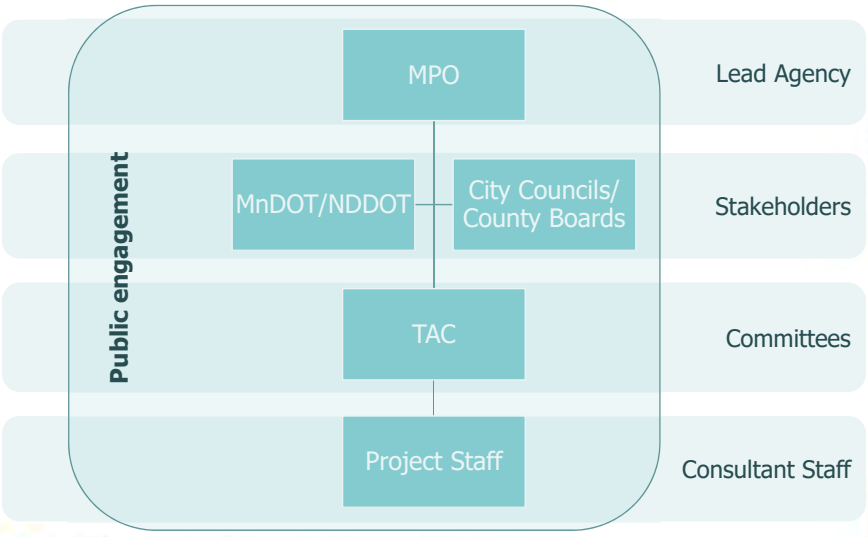
Agenda

- Plan overview
- Plan update schedule
- Universe of projects
- River crossing analysis
- Questions

Plan Overview: Purpose

- Update street/highway element of the 2040 plan
  - Communicate local investment **needs** and **priorities**
  - Address federal regulations in the **FAST Act**
  - Required to **update every five years**

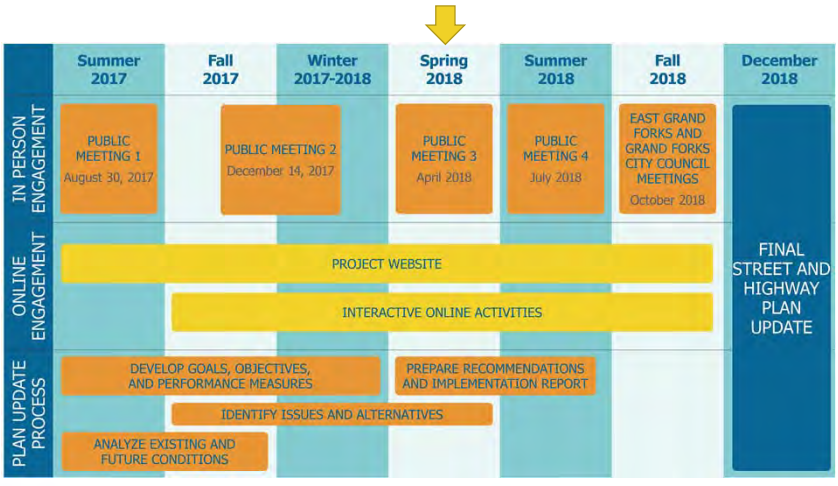
Plan Overview: Organizational Chart



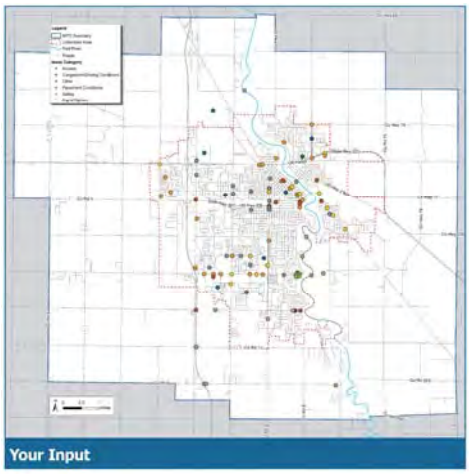
Plan Outcomes

1. Update or establish **vision, goals, objectives, performance measures and performance targets**
2. Understand **existing conditions and issues**
3. Identify and evaluate **planned projects and potential alternatives**
   - Apply updated performance measures and targets
4. Establish **financial plan**
5. Identify **future network recommendations**
6. Establish **implementation priorities**

Plan Update Schedule: Where We Are



Issues Identified





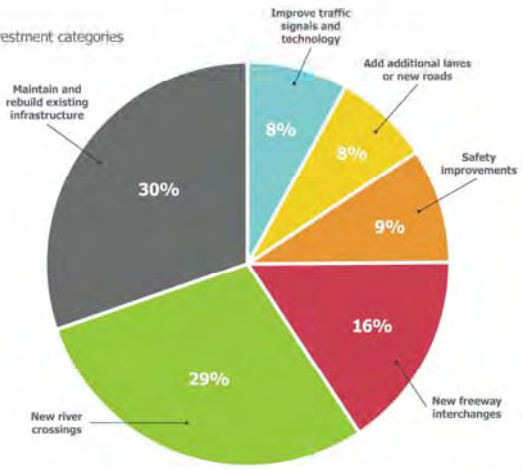
Grand Forks-East Grand Forks MPO STREET/HIGHWAY PLAN UPDATE

Financial Planning Activity

What We Heard:

- Participants allocated $100 between six public investment categories
- Received 69 responses in person and online





Grand Forks-East Grand Forks MPO STREET/HIGHWAY PLAN UPDATE

Universe of Projects: Definition

- A comprehensive list of all programmed, planned, or other investments within the MPO planning area
- Identified by city, county, MPO, state, or other stakeholders
- Purpose is improving the overall transportation system
- Does not consider social, environmental, or financial constraints

Universe of Projects: Issues Identification

- MPO Transportation Improvement Program
- NDDOT and MnDOT State Transportation Improvement Programs
- City and County Capital Improvement Plans
- Existing conditions level of service
- Crash analysis
- Bridge sufficiency
- Pavement condition
- 2030/2045 traffic demand forecasts
- Interactive mapping, open house, staff and elected official input
- MPO 2040 Long-Range Transportation Plan project list
- Recent MPO corridor studies
- Public meetings
- Online engagement

Universe of Projects: Investment Categories

- MPO Transportation Improvement Program
- Existing + committed network (i.e., "No-Build" network)
- Safety/operations
- Multimodal projects, streetscape projects, and studies
- State of good repair
- Discretionary

Existing Pavement/Bridge Condition Data



Facility	Feature	Location	City/ County	Year Built	Most Recent Year Inspected	Operating/ Load Rating**	Sufficiency Rating**
Interstate 29	Railroad	North of US 2 Interchange	City of GF	1967	2013	NA	NA
Washington St.	Railroad	North of DeMers Ave	City of GF	1937	2015	NA	NA
27th Avenue North	English Coulee	27th Ave. North	City of GF	1947	2015	.0	20.7
Kennedy Bridge	Red River	US 2	City of GF/EGF	1953	2015	74.7	48.2
Sutler Bridge	Red River	DeMers Ave.	City of GF/EGF	1929	2015	38.9	52.3
Columbia Road	Railroad	DeMers Ave.	City of GF	1984	2015	39.8	68.1
Kennedy Bridge	Red River	East of US 81	City of GF/EGF	1953	2015	74.7	67.4
Louis Murray Bridge	Red Lake River	2nd Ave.	City of EGF	NA	2016	36	75.3
University Avenue	Underpass	Interstate 29	City of GF	1968	2015	74.7	78.4
University Avenue	English Coulee	University Ave	City of GF	1985	2015	99.8	79
4th Street NW	Underpass	US 2	City of EGF	NA	2015	40.8	79.5
Point Bridge	Red River	Minnesota Ave.	City of GF/EGF	1907	2016	76.6	79.9

2045 Link Level of Service

- Links with LOS E/F
  - Sorlie Bridge
  - Kennedy Bridge
  - Point/Minnesota Bridge
  - Gateway Drive
  - 42nd Street
  - Columbia Road
  - Washington Street
  - 32nd Avenue
  - DeMers Avenue



Range of Alternatives

2030/2045 Plan Universe of Project Needs:

Project Type	Current Cost	Percent of Total
MPO Transportation Improvement Program	$72,390,000	10.3%
Existing + Committed Network	$64,830,000	9.2%
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Discretionary	$454,650,000	64.5%
TOTAL	$704,280,000	100%

*$14.1 million in TIP are safety/operations projects



Alternatives

Universe of Projects: Next Steps

- Finalize state of good repair and multimodal/main street projects
- Consider 2045 "No-Build" network needs
- Consider performance measures and targets
- Establish investment priorities and levels for constrained plan
  - State of good repair projects
  - Safety/operations projects
  - Multimodal/main street projects
  - Capacity expansion projects
- Run financially constrained 2030/2045 "Build Alternative"
  - i.e., Constrained capacity expansion projects
- Finalize discretionary/illustrative projects beyond financial constraint

Previous Plans and Added River Crossings

Nearing 50 years of considering the need for additional bridges over the Red River. The focus has been generally for the need for a southern location.

Spent 1998/2004 trying to reach agreement in conjunction with flood protection project planning. Went through mediator to conclude 2 bridges: Merrifield for "bypass" and 32nd Ave for local.



River Crossing Analysis: Scope of Work

- Review transportation impacts of 4 river crossing locations
- Improve local traffic and connectivity
- Use 2045 travel demand model
- Review impacts on:
  - Existing crossings
  - Neighborhoods
  - Local and regional roadway network
- Compare impacts of each crossing



Example of Other Documents

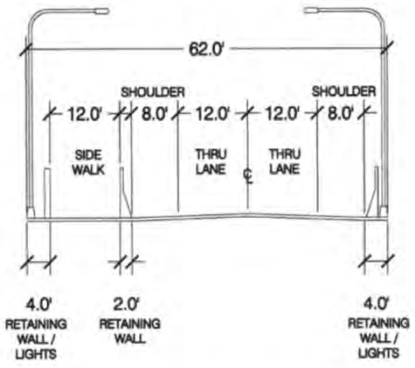
Each City has adopted the exact same Plan as the MPO: 2004, 2007 and 2013.

The Greenway Plan shows possible future bridges over the Red River. This curtails issues under NEPA.



River Crossing Modeling Assumptions

- All proposed river crossing bridges are two-lane bridges
- All connections on each side are to two-lane roads
- No additional thru lane capacity was added
- No new connections were made to I-29 to the west
- No new connections were made to US 2 to the east

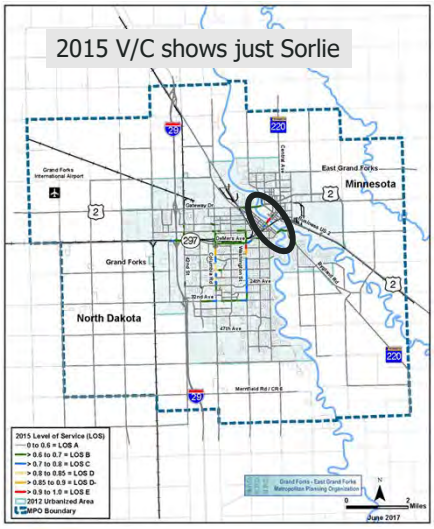


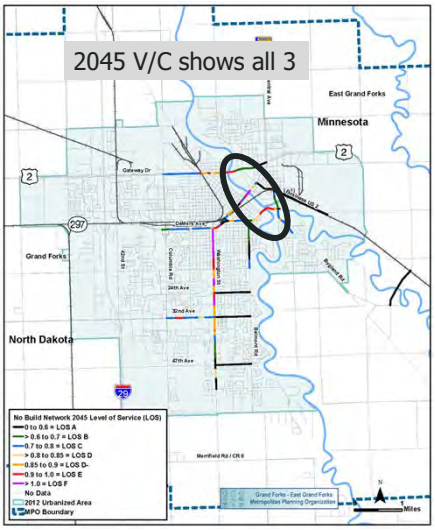
TYPICAL BRIDGE SECTION

Local Traffic Impact



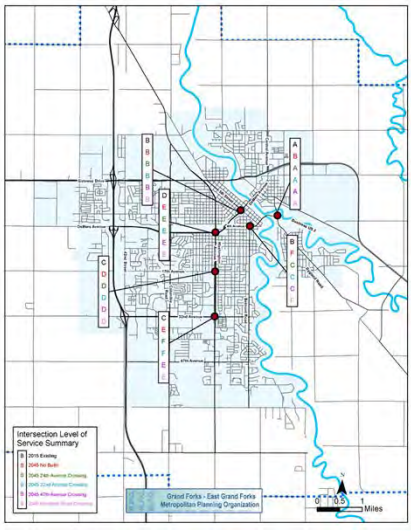
River Crossing – Link LOS





River Crossing – Intersection LOS

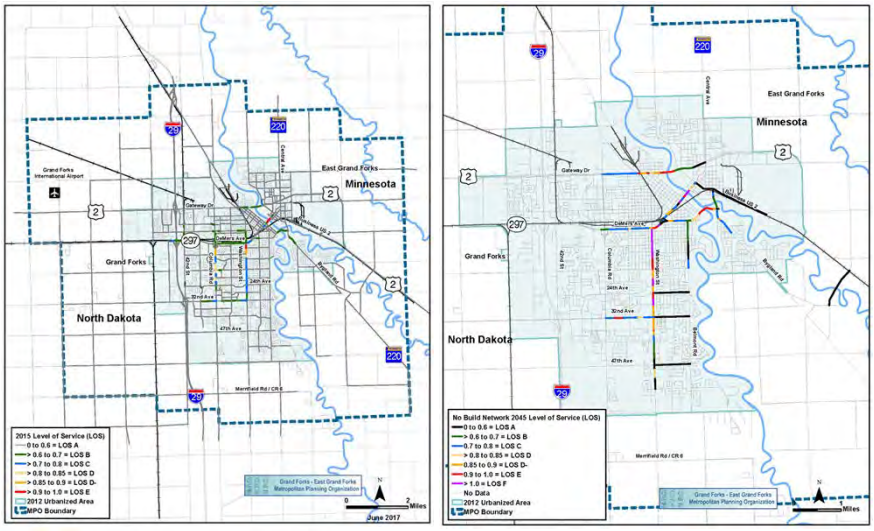
- Exhibit shows intersection LOS
- Most notable changes were at
  - Washington at 32nd Ave
  - Belmont at 4th Ave
- Intersections with LOS E/F
  - Washington at 32nd Ave
  - Belmont at 4th Ave
  - Washington at DeMers



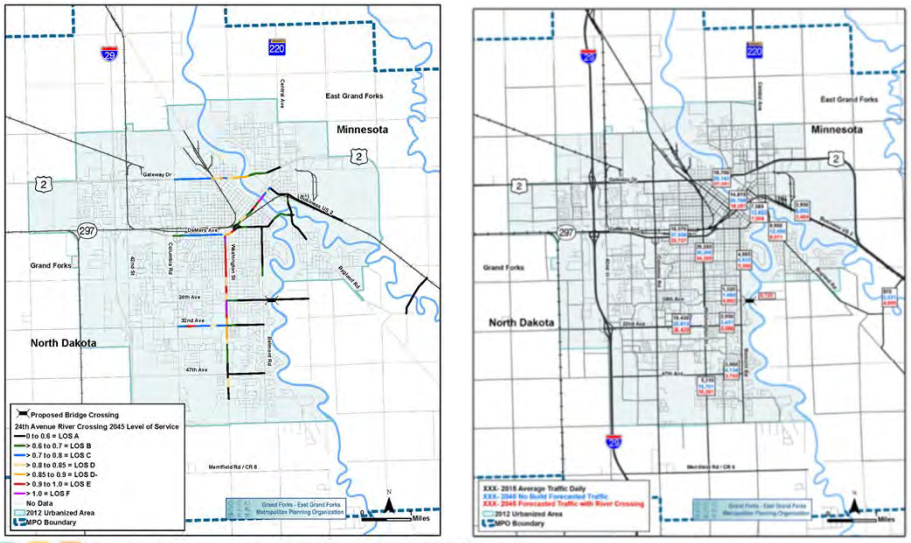
River Crossing – Link LOS

- Point Bridge operates better under 24th and 32nd Avenue crossing scenarios
- Gateway Drive operates better under all crossing scenarios except Merrifield Road
- Washington Street operates better under 32nd and 47th Avenue crossing scenarios
- Belmont Road operates better under all crossing scenarios

River Crossing – Link LOS

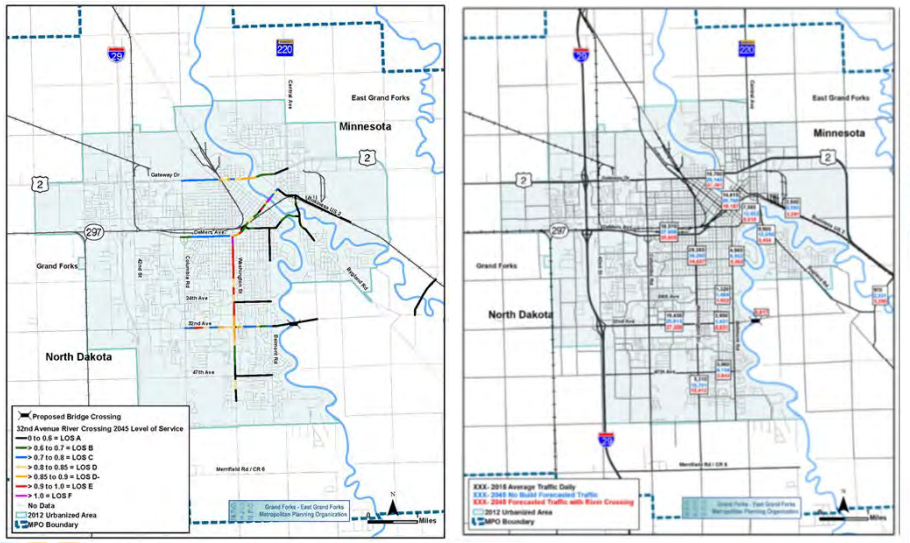


24th Ave. S
River Crossing – Link LOS



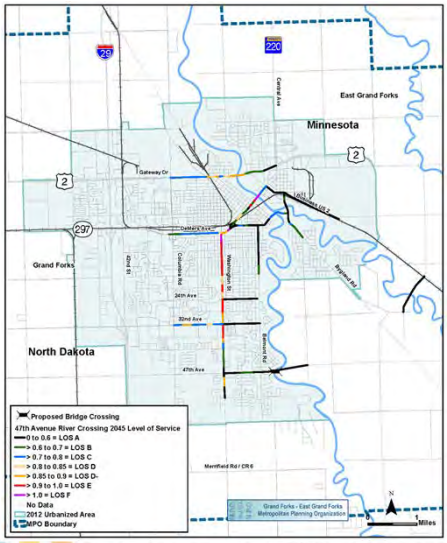
Grand Forks-East Grand Forks MPO STREET/HIGHWAY PLAN UPDATE

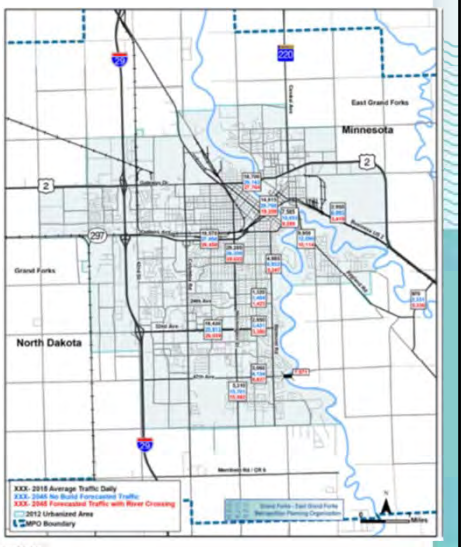
32nd Ave. S
River Crossing – Link LOS



Grand Forks-East Grand Forks MPO STREET/HIGHWAY PLAN UPDATE

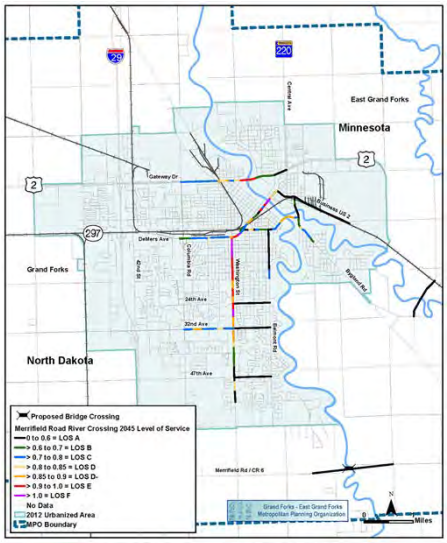
47th Ave. S River Crossing – Link LOS





Grand Forks-East Grand Forks MPO STREET/HIGHWAY PLAN UPDATE

Merrifield (GF#6 and Polk #58 River Crossing – Link LOS





Grand Forks-East Grand Forks MPO STREET/HIGHWAY PLAN UPDATE

River Crossing – Regional Impacts

- No river crossing solves all issues
- LOS is improved on Minnesota Ave / 1st Ave under the 24th 32nd, and 47th Avenue crossing alternatives
- Washington Street operates better under 32nd and 47th Avenue crossing scenarios
- Belmont Road operates better under all crossing scenarios
- ADTs on Bygland Road north of Rhinehart decrease more if 24th or 32nd Avenue crossing are selected
- TH 220 ADTs over Red Lake River are highest if 32nd or 47th Avenue crossings are selected

River Crossing – Link LOS

River Crossing Location	2045 No Build	2045 with 24th Crossing	2045 with 32nd Crossing	2045 with 47th Crossing	2045 with Merrifield Crossing
US 2	E	D	D	D	E
Demers Avenue	F	F	F	F	F
Minnesota Avenue / 1st Street	E	B	B	C	D
24th Avenue	--	A	--	--	--
32nd Avenue	--	--	A	--	--
47th Avenue	--	--	--	A	--
Merrifield Road	--	--	--	--	A

River Crossing Location	Existing	2045 No Build	2045 with 24th Crossing	2045 with 32nd Crossing	2045 with 47th Crossing	2045 with Merrifield Crossing
TH 220 River Crossing	970	2,330	4,900	5,290	5,340	3,520
Bygland Road N. of Rhinehart Dr.	9,900	12,090	8,070	8,450	10,110	11,420

River Crossing Location	2045 with 24th Crossing	2045 with 32nd Crossing	2045 with 47th Crossing	2045 with Merrifield Crossing
TH 220 River Crossing	+2,570	+2,960	+3,010	+1,190
Bygland Road N. of Rhinehart Dr.	-4,020	-3,600	-1,980	-680

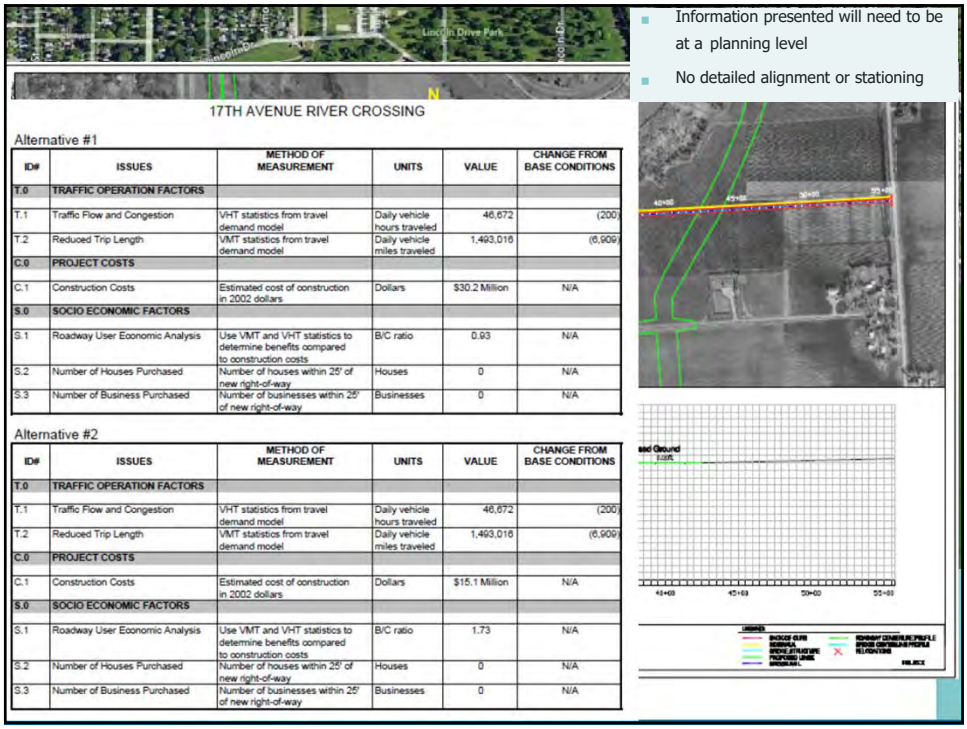
River Crossing – Link LOS

Facility Type	2045 No Build	24th Avenue River Crossing	32nd Avenue River Crossing	47th Avenue River Crossing	Merrifield Road River Crossing	
Freeways and Ramps	101,186	-3,611	-4,054	-2,662	-1,170	
Major Arterials	530,889	-20,123	-19,346	-11,448	-12,321	
Minor Arterials	237,590	-641	-18	-252	-2,607	
Collectors	139,010	2,318	-105	1,987	-134	
Local Streets/Rural	46,109	-1,478	-1,198	-1,018	-1,485	
Total VMT Reduction Compared to 2045 No Build	**1,054,784**	**-23,535**	**-24,721**	**-13,393**	**-17,717**	**Total VMT Reduction**

Facility Type	2045 No Build Network	24th Avenue River Crossing	32nd Avenue River Crossing	47th Avenue River Crossing	Merrifield Road River Crossing
Total VHT Reduction Compared to 2045 No Build	**59,702**	**-1,001**	**-831**	**174**	**-679**

Future Bridge Next Steps

- Agree to only update 2030 Plan to Include 47th Avenue Crossing
- Requires quick approval of additional scope
- Needs to be completed along with everything else



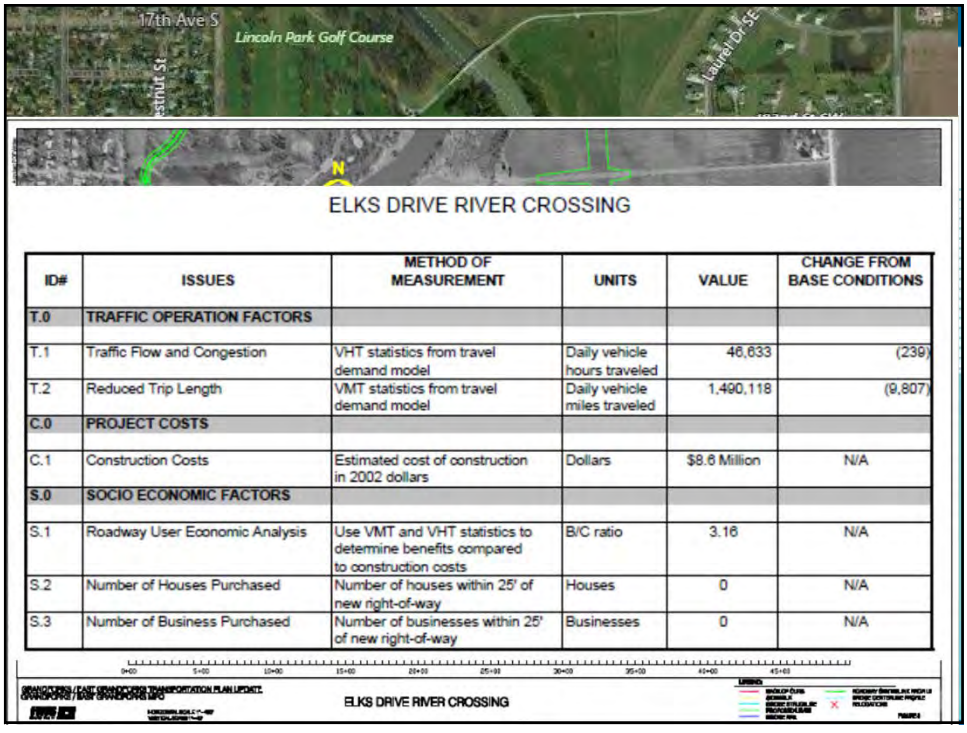
- Information presented will need to be at a planning level
- No detailed alignment or stationing

Alternative #1

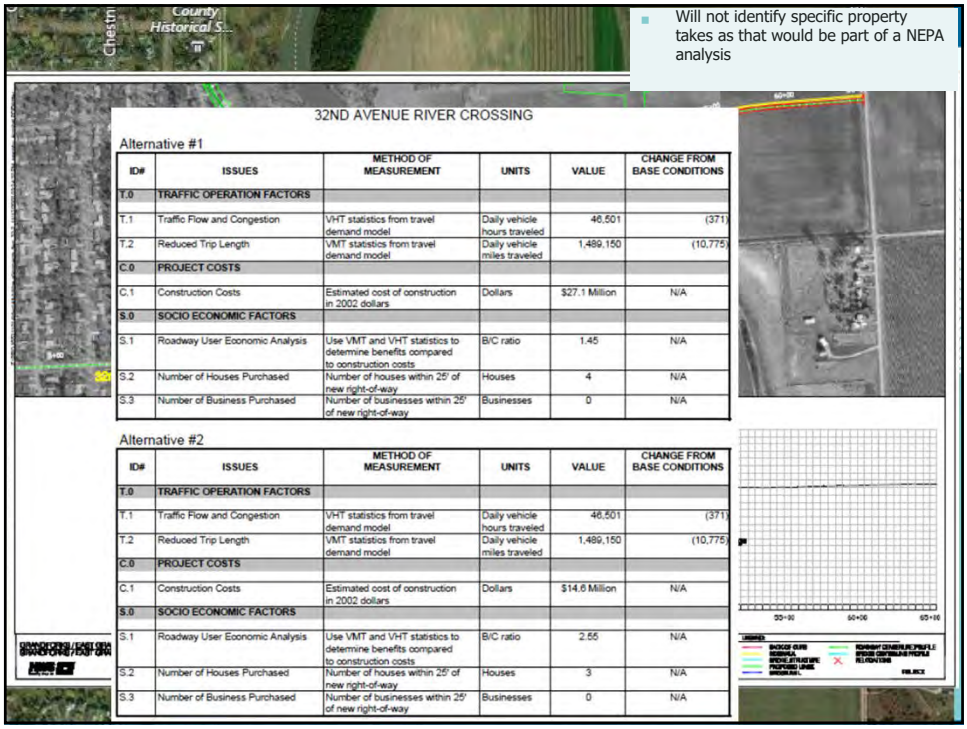
ID#	ISSUES	METHOD OF MEASUREMENT	UNITS	VALUE	CHANGE FROM BASE CONDITIONS
T.0	TRAFFIC OPERATION FACTORS				
T.1	Traffic Flow and Congestion	VHT statistics from travel demand model	Daily vehicle hours traveled	46,672	(200)
T.2	Reduced Trip Length	VMT statistics from travel demand model	Daily vehicle miles traveled	1,493,016	(6,909)
C.0	PROJECT COSTS				
C.1	Construction Costs	Estimated cost of construction in 2002 dollars	Dollars	$30.2 Million	N/A
S.0	SOCIO ECONOMIC FACTORS				
S.1	Roadway User Economic Analysis	Use VMT and VHT statistics to determine benefits compared to construction costs	B/C ratio	0.93	N/A
S.2	Number of Houses Purchased	Number of houses within 25' of new right-of-way	Houses	0	N/A
S.3	Number of Business Purchased	Number of businesses within 25' of new right-of-way	Businesses	0	N/A

Alternative #2

ID#	ISSUES	METHOD OF MEASUREMENT	UNITS	VALUE	CHANGE FROM BASE CONDITIONS
T.0	TRAFFIC OPERATION FACTORS				
T.1	Traffic Flow and Congestion	VHT statistics from travel demand model	Daily vehicle hours traveled	46,672	(200)
T.2	Reduced Trip Length	VMT statistics from travel demand model	Daily vehicle miles traveled	1,493,016	(6,909)
C.0	PROJECT COSTS				
C.1	Construction Costs	Estimated cost of construction in 2002 dollars	Dollars	$15.1 Million	N/A
S.0	SOCIO ECONOMIC FACTORS				
S.1	Roadway User Economic Analysis	Use VMT and VHT statistics to determine benefits compared to construction costs	B/C ratio	1.73	N/A
S.2	Number of Houses Purchased	Number of houses within 25' of new right-of-way	Houses	0	N/A
S.3	Number of Business Purchased	Number of businesses within 25' of new right-of-way	Businesses	0	N/A



ID#	ISSUES	METHOD OF MEASUREMENT	UNITS	VALUE	CHANGE FROM BASE CONDITIONS
T.0	TRAFFIC OPERATION FACTORS				
T.1	Traffic Flow and Congestion	VHT statistics from travel demand model	Daily vehicle hours traveled	46,633	(239)
T.2	Reduced Trip Length	VMT statistics from travel demand model	Daily vehicle miles traveled	1,490,118	(9,807)
C.0	PROJECT COSTS				
C.1	Construction Costs	Estimated cost of construction in 2002 dollars	Dollars	$8.6 Million	N/A
S.0	SOCIO ECONOMIC FACTORS				
S.1	Roadway User Economic Analysis	Use VMT and VHT statistics to determine benefits compared to construction costs	B/C ratio	3.16	N/A
S.2	Number of Houses Purchased	Number of houses within 25' of new right-of-way	Houses	0	N/A
S.3	Number of Business Purchased	Number of businesses within 25' of new right-of-way	Businesses	0	N/A



- Will not identify specific property takes as that would be part of a NEPA analysis

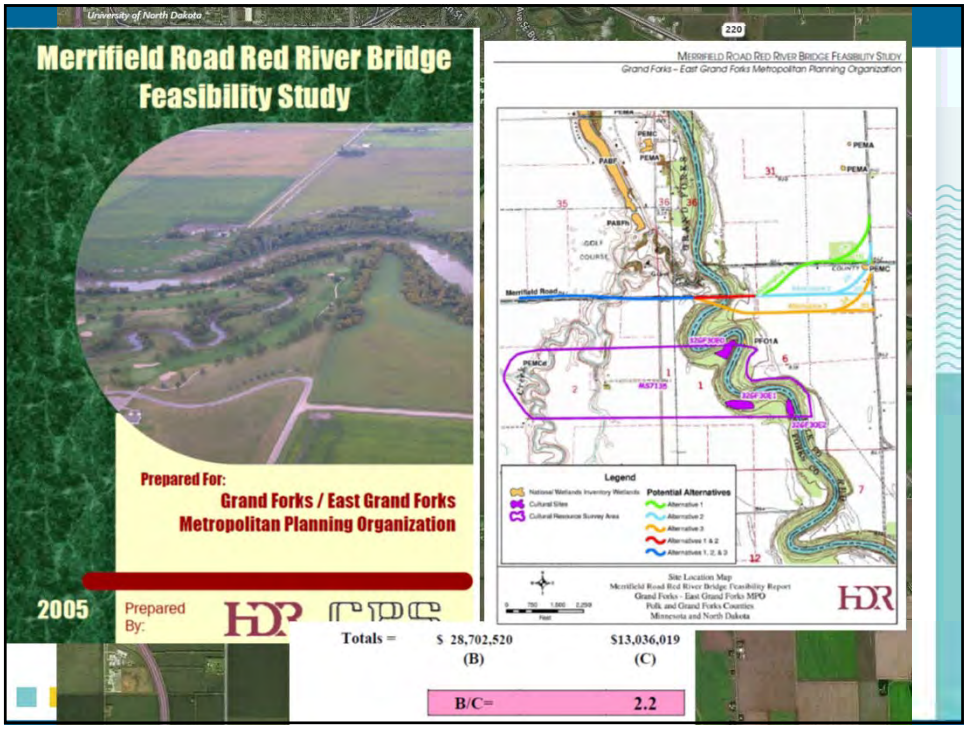
Alternative #1

ID#	ISSUES	METHOD OF MEASUREMENT	UNITS	VALUE	CHANGE FROM BASE CONDITIONS
T.0	TRAFFIC OPERATION FACTORS				
T.1	Traffic Flow and Congestion	VHT statistics from travel demand model	Daily vehicle hours traveled	46,501	(371)
T.2	Reduced Trip Length	VMT statistics from travel demand model	Daily vehicle miles traveled	1,489,150	(10,775)
C.0	PROJECT COSTS				
C.1	Construction Costs	Estimated cost of construction in 2002 dollars	Dollars	$27.1 Million	N/A
S.0	SOCIO ECONOMIC FACTORS				
S.1	Roadway User Economic Analysis	Use VMT and VHT statistics to determine benefits compared to construction costs	B/C ratio	1.45	N/A
S.2	Number of Houses Purchased	Number of houses within 25' of new right-of-way	Houses	4	N/A
S.3	Number of Business Purchased	Number of businesses within 25' of new right-of-way	Businesses	0	N/A

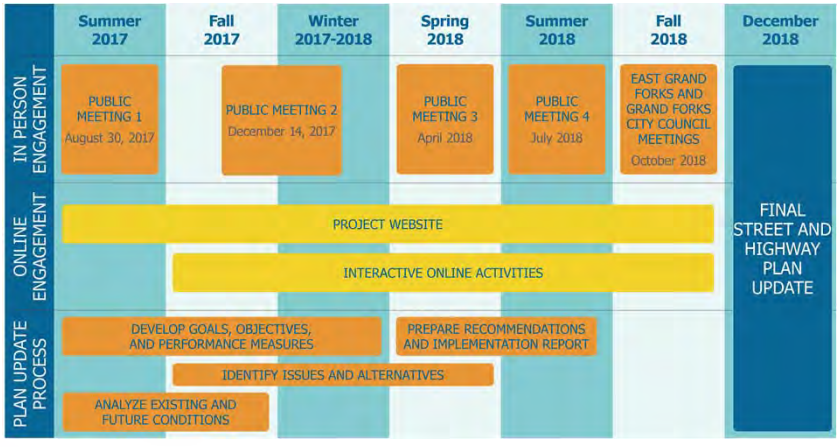
Alternative #2

ID#	ISSUES	METHOD OF MEASUREMENT	UNITS	VALUE	CHANGE FROM BASE CONDITIONS
T.0	TRAFFIC OPERATION FACTORS				
T.1	Traffic Flow and Congestion	VHT statistics from travel demand model	Daily vehicle hours traveled	46,501	(371)
T.2	Reduced Trip Length	VMT statistics from travel demand model	Daily vehicle miles traveled	1,489,150	(10,775)
C.0	PROJECT COSTS				
C.1	Construction Costs	Estimated cost of construction in 2002 dollars	Dollars	$14.6 Million	N/A
S.0	SOCIO ECONOMIC FACTORS				
S.1	Roadway User Economic Analysis	Use VMT and VHT statistics to determine benefits compared to construction costs	B/C ratio	2.55	N/A
S.2	Number of Houses Purchased	Number of houses within 25' of new right-of-way	Houses	3	N/A
S.3	Number of Business Purchased	Number of businesses within 25' of new right-of-way	Businesses	0	N/A





Wrap Up: Next Steps



Wrap Up: Questions

Earl Haugen, MPO Executive Director
(218) 399-3370
(701) 746-2660
Earl.Haugen@theforksmpo.org

www.theforksstreets2045.org

PUBLIC INPUT MEETING

WHY?

Come learn and let us know what you think! We'll present information about available street/highway funding. Based upon these levels of funding we'll share the street/highway projects that match the available funding and focus on preserving pavements for the movement of people and freight on our national and state roads. We'll also share results from analysis of the new river crossing options.

WHEN?

September 12, 2018
5:30 PM to 7:00 PM
Presentation at 5:45 PM

WHERE?

Room #12
Alerus Center
1200 S. 42nd St.
Grand Forks, ND

OPEN HOUSE CONDUCTED BY

M.P.O. M.P.O. M.P.O.
Grand Forks - East Grand Forks
Metropolitan Planning Organization

Representatives from the Grand Forks/ East Grand Forks Metropolitan Planning Organization (GF-EGF MPO) and Kimley-Horn/WSB Consulting Team will be on hand to answer your questions and discuss your concerns. Additional information available at www.theforksmpo.org

WRITTEN STATEMENTS or comments about this project must be mailed by September 28th, to Earl Haugen, GF-EGF MPO, PO Box 5200, Grand Forks, ND 58206
Email: info@theforksmpo.org
Note "Street and Highway" in email subject heading.

The GF-EGF MPO will consider every request for reasonable accommodation to provide:

- an accessible meeting facility or other accommodation for people with disabilities,
- language interpretation for people with limited English proficiency (LEP), and
- translations of written material necessary to access GF-EGF MPO programs and information.

Appropriate provisions will be considered when the MPO is notified at least 5 days prior to the meeting date or the date the written material translation is needed.

To request accommodations, contact Earl Haugen, at 701-746-2660 or earl.haugen@theforksmpo.org.

Public Meeting #4 Summary

Time and Location

Wednesday, September 12, 2018
5:30-7:00 p.m.

Alerus Center, Room 12
1200 S 42nd Street
Grand Forks, ND 58201

Purpose of Meeting

The purpose of the fourth public meeting was to present information about available street/highway funding and share the street/highway projects that match the funding available. Results from the analysis of new river crossing options were also shared.

Materials

Display boards were available that provided information on the LRTP and Street and Highway Plan Update; the project schedule; the 2045 LRTP vision statement, goals, and performance measures and targets; performance goals, measures, and targets for safety, system preservation, and accessibility and mobility; the financial plan; input issues areas and investment priorities; the alternatives evaluation framework; the proposed investment scenario; and potential discretionary projects. Display boards were also available on the river crossing analysis, including information on the scope of work, traffic analysis, and benefit-cost analysis. This information was also presented through a formal presentation during the public meeting.

Participants

Eighteen attendees signed in on the meeting sign-in sheets, and nine attendees completed the NDDOT Title VI Public Participation Survey. The results of this survey are summarized below.

- Sex
  - Number of respondents: 9
  - Male: 6 (67%)
  - Female: 3 (33%)
- Disability
  - Number of respondents: 8
  - Yes: 2 (25%)
  - No: 6 (75%)
- Age
  - Number of respondents: 9
  - 34 and younger: 5 (56%)
  - 35-54: 1 (11%)
  - 55 and older: 3 (33%)

- Race
  - Number of respondents: 9
  - White: 9 (100%)
- Language most frequently spoken in your home
  - Number of respondents: 9
  - English: 9 (100%)
- Do you receive public assistance?
  - Number of respondents: 8
  - No: 8 (100%)
- Indicate how you heard about the event (note that some respondents checked more than one box)
  - Number of respondents: 7
  - Internet: 2 (29%)
  - Radio: 0 (0%)
  - Advocacy Group: 1 (14%)
  - Mailing: 2 (29%)
  - NDDOT Contact: 1 (14%)
  - Newspaper: 2 (29%)

Input Received

One written comment was received. It noted the commenter's opposition to the 24th Avenue S river crossing option due to the impact to the historical society's grounds and recommended pursuing a crossing further south.

Next Steps

The final draft plan will be presented to the Grand Forks and East Grand Forks city councils in October 2018 for approval and any final direction on plan content. After receiving approval for the city councils, the MPO will finalize the Street/Highway Plan Update and post it on the project website.

Grand Forks-East Grand Forks MPO

STREET/HIGHWAY PLAN UPDATE

Welcome

Public Meeting

Grand Forks-East Grand Forks Metropolitan Planning Organization

M.P.O. M.P.O. M.P.O. Grand Forks - East Grand Forks Metropolitan Planning Organization

Kimley»Horn

WSB & Associates, Inc.

Overview

What is a Long-Range Transportation Plan (LRTP)?

- Sets a direction and strategies to help shape a region's transportation network
- Includes three elements:

Streets and highways | Transit | Pedestrians and bicycles

- The MPO is required to update its LRTP every 5 years – the last update for Grand Forks-East Grand Forks was completed in 2013

What's an MPO?

Federal law requires that all urbanized areas in the US with populations over 50,000 people establish Metropolitan Planning Organizations (MPO) responsible for area transportation planning and programming services.

What is the Street and Highway Plan Update?

- This part of the LRTP will develop a performance-based investment decision framework for the streets and highways in the MPO area that is consistent with requirements of the FAST Act

Who is Involved?

- North Dakota Department of Transportation
- Minnesota Department of Transportation
- City of Grand Forks
- City of East Grand Forks
- Grand Forks County
- Polk County
- Federal Highway Administration
- Federal Transit Administration
- Residents and regional stakeholders

U.S. Department of Transportation Federal Highway Administration

U.S. Department of Transportation Federal Transit Administration

YOUR INPUT IS IMPORTANT TO US!

Schedule

	Summer 2017	Fall 2017	Winter 2017-2018	Spring 2018	Summer 2018	Fall 2018	December 2018
IN PERSON ENGAGEMENT	PUBLIC MEETING 1 August 30, 2017	PUBLIC MEETING 2 December 14, 2017		PUBLIC MEETING 3 April 18, 2018	PUBLIC MEETING 4 September 12, 2018	EAST GRAND FORKS AND GRAND FORKS CITY COUNCIL MEETINGS October 2018	FINAL STREET AND HIGHWAY PLAN UPDATE
ONLINE ENGAGEMENT	PROJECT WEBSITE						
	INTERACTIVE ONLINE ACTIVITIES						
PLAN UPDATE PROCESS	DEVELOP GOALS, OBJECTIVES, AND PERFORMANCE MEASURES			PREPARE RECOMMENDATIONS AND IMPLEMENTATION REPORT			
	IDENTIFY ISSUES AND ALTERNATIVES						
	ANALYZE EXISTING AND FUTURE CONDITIONS						

2045 LRTP Vision Statement, Goals, and Status of Performance Measure sand Targets

Vision Statement: The Grand Forks-East Grand Forks Long Range Transportation Plan (LRTP) envisions a community that provides a variety of complementary transportation choices for people and goods that is fiscally constrained.

	GOAL	DESCRIPTION	STATUS OF PERFORMANCE MEASURES AND TARGETS
1	**Economic Vitality**	Support the economic vitality through enhancing the economic competitiveness of the metropolitan area by giving people access to jobs and education services as well as giving business access to markets	No change from 2040 plan
2	**Security**	Increase the security of the transportation system for motorized and non-motorized uses	No change from 2040 plan
3	**Accessibility and Mobility**	Increase the accessibility and mobility options for people and freight by providing more transportation choices	See board
4	**Environmental/ Energy/Quality of Life**	Protect and enhance the environment, promote energy conservation, and improve quality of life by valuing the unique qualities of all communities – whether urban, suburban, or rural	No change from 2040 plan
5	**Integration and Connectivity**	Enhance the integration and connectivity of the transportation system across and between modes for people, freight, and housing, particularly affordable housing located close to transit	No change from 2040 plan
6	**Efficient System Management**	Promote efficient system management and operation by increasing collaboration among federal, state, and local government to better target investments and improve accountability	No change from 2040 plan
7	**System Preservation**	Emphasize the preservation of the existing transportation system by first targeting federal funds towards existing infrastructure to spur revitalization, promote urban landscapes, and protect rural landscapes	See board
8	**Safety**	Increase safety of the transportation system for motorized and non-motorized uses.	See board
9	**Resiliency***	Improve resiliency and reliability of the transportation system and reduce or mitigate storm water impacts of surface transportation	No proposed measures and targets
10	**Tourism***	Enhance travel and tourism	No proposed measures and targets

* A new goal for the 2045 LRTP (not included in 2040 LRTP)

Performance-Based Planning: Delivering Results

This update of the long-range transportation plan is refining each goal area's objectives, standards, and performance measures.
We are also adding performance targets for some goal areas to measure our region's progress toward delivering the transportation system we want.

WHAT ARE THE ELEMENTS OF A PERFORMANCE-BASED PLAN?

- **Goal and Goal Statement:** Desired 'big picture' future outcome for the metropolitan transportation system, broad statement of aspiration
- **Objective:** Specific outcome desired within a goal area, achievable by 2045 (plan timeframe)
- **Standard:** Specific technique for achieving an objective; identifies HOW objective will be met
- **Performance Measure:** Things that can be measured to evaluate if a standard is working
- **Performance Target:** Data point that defines success for a performance measure

NOTE:

The safety performance measures and targets were adopted at the February 21, 2018 MPO meeting. These targets will be reviewed and adopted annually by the MPO.

GOAL

	SAFETY				
Goal Statement	Increase safety of the transportation system for motorized and non-motorized uses.				
Objectives	See handout				
Standards	See handout				
Performance Measures	Number of traffic fatalities	Number of fatalities per 100 million vehicle miles traveled	Number of crash-related serious injuries	Number of serious injuries per 100 million vehicle miles traveled	Number of non-motorized fatalities and non-motorized serious injuries
Performance Targets	**Local Target:** ▪ 3 or fewer traffic fatalities by 2018 ▪ No change in trend	**Local Target:** ▪ 0.673/mvmt or lower by 2018 ▪ No change in trend	**Local Target:** ▪ 18 or fewer serious injuries by 2018 ▪ Decline in trend	**Local Target:** ▪ 5.933/mvmt or lower by 2018 ▪ Decline in trend	**Local Target:** ▪ 3 or fewer non-motorized fatal and serious injury crashes by 2018 ▪ Decline in trend
	State Targets: NORTH DAKOTA ▪ 138 traffic fatalities or fewer statewide ▪ 0.5% decline in trend MINNESOTA ▪ 375 traffic fatalities or fewer statewide ▪ 3% decline in trend	**State Targets:** NORTH DAKOTA ▪ 1.336/mvmt ▪ 0.5% decline in trend MINNESOTA ▪ 0.62/mvmt ▪ No change in trend	**State Targets:** NORTH DAKOTA ▪ 516 serious injuries or fewer statewide ▪ No change in trend MINNESOTA ▪ 1,935 serious injuries or fewer statewide ▪ Decline in trend	**State Targets:** NORTH DAKOTA ▪ 5.088/mvmt MINNESOTA ▪ 3.15/mvmt	**State Targets:** NORTH DAKOTA ▪ 34 fatalities and serious injuries or fewer statewide ▪ No change in trend MINNESOTA ▪ 348 fatalities and serious injuries or fewer statewide ▪ 5% decline in trend

Performance-Based Planning: Delivering Results

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- **Performance Measure:** Things that can be measured to evaluate if a standard is working
- **Performance Target:** Data point that defines success for a performance measure

What should we add or refine?

GOAL: SYSTEM PRESERVATION

Goal Statement	Emphasize the preservation of the existing transportation system by first targeting federal funds towards existing infrastructure to spur revitalization, promote urban landscapes and protect rural landscapes.					
Objectives	See handout					
Standards	See handout					
Performance Measures	Percent of Interstate pavement in good condition	Percent of Interstate pavement in poor condition	Percent of non-Interstate NHS pavement in good condition	Percent of non-Interstate NHS pavement in poor condition	Percent of NHS Bridges in good condition	Percent of NHS bridges in poor condition
Performance Targets	**DRAFT Local Target:** ▪ **75.6%**	**DRAFT Local Target:** ▪ **3%**	**DRAFT Local Target:** ▪ **Adopt State Target**	**DRAFT Local Target:** ▪ **Adopt State Target**	**DRAFT Local Target:** ▪ **Adopt State Target**	**DRAFT Local Target:** ▪ **Adopt State Target**
Performance Targets	**State Targets:** NORTH DAKOTA ▪ 75.6% MINNESOTA ▪ Not applicable in Grand Forks-East Grand Forks MPO area.	**State Targets:** NORTH DAKOTA ▪ 3% MINNESOTA ▪ Not applicable in Grand Forks-East Grand Forks MPO area.	**State Targets:** NORTH DAKOTA ▪ 58.3% MINNESOTA ▪ Two-year target: 50% ▪ Four-year target: 50%	**State Targets:** NORTH DAKOTA ▪ 3% MINNESOTA ▪ Two-year target: 4% ▪ Four-year target: 4%	**State Targets:** NORTH DAKOTA ▪ 60% MINNESOTA ▪ Two-year target: 50% ▪ Four-year target: 50%	**State Targets:** NORTH DAKOTA ▪ 40% MINNESOTA ▪ Two-year target: 4% ▪ Four-year target: 4%

Performance-Based Planning: Delivering Results

This update of the long-range transportation plan is refining each goal area's objectives, standards, and performance measures.
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- **Performance Measure:** Things that can be measured to evaluate if a standard is working
- **Performance Target:** Data point that defines success for a performance measure

What should we add or refine?

GOAL

ACCESSIBILITY AND MOBILITY

Goal Statement	Increase the accessibility and mobility options for people and freight by providing more transportation choices		
Objectives	See handout		
Standards	See handout		
Performance Measures	Interstate Truck Travel Time Reliability	Interstate travel reliability	Non-Interstate travel reliability
Performance Targets	**DRAFT Local Target:** ▪ **1.5**	**DRAFT Local Target:** ▪ **90%**	**DRAFT Local Target:** ▪ **85%**

	State Targets:
	NORTH DAKOTA
	▪ Interstate truck travel time reliability index:
	  ▪ Two-year: 3
	  ▪ Four-year: 3
	MINNESOTA
	▪ Not applicable in Grand Forks-East Grand Forks MPO area.
		State Targets:
		NORTH DAKOTA
		▪ Percent of person-miles traveled on the Interstate that are reliable:
		  ▪ Two-year: 85%
		  ▪ Four-year: 85%
		MINNESOTA
		▪ Not applicable in Grand Forks-East Grand Forks MPO area.
			State Targets:
			NORTH DAKOTA
			▪ Percent of person-miles traveled on the non-Interstate NHS that are reliable:
			  ▪ Two-year: Not applicable
			  ▪ Four-year: 85%
			MINNESOTA
			▪ Percent of person-miles traveled on the non-Interstate NHS that are reliable:
			  ▪ Two-year: Not applicable
			  ▪ Four-year: 75%

What Is Our Financial Plan?

A financial plan aligns revenues with eligible projects.

WHAT ARE OUR INVESTMENT PRIORITIES?

Help us update the investment priorities that will inform the financial plan.

INVESTMENT CATEGORY	Economic Vitality	Security	Accessibility and Mobility	Environmental/Energy/ Quality of Life	Integration and Connectivity	Efficient System Management	System Preservation	Safety	Resiliency	Tourism
Maintain and Rebuild Existing Infrastructure	●	●	●	●		●	●	●	●	●
Safety Improvements	●		●					●	●	●
Improve Traffic Signals and Technology	●		●	●	●	●		●	●	●
Build New Freeway Interchanges	●		●	●				●	●	●
Build New River Crossings	●		●		●			●	●	
Add General Lanes - Add Lanes or Build New Roads	●		●							●

2045 STREET AND HIGHWAY PLAN REVENUE SOURCES

FEDERAL

- Highway Safety Improvement Program (HSIP)
- Surface Transportation Block Grant Program (STPBG)
- National Highway Performance Program (NHPP)
- National Highway Freight Program
- National Discretionary Programs (INFRA, TIGER, etc.)

NORTH DAKOTA

- Urban Roads Program
- Main Street Urban Grant Program (NEW!)
- State Highways Tax Distribution Fund
- County Road Fund

MINNESOTA

- Area Transportation Partnership City Sub-Targets; County Sub-Target
- State Trunk Highway Fund
- Municipal State Aid
- Corridors of Commerce Program
- Transportation Economic Development (TED) Program

GRAND FORKS

- Sales tax (Current + NEW!)
- Special assessments
- General funds

EAST GRAND FORKS

- Special assessment
- General funds

GRAND FORKS COUNTY

POLK COUNTY

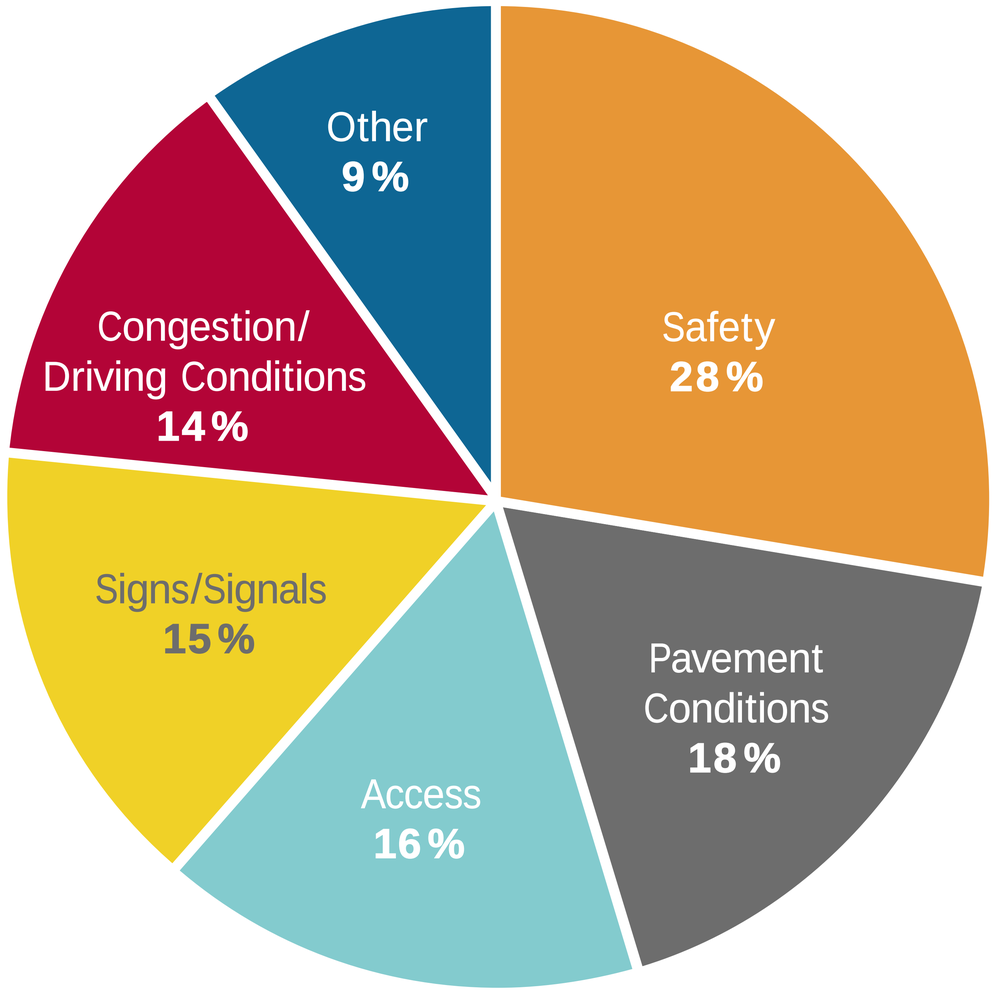
ISSUES

- Costs are rising faster than federal and state revenues
- Developing reasonably expected revenue estimates for new sources (ND HSIP, ND Main Street Program, Grand Forks sales tax)
- Identifying and positioning projects to successfully compete for grants
- Maintenance and operations costs are a significant part of overall costs

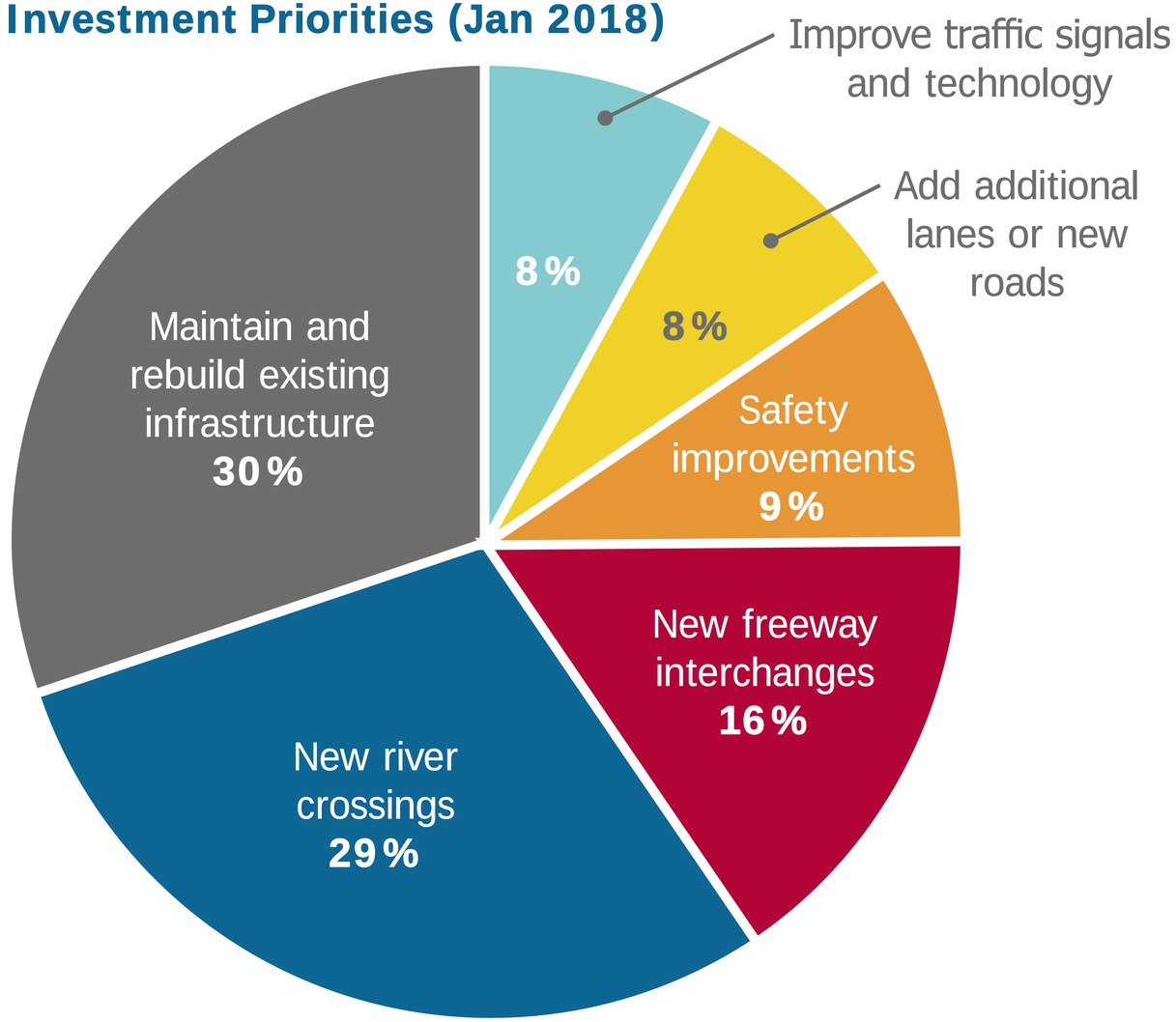
Input to Investment Direction

Public Input

Issue Areas (Aug 2017)



Investment Priorities (Jan 2018)



Alternatives Evaluation Framework

ISSUES IDENTIFICATION

- MPO Transportation Improvement Program
- NDDOT and MnDOT State Transportation Improvement Programs
- City and County Capital Improvement Plans
- Existing conditions level of service
- Crash analysis
- Bridge sufficiency
- Pavement condition
- 2030/2045 traffic demand forecasts
- Interactive mapping, open house, staff and elected official input
- MPO 2040 Long-Range Transportation Plan project list
- Recent MPO corridor studies
- Public meetings
- Online engagement

MPO Transportation Improvement Program

Existing + Committed Network

Safety/ Operations

Multimodal Projects, Streetscape Projects, and Studies

State of Good Repair

Discretionary

Financial Forecast

Travel Demand Modeling

Public + Staff Input

Range of Alternatives

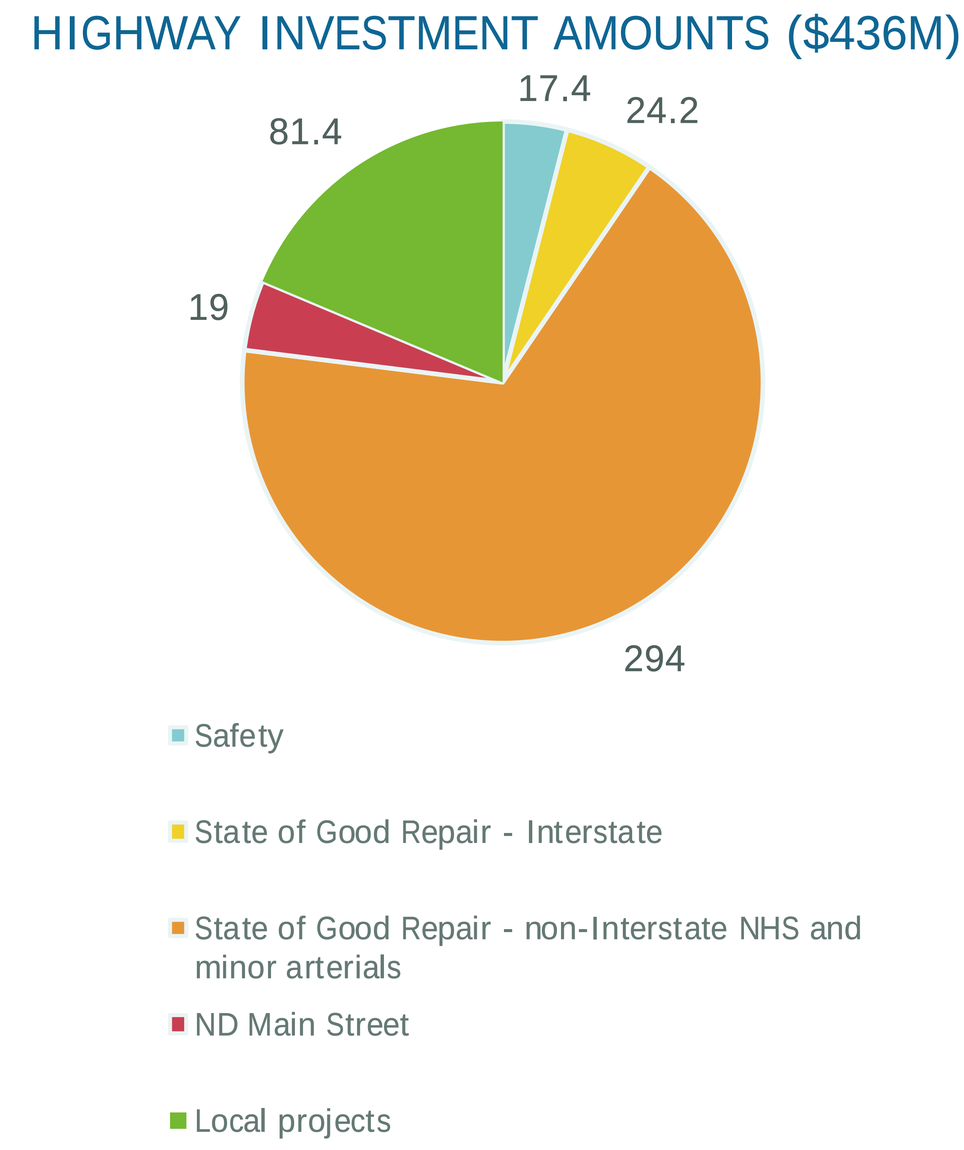
Goals, Objectives, + Performance Measures

Financially Constrained Plan

Investment Scenarios

Current Revenue Scenario

	AMOUNT	SHARE
Safety	$17.4M	4%
ND Main Street	$19M	4%
State of Good Repair - Interstate	$24.2M	6%
State of Good Repair - non-Interstate NHS and minor arterials	$294M	67%
Local projects	$81.4M	19%
Total	**$436M**	**100%**



Investment Scenarios

Potential Discretionary Projects

State of good repair

- Non-NHS federal aid-eligible streets and highways

Bridge repair

- East Grand Forks Point Bridge Approach

Intersections

- 32nd Avenue/S Washington
- Central Ave 17th St to 23rd St
- Washington St/DeMers
- US 2 (Gateway) Washington St to Mill Rd
- US 2 (Gateway) Cambridge St to Columbia Rd

Additional lanes

- Columbia Rd 14th Ave S to 24th Ave S

I-29 interchange upgrades

- North Washington, US 2 (Gateway), DeMers, 32nd Avenue

New grade separations

- US 2 (Gateway) east of I-29
- 42nd Street north of DeMers Avenue

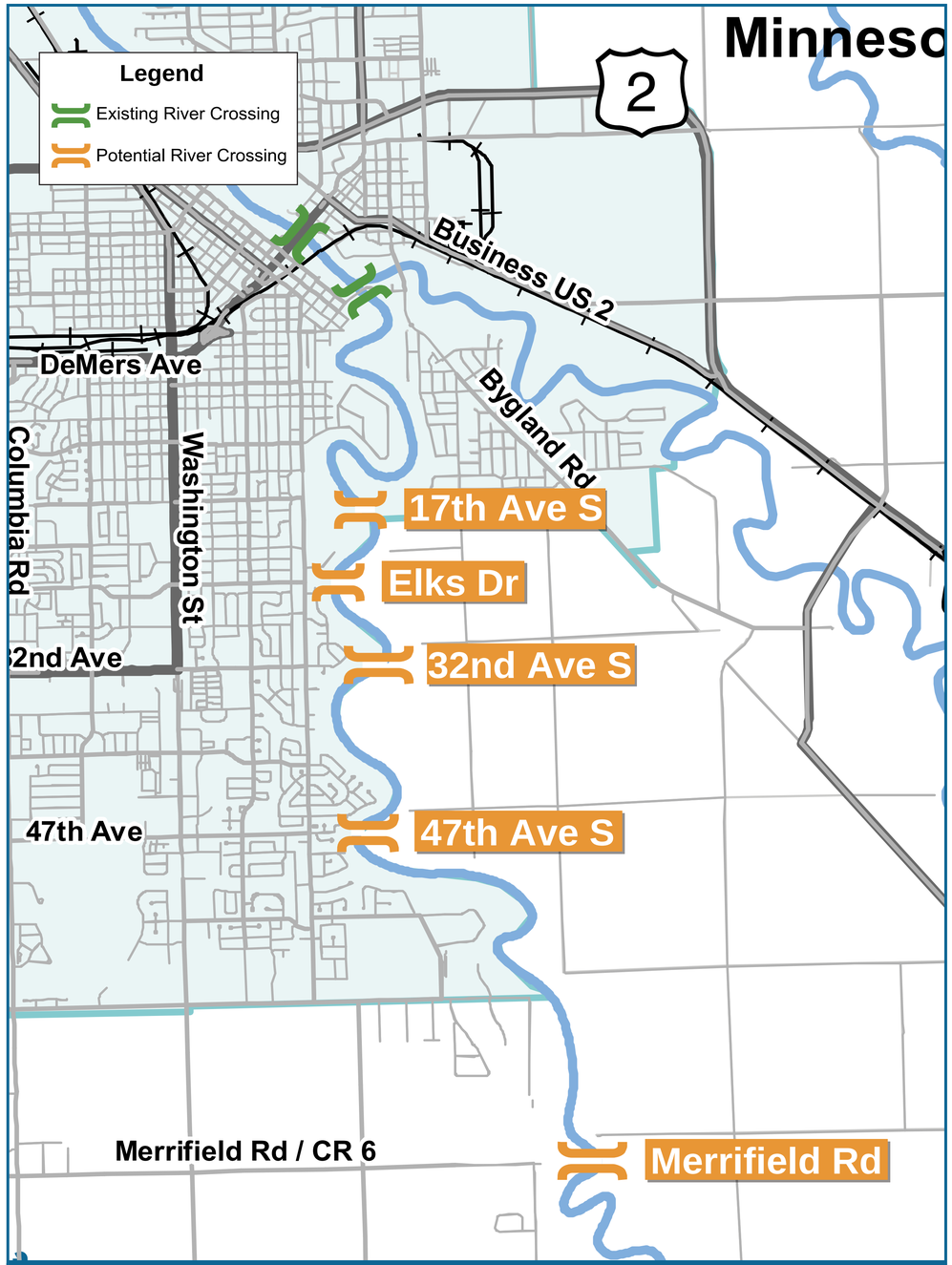
River crossings

- 32nd Avenue
- Merrifield Road

River Crossing Analysis

Scope of Work

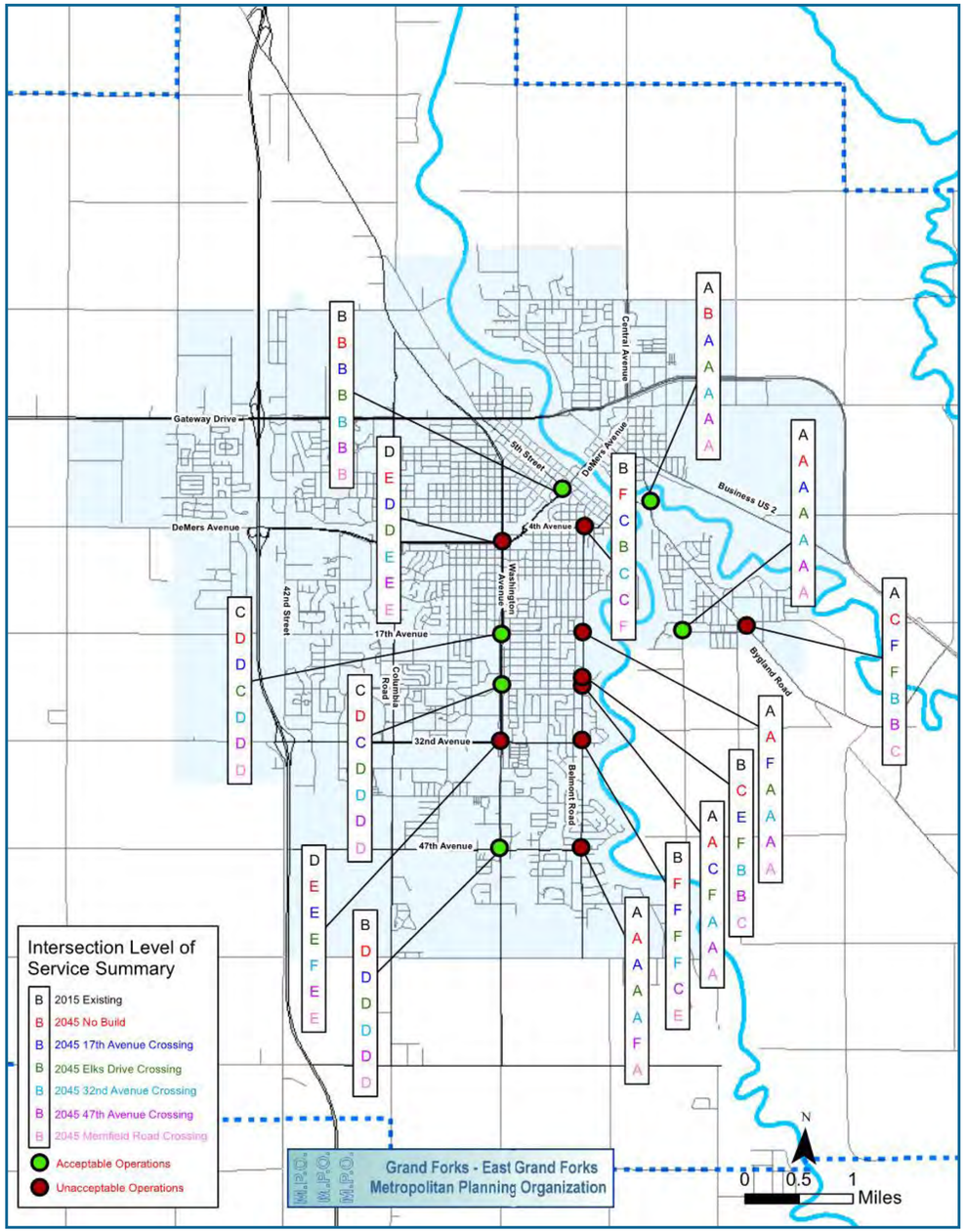
- Review transportation impacts of 5 river crossing locations
- Improve local traffic and connectivity
- Use 2045 travel demand model
- Review impacts on:
  - Existing crossings
  - Neighborhoods
  - Local and regional roadway network
- Compare impacts of each crossing



Potential River Crossing Locations

River Crossing

Intersection LOS



INTERSECTION	EXISTING CONTROL	2015 UNMITIGATED LOS	PROPOSED CONTROL	MITIGATED LOS
Demers Avenue at S Washington	Traffic Signal	E	Traffic Signal	D
S Washington at 32nd Avenue	Traffic Signal	F	Traffic Signal	D
4th Avenue at Belmont Road	All-Way Stop	F	Mini-Roundabout / Traffic Signal	B
17th Avenue at Belmont Road	Two-Way Stop	F	Traffic Signal	C
Greenway Blvd / Bygland Rd / 13th	Two-Way Stop	F	Conventional Roundabout / Traffic Signal	B
24th Avenue at Belmont Road	Two-Way Stop	F	Traffic Signal	B
Elks Drive at Belmont Road	Two-Way Stop	F	Traffic Signal	B
32nd Avenue at Belmont Road	All-Way Stop	F	Traffic Signal	C
47th Avenue at Belmont Road	Two-Way Stop	F	Traffic Signal	B

River Crossing Analysis

Segment Level of Service and Change in Miles and Hours Traveled:

KEY OBSERVATIONS

- The Point Bridge link LOS operates better under the 17th Avenue S, Elks Drive and 32nd Avenue S river crossing alternatives.
- Gateway Drive operates better under the 17th Avenue S, Elks Drive, 32nd Avenue S, and 47th Avenue S river crossings.
- DeMers Avenue experienced similar operations under each of the alternatives analyzed.
- Belmont Road operations were better under all the river crossing alternatives when compared to the No Build scenario.

Segment Level of Service:

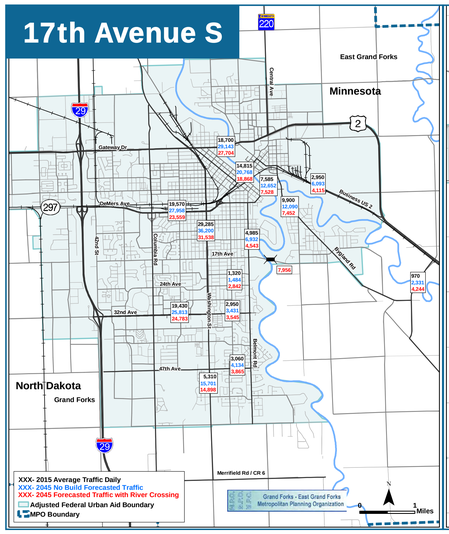
RIVER CROSSING LOCATION	2045 No Build	2045 with 17th Crossing	2045 with Elks Crossing	2045 with 32nd Crossing	2045 with 47th Crossing	2045 with Merrifield Crossing
US 2	**E**	**D-**	**D-**	**D**	**D**	**E**
Demers Avenue	**F**	**F**	**F**	**F**	**F**	**F**
Minnesota Avenue / 4th Avenue / 1st Street SE	**E**	**A**	**A**	**B**	**C**	**D**
17th Avenue S	—	**A**	—	—	—	—
Elks Drive	—	—	**A**	—	—	—
32nd Avenue S	—	—	—	**A**	—	—
47th Avenue S	—	—	—	—	**A**	—
Merrifield Road	—	—	—	—	—	**A**

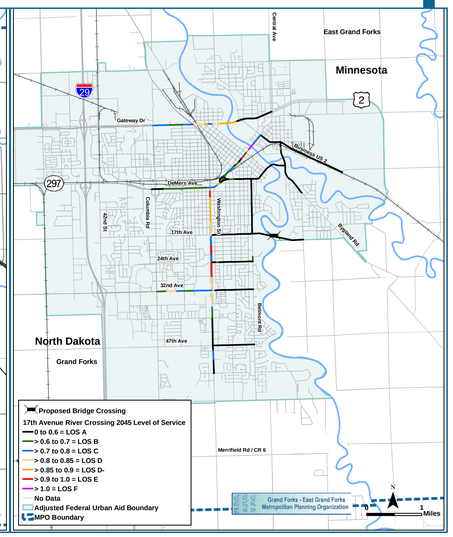
Change in Vehicle Miles Traveled and Vehicle Hours Traveled Compared to 2045 No Build:

METRIC	2045 No Build	17th Avenue S River Crossing	Elks Drive River Crossing	32nd Avenue S River Crossing	47th Avenue S River Crossing	Merrifield Road River Crossing
Change in Daily Vehicle Miles Traveled	1,054,784	-9,858	-14,600	-24,721	-13,393	-17,717
Change in Daily Vehicle Hours Traveled	59,702	-12,374	-12,254	-831	174	-679

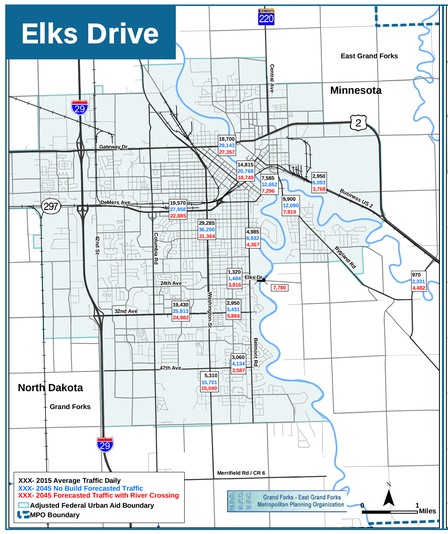
Link LOS & Volume Maps

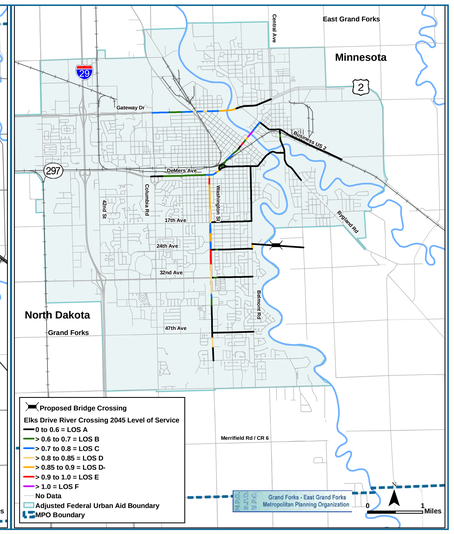
17th Avenue S



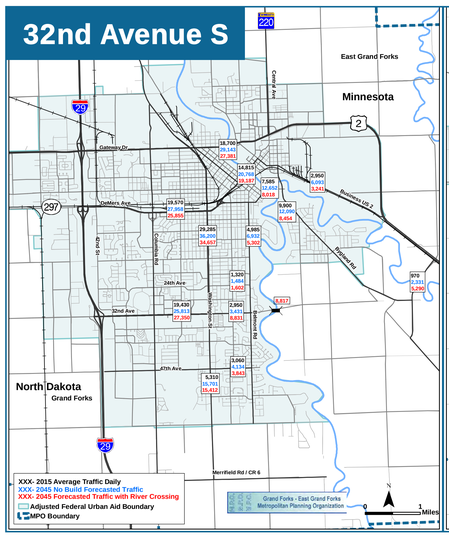


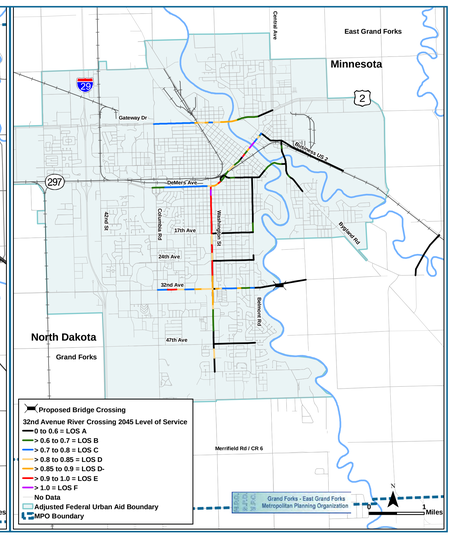
Elks Drive



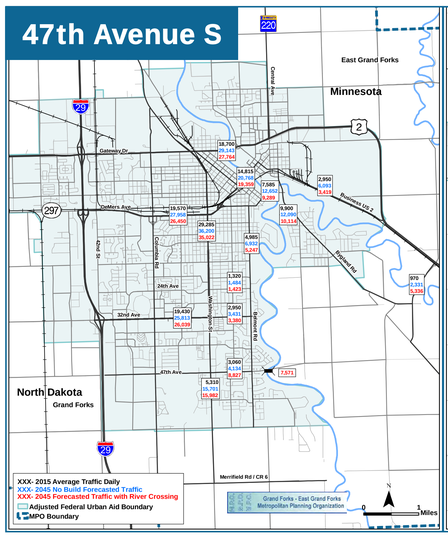


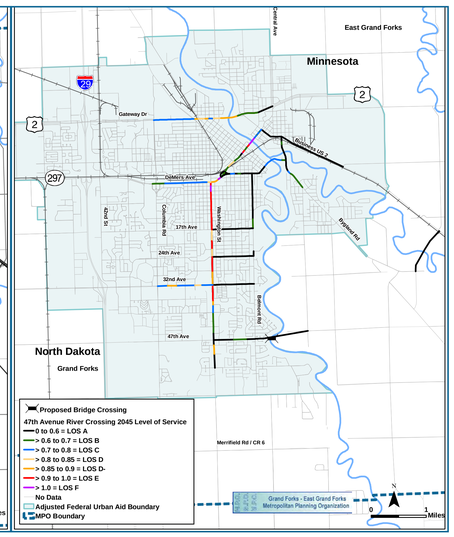
32nd Avenue S



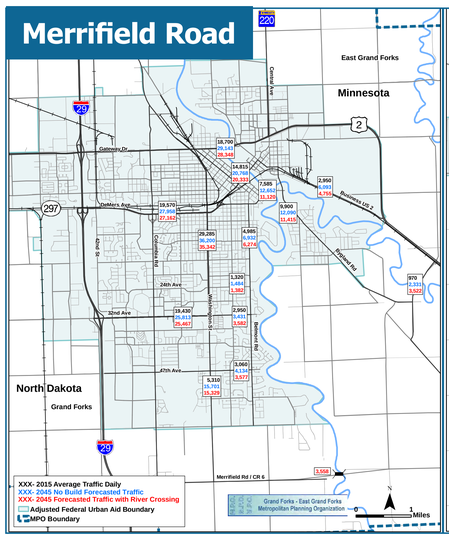


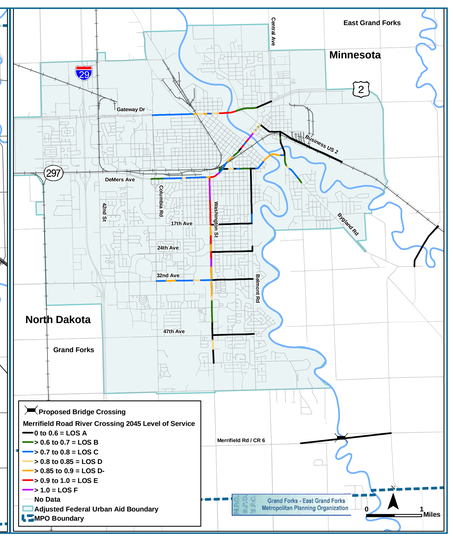
47th Avenue S





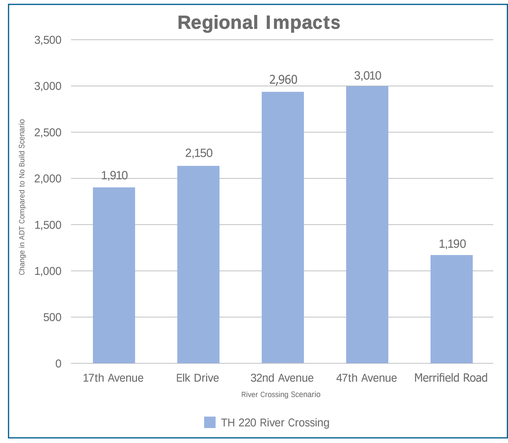
Merrifield Road



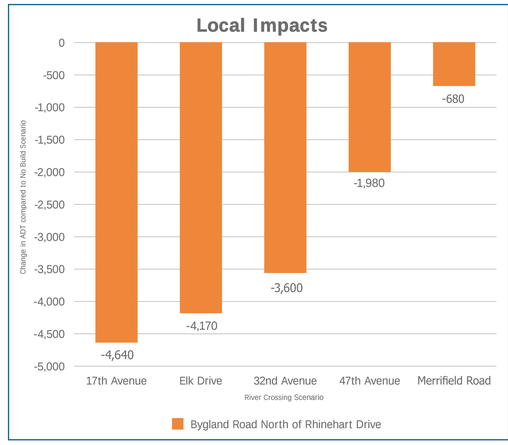


Roadways with Similar Volumes

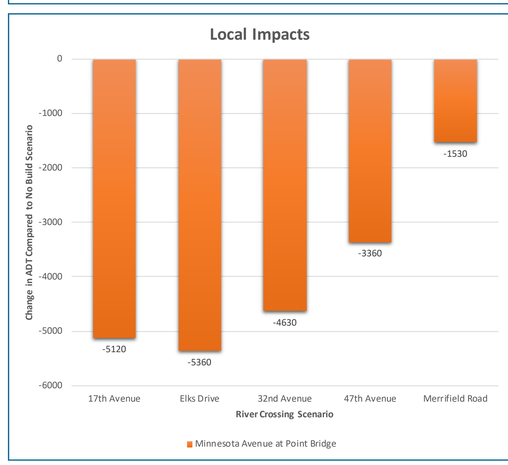
32nd Avenue S West of Belmont with 32nd Avenue S River Crossing (2045 Forecast)	8,800
Point Bridge River Crossing (Existing ADT)	7,600



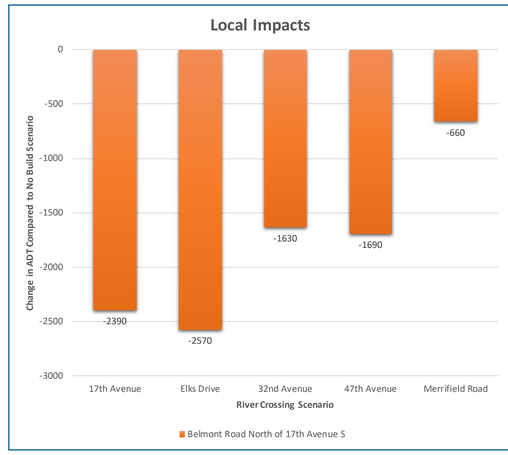
Change in traffic volumes on TH 220 at Red Lake River by River Crossing Scenario



Change in traffic volumes on Bygland Road, North of Rhinehart Drive by River Crossing Scenario



Change in traffic volumes on Minnesota Avenue at Point Bridge by River Crossing Scenario



Change in traffic volumes on Belmont Road North of 17th Avenue S by River Crossing Scenario

River Crossing Analysis: Benefits & Costs

Where we were:

Early 2000 Planning Level Costs:

CROSSING LOCATION	ALTERNATIVE	COST
17th Avenue	Low	$16,368,000
	High	$30,204,000
Elks Drive	Low	$10,668,000
32nd Avenue	Low	$19,140,000
	High	$24,804,000
47th Avenue	-	NA
Merrifield Road	Low	$19,500,000

Where we are now:

2018 Planning Level Costs

CROSSING LOCATION	ALTERNATIVE	COST
17th Avenue	Low	$33,000,000-$39,000,000
Elks Drive	Low	$21,000,000-$24,000,000
32nd Avenue	Low	$29,000,000-$33,000,000
47th Avenue	Low	$26,000,000-$30,000,000
Merrifield Road	Low	$32,000,000-$35,000,000

Due to lack of funding available and resulting lower B/C rations, the Grand Forks-East Grand Forks MPO Executive Board voted to eliminate addition work on high river crossings

KEY ASSUMPTIONS

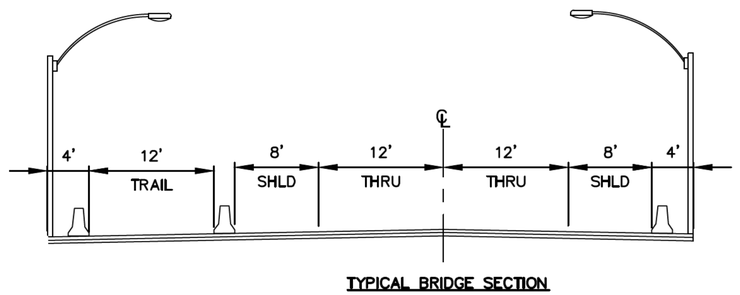
- All proposed river crossing bridges are two-lane bridges
- All connections on each side are to two-lane roads
- No additional thru lane capacity was added
- No new connections were made to I-29 to the west
- No new connections were made to US 2 to the east
- All bridges have a trail except for Merrifield Road due to its rural location

Benefits

LOCATION	TRAVEL TIME	OPERATIONS	CRASH COSTS	AIR QUALITY	TOTAL BENEFITS
17th Avenue	$22,926,000	$6,232,000	$898,000	$90,000	$30,146,000
Elks Drive	$17,523,000	$8,144,000	$1,685,000	$118,000	$27,470,000
32nd Avenue	$26,596,000	$14,320,000	$2,885,000	$207,000	$44,008,000
47th Avenue	-$5,568,000	$7,758,000	$1,520,000	$112,000	$3,822,000
Merrifield Road	$22,372,000	$8,267,000	$1,920,000	$120,000	$32,679,000

Ratio of Benefits to Costs (B/C)

LOCATION	17TH AVENUE	ELKS DRIVE	32ND AVENUE	47TH AVENUE	MERRIFIELD ROAD
B/C without Trucks	**1.9-2.1**	**2.6-3.0**	**3.1-3.5**	0.4-0.5	**2.2-2.4**



TYPICAL BRIDGE SECTION

Grand Forks-East Grand Forks MPO
STREET/HIGHWAY PLAN UPDATE

COMMENT CARD

Please share your thoughts below or on the project website at
https://www.theforksstreets2045.org/contact

OPTIONAL

NAME Nelson Rosit PHONE

ADDRESS Grand Forks, ND EMAIL north_house2@yahoo.com

COMMENT I'm a board member of the GFC Historical Soc. I oppose the 24th Ave S site for a new bridge as it would negatively impact the historical society's grounds. A more southerly location suggests itself.

Grand Forks - East Grand Forks Metropolitan Planning Organization

Kimley»Horn WSB

Streets + Highways Plan Update

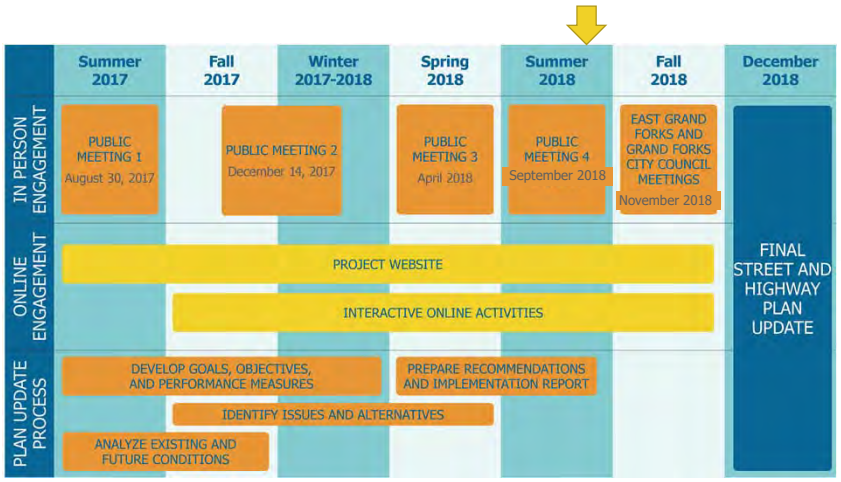
September 12, 2018

Kimley»Horn

Agenda

- Update process and timeline
- Goals, objectives, performance measures and targets
- Final revenue forecasts
- Investment direction
- Investment scenarios
- River crossing analysis
- Next steps and timeline

Plan Update Schedule: Where We Are



Goals, Objectives, Performance Measures and Targets

Goals, Objectives, Performance Measures and Targets Update Process

- November 2017
  - DRAFT goal, objective, and strategy statements
    - Resiliency and Tourism
  - Potential safety targets, continued discussion
- December 2017
  - DRAFT goal, objective, and strategy statements
    - All goal areas
  - Potential safety targets, continued discussion
- February 2018
  - Finalized goal, objective, and strategy statements
  - Reviewed recommended safety targets; Policy board adopted
- July 2018
  - Reviewed draft pavement and bridge targets
- August 2018
  - Reviewed draft travel time reliability targets
- September 2018
  - Review recommended pavement, bridge, travel time reliability, and green house gas targets

Tools for performance-based planning



Mobility Measures

- Interstate truck travel time reliability
  - Interstate truck travel time reliability index
- Interstate travel reliability
  - Percent of person-miles traveled on the Interstate that are reliable
- Non-Interstate travel reliability
  - Percent of person-miles traveled on the non-Interstate NHS that are reliable

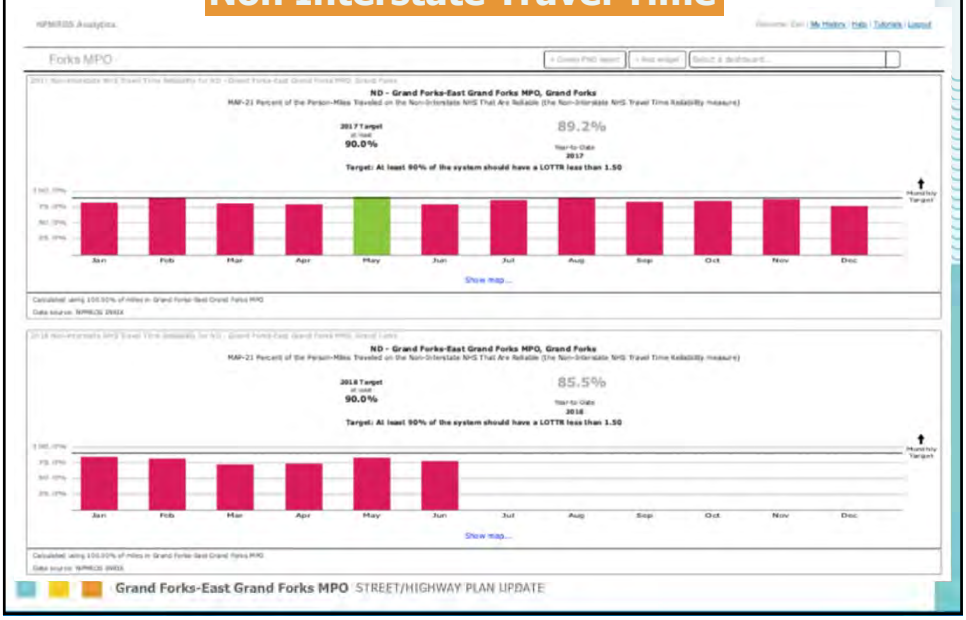
Mobility Targets

- Must adopt 3 targets; Can adopt up to 6 targets; Or a number between
  - 3 targets would mean just for MPO Area
  - 6 Targets would mean just both state targets
  - Can choose to adopt combinations of MPO and state targets
- Next slides present the targets adopted for each state

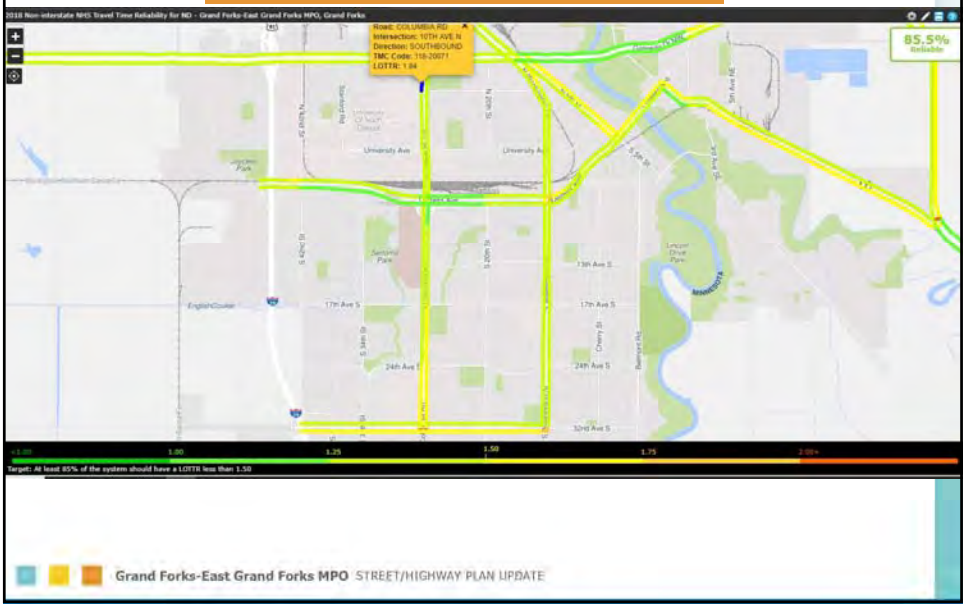
Mobility Measures and Targets

	North Dakota	Minnesota	GF-EGF MPO
Interstate truck travel time reliability	Two-year target: 3 Four-year target: 3	Two-year target: 1.5 Four-target : 1.5 No facilities in Grand Forks-East Grand Forks MPO area	***Data shows :*** • ***1.19 (2017)*** • ***1.22 (2018)*** **DRAFT TARGET:** • **1.5**
Interstate travel reliability	Two-year target: 85% Four-year target: 85%	Two-year target: 80% Four-year target: 80% No facilities in Grand Forks-East Grand Forks MPO area	***Data shows 100%*** **DRAFT TARGET:** • **90%**
Non-Interstate travel reliability	Two-year target: Not applicable Four-year target: 85%	Two-year target: Not applicable Four-year target: 75%	***Data shows :*** • ***89.2%(2017)*** • ***85.5% (2018)*** **DRAFT TARGET:** • **85%**

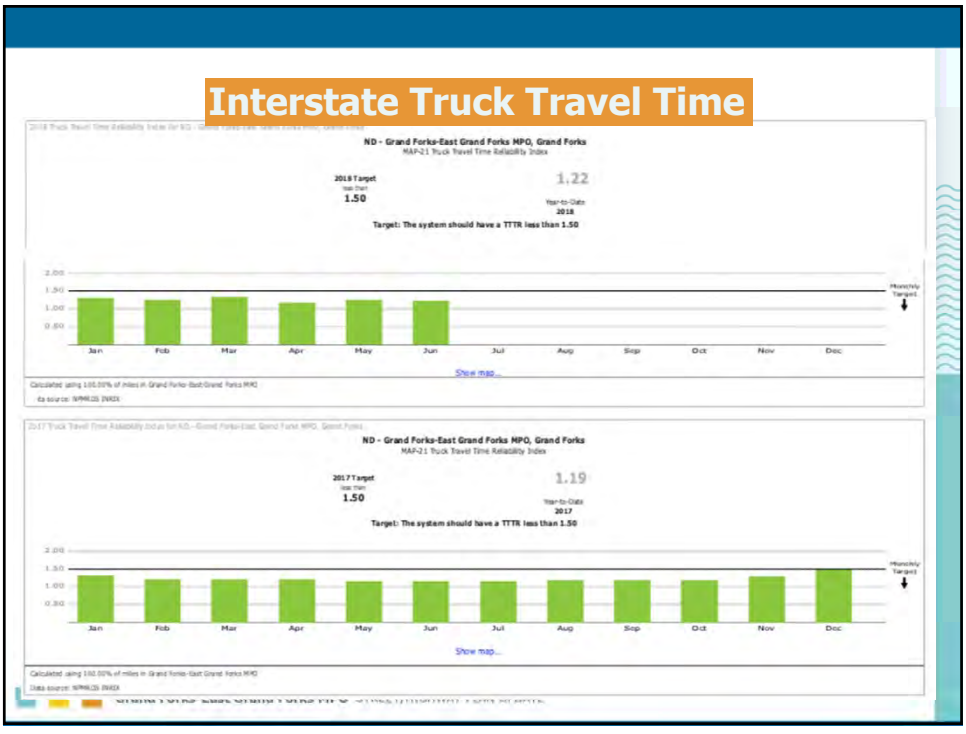
Non Interstate Travel Time



Non Interstate Travel Time



Interstate Truck Travel Time



Interstate Truck Travel Time



Interstate Travel Time



Interstate Travel Time



		MN		ND		MPO
	Measure	Two-Year Target	Four-Year Target	Two-Year Target	Four-Year Target	Four-Year Target
PM2	Percent of NHS Bridges in Good Condition	50%	50%	60%	60%	States
	Percent of NHS Bridges in Poor Condition	4%	4%	4%	4%	States
	Percent of Interstate Pavement in Good Condition	55%	55%	75.6%	75.6%	75.6%
	Percent of Interstate Pavement in Poor Condition	2%	2%	3%	3%	3%
	Percent of Non-Interstate NHS Pavement in Good Condition	50%	50%	58.3%	58.3%	states
	Percent of Non-Interstate NHS Pavement in Poor Condition	4%	4%	3%	3%	States
PM3	Percent of Reliable Person Miles on the Interstate	80%	80%	85%	85%	90%
	Percent of Reliable Person Miles Reliable on the Non-Interstate NHS	N/A	75%	N/A	85%	85%
	Truck Travel Time Reliability Index	1.5	1.5	3	3	1.5

Environment Measures

- Percent change in tailpipe CO2 emissions on National Highway System as compared to calendar year 2017
- 2040 Plan Target reduce tailpipe CO2 emissions by 10 percent below 2007 levels

Compare 2006-2010-2015

Year	Total Vehicle-Miles Traveled by Year by Passenger Cars and Light Trucks (Change from 2006)	Average Miles of Travel per Gallon of Fuel Consumed (Change from 2006)	Gallons of Fuel Consumed by Year by Passenger Cars and Light Trucks (Change from 2006)	Metric Tons of Carbon Dioxide or CO2 Equivalent (Change from 2006)
2006	269,698,500	20.04	13,458,009	119,642
2010	265,428,000 (-4,270,500)	20.04 (no change)	13,244,910 (-213,099)	117,747 (-1,895)
2015	294,365,293 (+24,666,793)	22.0 (+1.96)	13,380,241 (-77,768)	118,950 (-692)

Source: 2040 Street/Highway Plan

- Downward trend in CO_2 or CO_2 equivalents
- Current trend would not achieve 2040 target (10% reduction from 2007 levels)

Investment Direction

Input to Investment Direction

- Goals, objective, performance measures and targets
- Public input
  - Issue areas (August 2017 public meeting)
  - Investment priorities (January 2018 public meeting)
- State and local plans
  - Safety plans
  - Asset management plans
  - Investment plans
- Available revenues

Input to Investment Direction:
Goals, objectives, performance measures and performance targets

GF-EGF goal areas

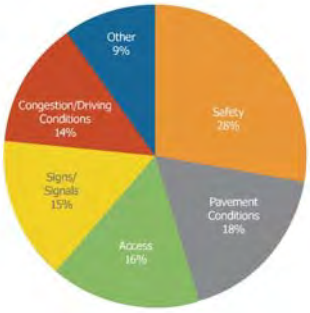
1. Economic vitality
2. Security
3. Accessibility and mobility
4. Environment/energy/quality of life
5. Integration and connectivity
6. Efficient system management
7. System preservation
8. Safety
9. Resiliency
10. Tourism

Federal performance measures

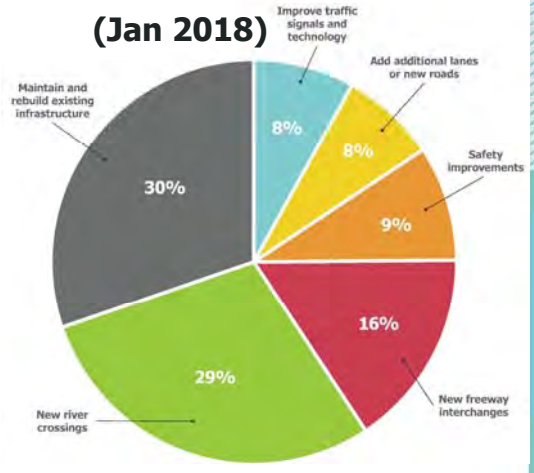
- Safety
  - Fatalities
  - Serious injuries
  - Non-motorized fatalities and serious injuries
- State of Good Repair
  - Pavement
  - Bridge
- Mobility and Environment
  - Truck travel time reliability
  - Interstate travel reliability
  - Non-Interstate travel reliability
  - Percent change in tailpipe CO2 emissions on NHS vs CY2017

Input to Investment Direction:
Public Input

Issue Areas (Aug 2017)



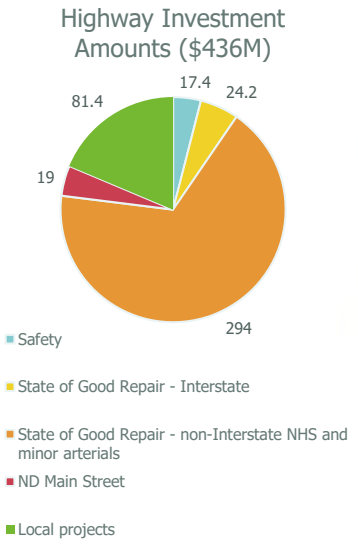
Investment Priorities (Jan 2018)



Investment Scenarios

Investment Scenarios: Current Revenue Scenario

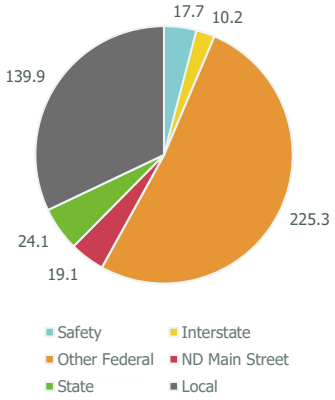
	Amount	Share
Safety	$17.4M	4%
ND Main Street	$19M	4%
State of Good Repair – Interstate	$24.2M	6%
State of Good Repair – non-Interstate NHS and minor arterials	$294M	67%
Local projects	$81.4M	19%
TOTAL	$436M	100%



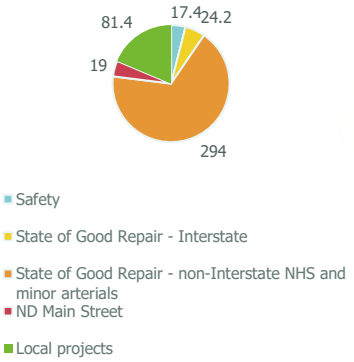
Grand Forks-East Grand Forks MPO STREET/HIGHWAY PLAN UPDATE

Investment Scenarios:
Current Revenue Scenario – Fiscal Constraint

Highway Revenues ($436M)



Highway Investment Amounts ($436M)



Investment Scenarios:
Potential Discretionary Projects

- State of good repair
  - Non-NHS federal aid-eligible streets and highways
- Bridge repair
  - East Grand Forks Point Bridge Approach
- Intersections
  - 32nd Avenue/S Washington
  - Central Ave 17th St to 23rd St
  - Washington St/DeMers
  - US 2 (Gateway) Washington St to Mill Rd
  - US 2 (Gateway) Cambridge St to Columbia Rd
- Additional lanes
  - Columbia Rd 14th Ave S to 24th Ave S
- I-29 interchange upgrades
  - North Washington, US 2 (Gateway), DeMers, 32nd Avenue
- New grade separations
  - US 2 (Gateway) east of I-29
  - 42nd Street north of DeMers Avenue
- River crossings
  - 32nd Avenue
  - Merrifield Road

River Crossing Analysis

River Crossing Analysis: Scope of Work

- Review transportation impacts of 5 river crossing locations
- Improve local traffic and connectivity
- Use 2045 travel demand model
- Review impacts on:
  - Existing crossings
  - Neighborhoods
  - Local and regional roadway network
- Compare impacts of each crossing



Potential River Crossing Locations

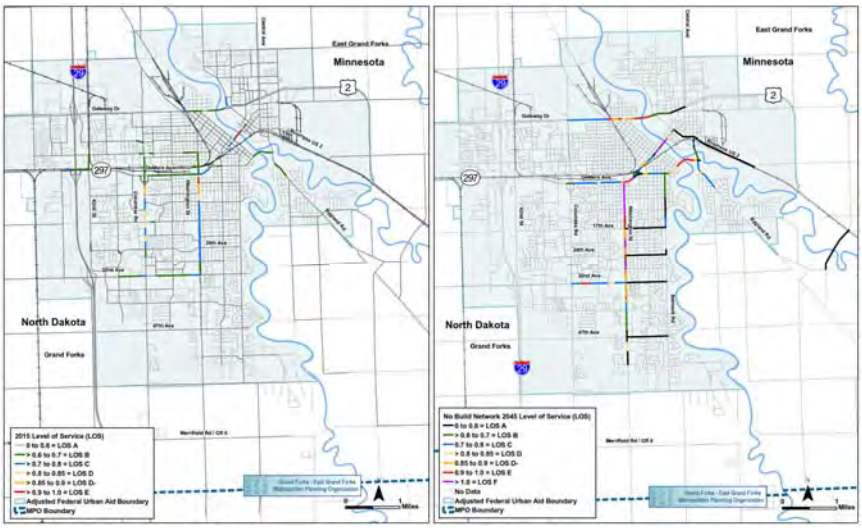
River Crossing Modeling Assumptions

- All proposed river crossing bridges are two-lane bridges
- All connections on each side are to two-lane roads
- No additional thru lane capacity was added
- No new connections were made to I-29 to the west
- No new connections were made to US 2 to the east

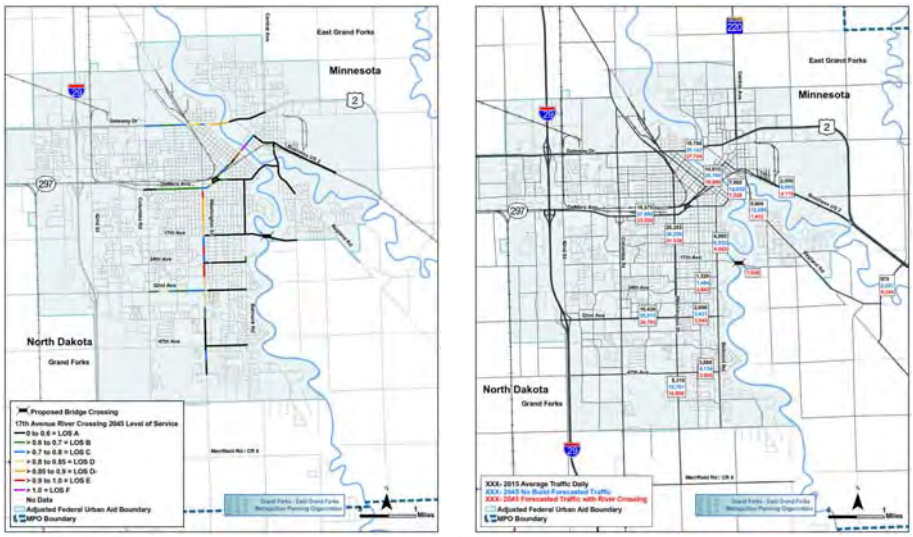
River Crossing Analysis

- Present link daily volumes and LOS
- Present draft intersection LOS from Synchro analysis
- Present initial alignment concepts
- Report on meeting held June 27 to discuss how Minnesota 47th Ave S connection may occur
- Review opinion of probable costs
- Review benefit/cost ratio
- Present evaluation tables

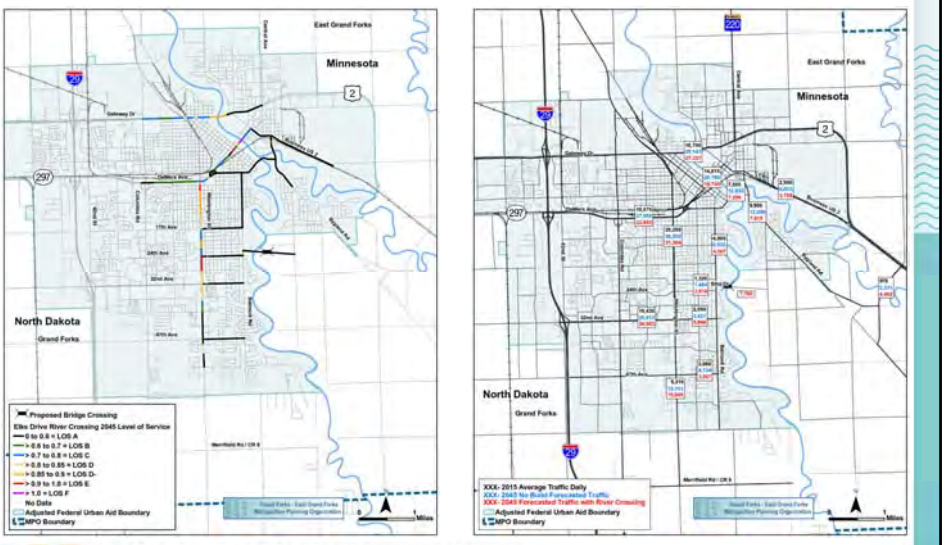
River Crossing – Link LOS



17th Ave. S
River Crossing – Link LOS

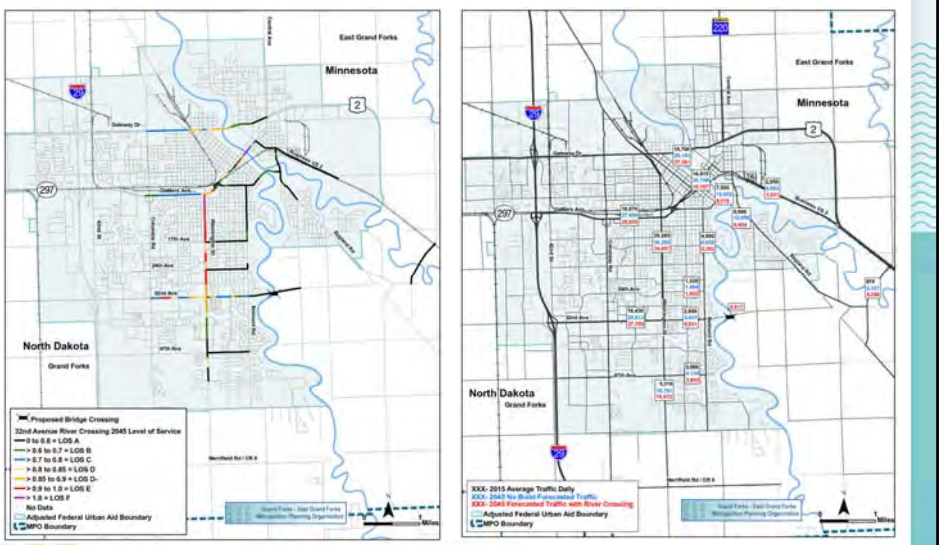


Elks Drive
River Crossing – Link LOS



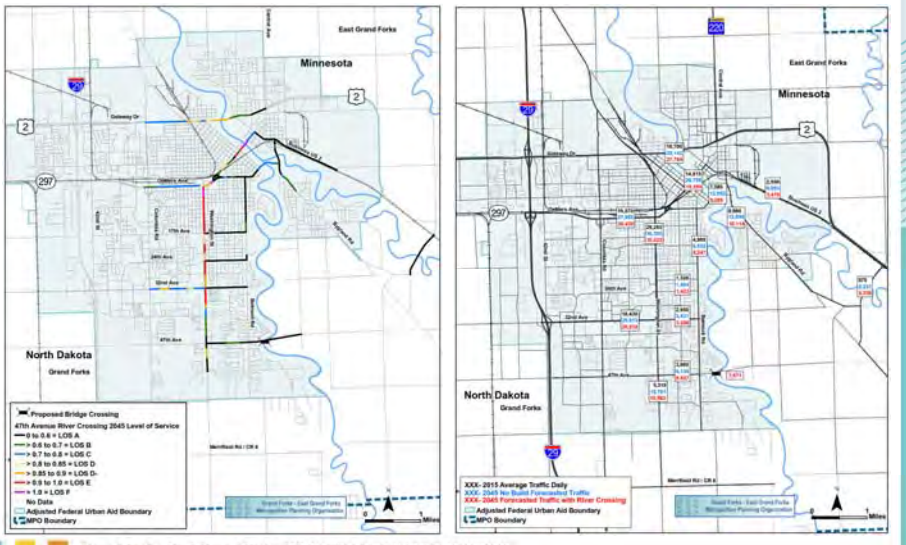
Grand Forks-East Grand Forks MPO STREET/HIGHWAY PLAN UPDATE

32nd Ave. S
River Crossing – Link LOS



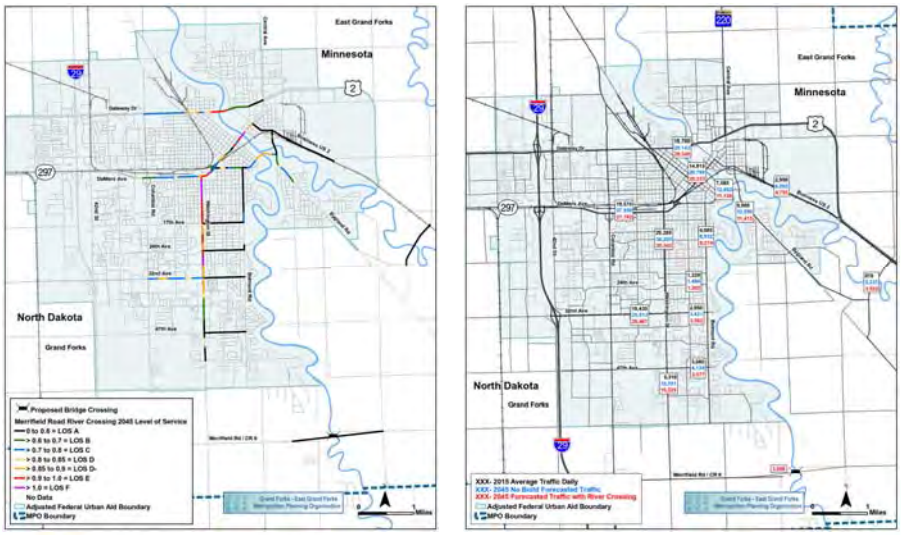
Grand Forks-East Grand Forks MPO STREET/HIGHWAY PLAN UPDATE

47th Ave. S River Crossing – Link LOS



Grand Forks-East Grand Forks MPO STREET/HIGHWAY PLAN UPDATE

Merrifield (GF#6 and Polk #58 River Crossing – Link LOS



Grand Forks-East Grand Forks MPO STREET/HIGHWAY PLAN UPDATE

River Crossing – Link LOS

- Point Bridge operates better under 17th, Elks Drive and 32nd Avenue crossing scenarios
- Gateway Drive operates better under all crossing scenarios except Merrifield Road
- Washington Street operates better under 17th Avenue and Elks Drive crossing scenarios although all scenarios have segments with undesirable operations
- Belmont Road operates better under all crossing scenarios based on link LOS but Belmont Road / 4th Avenue intersection LOS shows mitigation is required under Merrifield crossing scenario

2045 Traffic Demand on Roadway Segments

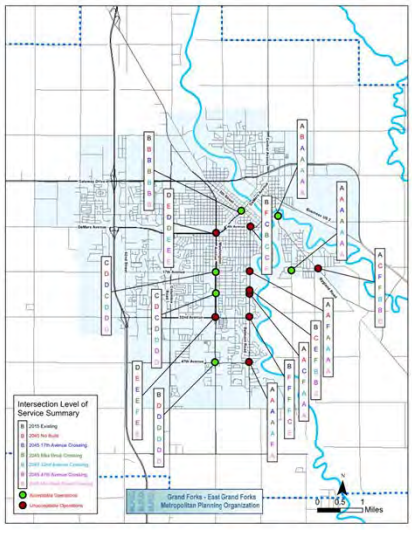
- 17th Avenue S (2-lane today) ~3,000 and ~10,000 vpd just west of Belmont and east of Washington Street, respectively (under 17th crossing scenario)
- 24th Avenue S (2-lane today) ~4,000 and ~7,500 vpd just west of Belmont and east of Washington, respectively (under Elks crossing scenario)
- 32nd Avenue S (mostly 2-lane today) ~10,500 and ~13,000 vpd just west of Belmont and east of Washington, respectively (under 32nd crossing scenario)
- 47th Avenue S (3-lane today) ~8,000 and ~9,000 vpd just west of Belmont and east of Washington, respectively (under 47th crossing scenario)

Roadway Planning Capacities

- 2-lane urban roadway capacity is ~8,000 - 10,000 vpd
  - 17th Avenue is at high end of capacity threshold on the west end without conversion to 3-lane on west end (east end is fine)
  - 24th Avenue demand is under low end of capacity threshold throughout
- 3-lane urban roadway capacity is ~14,000 – 17,000 vpd
  - 32nd Avenue requires 3-lane section
    - Between Cherry and Washington restriping required
    - Between Cherry and Belmont minor widening may be required (additional as-built and design standard input needed – appears 3-11 foot lanes would fit)
  - 47nd Avenue requires a 3-lane section
    - Between Washington and Belmont no changes are required
    - East of Belmont a 3-lane section could be added with restriping only

River Crossing – Intersection LOS

- Exhibit shows intersection LOS under each crossing scenario
- Expanded list from prior analysis



River Crossing – Intersection LOS

Intersection	Existing Control	2045 Unmitigated LOS	Proposed Control	Mitigated LOS	Mitigation Summary
Demers Avenue at S Washington	Traffic Signal	E	Traffic Signal	N/A	Additional lanes are required and that is not very feasible given existing right-of-way using a conventional intersection improvement. CFI option showed benefit in 2013 analysis.
S Washington at 32nd Avenue	Traffic Signal	F	Traffic Signal	D	Additional lanes are required and that is not very feasible given existing right-of-way using a conventional intersection. A quadrant roadway has some merit, but additional analysis is required.
4th Avenue at Belmont Road	All-Way Stop	F	Mini-Roundabout / Traffic Signal	B	Based on a high-level volume analysis, a mini-roundabout is also anticipated to operate at an acceptable LOS. Also could convert to a signal.
17th Avenue at Belmont Road	Two-Way Stop	F	Traffic Signal	C	Convert to a signal.
Greenway Blvd / Bygland Rd / 13th	Two-Way Stop	F	Conventional Roundabout / Traffic Signal	B	A conventional single lane roundabout would also result in acceptable operations. Also could convert to a signal.
24th Avenue at Belmont Road	Two-Way Stop	F	Traffic Signal	B	Convert to a signal.
Elks Drive at Belmont Road	Two-Way Stop	F	Traffic Signal	B	Convert to a signal. The WB approach also requires a left turn lane and a right turn lane. Right-of-way will need to be acquired to accommodate the WB approach widening.
32nd Avenue at Belmont Road	All-Way Stop	F	Traffic Signal	D	Convert to a signal. Avoided adding left turn lanes because downstream widening would be required to avoid skew for through traffic through intersection.
47th Avenue at Belmont Road	Two-Way Stop	F	Traffic Signal	B	Convert to a signal and add a left turn lane on the NB/SB/WB approaches. Widening and urban street cross section will be required on the NB approach.

Draft River Crossing Alignments
17th Avenue S



Draft River Crossing Alignments
Elks Drive



Grand Forks-East Grand Forks MPO STREET/HIGHWAY PLAN UPDATE

Draft River Crossing Alignments
32nd Avenue S



Grand Forks-East Grand Forks MPO STREET/HIGHWAY PLAN UPDATE

Draft River Crossing Alignments
47th Avenue S



Grand Forks-East Grand Forks MPO STREET/HIGHWAY PLAN UPDATE

Draft River Crossing Alignments
Merrifield Road



Grand Forks-East Grand Forks MPO STREET/HIGHWAY PLAN UPDATE

47th MN Jurisdiction Meeting



47th MN Jurisdictional Meeting

- Rhinehart Drive south of dike could be converted to County Road or County State Aid Highway (~1.1 miles)
- Rhinehart Drive between 13th Street SE and dike could be converted to City Street and likely to be reconstructed as an urban section (~0.8 miles)
- 200th Street to be converted to County Road or County State Aid Highway between the Red River and CSAH 58 (~2.1 miles)
- Improvements could be phased (i.e. Rhinehart Drive and 200th Street would not all have to be completed at once)

River Crossing Analysis: Opinion of Probable Costs

- Developed revised concept level quantities
- Developed opinion of probable cost for each alternative
- 2002 analysis typically had 3 pay items
- 17th Ave S (low bridge) example:

Description	Quantity	UM	Unit Price	Total
COMMON EXCAVATION	12,500	CY	$ 8.00	$ 100,000
COMMON FILL	22,300	CY	$ 13.00	$ 289,900
WALKS	56,500	SF	$ 15.00	$ 847,500
BITUMINOUS	205,800	SF	$ 2.50	$ 514,500
CURB AND GUTTER	6,800	LF	$ 20.00	$ 136,000
DRAINAGE AND EROSION CONTROL	1	LS	40%	$ 755,160
NON QUANTIFIED MINOR ITEMS			20%	$ 528,612
BRIDGE	74,400	SF	$ 250.00	$ 18,600,000
50-FT DIKE STRUCTURE	2	EA	$ 200,000.00	$ 400,000
MOBILIZATION			8%	$ 1,773,734
CONTINGENCY			10%	$ 2,394,541
ENGINEERING / CONST.			25%	$ 6,584,987
Total				$ 32,924,933

River Crossing Analysis: Comparison to 2002 Costs

- Early 2000 Opinion of Probable Costs:

Cost Summary - Early 2000 Analysis		
Crossing Location	Alternative	Cost
17th Avenue S	Low	$ 16,368,000
	High	$ 30,204,000
Elks Drive	Low	$ 10,668,000
32nd Avenue S	Low	$ 19,140,000
	High	$ 24,804,000
47th Avenue S	--	NA
Merrifield Road	Low	$ 19,500,000

- 2018 Opinion of Probable Costs:

Cost Summary - Year 2018		
Crossing Location	Alternative	Cost
17th Avenue S	Low	$33,000,000-$39,000,000
	High	$76,000,000-$91,000,000
Elks Drive	Low	$21,000,000-$24,000,000
	High	$63,000,000-$74,000,000
32nd Avenue S	Low	$29,000,000-$33,000,000
	High	$63,000,000-$75,000,000
47th Avenue S	Low	$26,000,000-$30,000,000
Merrifield Road	Low	$32,000,000-$35,000,000

Due to a lack of available funding and resulting lower B/C ratios, the Grand Forks-East Grand Forks MPO Executive Board voted to eliminate additional work on high river crossing

River Crossing Analysis: Benefit Analysis

Benefit 17th Avenue S

Benefit Category	Benefits Compared to No Build Alternative ($2017)
Travel Time	$22,926,000
Operations	$6,232,000
Crash Costs	$898,000
Air Quality	$90,000
Total Benefits	**$30,146,000**

Benefit Elks Drive

Benefit Category	Benefits Compared to No Build Alternative ($2017)
Travel Time	$17,523,000
Operations	$8,144,000
Crash Costs	$1,685,000
Air Quality	$118,000
Total Benefits	**$27,470,000**

Benefit 32nd Avenue S

Benefit Category	Benefits Compared to No Build Alternative ($2017)
Travel Time	$26,596,000
Operations	$14,320,000
Crash Costs	$2,885,000
Air Quality	$207,000
Total Benefits	**$44,008,000**

Benefit 47th Avenue S

Benefit Category	Benefits Compared to No Build Alternative ($2017)
Travel Time	-$5,568,000
Operations	$7,758,000
Crash Costs	$1,520,000
Air Quality	$112,000
Total Benefits	**$3,822,000**

Benefit Merrifield Road

Benefit Category	Benefits Compared to No Build Alternative ($2017)
Travel Time	$22,372,000
Operations	$8,267,000
Crash Costs	$1,920,000
Air Quality	$120,000
Total Benefits	**$32,679,000**

Comparison Matrices

17th Avenue S Low Bridge

Issue	Method of Measurement	Units	Value	Change from Base Conditions
Traffic Operations Factors				
Traffic Flow and Congestion	VHT statistics from the travel demand model	Daily vehicle hours traveled	59,056	(646)
Reduced Trip Length	VMT statistics from the travel demand model	Daily vehicle miiles traveled	1,044,926	(9,858)
Project Costs				
Construction Costs	Estimated cost of construction in 2018 dollars	Dollars	$33,000,000-$39,000,000	N/A
Socio Economic Factors				
Roadway User Economic Analysis	Use VMT and VHT statistices to determine benefits compared to construction costs	B/C ratio	1.9 - 2.1	N/A

Elks Drive Low Bridge

Issue	Method of Measurement	Units	Value	Change from Base Conditions
Traffic Operations Factors				
Traffic Flow and Congestion	VHT statistics from the travel demand model	Daily vehicle hours traveled	59,180	(522)
Reduced Trip Length	VMT statistics from the travel demand model	Daily vehicle miiles traveled	1,040,184	(14,600)
Project Costs				
Construction Costs	Estimated cost of construction in 2018 dollars	Dollars	$21,000,000-$24,000,000	N/A
Socio Economic Factors				
Roadway User Economic Analysis	Use VMT and VHT statistices to determine benefits compared to construction costs	B/C ratio	2.6 - 3.0	N/A

Comparison Matrices

32nd Avenue S Low Bridge

Issue	Method of Measurement	Units	Value	Change from Base Conditions
Traffic Operations Factors				
Traffic Flow and Congestion	VHT statistics from the travel demand model	Daily vehicle hours traveled	58,871	(831)
Reduced Trip Length	VMT statistics from the travel demand model	Daily vehicle miiles traveled	1,030,063	(24,721)
Project Costs				
Construction Costs	Estimated cost of construction in 2018 dollars	Dollars	$29,000,000-$33,000,000	N/A
Socio Economic Factors				
Roadway User Economic Analysis	Use VMT and VHT statistices to determine benefits compared to construction costs	B/C ratio	3.1 - 3.5	

47th Avenue S Low Bridge

Issue	Method of Measurement	Units	Value	Change from Base Conditions
Traffic Operations Factors				
Traffic Flow and Congestion	VHT statistics from the travel demand model	Daily vehicle hours traveled	59,876	174
Reduced Trip Length	VMT statistics from the travel demand model	Daily vehicle miiles traveled	1,041,391	(13,393)
Project Costs				
Construction Costs	Estimated cost of construction in 2018 dollars	Dollars	$26,000,000-$30,000,000	N/A
Socio Economic Factors				
Roadway User Economic Analysis	Use VMT and VHT statistices to determine benefits compared to construction costs	B/C ratio	0.4 - 0.5	

Comparison Matrices

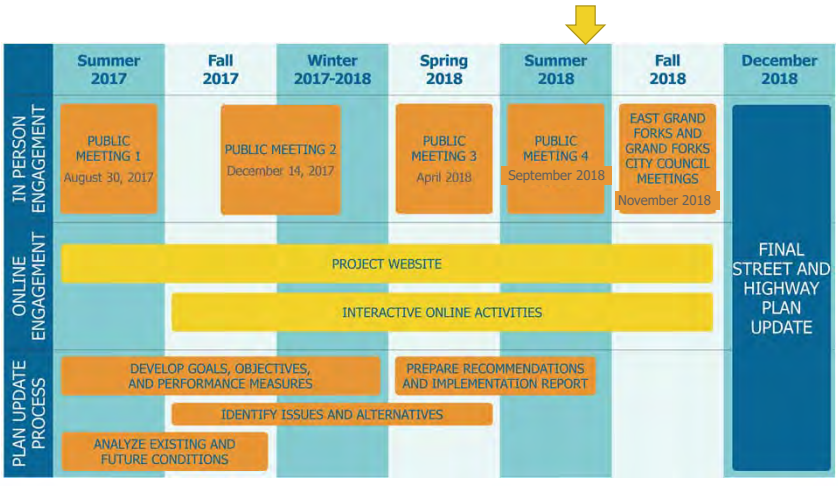
Merrifield Road Low Bridge

Issue	Method of Measurement	Units	Value	Change from Base Conditions
Traffic Operations Factors				
Traffic Flow and Congestion	VHT statistics from the travel demand model	Daily vehicle hours traveled	59,023	(679)
Reduced Trip Length	VMT statistics from the travel demand model	Daily vehicle miiles traveled	1,037,067	(17,717)
Project Costs				
Construction Costs	Estimated cost of construction in 2018 dollars	Dollars	$32,000,000-$35,000,000	N/A
Socio Economic Factors				
Roadway User Economic Analysis	Use VMT and VHT statistices to determine benefits compared to construction costs	B/C ratio	2.2 - 2.4	

Benefit Cost Summary

B/C Summary		
Crossing Location	Alternative	Cost
17th Avenue S	Low	**1.9 - 2.1**
Elks Drive	Low	**2.6 - 3.0**
32nd Avenue S	Low	**3.1 - 3.5**
47th Avenue S	Low	0.4 - 0.5
Merrifield Road	Low	**2.2 - 2.4**

Plan Update Schedule: Where We Are



Overcoming Barriers **Strengthening Connections**

M.P.O. M.P.O. M.P.O.

Grand Forks - East Grand Forks Metropolitan Planning Organization

Ensuring Opportunities **Planning One Community**

"A community that provides a variety of complementary transportation choices, that are fiscally constrained, for people and goods."

November 13, 2018

Subject: Grand Forks-East Grand Forks Metropolitan Transportation Plan Update

To whom it may concern:

The Grand Forks-East Grand Forks Metropolitan Planning Organization is currently conducting a comprehensive update to our Metropolitan Transportation Plan. This plan serves as the reference document for federally or locally funded regionally significant transportation projects. The Update will bring our planning documents to the planning horizon year of 2045. We seek your consultation regarding our transportation planning efforts.

With limited revenues, our focus is on preserving the transportation system currently in place. No new facilities, no expansion of existing facilities beyond current right-of-way, no new alignments, and no additional crossing of rivers are financially feasible.

Attached is a map, that we have created based upon review of available resources, identifying environmentally sensitive areas. Please review and compare with your data and alert of us of any errors or omissions of information. We appreciate any comments prior to December 13, 2018 sent to me at Grand Forks-East Grand Forks MPO 255 N 4th Street, Grand Forks, ND 58206 or earl.haugen@theforksmpo.org.

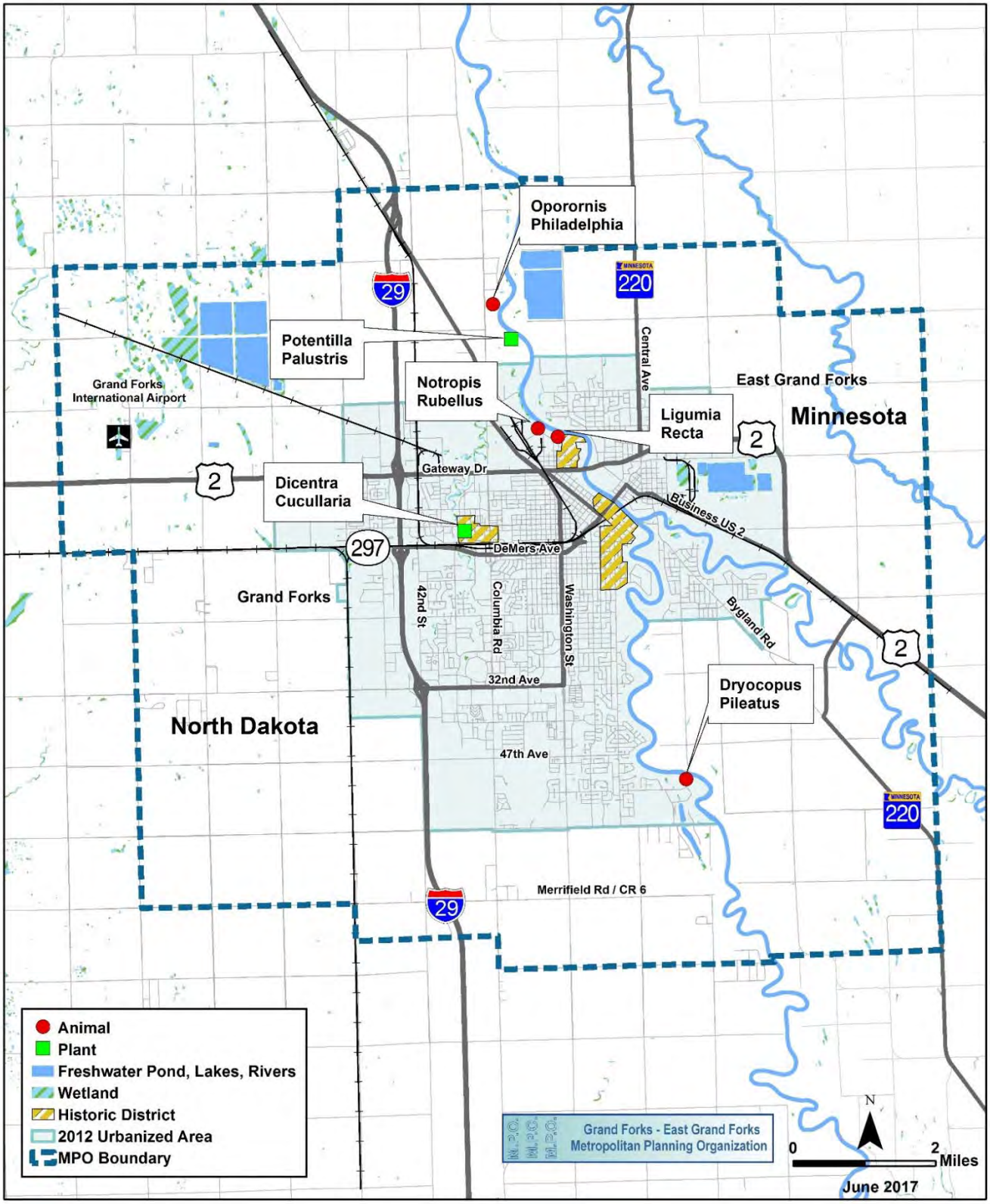
Please feel free to visit our website: www.theforksmpo.org to learn more about our efforts to bring comprehensive, continuing, and coordinated transportation planning to our region. Also, please contact us at 701-746-2660 if you have any questions or would like additional information.

Sincerely,



Earl Haugen
Executive Director

Figure 7-7: Sensitive Environmental Features



Source: Grand Forks-East Grand Forks MPO

NORTH DAKOTA DEPARTMENT of HEALTH

ENVIRONMENTAL HEALTH SECTION
Gold Seal Center, 918 E. Divide Ave.
Bismarck, ND 58501-1947
701.328.5200 (fax)
www.ndhealth.gov

RECEIVED DEC 12 2018

December 3, 2018

Mr. Earl Haugen, Executive Director
Grand Forks – East Grand Forks MPO
255 North 4th Street
Grand Forks, ND 58206

Re: Grand Forks – East Grand Forks Metropolitan Transportation Plan Update
Grand Forks County

Dear Mr. Haugen:

This department has reviewed the information concerning the above-referenced project submitted under date of November 15, 2018, with respect to possible environmental impacts.

This department believes that environmental impacts from the proposed construction will be minor and can be controlled by proper construction methods. With respect to construction, we have the following comments:

1. Care is to be taken during construction activity near any water of the state to minimize adverse effects on a water body. This includes minimal disturbance of stream beds and banks to prevent excess siltation, and the replacement and revegetation of any disturbed area as soon as possible after work has been completed. Caution must also be taken to prevent spills of oil and grease that may reach the receiving water from equipment maintenance, and/or the handling of fuels on the site. Guidelines for minimizing degradation to waterways during construction are attached.

2. Projects disturbing one or more acres are required to have a permit to discharge storm water runoff until the site is stabilized by the reestablishment of vegetation or other permanent cover. Further information on the storm water permit may be obtained from the Department's website or by calling the Division of Water Quality (701-328-5210). Projects disturbing less than one acre are also required to have a permit to discharge storm water runoff if they are part of a larger common plan of development or sale that disturbs one or more acres. A permit is not required for routine maintenance activities performed to maintain the original line and grade, hydraulic capacity, or original purpose of the facility.

3. The City of Grand Forks, Grand Forks County, the University of North Dakota, and the North Dakota Department of Transportation are required to address post-construction storm water quality as part of the North Dakota Pollutant Discharge Elimination System (NDPDES) Small Municipal Separate Storm Sewer System (MS4) General Permit

requirements. Check with local officials to be sure local storm water management considerations are addressed.

4. Slurry, residue and concrete wash water resulting from concrete paving or repair activities must be managed or treated to prevent the material from adversely affecting waters of the state.

5. Storm water runoff from the project area discharges to a 303(d) listed water body (English Coulee). Extra care should be taken to ensure construction activity does not affect the water body.

6. The proposed project area overlies the Grand Forks glacial drift aquifer and portions of the project area are within Grand Forks' wellhead protection area. Care should be taken to avoid spills of any materials that may have an adverse effect on groundwater quality. All spills must be immediately reported to this Department and appropriate remedial actions performed.

The department owns no land in or adjacent to the proposed improvements, nor does it have any projects scheduled in the area. In addition, we believe the proposed activities are consistent with the State Implementation Plan for the Control of Air Pollution for the State of North Dakota.

These comments are based on the information provided about the project in the above-referenced submittal. The U.S. Army Corps of Engineers may require a water quality certification from this department for the project if the project is subject to their Section 404 permitting process. Any additional information which may be required by the U.S. Army Corps of Engineers under the process will be considered by this department in our determination regarding the issuance of such a certification.

If you have any questions regarding our comments, please feel free to contact this office.

Sincerely,

L. David Glatt, P.E., Chief
Environmental Health Section

LDG:cc
Attach.

NORTH DAKOTA
DEPARTMENT of HEALTH

ENVIRONMENTAL HEALTH SECTION
Gold Seal Center, 918 E. Divide Ave.
Bismarck, ND 58501-1947
701.328.5200 (fax)
www.ndhealth.gov

Construction and Environmental Disturbance Requirements

These represent the minimum requirements of the North Dakota Department of Health. They ensure that minimal environmental degradation occurs as a result of construction or related work which has the potential to affect the waters of the State of North Dakota. All projects will be designed and implemented to restrict the losses or disturbances of soil, vegetative cover, and pollutants (chemical or biological) from a site.

Soils

Prevent the erosion of exposed soil surfaces and trapping sediments being transported. Examples include, but are not restricted to, sediment dams or berms, diversion dikes, hay bales as erosion checks, riprap, mesh or burlap blankets to hold soil during construction, and immediately establishing vegetative cover on disturbed areas after construction is completed. Fragile and sensitive areas such as wetlands, riparian zones, delicate flora, or land resources will be protected against compaction, vegetation loss, and unnecessary damage.

Surface Waters

All construction which directly or indirectly impacts aquatic systems will be managed to minimize impacts. All attempts will be made to prevent the contamination of water at construction sites from fuel spillage, lubricants, and chemicals, by following safe storage and handling procedures. Stream bank and stream bed disturbances will be controlled to minimize and/or prevent silt movement, nutrient upsurges, plant dislocation, and any physical, chemical, or biological disruption. The use of pesticides or herbicides in or near these systems is forbidden without approval from this Department.

Fill Material

Any fill material placed below the high water mark must be free of top soils, decomposable materials, and persistent synthetic organic compounds (in toxic concentrations). This includes, but is not limited to, asphalt, tires, treated lumber, and construction debris. The Department may require testing of fill materials. All temporary fills must be removed. Debris and solid wastes will be removed from the site and the impacted areas restored as nearly as possible to the original condition.

DEPARTMENT OF THE ARMY
CORPS OF ENGINEERS, OMAHA DISTRICT
1616 CAPITOL AVENUE
OMAHA NE 68102-4901

DEC 10 2018

RECEIVED DEC 20 2018

REPLY TO
ATTENTION OF

Planning, Programs, and Project Management Division

Mr. Earl Haugen
Grand Forks – East Grand Forks Metropolitan Planning Organization
255 North 4th Street
Grand Forks, North Dakota 58206

Dear Mr. Haugen:

The U.S. Army Corps of Engineers, Omaha District (Corps) has reviewed your letter dated November 13, 2018 (received November 23, 2018) regarding the environmental review of the Grand Forks – East Grand Forks Metropolitan Transportation Plan Update, located in Grand Forks County, North Dakota and Polk County Minnesota. The project area is land located outside of the Corps, Omaha District's civil works boundary; therefore, we cannot provide specific comments on impacts to Corps owned or operated lands or environmental-based comments on the project. For these type of comments you will need to contact our St. Paul District as they have civil works jurisdiction over this area. Please direct all future correspondence regarding this project to the following address:

U.S. Army Corps of Engineers
St. Paul District
Attention: Mr. Nathan Wallerstedt, CEMVP-PM-B
180 Fifth Street East, Suite 700
St. Paul, Minnesota 55101

This project is located within the Corps' North Dakota and Minnesota, regulatory boundaries. As such, any proposed placement of dredged or fill material into waters of the United States will require Department of the Army authorization under Section 404 of the Clean Water Act. Inquiries on Section 404 permit requirements should be directed to the Bismarck and St. Paul Regulatory Offices. Preliminary and final project plans should be sent to the following addresses:

U.S. Army Corps of Engineers
Bismarck Regulatory Office
Attention: Ms. Patricia McQueary, CENWO-ODR-ND
1513 South 12th Street
Bismarck, North Dakota 58504

U.S. Army Corps of Engineers
St. Paul Regulatory Office
Attention: Mr. Chad Konickson, CEMVP-OP-R
180 Fifth Street East, Suite 700
Saint Paul, Minnesota 55101-1678

If you have any questions, please contact Amee Rief of my staff at (402) 995-2544 or amee.l.rief@usace.army.mil and reference PD# 8123 in the subject line.

Sincerely,

Eric A. Laux, PMP
Chief, Environmental & Cultural Resources

Copy Furnished:
CENWO-ODR-ND/McQueary
CEMVP-OP-R/Konickson
CEMVP-PM-B/Wallerstedt

Doug Burgum, Governor
Melissa Baker, Director

1600 East Century Avenue, Suite 3
Bismarck, ND 58503-0649
Phone 701-328-5357
Fax 701-328-5363
E-mail parkrec@nd.gov
www.parkrec.nd.gov

December 13, 2018

Earl Haugen
Grand Forks East Grand Forks MPO
255 N 4th Street
Grand Forks, ND 58206

RE: Grand Forks-East Grand Forks Metropolitan Transportation Plan Update

Dear Mr. Haugen,

The North Dakota Parks and Recreation Department has reviewed the above referenced proposed Grand Forks-East Grand Forks Metropolitan Transportation Plan Update for Grand Forks, North Dakota.

Our agency scope of authority and expertise covers recreation and biological resources (in particular rare plants and ecological communities). The project as defined does not affect state park lands that we manage but may affect Land and Water Conservation Fund recreation projects that we coordinate. A map with LWCF project locations has been attached. All LWCF sites received assistance from the federal LWCF program and are under protection of section 6(f) of the LWCF Act. Any property taken from within the 6f boundary of these sites must be replaced with property of equal market value. Should any public or private utilities need to be added or relocated on the LWCF recreational lands, the NDPRD must be consulted prior to any action taken. Please contact Genny Giese at 701-328-5364 or ggiese@nd.gov if additional LWCF information is needed.

The North Dakota Natural Heritage biological conservation database has reviewed the project to determine if any current or historical plant or animal species of concern or other significant ecological communities are known to occur within an approximate one-mile radius of the project area. Based on this review, there are several rare species or significant ecological community documented within or adjacent to project site. Refer to map and spread sheet for more details.

We appreciate your commitment to rare plant, animal and ecological community conservation, management and inter-agency cooperation to date. For additional information, please contact me at (701-328-5370 or kgduttenhefner@nd.gov
Thank you for the opportunity to comment on this proposed project.

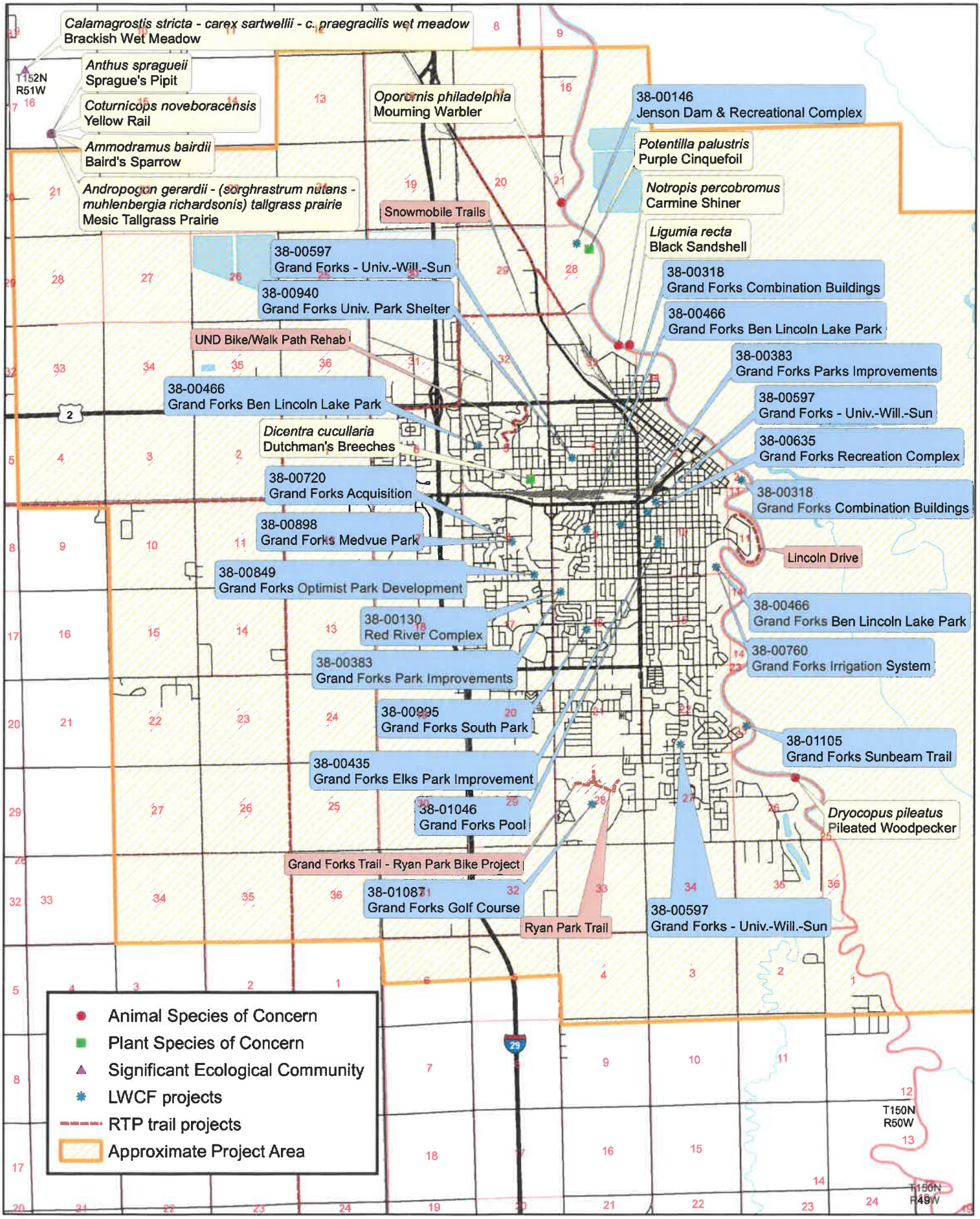
Sincerely,

Kathy Duttenhefner, Coordinator
Natural Resources Division

R.USNDNHI*2018_122KD12.13.2018DL12.13.18

Play in our backyard!

North Dakota Parks and Recreation Department
North Dakota Natural Heritage Inventory



December 2018

North Dakota Natural Heritage Inventory
Rare Animal and Plant Species and Significant Ecological Communities

State Scientific Name	State Common Name	State Rank	Global Rank	Federal Status	Township Range Section	County	Last Observation	Estimated Representation Accuracy	Precision
Ammodramus bairdii	Baird's Sparrow	SU	G4		152N051W - 16; 152N051W - 09; 152N051W - 08; 152N051W - 15; 152N051W - 22; 152N051W - 17; 152N051W - 10; 152N051W - 28; 152N051W - 20; 152N051W - 21	Grand Forks	1987		M
Andropogon gerardii - (sorghrastrum nutans - muhlenbergia richardsonis) tallgrass prairie	Mesic Tallgrass Prairie	S1	GNR		152N051W - 16	Grand Forks	1983-08-11		S
Anthus spragueii	Sprague's Pipit	S3	G4	C	152N051W - 16; 152N051W - 09; 152N051W - 08; 152N051W - 15; 152N051W - 22; 152N051W - 17; 152N051W - 10; 152N051W - 28; 152N051W - 20; 152N051W - 21	Grand Forks	1987		M
Calamagrostis stricta - carex sartwellii - c. praegracilis wet meadow	Brackish Wet Meadow	S2S3	GNR		152N051W - 16	Grand Forks	1983-08-11		S
Coturnicops noveboracensis	Yellow Rail	S2	G4		152N051W - 16; 152N051W - 09; 152N051W - 08; 152N051W - 15; 152N051W - 22; 152N051W - 17; 152N051W - 10; 152N051W - 28; 152N051W - 20; 152N051W - 21	Grand Forks	1987		M
Dicentra cucullaria	Dutchman's Breeches	S1	G5		151N050W - 05; 151N050W - 06; 152N050W - 33; 151N050W - 16; 151N050W - 07; 151N050W - 10; 151N050W - 08; 151N050W - 17; 151N050W - 03; 152N050W - 32; 151N050W - 09; 152N050W - 31; 151N050W - 04	Grand Forks	1951-05-21		M
Dryocopus pileatus	Pileated Woodpecker	S3	G5		151N050W - 26; 150N049W - 18; 150N050W - 16; 151N050W - 17; 152N050W - 33; 151N050W - 29; 150N050W - 02; 150N050W - 11; 151N050W - 02; 151N050W - 30; 151N050W - 07; 151N050W - 35; 151N050W - 25; 151N050W - 23; 151N050W - 28; 151N050W - 11; 150N050W - 01	Grand Forks	1972		G
Ligumia recta	Black Sandshell	S4	G5		152N050W - 33	Grand Forks	1965		S
Notropis percobromus	Carmine Shiner	S3	G5		152N050W - 33; 151N051W - 11; 152N051W - 13; 151N051W - 14; 152N050W - 06; 151N050W - 28; 151N050W - 15; 151N050W - 02; 151N050W - 22; 152N050W - 28; 151N050W - 16; 151N050W - 29; 151N050W - 07; 152N051W - 27; 152N050W - 08; 151N050W - 21; 152N051W - 34	Grand Forks	1892		G
Oporornis philadelphia	Mourning Warbler	S4	G5		152N050W - 21; 152N051W - 12; 152N051W - 10; 152N051W - 23; 152N050W - 09; 152N051W - 26; 151N051W - 03; 151N050W - 17; 151N050W - 18; 151N050W - 10; 151N051W - 01; 152N050W - 04; 151N050W - 03; 152N050W - 31; 152N051W - 01; 152N051W - 22; 152N050W - 32	Grand Forks			G
Potentilla palustris	Purple Cinquefoil	S2	G5		152N050W - 21; 152N051W - 12; 152N051W - 23; 153N050W - 33; 152N051W - 26; 151N051W - 03; 151N050W - 17; 151N050W - 18; 152N051W - 24; 151N051W - 01; 152N050W - 04; 151N050W - 03; 153N050W - 32; 152N051W - 22; 152N050W - 07; 151N050W - 20; 151N050W - 05	Grand Forks	1977-06-23		G

North Dakota Natural Heritage Inventory Biological and Conservation Data Disclaimer

The quantity and quality of data collected by the North Dakota Natural Heritage Inventory are dependent on the research and observations of many individuals and organizations. In most cases, this information is not the result of comprehensive or site-specific field surveys; many natural areas in North Dakota have never been thoroughly surveyed, and new species are still being discovered. For these reasons, the Natural Heritage Inventory cannot provide a definite statement on the presence, absence, or condition of biological elements in any part of North Dakota. Natural Heritage data summarize the existing information known at the time of the request. Our data are continually upgraded and information is continually being added to the database. This data should never be regarded as final statements on the elements or areas that are being considered, nor should they be substituted for on-site surveys.

Estimated Representation Accuracy

Value that indicates the approximate percentage of the Element Occurrence Representation (EO Rep) that was observed to be occupied by the species or community (versus buffer area added for locational uncertainty). Use of estimated representation accuracy provides a common index for the consistent comparison of EO reps, thus helping to ensure that aggregated data are correctly analyzed and interpreted.

Very high (>95%)
High (>80%, <= 95%)
Medium (>20%, <= 80%)
Low (>0%, <= 20%)
Unknown
(null) - Not assessed

Precision

A single-letter code for the precision used to map the Element Occurrence (EO) on a U.S. Geological Survey (USGS) 7.5' (or 15') topographic quadrangle map, based on the previous Heritage methodology in which EOs were located on paper maps using dots.

S - Seconds: accuracy of locality mappable within a three-second radius; 100 meters from the centerpoint
M - Minute: accuracy of locality mappable within a one-minute radius; 2 km from the centerpoint
G - General: accuracy of locality mappalbe to map or place name precision only; 8 km from centerpoint
U - Unmappable

Land and Water Conservation Fund Projects

Project Name	Project Number
Grand Forks - Univ.-Will.-Sun	38-00597
Grand Forks Acquisition	38-00720
Grand Forks Ben Lincoln Lake Park	38-00466
Grand Forks Combination Buildings	38-00318
Grand Forks Elks Park Improvement	38-00435
Grand Forks Golf Course	38-01087
Grand Forks Irrigation System	38-00760
Grand Forks Medvue Park	38-00898
Grand Forks Optimist Park Development	38-00849
Grand Forks Parks Improvements	38-00383
Grand Forks Pool	38-01046
Grand Forks Recreation Complex	38-00635
Grand Forks South Park	38-00995
Grand Forks Sunbeam Trail	38-01105
Grand Forks Univ. Park Shelter.	38-00940
Jenson Dam & Recreational Complex	38-00146
Red River Complex	38-00130

Recreational Trails Program Projects

Project Name	Project Number
Grand Forks Trail - Ryan Park Bike Project	22012
Lincoln Drive	25023
Ryan Park Trail	25022
Snowmobile Trails	Multiple
UND Bike/Walk Path Rehab	201005

Appendix C

Red River Crossing Analysis Technical Report

MEMORANDUM

To: **Earl Haugen, Executive Director Grand Forks – East Grand Forks MPO**

From: **Brandon Bourdon, P.E. (ND, MN), Kimley-Horn and Associates**

Date: **September 27, 2018**

Re: **Grand Forks-East Grand Forks MPO 2045 Street/Highway Plan Update**
River Crossing Alternatives Analysis

A variety of additional potential Red River crossing locations have been included in prior Grand Forks – East Grand Forks long range transportation plans. These additional river crossings have been discussed, documented, and analyzed at varying degrees since the late 1960s. Since the 2004 long range transportation plan update, the locations for any new river crossings have included both the 32nd Avenue S and Merrifield Road river crossings. The Merrifield Road crossing has been a "bypass" option that would provide regional benefit by reducing trips, particularly truck trips, through the urbanized area.

There has been renewed interest in adding an additional river crossing(s) recently. Since the Grand Forks – East Grand Forks Metropolitan Planning Organization (MPO) is in the process of updating the region's transportation plan, a high-level transportation focused planning analysis has been completed to assess some transportation benefits of several potential river crossings. This analysis focuses on the transportation planning impacts of the following potential river crossing locations:

- 17th Avenue S
- Elks Drive (formerly referenced as 24th Avenue S)
- 32nd Avenue S
- 47th Avenue S
- Merrifield Road

Advanced Traffic Analysis Center (ATAC) has been completing travel demand modeling as part of the 2045 Street/Highway Plan Update. ATAC used the regions travel demand model for this analysis to develop 2045 daily traffic forecasts. Kimley-Horn and WSB used these forecasts to analyze regional traffic pattern changes, link level volume to capacity (V/C) ratios, and local intersection level of service (LOS) for each of the five potential new river crossings scenarios. Each river crossing was analyzed at a regional and local level to allow for a comparison of transportation impacts. The purpose of this memorandum is to summarize the findings of this analysis.

In February 2018, an analysis was completed for the 24th Avenue S, 32nd Avenue S, 47th Avenue S, and Merrifield Road river crossings. That also included the analysis of level of service at six intersections. This document has been revised to include additional analysis as directed by the Executive Board to revise the 24th Avenue S crossing to Elks Drive, add the 17th Avenue S crossing, and analyze intersection level of service at 15 intersections. One reason 24th Avenue S was referred to previously was familiarity with that roadway as opposed to Elks Drive that is less known in the community due to its much shorter length. **Figure 1** shows the location of Elks Drive, 24th Avenue S and their proximity to Grand Forks County Historical Society.

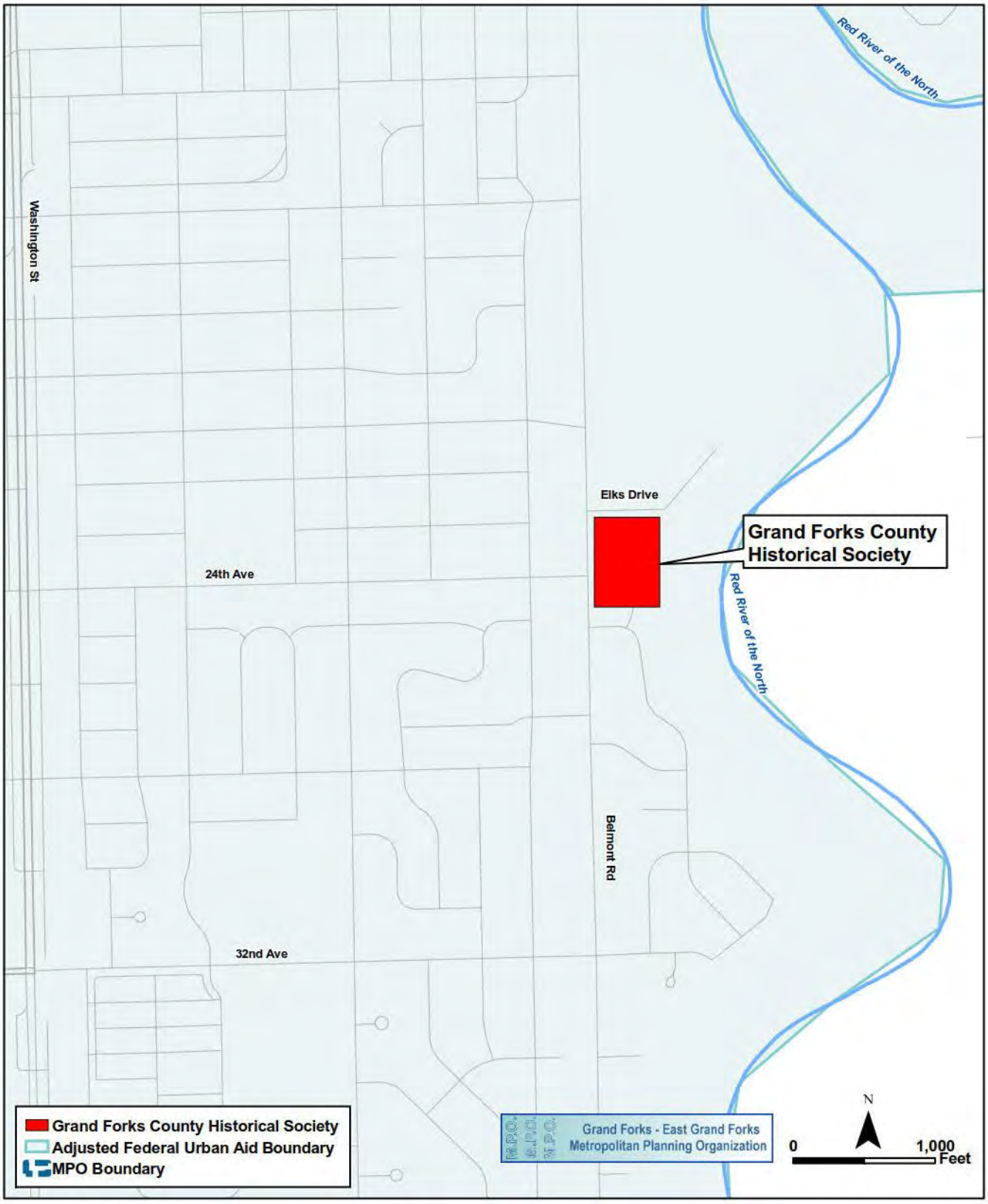


Figure 1: Location of Elks Drive

Existing and No Build Traffic Conditions

Existing and No Build traffic conditions were analyzed on both a link and intersection LOS basis. The No Build scenario assumes no additional river crossing will be constructed. The link level analysis focused on several key corridors within the urbanized area of the MPO. The corridors analyzed are:

- Gateway Drive (US 2) from Columbia Road to Central Avenue
- DeMers Avenue from S Columbia Road to 4th Street NW (Business US 2)
- 4th Avenue S / Minnesota Avenue / 1st Street SE from DeMers Avenue to 3rd Avenue SE
- Bygland Road / 3rd Avenue SE / 2nd Avenue NE from Rhinehart Drive to Business US 2
- 4th Street NW / Business US 2 from DeMers Avenue to Polk CSAH 17
- TH 220 between US 2 and Polk CSAH 72
- 17th Avenue S from S Washington Street to Belmont Road
- 24th Avenue S from S Washington Street to Belmont Road
- 32nd Avenue S from Columbia Road to Belmont Road
- 47th Avenue S from S Washington Street to Belmont Road
- Belmont Road from 4th Avenue S to 17th Avenue S
- S Washington Street from DeMers Avenue to 55th Avenue S

Figure 2 below, shows the location of the analyzed corridors. The proposed new river crossing corridors were also analyzed.

In addition to the corridors, fifteen intersections were analyzed at an overall intersection LOS basis. The analyzed intersections include the following:

- 1st Street SE at 3rd Avenue SE
- Greenway Boulevard SE, Bygland Road SE, 13th Street SE
- Greenway Boulevard SE at Rhinehart Drive SE
- DeMers Avenue at N 5th Street
- DeMers Avenue at S Washington Street
- S Washington Street at 17th Avenue S
- S Washington Street at 24th Avenue S
- S Washington Street at 32nd Avenue S
- S Washington Street at 47th Avenue S
- 4th Avenue S at Belmont Road
- 17th Avenue S at Belmont Road
- Elks Drive at Belmont Road
- 24th Avenue S at Belmont Road
- 32nd Avenue S at Belmont Road
- 47th Avenue S at Belmont Road

Traffic patterns are anticipated to change at the intersection of US 2 / TH 220 / CR 76 if a river crossing was constructed. These changes in traffic patterns would result in lower traffic 2045 forecasts to the north on US 2 and higher traffic 2045 forecasts on TH 220. The amount of those changes will vary under each river crossing alternative. Operations and safety should be monitored at this location under future conditions to see if a change in traffic control is required based on changes in traffic patterns or crashes at this location.

Existing traffic patterns were first analyzed at a link level. To complete the link level analysis, ADT volumes (average daily traffic) and V/C ratios under Existing conditions were provided by ATAC. The V/C ratios were then compared to planning level LOS ratings based on typical facility V/C ratios. LOS ratings were then assigned to the links that were reviewed as part of this analysis.

Overall, the urbanized area is operating acceptably under Existing conditions although several links operate LOS C and D. **Figure 3,** below, shows the link level LOS under Existing conditions. **Table 1** below describes the V/C thresholds for each of the LOS criteria.

Table 1: Link Level of Service Thresholds

Level of Service	Link Level Volume to Capacity LOS Threshold
A	0.0 to 0.6
B	>0.6 to 0.7
C	>0.7 to 0.8
D	>0.8 to 0.85
D-	>0.85 to 0.9
E	>0.9 to 1.0
F	>1.0

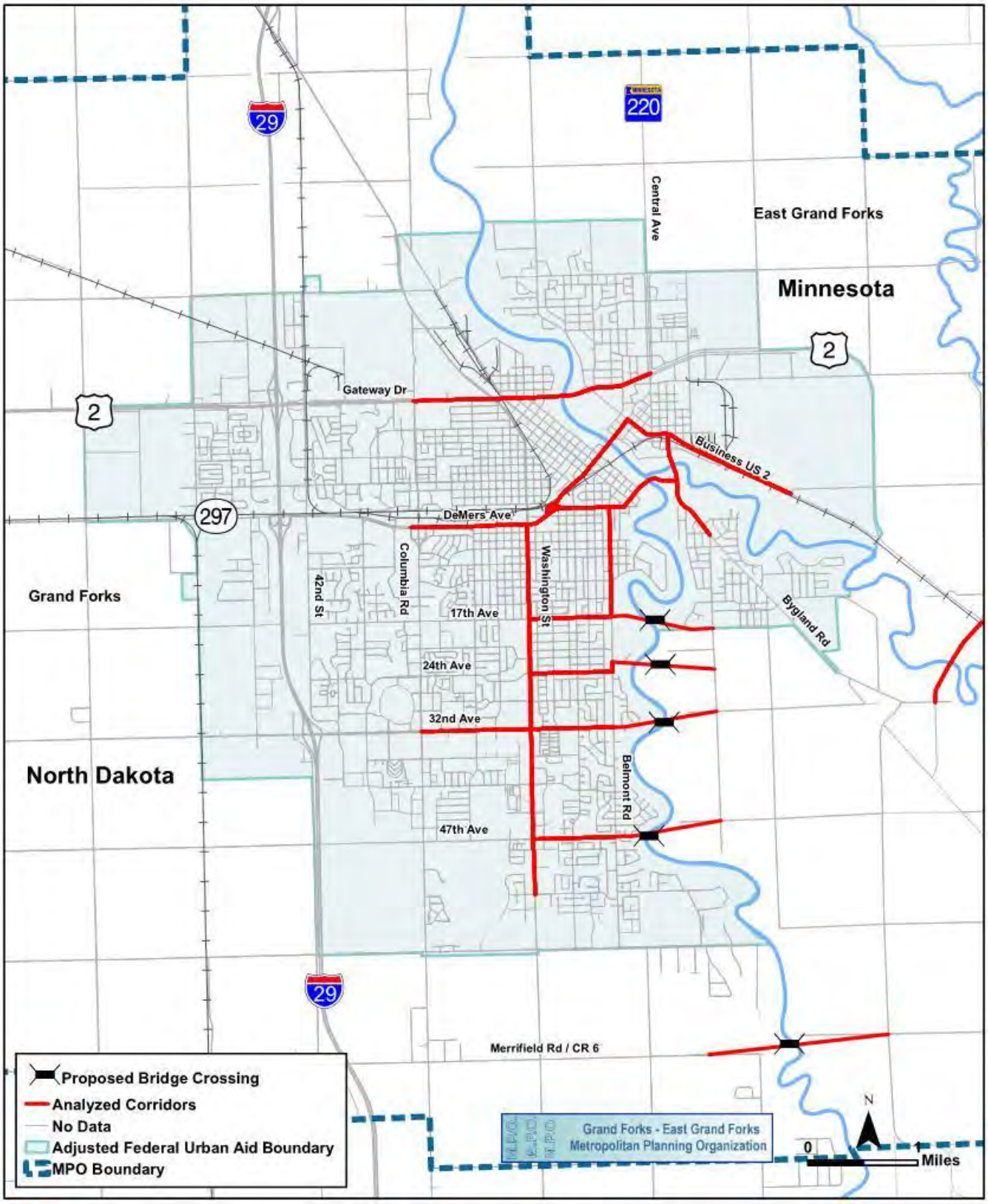


Figure 2: Analyzed Corridors

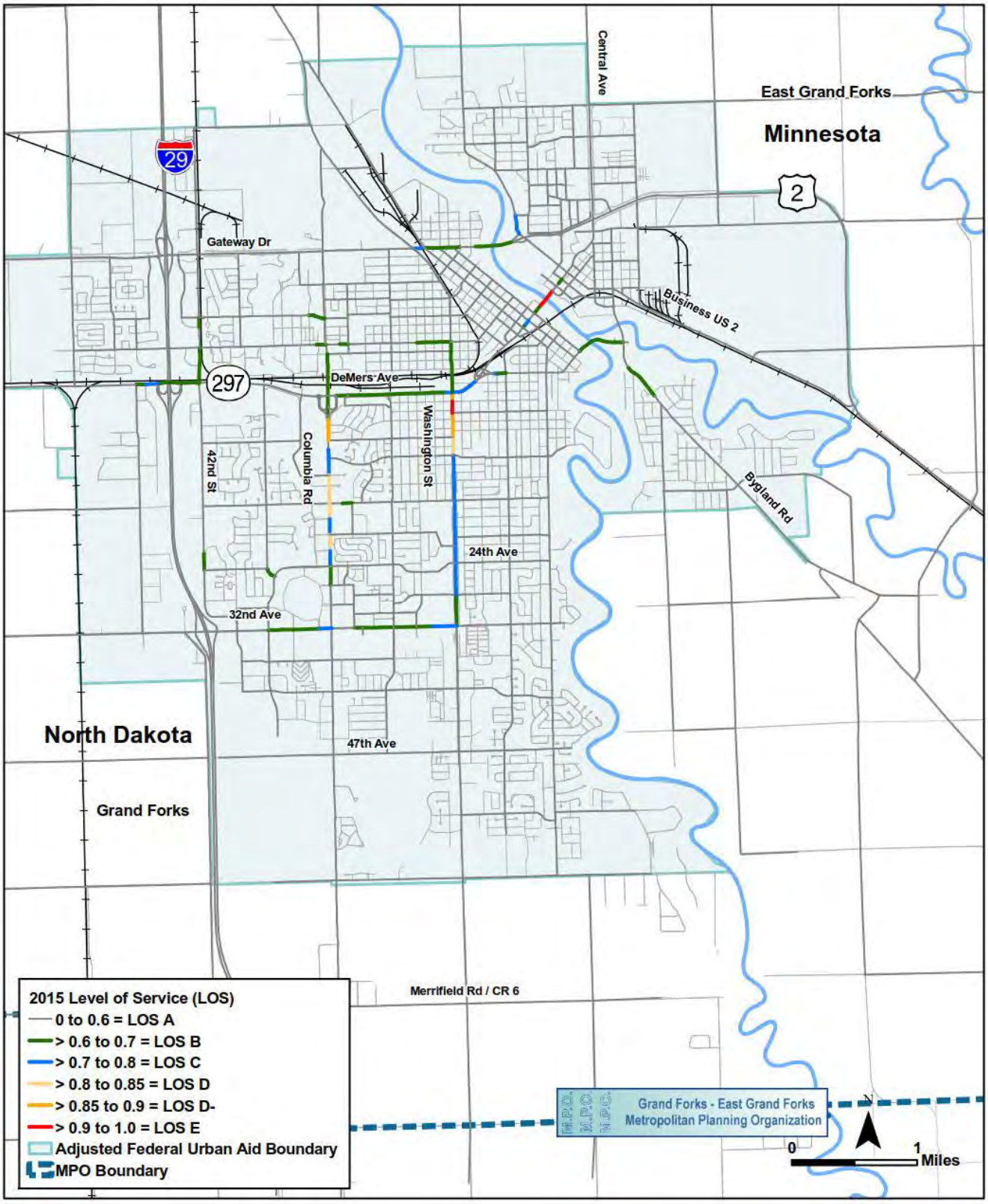


Figure 3: Existing Conditions Link Level LOS Summary

Although analyzing link V/C ratios and LOS are beneficial, another way to analyze traffic is to focus on intersection operations. An intersection capacity analysis can identify operational concerns that may not be apparent by completing a link LOS analysis. To complete the intersection analysis existing turning movement counts, collected in 2017, were used to model intersection operations and review intersection LOS. This analysis was completed during the PM peak hour at the study intersections for Existing, 2045 No Build, and the five potential bridge crossing alternatives under 2045 conditions. Synchro version 9 was used to complete this analysis.

The LOS grades shown below, which are provided in the Transportation Research Board's Highway Capacity Manual (HCM), quantify and categorize the driver's discomfort, frustration, fuel consumption, and travel times experienced as a result of intersection control and the resulting traffic queuing. A detailed description of each LOS rating can be found in **Table 2**.

Table 2: Level of Service Grading Descriptions

Level of Service	Description
A	Minimal control delay; traffic operates at primarily free-flow conditions; unimpeded movement within traffic stream.
B	Minor control delay at signalized intersections; traffic operates at an unimpeded level with slightly restricted movement within traffic stream.
C	Moderate control delay; movement within traffic stream more restricted than at LOS B; the formation of queues contributes to lower average travel speeds.
D	Considerable control delay that may be substantially increased by small increases in flow; average travel speeds continue to decrease.
E	High control delay; average travel speed no more than 33 percent of free flow speed.
F	Extremely high control delay; extensive queuing and high volumes create exceedingly restricted traffic flow.

The range of control delay for each rating (as detailed in the HCM) is shown in **Table 3**. Signalized intersections are expected to carry a larger volume of vehicles and stopping is required during red time, so higher delays are generally tolerated more by drivers for each corresponding LOS ratings. In general, LOS D or better for overall intersection LOS is the accepted standard for existing and future intersection operations.

Table 3: Level of Service Grading Descriptions

Level of Service	Average Control Delay (s/veh) at:	
	Unsignalized Intersections	**Signalized Intersections**
A	0 – 10	0 – 10
B	> 10 – 15	> 10 – 20
C	> 15 – 25	> 20 – 35
D	> 25 – 35	> 35 – 55
E	> 35 – 50	> 55 – 80
F	> 50	> 80

For unsignalized intersections, LOS is reported for the worst approach and overall intersection. Similar to the link level analysis, the overall intersection LOS does not show any issues at the analyzed intersections under Existing conditions. **Table 4** below summarizes the Existing PM peak intersection operations.

Table 4: Existing Intersection LOS Summary

Intersection/Crossing Scenario	Existing PM Peak
1st Street SE at 3rd Avenue SE	A
Greenway Boulevard SE, Bygland Road SE, 13th Street SE	A
Greenway Boulevard SE at Rhinehart Drive SE	A
DeMers Avenue at N 5th Street	B
DeMers Avenue at S Washington Street	D
S Washington Street at 17th Avenue S	C
S Washington Street at 24th Avenue S	C
S Washington Street at 32nd Avenue S	D
S Washington Street at 47th Avenue S	B
4th Avenue S at Belmont Road	B
17th Avenue S at Belmont Road	A
Elks Drive at Belmont Road	B
24th Avenue S at Belmont Road	A
32nd Avenue S at Belmont Road	B
47th Avenue S at Belmont Road	A

No Build conditions were analyzed in the same manner as existing conditions except using 2045 No Build ADTs and V/Cs provided by ATAC. Under this scenario, no additional bridge crossings were assumed by 2045. **Figure 4** on the next page shows the link level LOS under 2045 No Build conditions. This analysis shows that several key corridors are operating undesirably (LOS worse than D). All three existing river crossings in addition to segments of S Washington Street and 32nd Avenue S are anticipated to operate at LOS E or F.

The link LOS is anticipated to deteriorate from LOS B to LOS E on the Point Bridge between today and 2045 under No Build conditions. This is not surprising given that ADTs on the Point Bridge have increased by 50% between 2010 and 2015.

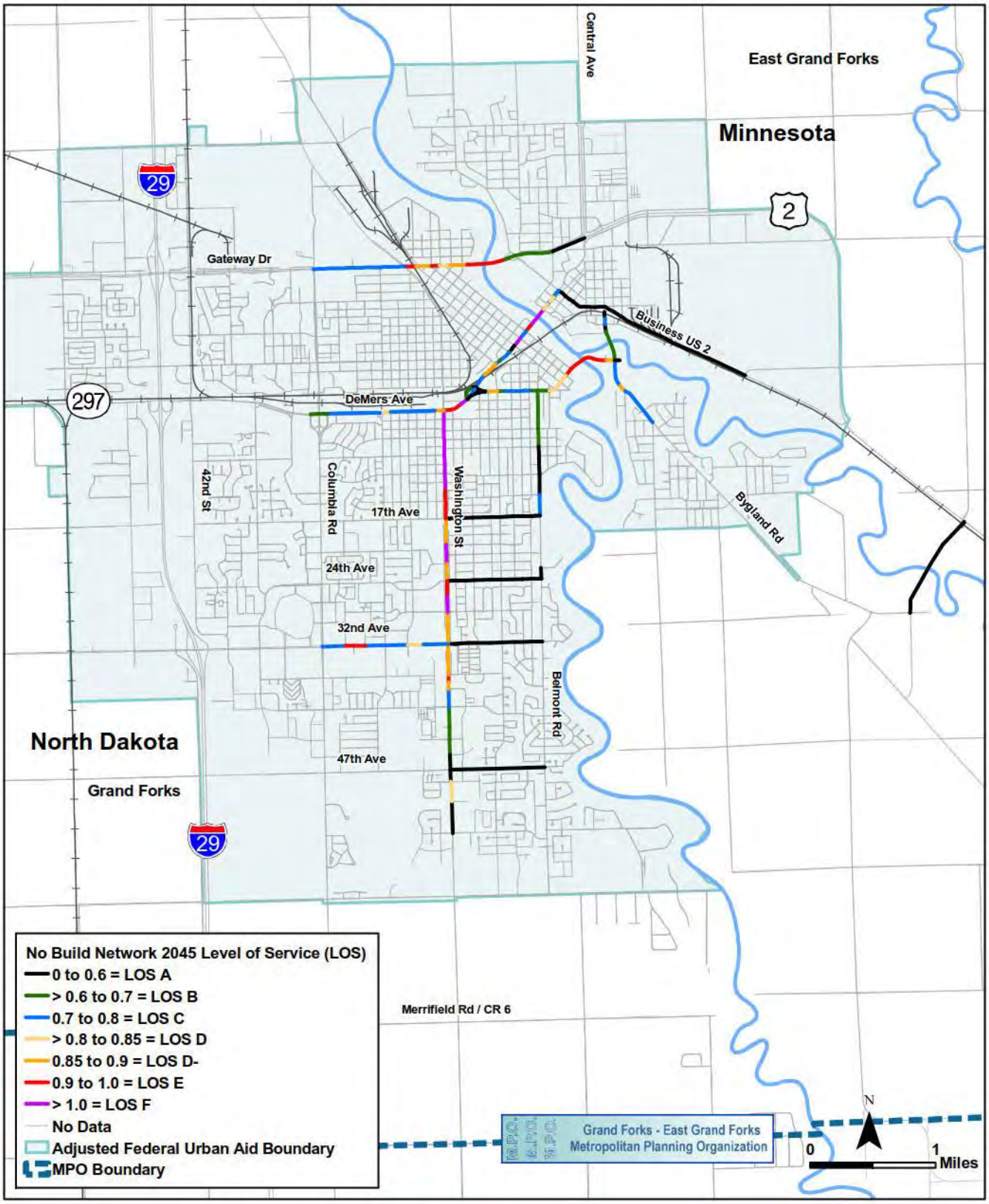


Figure 4: 2045 No Build Conditions Link Level LOS Summary

In addition to the link level analysis, an intersection analysis was also completed. To develop volumes for the 2045 No Build scenario, link ADTs under Existing and 2045 No Build conditions were compared on all intersection approaches. Then a growth factor for each approach was developed based on that comparison. The growth factor was used to adjust the existing turning movement counts to create future turning movement volumes at each intersection.

The intersection LOS analysis shows a similar trend as the link level LOS. The intersections of S Washington Street and DeMers Avenue, S Washington Street and 32nd Avenue S, 4th Avenue S and Belmont Road and 32nd Avenue S and Belmont Road show undesirable operations under 2045 No Build conditions. **Table 5** below is a continuation of **Table 4**, it summarizes the intersection LOS under both Existing and 2045 No Build conditions.

Table 5: Existing and 2045 No Build Intersection LOS Summary

Intersection/Crossing Scenario	Existing PM Peak	2045 No Build PM Peak
1st Street SE at 3rd Avenue SE	A	B
Greenway Boulevard SE, Bygland Road SE, 13th Street SE	A	C
Greenway Boulevard SE at Rhinehart Drive SE	A	A
DeMers Avenue at N 5th Street	B	B
DeMers Avenue at S Washington Street	D	E
S Washington Street at 17th Avenue S	C	D
S Washington Street at 24th Avenue S	C	D
S Washington Street at 32nd Avenue S	D	E
S Washington Street at 47th Avenue S	B	D
4th Avenue S at Belmont Road	B	F
17th Avenue S at Belmont Road	A	A
Elks Drive at Belmont Road	B	C
24th Avenue S at Belmont Road	A	A
32nd Avenue S at Belmont Road	B	F
47th Avenue S at Belmont Road	A	A

The operational challenges at the two S Washington Street intersections are also evident when looking at **Figure 3**, many areas where links are anticipated to operate at LOS E or F occur around these two intersections. The poor operations at 4th Avenue S at Belmont Road are attributed to the existing intersection control. The 2045 No Build volumes exceed the capacity of an all-way stop. The intersection of 4th Avenue S at Belmont Road was recently a signal, but it was removed after a vehicular crash rendered it inoperable. The poor operations at 32nd Avenue S at Belmont Road are attributed to the existing intersection control. The intersection is currently an all-way stop and the anticipated growth on each approach exceeds the capacity of an all-way stop. **Figure 5** on the next page shows intersection LOS values from **Table 5** on a map.

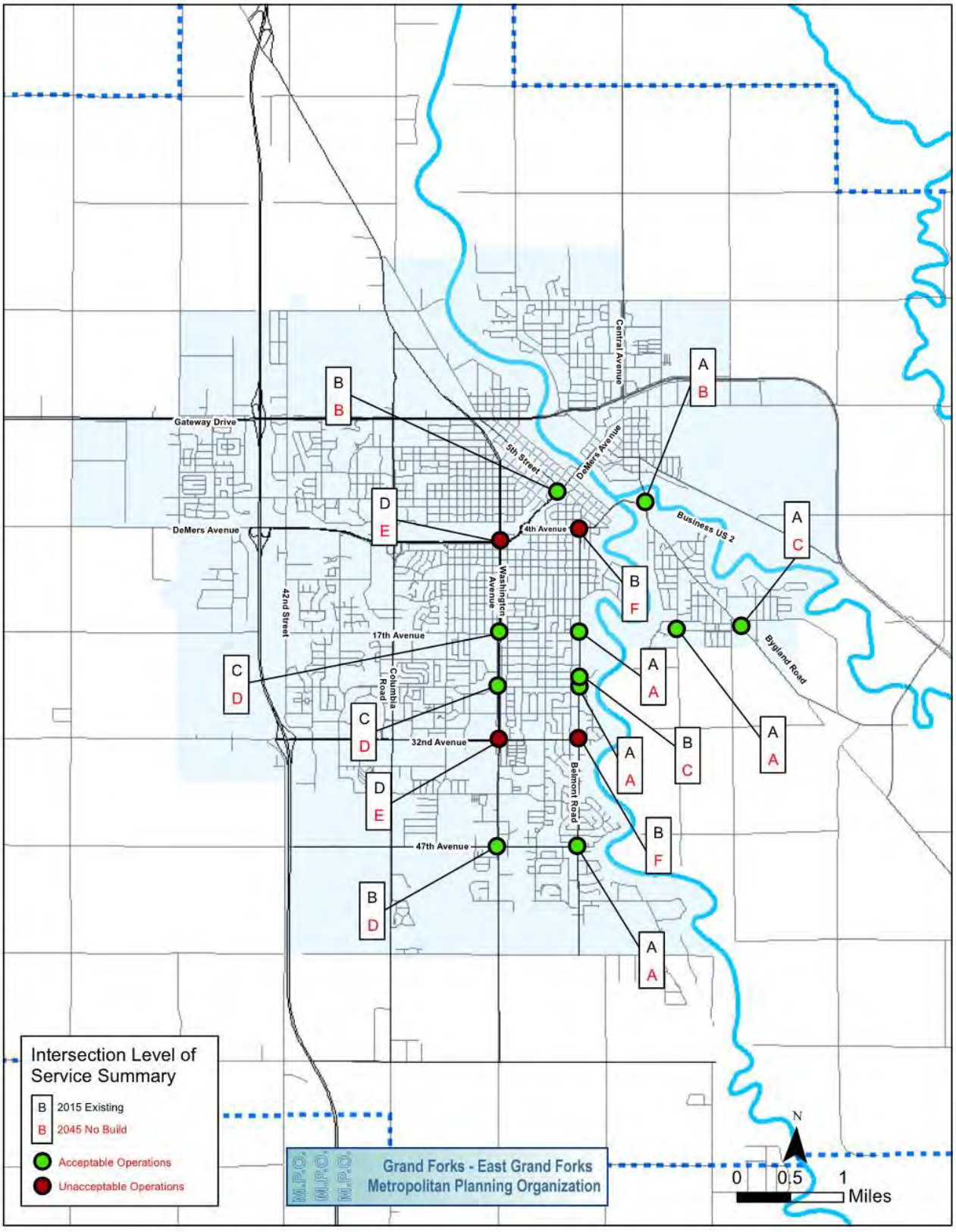


Figure 5: Existing and 2045 No Build Intersection LOS Summary

River Crossing Analysis

Based on input from area political leaders and agency staff in the region, the following five potential new river crossing locations were analyzed: 17th Avenue S, Elks Drive, 32nd Avenue S, 47th Avenue S and Merrifield Road. Each river crossing was analyzed at a local level (intersection and link LOS) and regional level (global metrics such as urban vehicle miles traveled) under 2045 conditions to determine transportation related impacts of each potential crossing on the transportation network. A summary matrix of each river crossing is included at the end of this memo that provides an overall comparison.

Local Impacts

Figures 6 through **15** on the following pages show the corridor ADTs and link level LOS for each of the potential river crossing alternatives. Here are a few observations noted:

- The Point Bridge link LOS operates better under the 17th Avenue S, Elks Drive and 32nd Avenue S river crossing alternatives.
- Gateway Drive operates better under the 17th Avenue S, Elks Drive, 32nd Avenue S, and 47th Avenue S river crossings.
- DeMers Avenue experienced similar operations under each of the alternatives analyzed.
- Belmont Road operations were better under all the river crossing alternatives when compared to the No Build scenario.

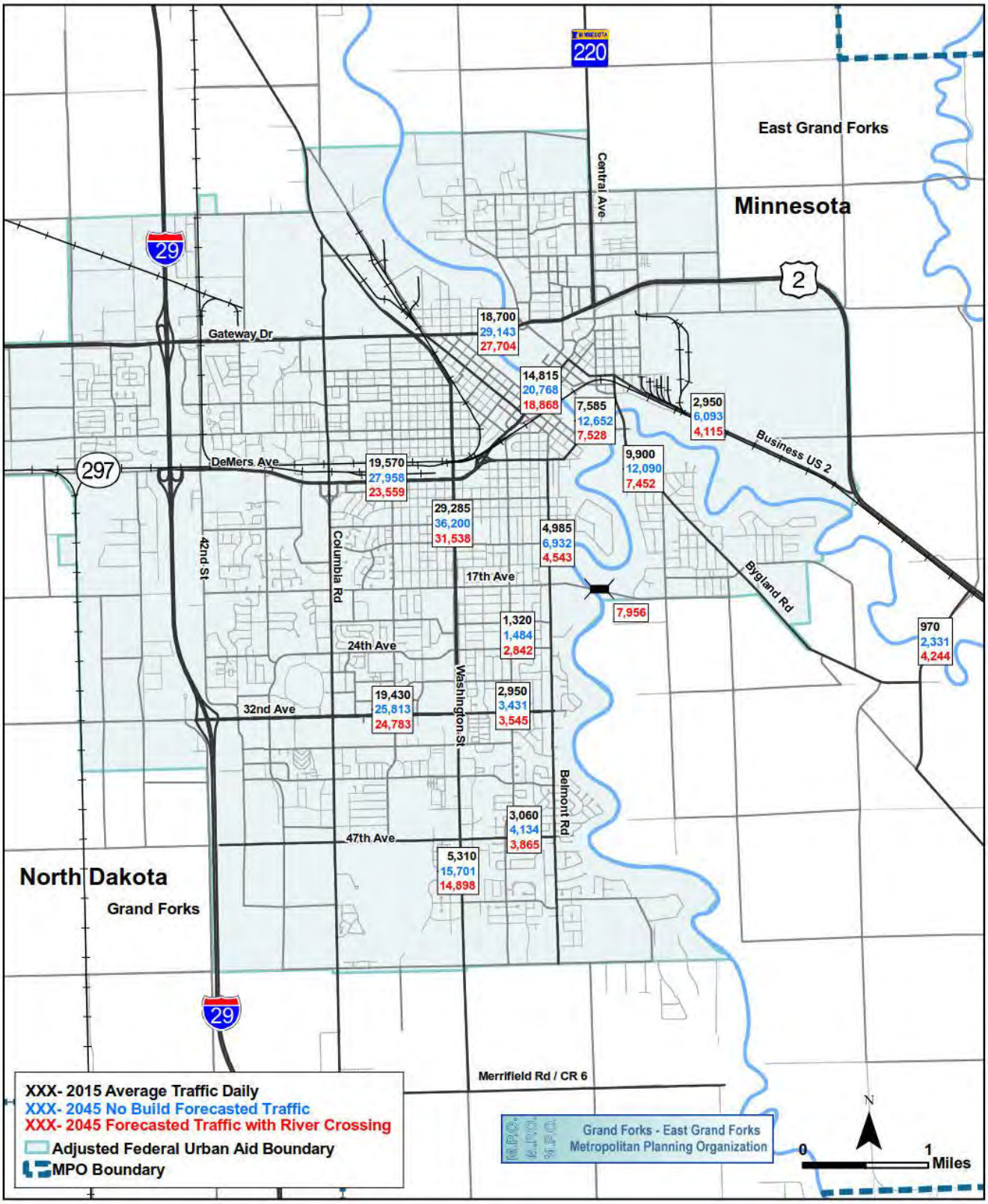


Figure 6: ADT Summary for the Proposed 17th Avenue S River Crossing

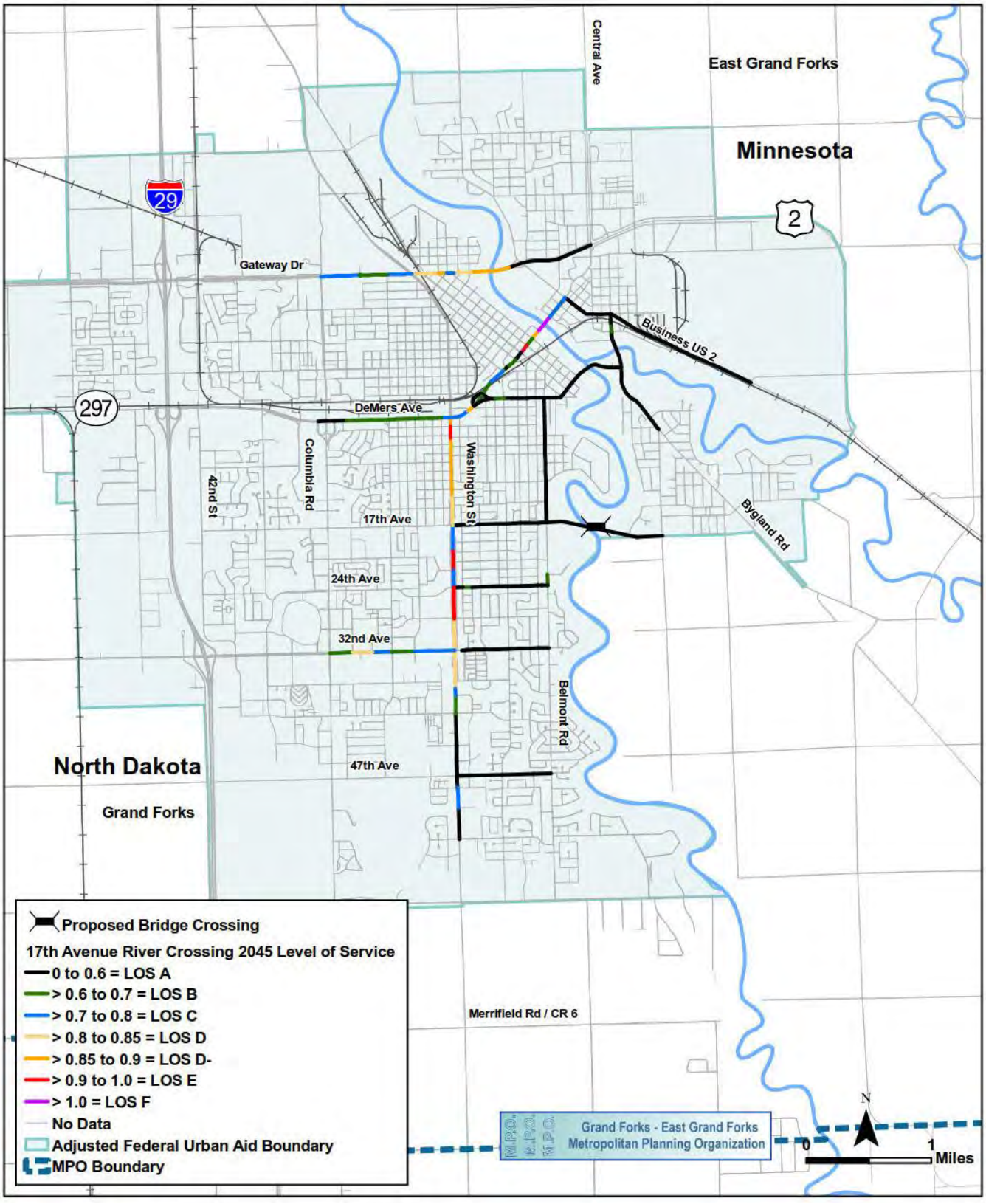


Figure 7: Link Level of Service Summary for the Proposed 17th Avenue S River Crossing

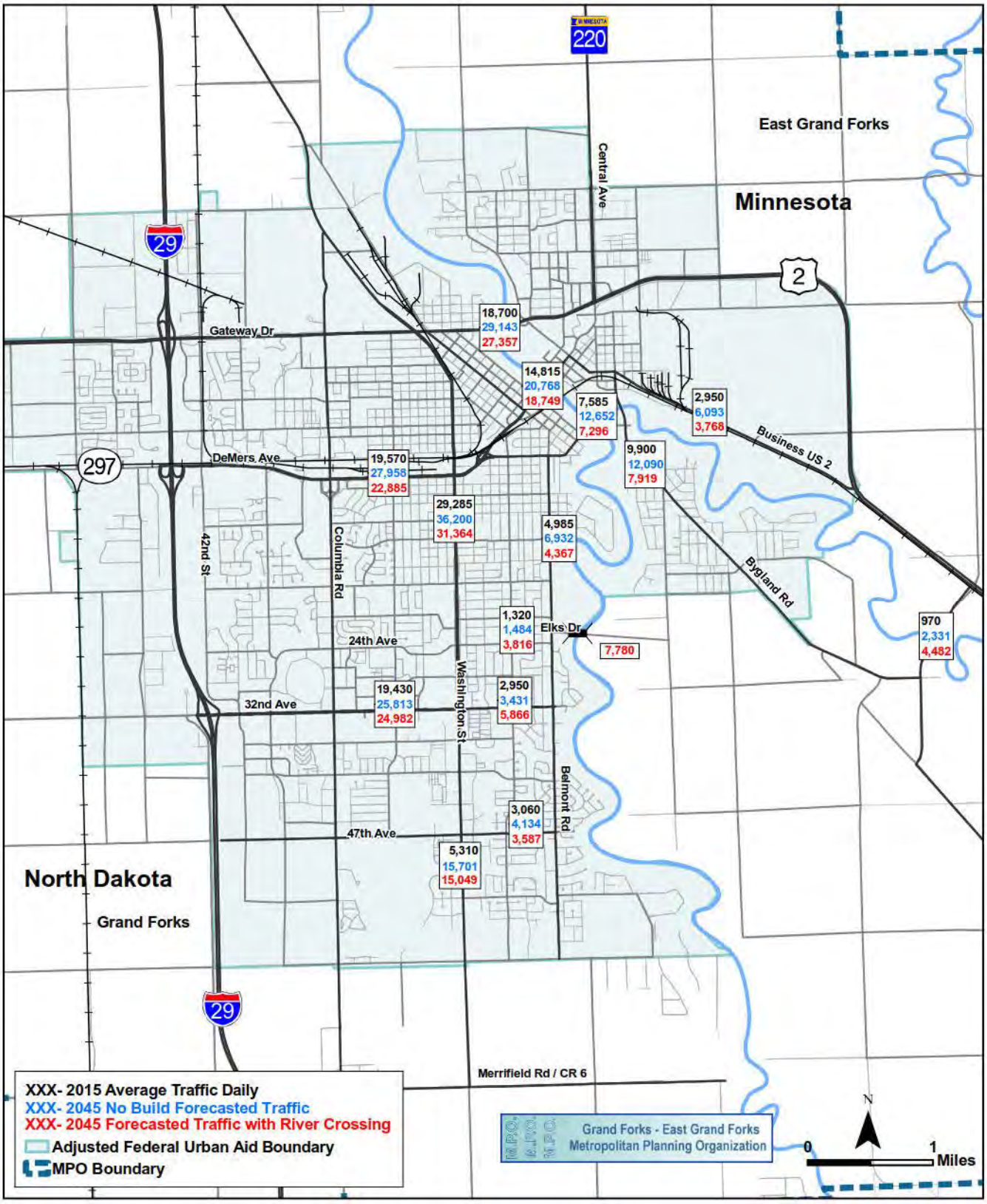


Figure 8: ADT Summary for the Proposed Elks Drive River Crossing

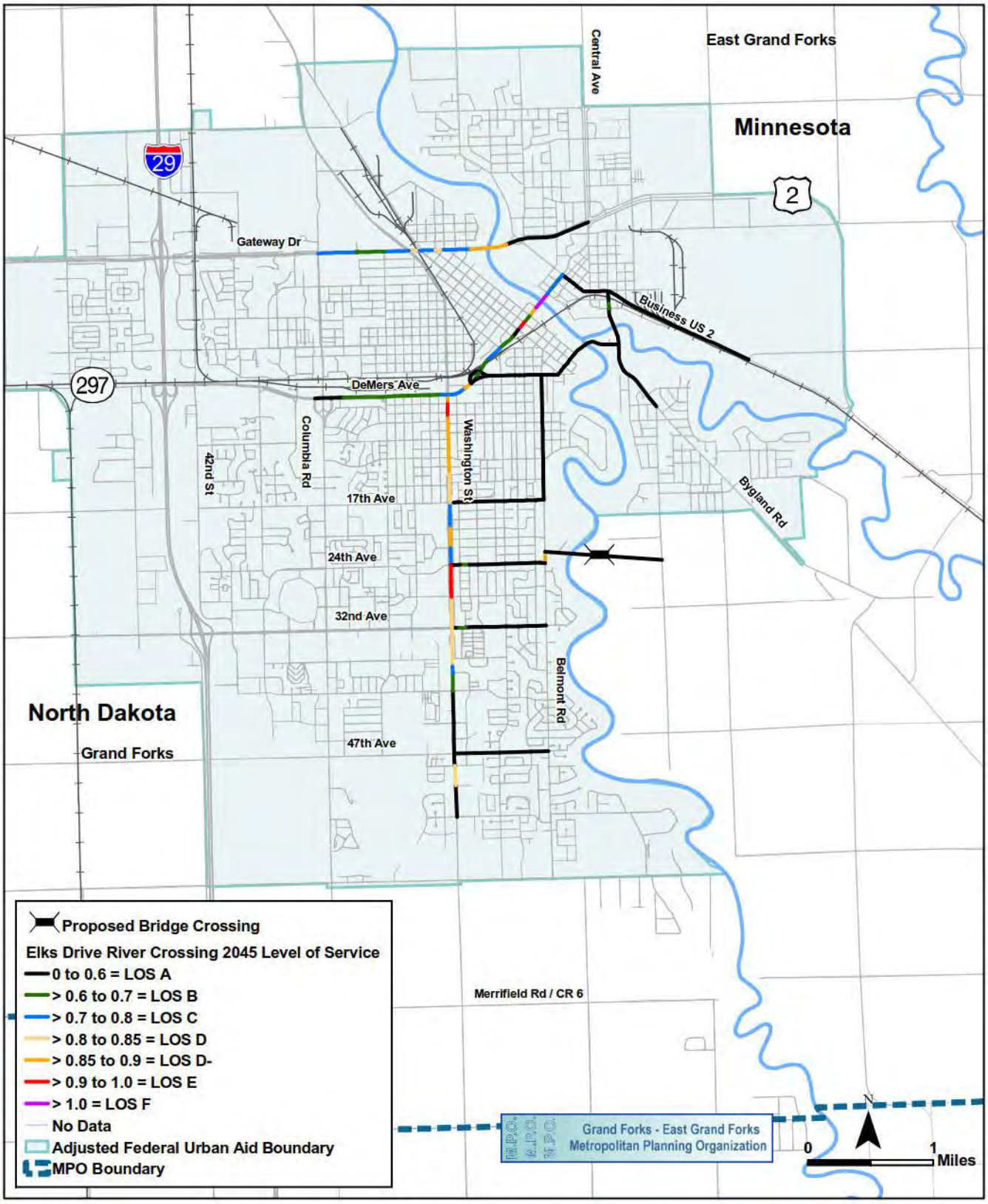


Figure 9: Link Level of Service Summary for the Proposed Elks Drive River Crossing

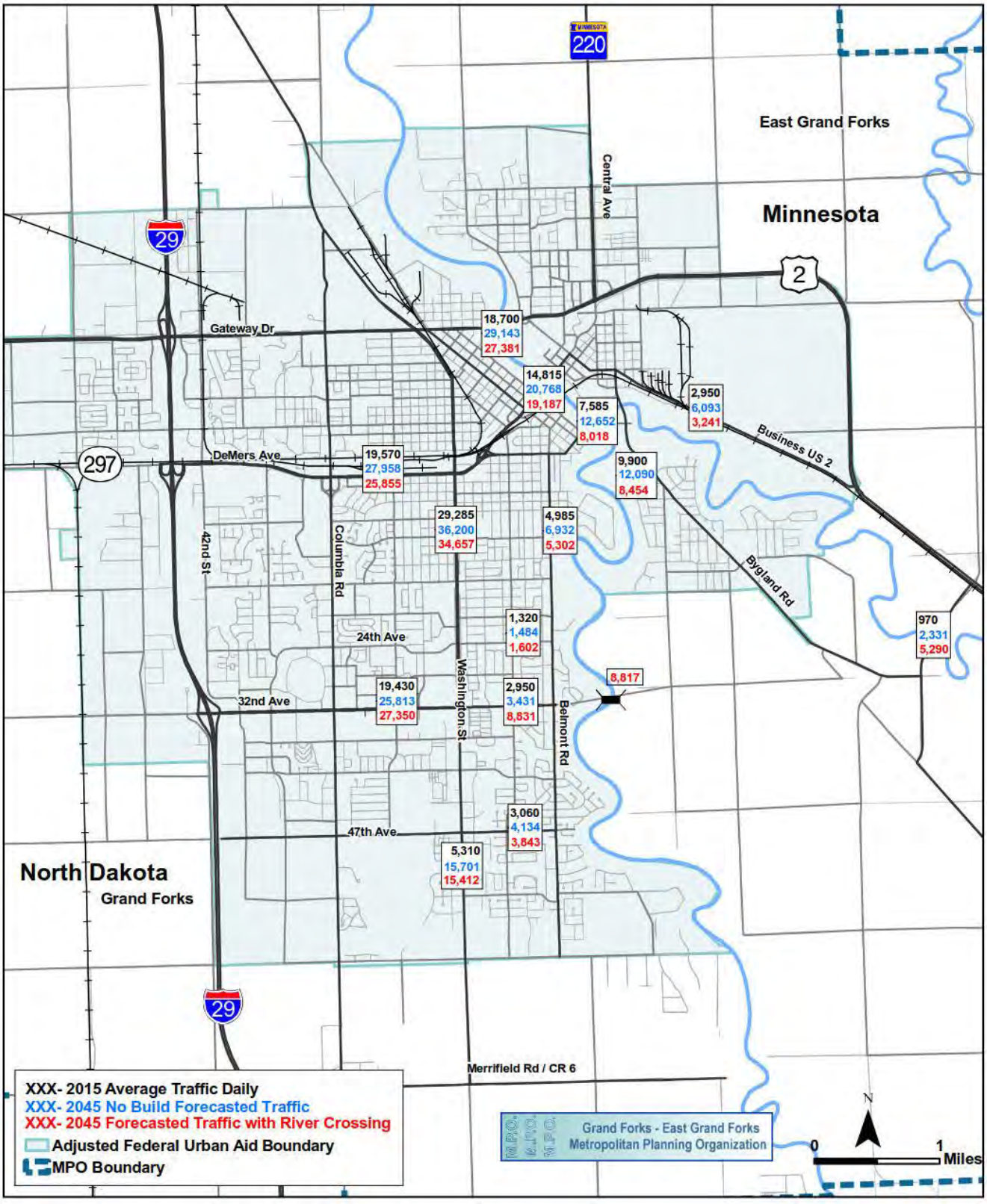


Figure 10: ADT Summary for the Proposed 32nd Avenue S River Crossing

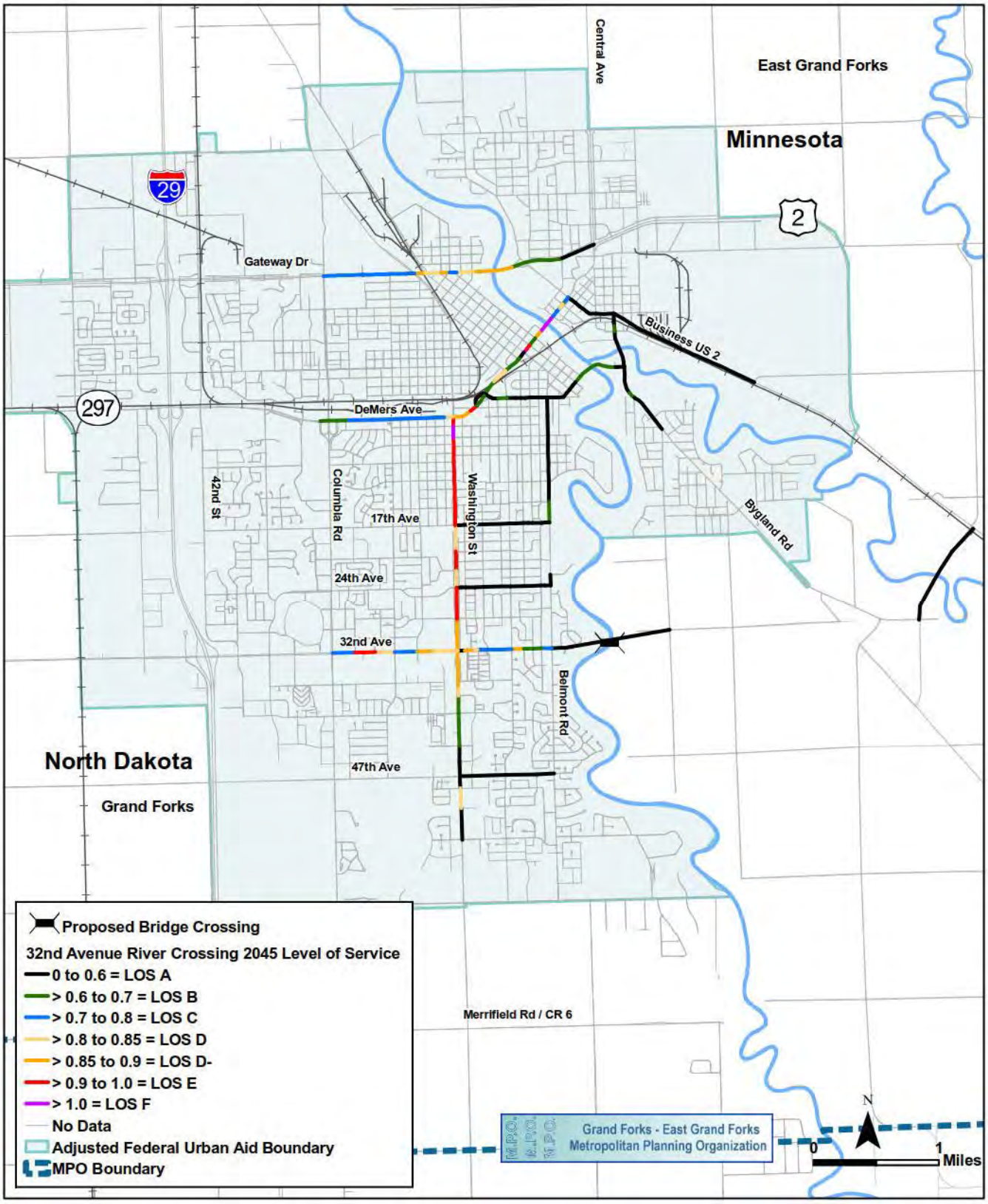


Figure 11: Link Level of Service Summary for the Proposed 32nd Avenue S River Crossing

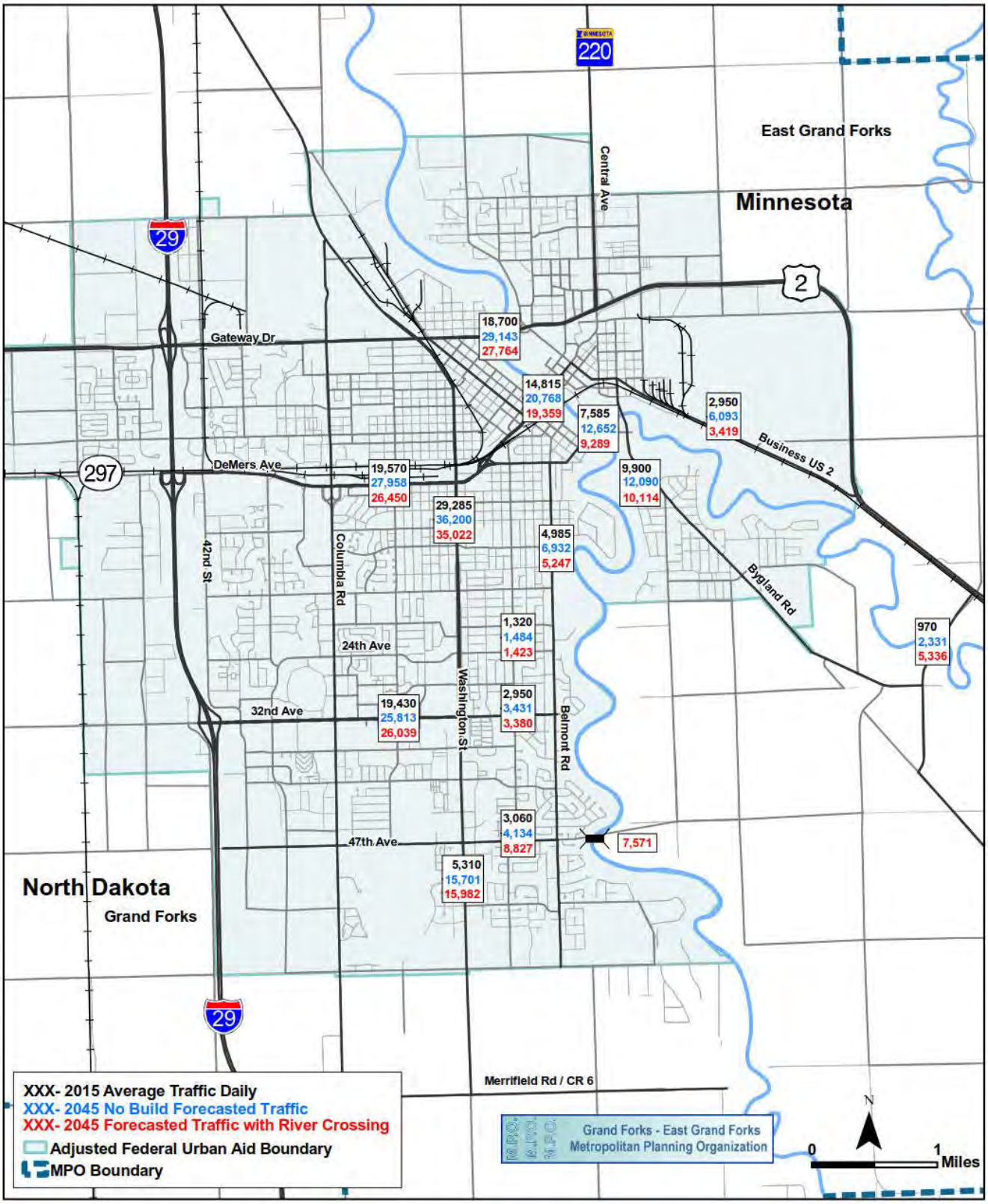


Figure 12:ADT Summary for the Proposed 47th Avenue S River Crossing

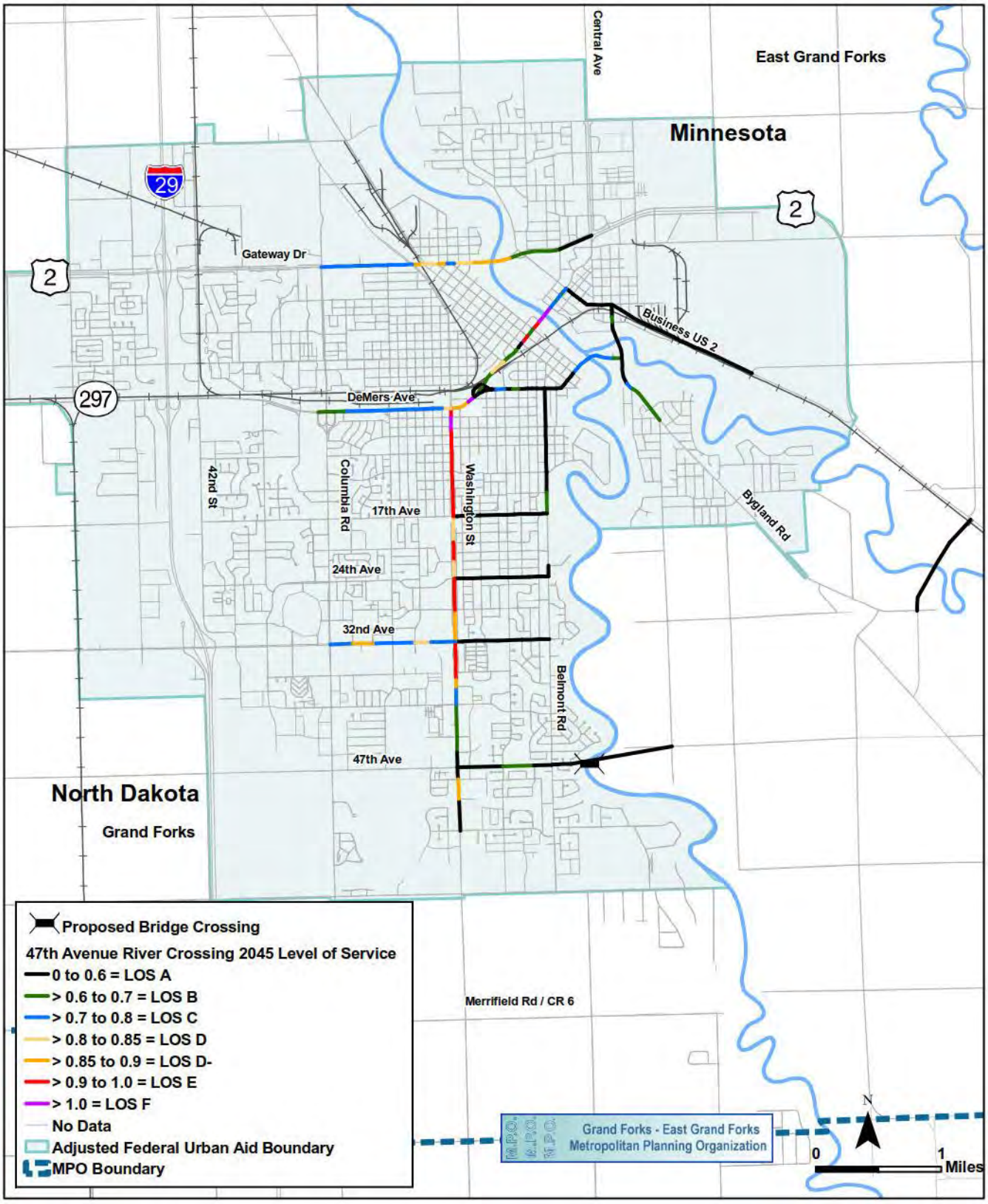


Figure 13: Link Level of Service Summary for the Proposed 47th Avenue S River Crossing



Figure 14: ADT Summary for the Proposed Merrifield Road River Crossing

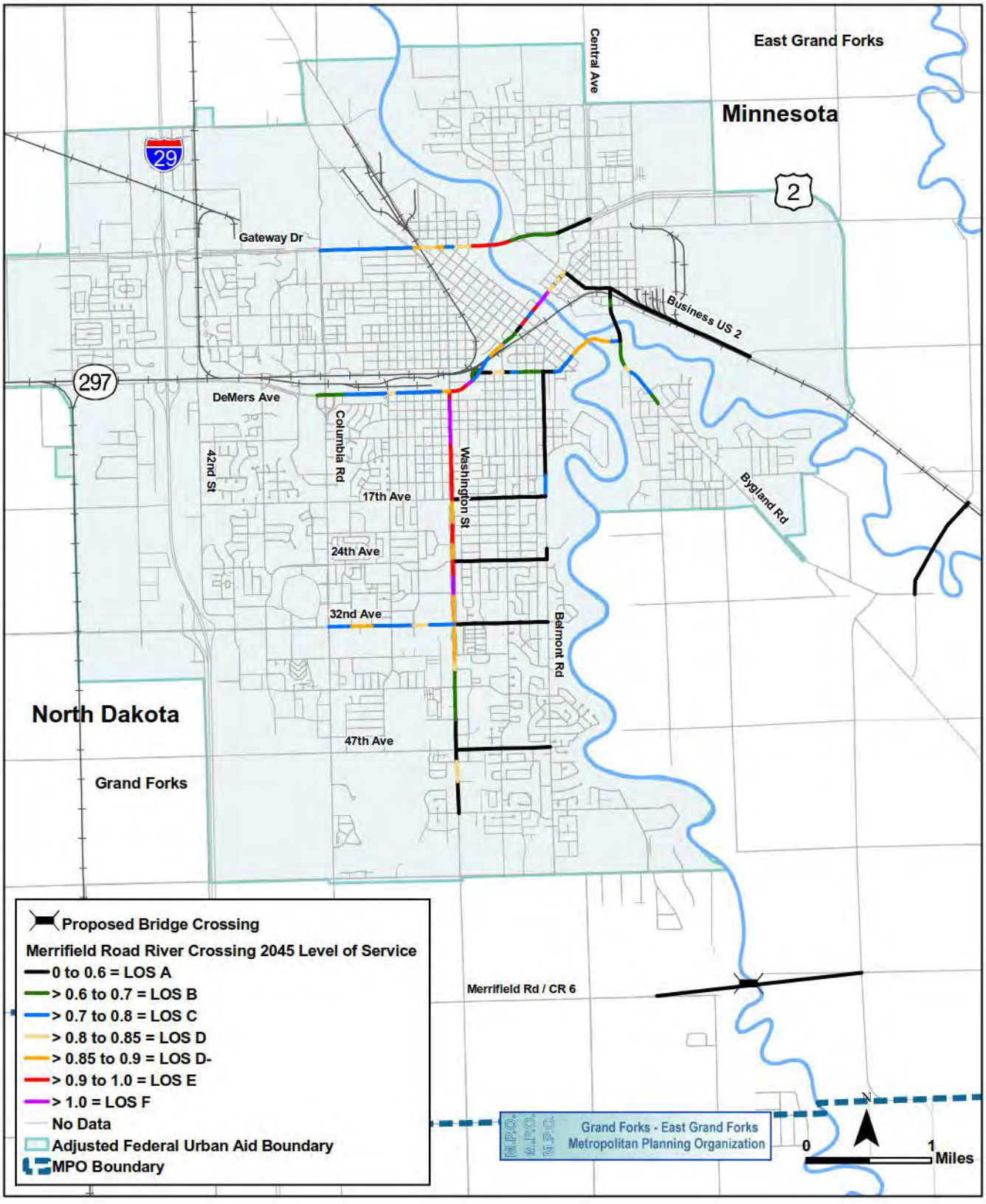


Figure 15: Link Level of Service Summary for the Proposed Merrifield Road River Crossing

The second part of the river crossing analysis looked at the same fifteen intersections analyzed under the Existing and No Build scenarios. Turning movement counts for each intersection and each river crossing scenario were created using the same methodology as for the No Build scenario. **Table 6** is a continuation of **Tables 4** and **5**. **Table 7** provides a comparison to the 2000 and 2025 intersection LOS results from the 2000 river crossing analysis to the 2018 and 2045 LOS results from the 2018 river crossing analysis. In general, there has been a general deterioration of LOS at all the intersections. Also, those intersections identified as having the most operational challenges in the 2000 analysis are also identified as having the most operational challenges under the 2018 analysis.

Table 6: Intersection LOS Summary

Intersection/Crossing Scenario	Existing PM Peak	2045 No Build PM Peak	2045 Build 17th Avenue S PM Peak	2045 Build Elks Drive Crossing	2045 Build 32nd Avenue S Crossing	2045 Build 47th Avenue S Crossing	2045 Build Merrifield Crossing
1st Street SE at 3rd Avenue SE	A	B	A	A	A	A	A
Greenway Boulevard SE, Bygland Road SE, 13th Street SE	A	C	F	F	B	B	C
Greenway Boulevard SE at Rhinehart Drive SE	A	A	A	A	A	A	A
DeMers Avenue at N 5th Street	B	B	B	B	B	B	B
DeMers Avenue at S Washington Street	D	E	D	D	E	E	E
S Washington Street at 17th Avenue S	C	D	D	C	D	D	D
S Washington Street at 24th Avenue S	C	D	C	D	D	D	D
S Washington Street at 32nd Avenue S	D	E	E	E	F	E	E
S Washington Street at 47th Avenue S	B	D	D	D	D	D	D
4th Avenue S at Belmont Road	B	F	C	B	C	C	F
17th Avenue S at Belmont Road	A	A	F	A	A	A	A
Elks Drive at Belmont Road	B	C	E	F	B	B	C
24th Avenue S at Belmont Road	A	A	C	F	A	A	A
32nd Avenue S at Belmont Road	B	F	F	F	F	C	E
47th Avenue S at Belmont Road	A	A	A	A	A	F	A

Table 7: Comparison between 2000 and 2018 River Crossing Analyses Intersection LOS

Intersection/Crossing Scenario	Existing PM Peak (2000)*	Existing PM Peak (2018)	2025 No Build PM Peak	2045 No Build PM Peak*
1st Street SE at 3rd Avenue SE	A	A	D-E	B
DeMers Avenue at S Washington Street	E	D	F	E
S Washington Street at 17th Avenue S	C	C	A-C	D
S Washington Street at 32nd Avenue S	C	D	F	E
S Washington Street at 47th Avenue S	N/A	B	A-C	D
17th Avenue S at Belmont Road	N/A	A	A-C	A
32nd Avenue S at Belmont Road	N/A	B	A-C	F

* - values from 2000 river crossing analysis

For the intersection analysis, there are some differences between the river crossing alternatives. **Figure 16** on the following page summarizes the overall intersection LOS for each of the analyzed river crossings including Existing and No Build conditions.

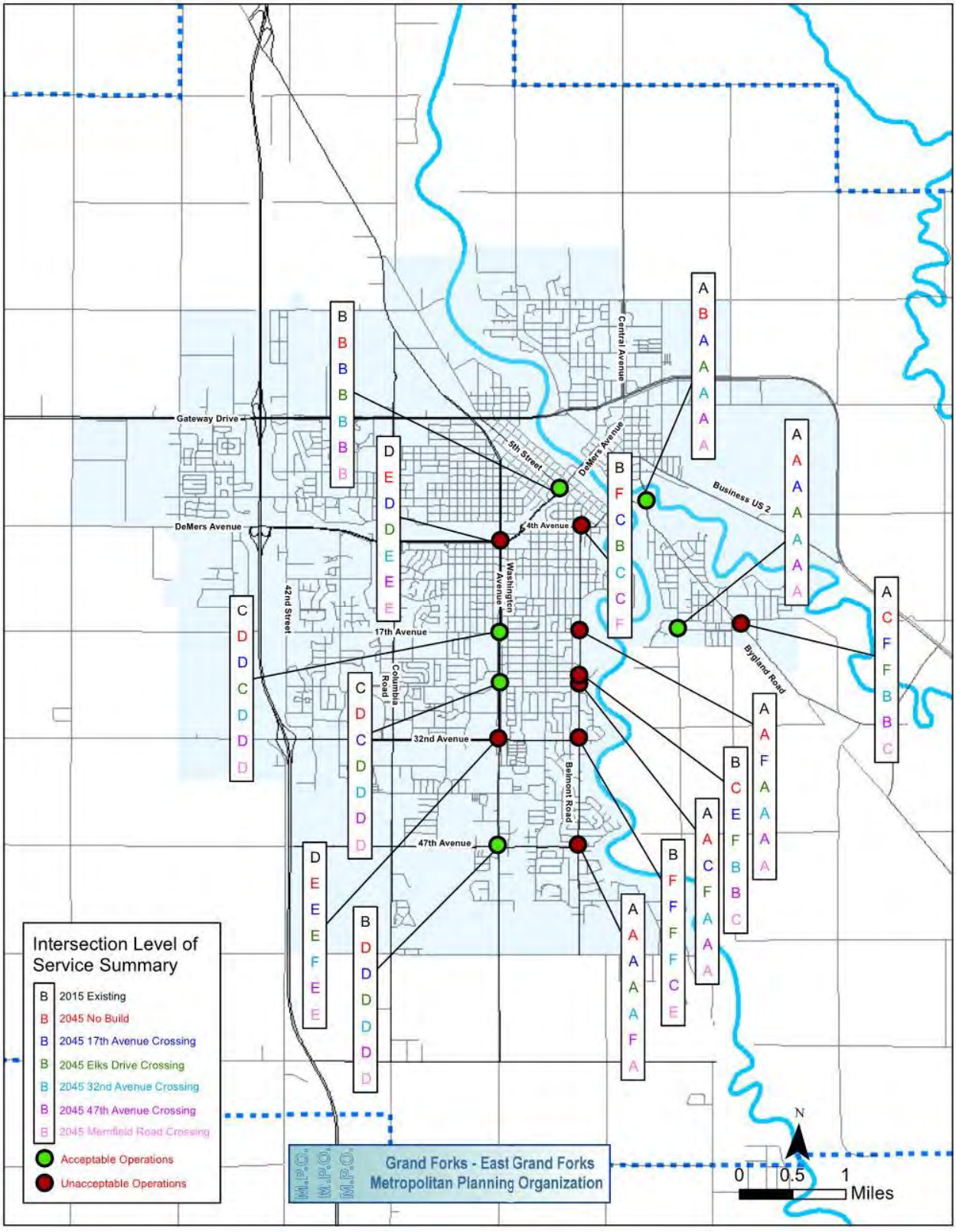


Figure 16: Intersection LOS Summary

Intersection Mitigation

As part of the river crossing intersection level of service analysis, mitigation for each intersection were analyzed to determine what if any mitigation techniques could be employed to bring all analyzed intersection to LOS D or better. As part of the mitigation process, the following mitigation hierarchy was established:

- Add turn lanes within existing ROW
- Intersection control modifications and/or add turn lanes that require additional ROW
- Alternative intersection design

Each intersection that operated at LOS E or LOS F under any of the 2045 Build scenarios, was analyzed using the hierarchy above to determine the most feasible mitigation. In most cases the worst-case river crossing scenario was similar to the No Build 2045 LOS. **Table 8** below summarizes the mitigations.

Based on the mitigations in **Table 8**, two intersections could not be reasonably mitigated with strategies from the mitigation hierarchy described above. The following innovative intersection solutions are recommended for further consideration at these locations:

- S Washington Street and DeMers Avenue – continuous flow intersection (see **Figure 17)**.

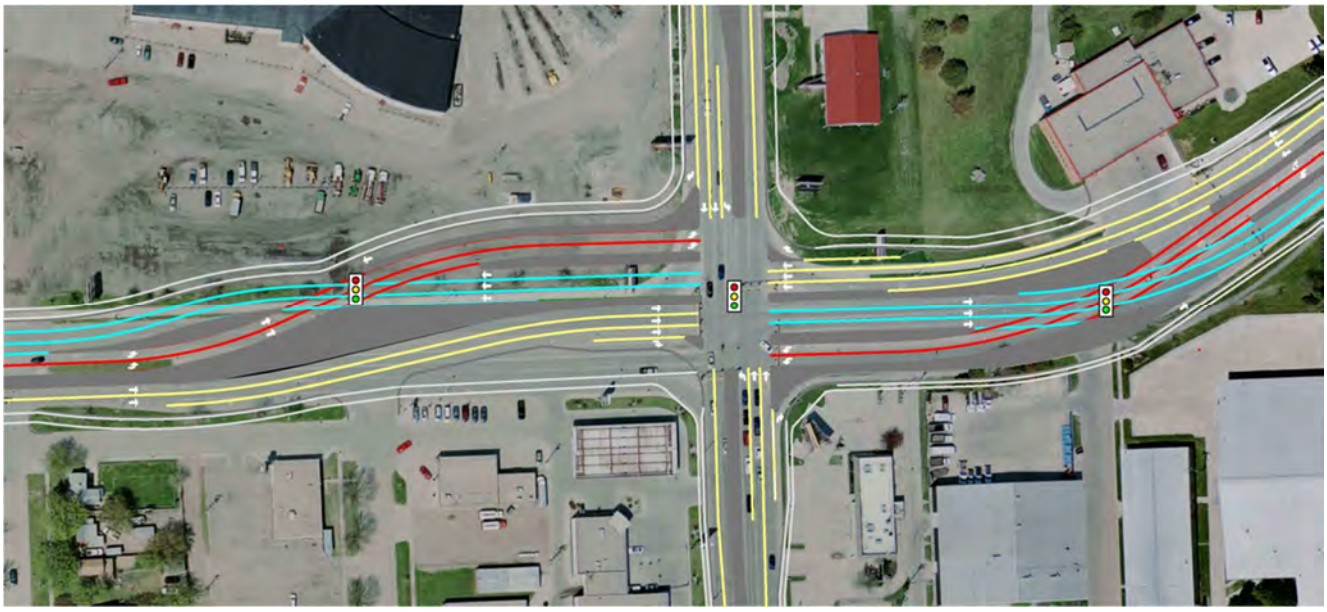


Figure 17: Continuous Flow Intersection Concept at S Washington Street and Demers Avenue

Table 8: Mitigated 2045 Build LOS Summary

Intersection/Crossing Scenario	Existing Intersection Control	Unmitigated LOS	Mitigated Control	Mitigated LOS	Mitigation Summary
Greenway Boulevard,13th Street SE at Bygland Road	Two-Way Stop	F[1]	Traffic Signal / Roundabout	B	A conventional single lane roundabout would also result in acceptable operations. Also, could convert to a signal.
S Washington Street at DeMers Avenue	Traffic Signal	E[5]	Traffic Signal	D	Additional lanes are required and that is not very feasible given existing right-of-way using a conventional intersection improvement. Conversion to a continuous flow intersection showed benefit in 2013 analysis.
S Washington Street at 32nd Avenue S	Traffic Signal	F[3]	Traffic Signal	NA	Additional lanes are required and that is not very feasible given existing right-of-way using a conventional intersection improvement.
4th Avenue S at Belmont Road	All-Way Stop	F[5]	Mini-Roundabout / Traffic Signal	B	Based on a high-level volume analysis, a mini-roundabout is also anticipated to operate at an acceptable LOS. Also, could convert to a signal.
17th Avenue S at Belmont Road	Two-Way Stop	F[1]	Traffic Signal	C	Convert to a signal.
24th Avenue S at Belmont Road	Two-Way Stop	F[2]	Traffic Signal	B	Convert to a signal.
Elks Drive at Belmont Road	Two-Way Stop	F[2]	Traffic Signal	B	Convert to a signal. The WB approach also requires a left turn lane and a right turn lane. Right-of-way will need to be acquired to accommodate the WB approach widening.
32nd Avenue S at Belmont Road	All-Way Stop	F[3]	Traffic Signal	C	Convert to a signal and add a EB and NB left. Widening on downstream approaches will be required to reduce skew through the intersection.
47th Avenue S at Belmont Road	Two-Way Stop	F[4]	Traffic Signal	B	Convert to a signal and add a left turn lane on the NB/SB/WB approaches. Widening and urban street cross section will be required on the NB approach.

1. Worst intersection LOS under 17th Avenue S River Crossing
2. Worst intersection LOS under Elks Drive River Crossing
3. Worst intersection LOS under 32nd Avenue S River Crossing
4. Worst intersection LOS under 47th Avenue S River Crossing
5. Worst intersection LOS under Merrifield Road Crossing

Regional Impacts

One goal of a new river crossing is to alleviate the anticipated congestion on the existing crossings by providing users an alternate route. **Table 9** summarizes the ADTs by scenario for each of the existing and proposed river crossings. Many of the river crossing scenarios have similar results from a traffic volume perspective, although there is generally a decrease in the river crossing volume served by the proposed river crossing as it moves further to the south. There are also some notable decreases in traffic volumes on the Minnesota Avenue / 1st Street SE crossing under the 17th Avenue S, Elks Drive, 32nd Avenue S and 47th Avenue S scenarios.

Table 9: Forecast River Crossing ADTs Summary

River Crossing Location	Existing	2045 No Build	2045 with 17th Crossing	2045 with Elks Crossing	2045 with 32nd Crossing	2045 with 47th Crossing	2045 with Merrifield Crossing
US 2	18,700	29,100	27,700	27,400	27,400	27,800	28,300
DeMers Avenue	14,800	20,800	18,900	18,800	19,200	19,400	20,300
Minnesota Avenue / 1st Street SE	7,600	12,700	7,500	7,300	8,000	9,300	11,100
17th Avenue S	--	--	8,000	--	--	--	--
Elks Drive	--	--	--	7,800	--	--	--
32nd Avenue S	--	--	--	--	8,800	--	--
47th Avenue S	--	--	--	--	--	7,600	--
Merrifield Road	--	--	--	--	--	--	3,600
Total ADT	41,100	62,600	62,100	61,300	63,400	64,100	63,300

Table 10 summarizes the net difference between each scenario at the Red River crossings as compared to No Build.

Table 10: Net ADT Change by Red River Crossing as Comparted to No Build ADT

River Crossing Location	2045 with 17th Crossing	2045 with Elks Crossing	2045 with 32nd Crossing	2045 with 47th Crossing	2045 with Merrifield Crossing
US 2	-1,400	-1,700	-1,700	-1,300	-800
DeMers Avenue	-1,900	-2,100	-1,600	-1,400	-500
Minnesota Avenue / 4th Avenue S/ 1st Street SE	-5,200	-5,400	-4,700	-3,400	-1,600
17th Avenue S	8,000	--	--	--	--
Elks Drive	--	7,800	--	--	--
32nd Avenue S	--	--	8,800	--	--
47th Avenue S	--	--	--	7,600	--
Merrifield Road	--	--	--	--	3,600
Net ADT Difference	-600	-1,400	800	1,500	700

Table 11 below summarizes the link LOS at each river crossing for each scenario.

Table 11: River Crossing Link LOS by Scenario

River Crossing Location	2045 No Build	2045 with 17th Crossing	2045 with Elks Crossing	2045 with 32nd Crossing	2045 with 47th Crossing	2045 with Merrifield Crossing
US 2	E	D -	D -	D	D	E
DeMers Avenue	F	F	F	F	F	F
Minnesota Avenue / 4th Avenue S/ 1st Street SE	E	A	A	B	C	D
17th Avenue S	--	A	--	--	--	--
Elks Drive	--	--	A	--	--	--
32nd Avenue S	--	--	--	A	--	--
47th Avenue S	--	--	--	--	A	--
Merrifield Road	--	--	--	--	--	A

Based on **Tables 9** through **11**, there is no one river crossing location that will solve all the issues shown under the No Build scenario. The improvement of the link LOS on Minnesota Avenue / 4th Avenue S/ 1st Street SE and Gateway Drive (US 2) for the 17th Avenue S, Elks Drive, 32nd Avenue S and 47th Avenue S proposed river crossings is notable.

Table 12 summarizes the ADT link volumes on Bygland Road and TH 220 for each of the scenarios analyzed.

Table 13 summarizes the net difference between each scenario as compared to No Build on Bygland Road and TH 220.

Reviewing two of the primary roadways that would provide access between East Grand Forks to the proposed Red River crossing, TH 220 over the Red Lake River and Bygland Road north of Rhinehart Drive, also provides insight as to the impacts on local and regional traffic for each of the alternatives analyzed. **Tables 12** and **13** shows that daily traffic on Bygland Road north of Rhinehart Drive will decrease more if the proposed 17th Avenue S, Elks Drive or 32nd Avenue S river crossings are constructed. Conversely the TH 220 daily traffic would be highest if the 32nd Avenue S or 47th Avenue S river crossings were constructed. This relationship indicates that the northern crossing alternatives serve more local trips and the southern crossings serve more regional trips, although all crossings will have each trip type. The results shown in **Table 13** are also shown in **Figures 18** and **19** for TH 220 River Crossing and Bygland Road N. of Rhinehart Drive, respectively.

Table 12: Forecast ADTs on Bygland Road and TH 220 Summary

River Crossing Location	Existing	2045 No Build	2045 with 17th Crossing	2045 with Elks Crossing	2045 with 32nd Crossing	2045 with 47th Crossing	2045 with Merrifield Crossing
TH 220 River Crossing	970	2,330	4,240	4,480	5,290	5,340	3,520
Bygland Road N. of Rhinehart Dr.	9,900	12,090	7,450	7,920	8,450	10,110	11,420

Table 13: Net ADT Change on Bygland Road and TH 220 as Comparted to No Build ADT

River Crossing Location	2045 with 17th Crossing	2045 with Elks Crossing	2045 with 32nd Crossing	2045 with 47th Crossing	2045 with Merrifield Crossing
TH 220 River Crossing	+1,910	+2,150	+2,960	+3,010	+1,190
Bygland Road N. of Rhinehart Dr.	-4,640	-4,170	-3,600	-1,980	-680

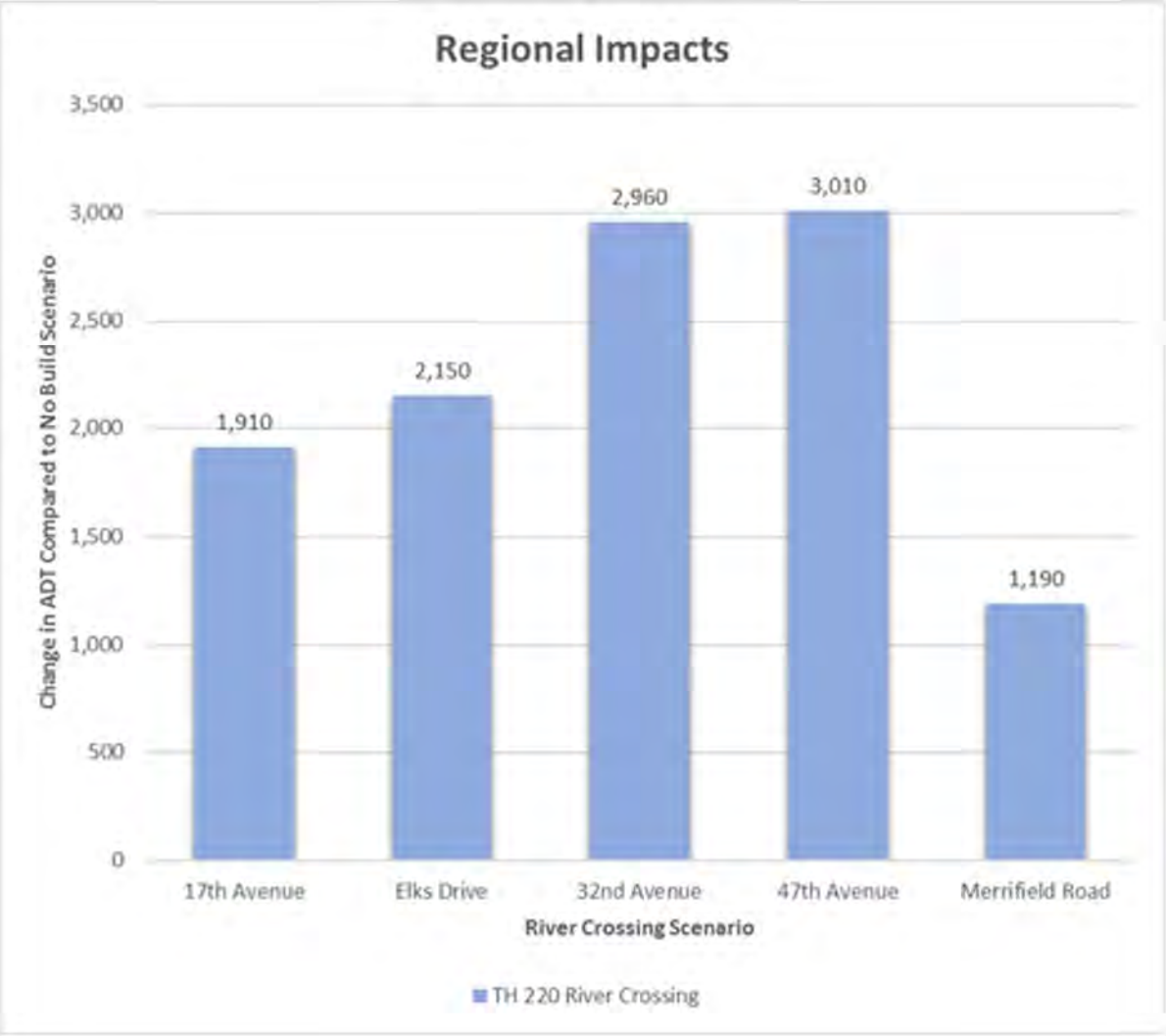


Figure 18: Change in traffic volumes on TH 220 at Red Lake River by River Crossing Scenario

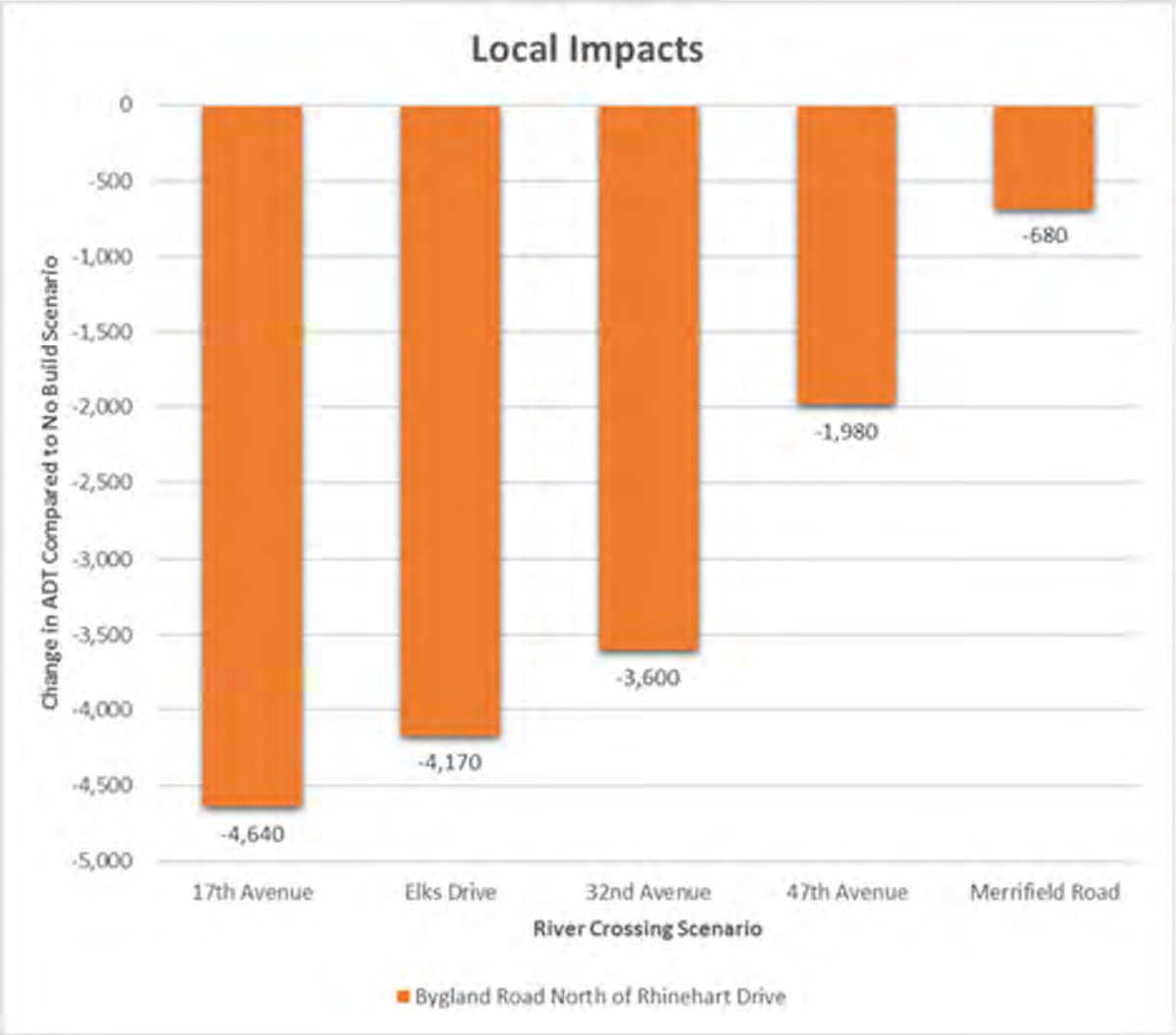


Figure 19: Change in traffic volumes on Bygland Road, North of Rhinehart Drive by River Crossing Scenario

The travel demand model generates several measures of effectiveness on a network basis that allows for a comparison between the various river crossing scenarios including total vehicle miles traveled (VMT) and total vehicle hours traveled (VHT). Comparing the values of these measures for each scenario provides a better understanding of which alternatives reduces travel time and travel distance. Reducing the values of these measures is desirable because additional VHT is typically due to delay, additional travel time required to avoid areas of delay, or additional travel time because a more direct route is not available. For this analysis, adding a river crossing could serve some travelers more directly and allow for reduced delay and distance traveled on their trip. Conversely, some drivers may travel slightly out of their way to avoid delay that is typically experienced on an existing crossing and that could increase VMT and decrease VHT. Delay adds stress to drivers, additional costs for businesses, increased fuel consumption, and higher vehicle emissions. The benefits of lower VMT are similar to VHT although VHT can be tied more directly to driver impacts and costs where VMT is more directly associated to impacts on emissions and fuel consumption.

Tables 14 and **15**, on the following pages, summarizes the urban VMT and VHT totals for each river crossing scenario by roadway classification and the differences in VMT as compared to the 2045 No Build scenario for all alternatives. **Table 16** summarizes the differences in VHT as compared to the 2045 No Build scenario for all alternatives. Below are a few observations that can be made after reviewing these network measures:

- **17th Avenue S River Crossing:** Increases "Lower Functionally Classified VMT" the most of any alternative (+9,358) and has the third greatest reduction in "Higher Functionally Classified VMT" (-19,770). VHT is reduced the most of any alternative with the 17th Avenue S Crossing (-12,374).
- **Elks Drive River Crossing:** Increases "Lower Functionally Classified VMT" by +4,627 and has the greatest reduction in "Higher Functionally Classified VMT" (-24,371). VHT is reduced the second most of any alternative with the Elks Drive Crossing at -12,254.
- **32nd Avenue S River Crossing:** Decreases "Lower Functionally Classified VMT" by -1,321 and has the second greatest reduction in "Higher Functionally Classified VMT" (-23,418). VHT is slightly reduced under the 32nd Avenue S Crossing (-831).
- **47th Avenue S River Crossing:** Increases "Lower Functionally Classified" by +717 and decreases "Higher Functionally Classified VMT" by -14,362. VHT is increased slightly with the 47th Avenue S Crossing (+174).
  Merrifield Road River Crossing: Decreases "Lower Functionally Classified VMT" the most of any alternative (-4,226) and "Higher Functionally Classified VMT" is decreased by -16,098. VHT is reduced the second most of any alternative (-679).

Table 14: Urban VMT and VHT Total per River Crossing

Facility Type	2045 No Build Network	17th Avenue S River Crossing	Elks Drive River Crossing	32nd Avenue S River Crossing	47th Avenue S River Crossing	Merrifield Road River Crossing
Freeways and Ramps	101,186	96,052	99,381	97,132	98,524	100,016
Major Arterials	530,889	516,807	513,467	511,543	519,441	518,568
Minor Arterials	237,590	237,036	232,446	237,572	237,338	234,983
Collectors	139,010	149,801	149,570	138,905	140,997	138,876
Local Streets/Rural	46,109	45,230	45,320	44,911	45,091	44,624
Urban VMT Totals	**1,054,784**	**1,044,926**	**1,040,184**	**1,030,063**	**1,041,391**	**1,037,067**
Total VHT	**59,702**	**47,328**	**47,448**	**58,871**	**59,876**	**59,023**

Table 15: Urban VMT Difference from 2045 No Build

Facility Type	2045 No Build	17th Avenue S River Crossing	Elks Drive River Crossing	32nd Avenue S River Crossing	47th Avenue S River Crossing	Merrifield Road River Crossing
Freeways and Ramps	101,186	-5,134	-1,805	-4,054	-2,662	-1,170
Major Arterials	530,889	-14,082	-17,422	-19,346	-11,448	-12,321
Minor Arterials	237,590	-554	-4,590	-18	-252	-2,607
Collectors	139,010	+10,791	+10,560	-105	1,987	-134
Local Streets/Rural	46,109	-879	-789	-1,198	-1,018	-1,485
Total VMT Reduction Compared to 2045 No Build	**1,054,784**	**-9,858**	**-14,600**	**-24,721**	**-13,393**	**-17,717**
Freeways, Ramps, Major Arterials VMT Compared to 2045 No Build	**869,665**	**-19,770**	**-24,371**	**-23,418**	**-14,362**	**-16,098**
Minor Arterials, Collectors, Local VMT Compared to 2045 No Build	**422,709**	**9,358**	**4,627**	**-1,321**	**717**	**-4,226**

Table 16: VHT Difference from 2045 No Build

Facility Type	2045 No Build Network	17th Avenue S River Crossing	Elks Drive River Crossing	32nd Avenue S River Crossing	47th Avenue S River Crossing	Merrifield Road River Crossing
Total VHT Reduction Compared to 2045 No Build	**59,702**	**-12,374**	**-12,254**	**-831**	**174**	**-679**

Conclusions

A regional and local level analysis was completed for five potential river crossing locations. The analysis included a link LOS analysis, intersection LOS analysis, and comparison of river crossing volumes and network wide VMT and VHT under Existing (2017), No Build (2045), and the five potential river crossing scenarios (2045). All intersection LOS analysis was completed for PM peak conditions.

Under Existing conditions, there are minimal issues within the analysis area. Under 2045 No Build conditions all three existing river crossings in addition to segments of Washington Street and 32nd Avenue S are anticipated to operate at LOS E or F. The intersections of S Washington Street and DeMers Avenue, S Washington Street and 32nd Avenue S, 4th Avenue S and Belmont Road, and 32nd Avenue S and Belmont Road also show undesirable operations under 2045 No Build conditions (LOS E or F). All three existing river crossings are anticipated to operate at an unacceptable LOS under 2045 No Build conditions.

A review of the daily traffic forecasts on Bygland Road north of Rhinehart Drive and the TH 220 Red Lake River crossing indicates that the northern crossing alternatives serve more local trips and the southern crossings serve more regional trips, although all crossings will have each trip type. Based on the information provided in **Tables 12** and **13**, a few conclusions can be made.

- There is an increase of about 2,000 vehicles per day at the TH 220 river crossing under the 17th Avenue S and Elks Drive crossings scenarios when compared to No Build. There is an increase of about 3,000 vehicles per day under the 32nd and 47th Avenue S crossings scenarios when compared to No Build. This increase is only 1,200 vehicles per day under the Merrifield Road Crossing scenario. TH 220 serves more regional trips since it is three miles from the edge of East Grand Forks. The higher volumes under the 32nd and 47th Avenue S crossing scenarios indicate that more regional trips are being pulled to those crossings as compared to the 17th Avenue S and Elks Drive Crossings. The fact that Merrifield Road has a lower forecast volume increase does not mean regional trips will not be the primary user but rather that many that travel from the southeast on US 2 would travel a different route to the river crossing to avoid traveling out of their way to use the TH 220.
- The traffic forecasts on Bygland Road N decrease under all river crossing scenarios but the amount of decrease is highest for the 17th Avenue S crossing and lowest for the Merrifield Crossing. Since Bygland Road N serves a higher proportion of local trips this suggest that under all crossing scenarios traffic is anticipated to decrease due to utilization of the proposed river crossing (i.e. trips will cross to the south and avoid downtown Grand Forks/East Grand Forks). Since the decrease is larger when the proposed crossing is farther north, an increased percentage of the local trips served under the northern river crossing scenarios is to be expected.

The ADTs on Belmont Road north of 17th Avenue S are anticipated to decrease under each river crossing scenario when compared to 2045 No Action volumes. These decreases range from about 2400 for the 17th Avenue S and Elks Drive crossings, 1600 for the 32nd Avenue S and 47th Avenue S crossings, and 600 under the Merrifield Road crossing.

A review of the link LOS analysis for the four river crossing alternatives yielded the following observations:

- The Point Bridge link LOS operates better under the 17th Avenue S, Elks Drive and 32nd Avenue S river crossing alternatives.
- Gateway Drive operates better under the 17th Avenue S, Elks Drive, 32nd Avenue S, and 47th Avenue S river crossings.
- DeMers Avenue experienced similar operations under each of the alternatives analyzed.
- Belmont Road operations were better under all the river crossing alternatives when compared to the No Build scenario.

Where the signalized intersection LOS analysis showed operational concerns under future conditions, mitigations were analyzed at each intersection generally following the below mitigation hierarchy:

- Add turn lanes within existing ROW
- Intersection control modifications and/or add turn lanes that require additional ROW

- Alternative intersection design

Below is a summary of each intersection that was mitigated and the associated mitigation.

- S Washington Street at DeMers Avenue – Additional lanes are required and that is not very feasible given existing right-of-way using a conventional intersection improvement. Conversion to a continuous flow intersection showed benefit in 2013 analysis.
- S Washington Street at 32nd Avenue S – Additional lanes are required and that is not very feasible given existing right-of-way using a conventional intersection improvement. A quadrant roadway has some merit, but additional analysis is required.
- 4th Avenue S at Belmont Road – Based on a high-level volume analysis, a mini-roundabout is also anticipated to operate at an acceptable LOS. Also, could convert to a signal.
- 17th Avenue S at Belmont Road – Convert to a signal.
- Greenway Boulevard/13th Street SE at Bygland Road – A conventional single lane roundabout would result in acceptable operations. Also, could convert to a signal.
- 24th Avenue S at Belmont Road – Convert to a signal.
- Elks Drive at Belmont Road – Convert to a signal. The WB approach also requires a left turn lane and a right turn lane. Right-of-way will need to be acquired to accommodate the WB approach widening.
- 32nd Avenue S at Belmont Road – Convert to a signal. Avoided adding left turn lanes because downstream widening would be required to avoid skew for through traffic through intersection.
- 47th Avenue S at Belmont Road – Convert to a signal and add a left turn lane on the NB/SB/WB approaches. Widening and urban street cross section will be required on the NB approach.

A review of the link LOS and ADTs on the actual river crossing shows:

- There are notable decreases in traffic volumes on the Minnesota Avenue / 4th Avenue S /1st Street SE crossing under the 17th Avenue S, Elks Drive, 32nd Avenue S and 47th Avenue S scenarios.
- There are improvements in the link LOS on Minnesota Avenue / 4th Avenue S / 1s Street SE and Gateway Drive (US 2) for the 17th Avenue S, Elks Drive, 32nd Avenue S and 47th Avenue S proposed river crossings.

A review of the network wide performance measures of VMT and VHT shows the following:

- **17th Avenue S River Crossing:** Shows the lowest reduction of any alternative, decreasing the total VMT by 9,858. VHT is reduced the most of any alternative with the 17th Avenue S Crossing (-12,374).
- **Elks Drive River Crossing:** Shows the third lowest reduction of any alternative, decreasing the total VMT by 14,600. VHT is reduced the second most of any alternative with the Elks Drive Crossing at -12,254.
- **32nd Avenue S River Crossing:** Shows the largest decrease of any alternative, decreasing the total VMT by 24,721. VHT is slightly reduced under the 32nd Avenue S Crossing (-831).
- **47th Avenue S River Crossing:** Shows the 4th lowest reduction of any alternative, decreasing the total VMT by 13,393. VHT is increased slightly with the 47th Avenue S Crossing (+174).
- **Merrifield Road River Crossing:** Shows the 2nd lowest decrease of any alternative, decreasing the total VMT by 17,717 VHT is reduced the second most of any alternative (-679).

Red River Crossing Alignment Concept Development

It is important to understand at a planning level the cost differences between the alternatives because traffic operations and changes in traffic patterns are only one piece of the equation. A review of a cost benefit ratio of alternatives is one method that allows for both the cost and transportation system impacts of each crossing alternative to be compared.

As part of the 2025 Grand Forks-East Grand Forks Transportation Plan Update, Red River crossing concepts were developed for 17th Avenue S, Elks Drive, 32nd Avenue S, and Merrifield Road. In 2005, there was a more detailed review of the Merrifield River Crossing completed as part of the "Merrifield Road Red River Bridge Feasibility Study" (Feasibility Study). The 17th Avenue S, Elks Drive and 32nd Avenue S Crossings each had two main alternatives: "high and dry" and "low" alternative. The high and dry alternative raised the elevation of the low steel on the bridge to three feet above the 210-year flood elevation. The lower alternatives more closely followed the alignment of the existing ground to reduce construction costs, although under this alternative there is a high likelihood of seasonal flooding.

The scope of this project is to build off the work that has been completed in the past to provide similar comparisons between the river crossings to allow decision-makers to provide input on river crossing location preferences at a planning level.

Concept level river crossing location exhibits were developed to show the potential river crossing horizontal alignment for each of alternative. These alignments generally follow previously developed concept alignments except for the following:

- 17th Avenue S previously ran on a nearly east-west alignment. 17th Avenue S starts at roughly the same location on the west side of the Red River but curves to the south on the Minnesota side of the river to avoid impacts to homes that have been constructed since the prior analysis was completed.
- Elk Drive is similar except on the west end the existing Elks Drive alignment is used as opposed to the prior alignment that ran in a northwest to southeast orientation.
- In the 2025 Plan, there were three alternative alignments shown for the 32nd Avenue S river crossing. The option that brought the east end of the roadway within the dike system was selected for this analysis.
- 47th Avenue S was not previously reviewed. There was interest as part of this analysis to review this additional potential river crossing location. The alignment will run east from 47th Avenue S over the Red River and then turn to the northeast to ultimately connect near the intersection of Rhinehart Drive/445th Avenue SW and 200th Street SW. This analysis only includes a low concept because a high and dry concept would likely require extending the dike system in Minnesota approximately one mile to the south.
- For Merrifield Road, the alignment was like alignment 1A in the Feasibility Study.

Since this is an area wide transportation plan, concept drawings are not allowed to show engineering level details This is required because further analysis such as bridge feasibility studies and environmental documents will be required to analyze a river crossing location that is selected to move forward. Those documents are the appropriate place to analyze these crossing with this additional detail.

Figures 20–24 show the alignments for each river crossing that were used to completed the cost benefit analysis.

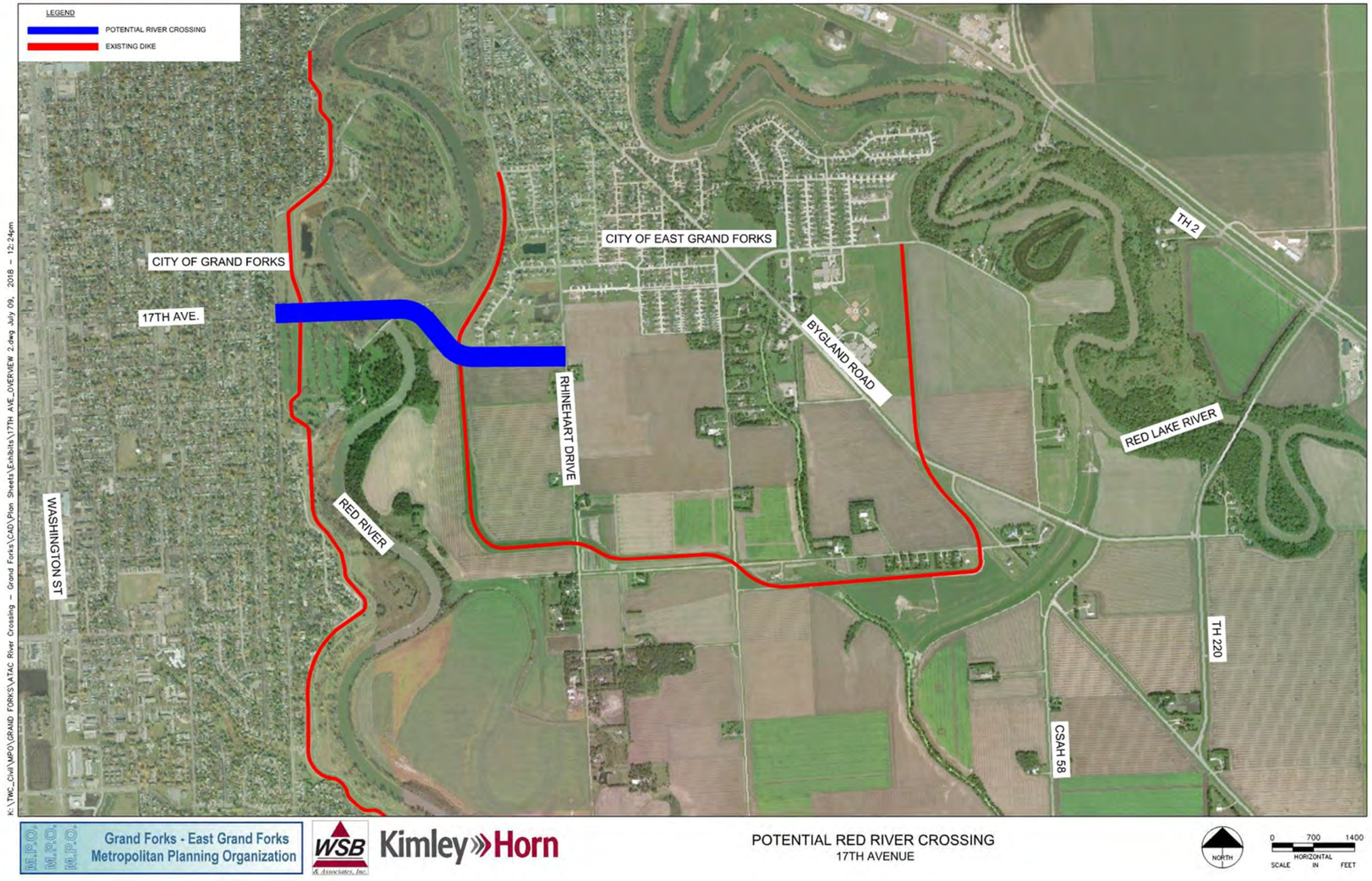


Figure 20: Potential Red River Crossing Alignment at 17th Avenue S



Figure 21: Potential Red River Crossing Alignment at Elks Drive



Figure 22: Potential Red River Crossing Alignment at 32nd Avenue S

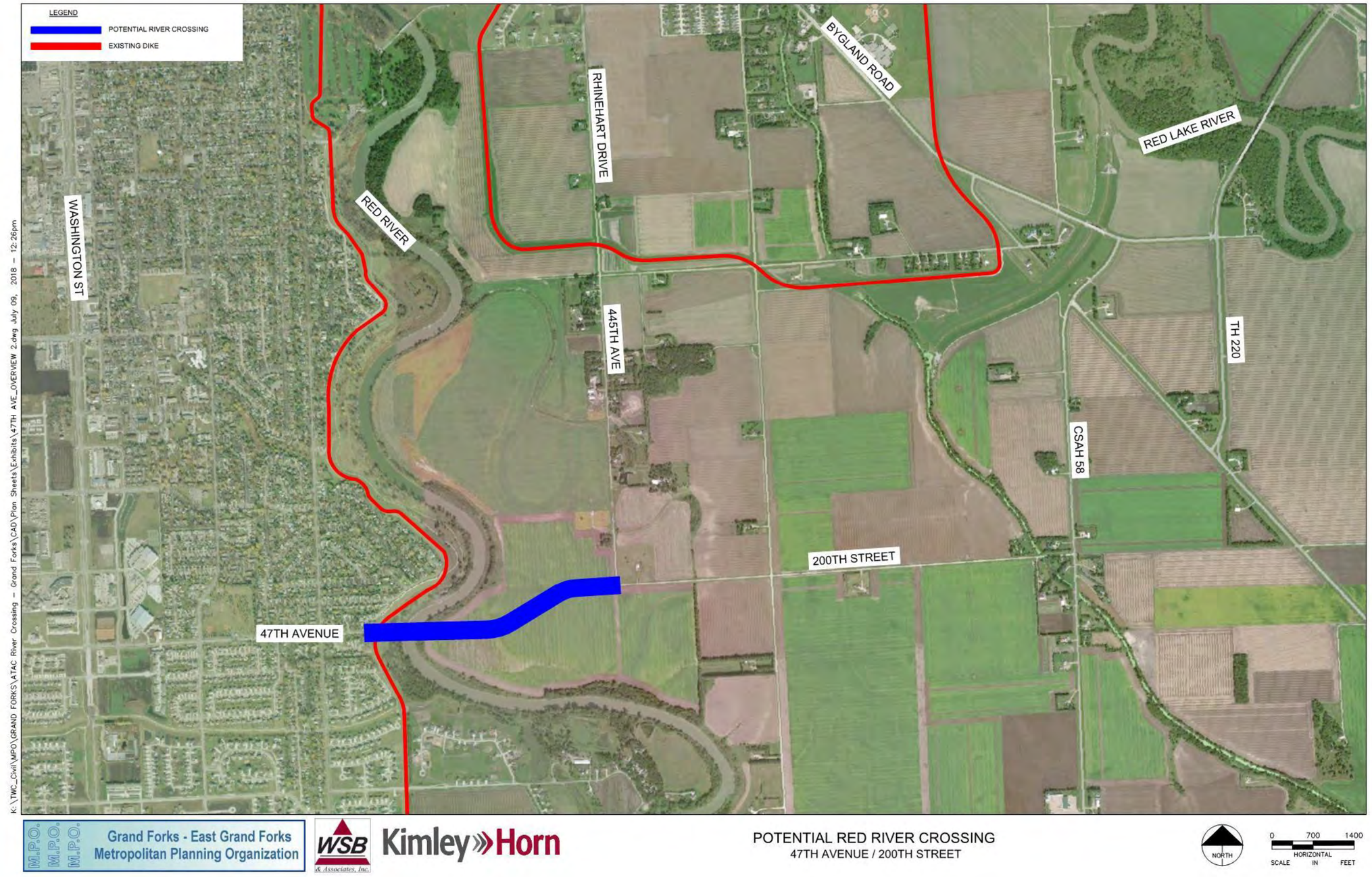


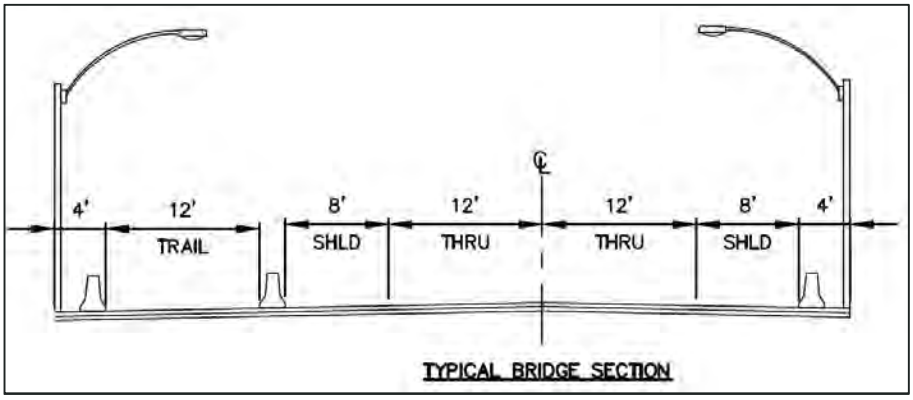
Figure 23: Potential Red River Crossing Alignment at 47th Avenue S



Figure 24: Potential Red River Crossing Alignment at Merrifield Road

Red River Crossing Opinion of Probable Costs

Once concept alignments were developed, quantities were estimated at a planning level for the five proposed Red River crossings locations. These quantities were developed using the concepts shown in **Figures 20-24**. The following typical section, consistent with the typical section assumed as part of the Feasibility Study, was used for all river crossings with the exception of the Merrifield Crossing where the trail section was not assumed given its rural location:



The following are some assumptions that were used to develop the opinion of probable costs:

- Drainage and erosion control - 40% of all items except bridge, dikes, and mobilization
- Non-quantifiable minor items - 20% of all items except for bridge, dikes, drainage, erosion control and mobilization
- Mobilization - 8% of all other construction items
- Contingency – 10% of all construction items
- Engineering design and construction - 25% of construction cost
- Right-of-way costs were not included in this analysis

The prior analysis completed for the 2025 plan develop cost estimates using very high level planning techniques. The following four unit prices that went into those costs: intersection reconstruction type, length of bridge, length of roadway and if there were dike modifications. Additional review was completed as a part of this analysis to expand the list of quantities used to develop the opinion of probable costs.

Since bridge costs have a history of considerable variation and are such a large part of these concept costs, additional detail is provided here to explain how the bridge planning level unit price was developed. A bridge construction cost of $150/SF is typically used for general, high-level planning purposes. However, bridges over the Red River will require significant costs not typically found in a 'normal' bridge (e.g., river cofferdams and significant quantities of large, driven piles), that drastically increase the construction cost. These bridges, in an urban setting, will also likely receive higher than normal amounts of architectural treatments, which will also increase cost. Due to several unknowns, a conservative unit cost well above the $150/SF planning level costs noted above was used.

In recent years, construction costs have increased significantly across the board. For illustration purposes, items and quantities from MnDOT Br 14012 (US-10 over the Red River in Fargo, built 2003), were combined with today's costs to give a 'real world' cost for a modern bridge constructed over the Red River in northern Minnesota, in an urban environment. Br 14012 is a continuous steel girder bridge, the cost of which has fluctuated dramatically over the last few years (e.g., $2.34/lb in 2017, $4.20/lb 2016 and $10.00/lb in 2015); this item's cost has a dramatic effect on the overall cost/square foot ($/SF) of the bridge. The estimate for this bridge could now be nearly $26 million, or around $360/SF, compared to the original cost of about $130/SF. However, these river crossing bridges are candidates for continuous steel beams, to shorten the structural depth to assist in obtaining the clearance over the high-water elevation. This type of structure could be over $300/SF. NDDOT and MnDOT both provided input on recent bridge costs and both DOT's agreed that $250/SF was a reasonable unit price estimate. Due to variability in historic construction costs, bridge unit costs of $250/SF and $300/SF were used to develop a range of opinion of

probable costs for each alternative. Since a 10% contingency is being assumed for the overall cost, addition contingency was not added to the assumed $250 - $300/SF bridge unit prices.

Tables 17-24 show the opinion of probable cost for each of the river crossing alternatives. **Table 25** summarizes the cost from the early 2000 river crossing analysis. **Table 26** summarizes the 2018 planning level opinion of probable costs for each river crossing alternative in one location. These options have not been vetted against geotechnical, hydraulic, or structural capacities, and represent a very high-level opinion of probable cost for each option. Further investigation of these unknowns will be required to more accurately define these costs. The quantities developed represents a level of effort coinciding with a regional long range planning study. To provide opinion of probable cost, items, quantities, and prices used have been determined using existing plans, previous project experience, and engineering judgement.

The bridge cross-section used as part of the prior analysis is still an appropriate cross-section to use as part of a long-range planning study. The goal is usually to be more conservative during planning phases of the project. Although it is still recommended that as part of a river crossing feasibility or environmental study additional review of the bridge cross-section is completed. At that time confirming the cross-section and testing more conservative options is prudent. Based on our review the following are potential areas where the bridge width could be reduced:

- There could be an option to save 4' by reducing the shoulders from 8' to 6' which provides 18' in each direction. This width is still wide enough for most traffic to get around a stalled vehicle if it were parked on the edge although many vehicles would not fit well within the provided 6' shoulder.
- Consider reducing the width of bridge provided from the end of the barrier to the edge of the bridge. There is a potential 2' (1' in each direction) that could be saved by reducing the bridge width between the edge of the barrier and edge of the bridge.
- The pedestrian facility could be reduced from 12' to 10' saving 2' of bridge width.

If the narrower cross-section discussed above is agreed to during a feasibility or environmental study, a reduction in bridge costs of about 12% could be achieved.

17TH AVENUE S RIVER CROSSING

Table 17: 17th Avenue S River Crossing Opinion of Probable Cost (Low)

Description	Quantity	UM	Unit Price	Total
COMMON EXCAVATION	12,500	CY	$ 8.00	$ 100,000
COMMON FILL	22,300	CY	$ 13.00	$ 289,900
WALKS	56,500	SF	$ 15.00	$ 847,500
BITUMINOUS	205,800	SF	$ 2.50	$ 514,500
CURB AND GUTTER	6,800	LF	$ 20.00	$ 136,000
DRAINAGE AND EROSION CONTROL	1	LS	40%	$ 755,160
NON QUANTIFIED MINOR ITEMS			20%	$ 528,612
BRIDGE	74,400	SF	$ 250.00	$ 18,600,000
50-FT DIKE STRUCTURE	2	EA	$ 200,000.00	$ 400,000
MOBILIZATION			8%	$ 1,773,734
CONTINGENCY			10%	$ 2,394,541
ENGINEERING / CONST.			25%	$ 6,584,987
Total				$ 32,924,933

Table 18: 17th Avenue S River Crossing Opinion of Probable Cost (High and Dry)

Description	Quantity	UM	Unit Price	Total
COMMON EXCAVATION	800	CY	$ 8.00	$ 6,400
COMMON FILL	29,300	CY	$ 13.00	$ 380,900
WALKS	56,500	SF	$ 15.00	$ 847,500
BITUMINOUS	205,800	SF	$ 2.50	$ 514,500
CURB AND GUTTER	2,900	LF	$ 20.00	$ 58,000
DRAINAGE AND EROSION CONTROL			40%	$ 722,920
NON QUANTIFIED MINOR ITEMS			20%	$ 506,044
BRIDGE	192,200	SF	$ 250.00	$ 48,050,000
MOBILIZATION			8%	$ 4,086,901
CONTINGENCY			10%	$ 5,517,317
ENGINEERING / CONST.			25%	$ 15,172,620
Total				$ 75,863,102

ELKS DRIVE RIVER CROSSING

Table 19: Elks Drive River Crossing Opinion of Probable Cost (Low)

Description	Quantity	UM	Unit Price	Total
COMMON EXCAVATION	3,800	CY	$ 8.00	$ 30,400
COMMON FILL	31,600	CY	$ 13.00	$ 410,800
WALKS	46,100	SF	$ 15.00	$ 691,500
BITUMINOUS	184,200	SF	$ 2.50	$ 460,500
CURB AND GUTTER	7,800	LF	$ 20.00	$ 156,000
DRAINAGE AND EROSION CONTROL			40%	$ 699,680
NON QUANTIFIED MINOR ITEMS			20%	$ 489,776
BRIDGE	43,400	SF	$ 250.00	$ 10,850,000
50-FT DIKE STRUCTURE	1	EA	$ 200,000.00	$ 200,000
MOBILIZATION			8%	$ 1,119,092
CONTINGENCY			10%	$ 1,510,775
ENGINEERING / CONST.			25%	$ 4,154,631
Total				$ 20,773,154

Table 20: Elks Drive River Crossing Opinion of Probable Cost (High and Dry)

Description	Quantity	UM	Unit Price	Total
COMMON EXCAVATION	500	CY	$ 8.00	$ 4,000
COMMON FILL	42,900	CY	$ 13.00	$ 557,700
WALKS	48,100	SF	$ 15.00	$ 721,500
BITUMINOUS	192,200	SF	$ 2.50	$ 480,500
CURB AND GUTTER	4,600	LF	$ 20.00	$ 92,000
DRAINAGE AND EROSION CONTROL			40%	$ 742,280
NON QUANTIFIED MINOR ITEMS			20%	$ 519,596
BRIDGE	155,000	SF	$ 250.00	$ 38,750,000
MOBILIZATION			8%	$ 3,349,406
CONTINGENCY			10%	$ 4,521,698
ENGINEERING / CONST.			25%	$ 12,434,670
Total				$ 62,173,350

32nd AVENUE S RIVER CROSSING

Table 21: 32nd Avenue S River Crossing Opinion of Probable Cost (Low)

Description	Quantity	UM	Unit Price	Total
COMMON EXCAVATION	13,900	CY	$ 8.00	$ 111,200
COMMON FILL	22,300	CY	$ 13.00	$ 289,900
WALKS	50,900	SF	$ 15.00	$ 763,500
BITUMINOUS	202,500	SF	$ 2.50	$ 506,250
CURB AND GUTTER	8,200	LF	$ 20.00	$ 164,000
DRAINAGE AND EROSION CONTROL			40%	$ 733,940
NON QUANTIFIED MINOR ITEMS			20%	$ 513,758
BRIDGE	62,000	SF	$ 250.00	$ 15,500,000
50-FT DIKE STRUCTURE	2	EA	$ 200,000.00	$ 400,000
MOBILIZATION			8%	$ 1,518,604
CONTINGENCY			10%	$ 2,050,115
ENGINEERING / CONST.			25%	$ 5,637,817
Total				$ 28,189,084

Table 22: 32nd Avenue S River Crossing Opinion of Probable Cost (High and Dry)

Description	Quantity	UM	Unit Price	Total
COMMON EXCAVATION	300	CY	$ 8.00	$ 2,400
COMMON FILL	53,700	CY	$ 13.00	$ 698,100
WALKS	50,900	SF	$ 15.00	$ 763,500
BITUMINOUS	203,000	SF	$ 2.50	$ 507,500
CURB AND GUTTER	5,200	LF	$ 20.00	$ 104,000
DRAINAGE AND EROSION CONTROL			40%	$ 830,200
NON QUANTIFIED MINOR ITEMS			20%	$ 581,140
BRIDGE	155,000	SF	$ 250.00	$ 38,750,000
MOBILIZATION			8%	$ 3,378,947
CONTINGENCY			10%	$ 4,561,579
ENGINEERING / CONST.			25%	$ 12,544,341
Total				$ 62,721,707

47th AVENUE S RIVER CROSSING

Table 23: 47th Avenue S River Crossing Opinion of Probable Cost (Low)

Description	Quantity	UM	Unit Price	Total
COMMON EXCAVATION	2,800	CY	$ 8.00	$ 22,400
COMMON FILL	43,500	CY	$ 13.00	$ 565,500
WALKS	44,600	SF	$ 15.00	$ 669,000
BITUMINOUS	178,300	SF	$ 2.50	$ 445,750
CURB AND GUTTER	7,100	LF	$ 20.00	$ 142,000
DRAINAGE AND EROSION CONTROL			40%	$ 737,860
NON QUANTIFIED MINOR ITEMS			20%	$ 516,502
BRIDGE	55,800	SF	$ 250.00	$ 13,950,000
50-FT DIKE STRUCTURE	1	EA	$ 200,000.00	$ 200,000
MOBILIZATION			8%	$ 1,379,921
CONTINGENCY			10%	$ 1,862,893
ENGINEERING / CONST.			25%	$ 5,122,957
Total				$ 25,614,783

MERRIFIELD ROAD RIVER CROSSING

Table 24: Merrifield Road River Crossing Opinion of Probable Cost (Low)

Description	Quantity	UM	Unit Price	Total
COMMON EXCAVATION	16,500	CY	$ 8.00	$ 132,000
COMMON FILL	141,800	CY	$ 13.00	$ 1,843,400
BITUMINOUS	262,700	SF	$ 2.50	$ 656,750
CURB AND GUTTER	11,600	LF	$ 20.00	$ 232,000
DRAINAGE AND EROSION CONTROL			40%	$ 1,145,660
NON QUANTIFIED MINOR ITEMS			20%	$ 801,962
BRIDGE	40,000	SF	$ 250.00	$ 10,000,000
BOX CULVERT[3]	460	LF	$ 1,650.00	$ 759,000
COLE CREEK DIVERSION[1, 3]			$ 3,900,000.00	$ 3,900,000
TOWNSHIP ROAD BRIDGE[2, 3]			$ 1,300,000.00	$ 1,300,000
50-FT DIKE STRUCTURE	1	EA	$ 200,000.00	$ 200,000
MOBILIZATION			8%	$ 1,677,662
CONTINGENCY			10%	$ 2,264,843
ENGINEERING / CONST.			25%	$ 6,228,319
Total				$ 31,141,596

[1] $2,200,000 from 2004 Feasibility Study Inflated by 4% and Rounded Up

[2] $707,000 from 2004 Feasiblity Study Inflated by 4% and Rounded Up

[3] Diversion, subsequent control structure(s), and culvert have not been vetted for feasibility.

RIVER CROSSING COST SUMMARY AND COMPARISON

Tables 25 and **26** that compare the early 2000 and 2018 river crossing costs show a significant increase in the anticipated costs that have occurred over the last 18 years. This is due in part to rising construction costs and inflation. A range is provided in **Table 26** due to the early stages of the planning process and to account for potential variations in construction costs. The range was developed using two different bridge unit costs, $250/SF and $300/SF, to develop a range of opinion of probable costs for each alternative..

Table 25: River Crossing Alternative Cost Summary (early 2000 costs)

Cost Summary - Early 2000 Analysis		
Crossing Location	Alternative	Cost
17th Avenue S	Low	$ 16,368,000
	High	$ 30,204,000
Elks Drive	Low	$ 10,668,000
32nd Avenue S	Low	$ 19,140,000
	High	$ 24,804,000
47th Avenue S	--	NA
Merrifield Road	Low	$ 19,500,000

Table 26: River Crossing Alternative Cost Summary (2018 costs)

Cost Summary - Year 2018		
Crossing Location	Alternative	Cost
17th Avenue S	Low	$33,000,000-$39,000,000
	High	$76,000,000-$91,000,000
Elks Drive	Low	$21,000,000-$24,000,000
	High	$63,000,000-$74,000,000
32nd Avenue S	Low	$29,000,000-$33,000,000
	High	$63,000,000-$75,000,000
47th Avenue S	Low	$26,000,000-$30,000,000
Merrifield Road	Low	$32,000,000-$35,000,000

The high bridge options all cost considerably more than the low bridge options. Given the lack of funding available and resulting lower B/C ratios, the Grand Forks – East Grand Forks MPO Executive Board voted to eliminate additional work associated with the high river crossing alternatives.

Red River Crossing Benefit Calculations

With opinion of probable cost estimates completed, benefit is the other variable that needs to be determined to calculate the benefit cost ratio. The cost difference for the following benefit categories: travel time, operations, crash costs, and air quality was calculated for each river crossing. The key assumptions used in these calculations were:

1. Year of Opening 2030; analysis consists of a 20-year benefit period consisting of 260 weekdays per year, consistent with best practices and USDOT guidance. Note, however, that some benefits would also accrue during weekend days; therefore, the results provided below may underestimate benefits (and associated benefit cost ratios).
2. Base year (2015) and forecasted (2045) VMT and VHT were from Grand Forks-East Grand Forks MPO Travel Demand Model. Base year VMT/VHT was adjusted to reflect the same proportional difference between No Build/Build scenarios as used in the previous analysis. Because 47th Avenue S was not previously analyzed, the proportion from the 32nd Avenue S Alternative was used for that alternative.
3. Values for discount rate (7%), vehicle occupancy rates, crash costs, and emissions costs were based on USDOT's *Benefit-Cost Analysis Guidance for Discretionary Grant Programs, June 2018. T*he auto vehicle operating cost/mile used was the IRS mileage rate of $0.545/mile. The auto travel time cost/hour used was the Bureau of Labor Statistics North Dakota mean hourly wage of $23.14.
4. Average crash rates were derived from MnDOT Segment Crash Toolkit and Grand Forks MPO functional classification system design criteria.
5. There were two different fleet compositions assumed: 1) fleet composition based on an estimate of 5% trucks (except for the Merrifield Road Alternative, where 10% was assumed) and 2) fleet composition with 0% trucks (assumes trucks are prohibited on the new crossings).

Tables 27-36 include the total benefits and travel time, operations, crash cost and air quality sub component benefits for each river crossing concept and fleet composition combination. There is only a slight difference between the with and without truck alternatives with the with truck alternatives having a higher benefit.

These benefit values were then divided by costs to develop a benefit cost ratio for each scenario. Construction costs were discounted to assume construction occurring in 2028-2029 and residual value (remaining capital value) was calculated to account for the fact that the service life of some infrastructure (e.g. bridges) would last beyond the assumed 20-year benefit period.

Table 27: 17th Avenue S River Crossing Benefits (with 5% trucks)

Benefit Category	Benefits Compared to No Build Alternative ($2017)
Travel Time	$22,799,000
Operations	$6,434,000
Crash Costs	$898,000
Air Quality	$91,000
Total Benefits	$30,222,000

Table 28: 17th Avenue S River Crossing Benefits (without trucks)

Benefit Category	Benefits Compared to No Build Alternative ($2017)
Travel Time	$22,926,000
Operations	$6,232,000
Crash Costs	$898,000
Air Quality	$90,000
Total Benefits	$30,146,000

Table 29: Elks Drive River Crossing Benefits (with 5% trucks)

Benefit Category	Benefits Compared to No Build Alternative ($2017)
Travel Time	$17,426,000
Operations	$8,410,000
Crash Costs	$1,685,000
Air Quality	$119,000
Total Benefits	$27,640,000

Table 30: Elks Drive River Crossing Benefits (without trucks)

Benefit Category	Benefits Compared to No Build Alternative ($2017)
Travel Time	$17,523,000
Operations	$8,144,000
Crash Costs	$1,685,000
Air Quality	$118,000
Total Benefits	$27,470,000

Table 31: 32nd Avenue S River Crossing Benefits (with 5% trucks)

Benefit Category	Benefits Compared to No Build Alternative ($2017)
Travel Time	$26,449,000
Operations	$14,787,000
Crash Costs	$2,885,000
Air Quality	$210,000
Total Benefits	$44,331,000

Table 32: 32nd Avenue S River Crossing Benefits (without trucks)

Benefit Category	Benefits Compared to No Build Alternative ($2017)
Travel Time	$26,596,000
Operations	$14,320,000
Crash Costs	$2,885,000
Air Quality	$207,000
Total Benefits	$44,008,000

Table 33: 47th Avenue S River Crossing Benefits (with 5% trucks)

Benefit Category	Benefits Compared to No Build Alternative ($2017)
Travel Time	-$5,537,000
Operations	$8,011,000
Crash Costs	$1,520,000
Air Quality	$114,000
Total Benefits	$4,108,000

Table 34: 47th Avenue S River Crossing Benefits (without trucks)

Benefit Category	Benefits Compared to No Build Alternative ($2017)
Travel Time	-$5,568,000
Operations	$7,758,000
Crash Costs	$1,520,000
Air Quality	$112,000
Total Benefits	$3,822,000

Table 35: Merrifield Road River Crossing Benefits (with 10% trucks)

Benefit Category	Benefits Compared to No Build Alternative ($2017)
Travel Time	$21,752,000
Operations	$9,613,000
Crash Costs	$1,920,000
Air Quality	$128,000
Total Benefits	$33,413,000

Table 36: Merrifield Road River Crossing Benefits (without trucks)

Benefit Category	Benefits Compared to No Build Alternative ($2017)
Travel Time	$22,372,000
Operations	$8,267,000
Crash Costs	$1,920,000
Air Quality	$120,000
Total Benefits	$32,679,000

Red River Crossing Evaluation Summaries

Using the information discussed previously, tables have been created for each river crossing documenting VHT, VMT, Construction Costs and B/C ratio. **Tables 37-41** summarize this information for each river crossing alternative. The tables included below are the fleet scenario that does not include trucks.

Table 37: 17th Avenue S River Crossing Evaluation Summary (Low) (without trucks)

Issue	Method of Measurement	Units	Value	Change from Base Conditions
Traffic Operations Factors				
Traffic Flow and Congestion	VHT statistics from the travel demand model	Daily vehicle hours traveled	59,056	(646)
Reduced Trip Length	VMT statistics from the travel demand model	Daily vehicle miiles traveled	1,044,926	(9,858)
Project Costs				
Construction Costs	Estimated cost of construction in 2018 dollars	Dollars	$33,000,000-$39,000,000	N/A
Socio Economic Factors				
Roadway User Economic Analysis	Use VMT and VHT statistices to determine benefits compared to construction costs	B/C ratio	1.9 - 2.1	N/A

Table 38: Elks Drive River Crossing Evaluation Summary (Low) (without trucks)

Issue	Method of Measurement	Units	Value	Change from Base Conditions
Traffic Operations Factors				
Traffic Flow and Congestion	VHT statistics from the travel demand model	Daily vehicle hours traveled	59,180	(522)
Reduced Trip Length	VMT statistics from the travel demand model	Daily vehicle miiles traveled	1,040,184	(14,600)
Project Costs				
Construction Costs	Estimated cost of construction in 2018 dollars	Dollars	$21,000,000-$24,000,000	N/A
Socio Economic Factors				
Roadway User Economic Analysis	Use VMT and VHT statistices to determine benefits compared to construction costs	B/C ratio	2.6 - 3.0	N/A

Table 39: 32nd Avenue S River Crossing Evaluation Summary (Low) (without trucks)

Issue	Method of Measurement	Units	Value	Change from Base Conditions
Traffic Operations Factors				
Traffic Flow and Congestion	VHT statistics from the travel demand model	Daily vehicle hours traveled	58,871	(831)
Reduced Trip Length	VMT statistics from the travel demand model	Daily vehicle miiles traveled	1,030,063	(24,721)
Project Costs				
Construction Costs	Estimated cost of construction in 2018 dollars	Dollars	$29,000,000-$33,000,000	N/A
Socio Economic Factors				
Roadway User Economic Analysis	Use VMT and VHT statistices to determine benefits compared to construction costs	B/C ratio	3.1 - 3.5	

Table 40: 47th Avenue S River Crossing Evaluation Summary (Low) (without trucks)

Issue	Method of Measurement	Units	Value	Change from Base Conditions
Traffic Operations Factors				
Traffic Flow and Congestion	VHT statistics from the travel demand model	Daily vehicle hours traveled	59,876	174
Reduced Trip Length	VMT statistics from the travel demand model	Daily vehicle miiles traveled	1,041,391	(13,393)
Project Costs				
Construction Costs	Estimated cost of construction in 2018 dollars	Dollars	$26,000,000-$30,000,000	N/A
Socio Economic Factors				
Roadway User Economic Analysis	Use VMT and VHT statistices to determine benefits compared to construction costs	B/C ratio	0.4 - 0.5	

The 47th Avenue S river crossing would also require the reconstruction of approximately 1.9 miles of Rhinehart Drive/445th Avenue SW between the intersections of 13th Street SE and Rhinehart Drive/445th Avenue SW and Rhinehart Drive/445th Avenue SW and 200th Street SW and 1.5 miles of 200th Street between Rhinehart Drive/445th Avenue SW and CSAH 58. Those reconstruction costs are not included in Table 40.

Table 41: Merrifield Road River Crossing Evaluation Summary (Low) (without trucks)

Issue	Method of Measurement	Units	Value	Change from Base Conditions
Traffic Operations Factors				
Traffic Flow and Congestion	VHT statistics from the travel demand model	Daily vehicle hours traveled	59,023	(679)
Reduced Trip Length	VMT statistics from the travel demand model	Daily vehicle miiles traveled	1,037,067	(17,717)
Project Costs				
Construction Costs	Estimated cost of construction in 2018 dollars	Dollars	$32,000,000-$35,000,000	N/A
Socio Economic Factors				
Roadway User Economic Analysis	Use VMT and VHT statistices to determine benefits compared to construction costs	B/C ratio	2.2 - 2.4	

We also reviewed the B/C ratios based on the with truck fleet scenario (assumed 5% trucks at all crossing except Merrifield where 10% trucks were assumed). The benefic cost ratios were the same under all scenarios above except the following:

- 32nd Avenue S has a high-end B/C ratio of 3.6 with trucks as compared to 3.5 without trucks
- Elks Drive has a low-end B/C ratio of 2.7 with trucks as compared to 2.6 without trucks.

Table 42 summarizes the B/C ratios for each river crossing alternative in one location.

Table 42: River Crossing Alternative B/C Summary

B/C Summary		
Crossing Location	Alternative	Cost
17th Avenue S	Low	**1.9 - 2.1**
Elks Drive	Low	**2.6 - 3.0**
32nd Avenue S	Low	**3.1 - 3.5**
47th Avenue S	Low	0.4 - 0.5
Merrifield Road	Low	**2.2 - 2.4**

Based on B/C information above, all the low river crossing options have B/C ratios above 1.0 except for the 47th Avenue S river crossing. The 32nd Avenue S river crossing has the highest B/C ratio of the three river crossings that will serve mostly local traffic. The Merrifield Road river crossing has the highest B/C ratio of the two river crossings that will serve mostly regional trips.

Appendices

Appendix A: Synchro Output

Appendix B: River Crossing Concept Drawings

Appendix A: Synchro Output

Level of Service and Delay by Scenario															
		Existing PM Peak		2045 No Build PM Peak		2045 Build 17th Avenue PM Peak		2045 Build Elks Drive Crossing		2045 Build 32nd Avenue Crossing		2045 Build 47th Avenue Crossing		2045 Build Merrifield Crossing	
Intesection	Approach	Delay	LOS	Delay	LOS	Delay	LOS	Delay	LOS	Delay	LOS	Delay	LOS	Delay	LOS
Demers Avenue at 5th Street	EB	11	B	17	B	14	B	15	B	15	B	16	B	16	B
	WB	13	B	19	B	16	B	17	B	18	B	18	B	19	B
	NB	19	B	23	C	22	C	20	B	20	C	20	C	21	C
	SB	17	B	20	B	20	B	18	B	18	B	18	B	18	B
	Intesection	14	B	19	B	17	B	17	B	17	B	18	B	18	B
Demers Avenue at S Washington	EB	51	D	71	E	53	D	54	D	53	D	50	D	59	E
	WB	54	D	89	F	63	E	63	E	72	E	70	E	88	F
	NB	29	C	70	E	36	D	32	C	61	E	64	E	66	E
	SB	50	D	82	F	52	D	58	E	74	E	90	F	83	F
	Intesection	47	D	80	E	53	D	53	D	67	E	70	E	77	E
S Washington at 17th Avenue	EB	45	D	66	E	67	E	45	D	69	E	64	E	69	E
	WB	33	C	44	D	55	D	37	D	46	D	43	D	44	D
	NB	25	C	32	C	27	C	30	C	29	C	29	C	30	C
	SB	27	C	49	D	30	C	28	C	35	C	37	D	42	D
	Intesection	30	C	45	D	39	D	32	C	40	D	40	D	43	D
S Washington at 32nd Avenue	EB	61	E	94	F	78	E	90	F	104	F	87	F	91	F
	WB	62	E	83	F	107	F	107	F	128	F	98	F	98	F
	NB	33	C	65	E	21	C	24	C	39	D	28	C	26	C
	SB	54	D	78	E	68	E	63	E	103	F	91	F	82	F
	Intesection	50	D	77	E	56	E	58	E	83	F	66	E	64	E
1st Street at 3rd Avenue	EB	14	B	22	C	17	B	14	B	17	B	14	B	17	B
	WB	13	B	18	B	14	B	13	B	14	B	12	B	14	B
	NB	4	A	8	A	4	A	4	A	4	A	5	A	7	A
	SB	5	A	7	A	5	A	5	A	5	A	6	A	7	A
	Intesection	6	A	11	B	6	A	6	A	7	A	7	A	9	A
24th Avenue at Washington Street	EB	56	E	107	F	99	F	99	F	95	F	107	F	99	F
	WB	44	D	52	D	54	D	54	D	47	D	48	D	48	D
	NB	5	A	12	B	8	A	15	B	10	A	5	A	6	A
	SB	49	D	44	D	39	D	43	D	48	D	61	E	54	D
	Intesection	35	C	38	D	34	C	38	D	37	D	43	D	39	D
47th Avenue at Washington Street	EB	24	C	132	F	109	F	113	F	128	F	144	F	130	F
	WB	21	C	47	D	44	D	51	D	45	D	63	E	41	D
	NB	15	B	78	E	71	E	82	F	80	E	96	F	73	E
	SB	17	B	48	D	45	D	50	D	51	D	57	E	51	D
	Intesection	18	B	74	E	67	E	74	E	76	E	87	F	74	E
4th Avenue at Belmont Road	Worst Approach	16	C	95	F	16	C	16	C	21	C	28	D	71	F
	Intesection	15	B	69	F	15	C	14	B	19	C	23	C	54	F
17th Avenue at Belmont Road	Worst Approach	15	C	26	D	>150	F	18	C	20	C	20	C	24	C
	Intesection	2	A	3	A	>150	F	2	A	3	A	2	A	3	A
Greenway Blvd/Bygland Rd/13th	Worst Approach	13	B	66	F	>150	F	>150	F	27	D	35	E	63	F
	Intesection	5	A	21	C	142	F	51	F	12	B	14	B	20	C
Greenway Blvd at Rhinehard Dr	Worst Approach	9	A	9	A	11	B	11	B	10	B	10	A	9	A
	Intesection	5	A	6	A	5	A	5	A	4	A	4	A	6	A
24th Avenue at Belmont Road	Worst Approach	16	C	27	D	105	F	>150	F	21	C	19	C	24	C
	Intesection	3	A	3	A	18	C	92	F	3	A	2	A	2	A
Elks Drive at Belmont Road	Worst Approach	13	B	22	C	44	E	>150	F	15	B	14	B	19	C
	Intesection	12	B	21	C	39	E	>150	F	14	B	13	B	18	C
32nd Avenue at Belmont Road	Worst Approach	13	B	91	F	85	F	>150	F	>150	F	33	D	76	F
	Intesection	12	B	55	F	52	F	112	F	>150	F	25	C	47	E
47th Avenue at Belmont Road	Worst Approach	13	B	21	C	19	C	18	C	21	C	>150	F	17	C
	Intesection	5	A	7	A	6	A	6	A	7	A	>150	F	6	A

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	354	266	215	40	230	72	190	531	36	81	733	420
Future Volume (veh/h)	354	266	215	40	230	72	190	531	36	81	733	420
Number	7	4	14	3	8	18	1	6	16	5	2	12
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj Sat Flow, veh/h/ln	1832	1850	1832	1779	1832	1814	1814	1814	1779	1814	1832	1832
Adj Flow Rate, veh/h	454	306	0	89	271	0	250	672	0	116	833	0
Adj No. of Lanes	2	1	1	1	1	1	2	2	1	1	2	1
Peak Hour Factor	0.78	0.87	0.96	0.45	0.85	0.75	0.76	0.79	0.75	0.70	0.88	0.97
Percent Heavy Veh, %	1	0	1	4	1	2	2	2	4	2	1	1
Cap, veh/h	519	494	416	111	328	276	505	1386	608	142	1131	506
Arrive On Green	0.05	0.09	0.00	0.07	0.18	0.00	0.15	0.40	0.00	0.03	0.11	0.00
Sat Flow, veh/h	3384	1850	1557	1694	1832	1542	3351	3446	1512	1727	3480	1557
Grp Volume(v), veh/h	454	306	0	89	271	0	250	672	0	116	833	0
Grp Sat Flow(s),veh/h/ln	1692	1850	1557	1694	1832	1542	1676	1723	1512	1727	1740	1557
Q Serve(g_s), s	16.0	19.1	0.0	6.2	17.1	0.0	8.2	17.4	0.0	8.0	27.8	0.0
Cycle Q Clear(g_c), s	16.0	19.1	0.0	6.2	17.1	0.0	8.2	17.4	0.0	8.0	27.8	0.0
Prop In Lane	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Lane Grp Cap(c), veh/h	519	494	416	111	328	276	505	1386	608	142	1131	506
V/C Ratio(X)	0.87	0.62	0.00	0.81	0.83	0.00	0.49	0.48	0.00	0.82	0.74	0.00
Avail Cap(c_a), veh/h	592	516	435	184	389	328	505	1386	608	216	1131	506
HCM Platoon Ratio	0.33	0.33	0.33	1.00	1.00	1.00	1.00	1.00	1.00	0.33	0.33	0.33
Upstream Filter(I)	1.00	1.00	0.00	1.00	1.00	0.00	0.90	0.90	0.00	0.84	0.84	0.00
Uniform Delay (d), s/veh	55.8	48.8	0.0	55.3	47.5	0.0	46.8	26.6	0.0	57.5	48.6	0.0
Incr Delay (d2), s/veh	11.4	3.3	0.0	5.1	14.8	0.0	0.3	1.1	0.0	6.6	3.6	0.0
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	8.3	10.3	0.0	3.1	10.0	0.0	3.8	8.4	0.0	4.1	14.0	0.0
LnGrp Delay(d),s/veh	67.2	52.1	0.0	60.4	62.3	0.0	47.0	27.7	0.0	64.1	52.2	0.0
LnGrp LOS	E	D		E	E		D	C		E	D	
Approach Vol, veh/h		760			360			922			949	
Approach Delay, s/veh		61.1			61.8			33.0			53.7	
Approach LOS		E			E			C			D	

Timer	1	2	3	4	5	6	7	8
Assigned Phs	1	2	3	4	5	6	7	8
Phs Duration (G+Y+Rc), s	23.6	45.0	12.8	38.6	14.8	53.8	23.4	28.0
Change Period (Y+Rc), s	5.5	* 6	5.0	6.5	5.0	5.5	5.0	6.5
Max Green Setting (Gmax), s	12.0	* 39	13.0	33.5	15.0	36.5	21.0	25.5
Max Q Clear Time (g_c+I1), s	10.2	29.8	8.2	21.1	10.0	19.4	18.0	19.1
Green Ext Time (p_c), s	0.3	5.8	0.0	3.7	0.0	8.0	0.4	2.3

Intersection Summary	
HCM 2010 Ctrl Delay	50.2
HCM 2010 LOS	D

Notes



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	67	529	55	75	603	37	119	151	47	49	211	58
Future Volume (veh/h)	67	529	55	75	603	37	119	151	47	49	211	58
Number	7	4	14	3	8	18	5	2	12	1	6	16
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj Sat Flow, veh/h/ln	1814	1814	1814	1814	1814	1814	1814	1814	1814	1814	1814	1814
Adj Flow Rate, veh/h	73	575	60	82	655	40	129	164	51	53	229	63
Adj No. of Lanes	1	1	1	1	1	1	1	1	1	1	1	1
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	2	2	2	2	2	2	2	2	2	2	2	2
Cap, veh/h	336	973	827	384	973	827	346	544	462	399	544	462
Arrive On Green	0.54	0.54	0.54	0.54	0.54	0.54	0.30	0.30	0.30	0.30	0.30	0.30
Sat Flow, veh/h	747	1814	1542	789	1814	1542	1083	1814	1542	1162	1814	1542
Grp Volume(v), veh/h	73	575	60	82	655	40	129	164	51	53	229	63
Grp Sat Flow(s),veh/h/ln	747	1814	1542	789	1814	1542	1083	1814	1542	1162	1814	1542
Q Serve(g_s), s	4.3	11.8	1.0	4.3	14.4	0.7	6.0	3.8	1.3	2.0	5.6	1.6
Cycle Q Clear(g_c), s	18.7	11.8	1.0	16.2	14.4	0.7	11.5	3.8	1.3	5.9	5.6	1.6
Prop In Lane	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Lane Grp Cap(c), veh/h	336	973	827	384	973	827	346	544	463	399	544	463
V/C Ratio(X)	0.22	0.59	0.07	0.21	0.67	0.05	0.37	0.30	0.11	0.13	0.42	0.14
Avail Cap(c_a), veh/h	336	973	827	384	973	827	346	544	463	399	544	463
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	16.1	8.7	6.2	14.1	9.3	6.1	20.0	14.8	13.9	17.1	15.4	14.0
Incr Delay (d2), s/veh	1.5	2.6	0.2	1.3	3.7	0.1	3.1	1.4	0.5	0.7	2.4	0.6
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	1.0	6.5	0.5	1.1	8.1	0.3	2.0	2.1	0.6	0.7	3.1	0.8
LnGrp Delay(d),s/veh	17.5	11.3	6.3	15.4	13.0	6.2	23.1	16.2	14.4	17.8	17.8	14.7
LnGrp LOS	B	B	A	B	B	A	C	B	B	B	B	B
Approach Vol, veh/h		708			777			344			345	
Approach Delay, s/veh		11.5			12.9			18.5			17.2	
Approach LOS		B			B			B			B	

Timer	1	2	3	4	5	6	7	8
Assigned Phs		2		4		6		8
Phs Duration (G+Y+Rc), s		21.0		34.0		21.0		34.0
Change Period (Y+Rc), s		4.5		4.5		4.5		4.5
Max Green Setting (Gmax), s		16.5		29.5		16.5		29.5
Max Q Clear Time (g_c+I1), s		13.5		20.7		7.9		18.2
Green Ext Time (p_c), s		1.1		5.8		2.3		7.0

Intersection Summary		
HCM 2010 Ctrl Delay		14.0
HCM 2010 LOS		B



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	184	210	182	128	170	131	70	961	103	100	1118	173
Future Volume (veh/h)	184	210	182	128	170	131	70	961	103	100	1118	173
Number	7	4	14	3	8	18	1	6	16	5	2	12
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj Sat Flow, veh/h/ln	1814	1832	1850	1850	1832	1832	1832	1832	1850	1850	1832	1850
Adj Flow Rate, veh/h	211	273	212	151	187	142	84	1022	149	147	1202	204
Adj No. of Lanes	1	1	1	1	1	1	1	2	1	1	2	1
Peak Hour Factor	0.87	0.77	0.86	0.85	0.91	0.92	0.83	0.94	0.69	0.68	0.93	0.85
Percent Heavy Veh, %	2	1	0	0	1	1	1	1	0	0	1	0
Cap, veh/h	283	286	393	230	286	403	164	1317	712	181	1283	698
Arrive On Green	0.08	0.16	0.16	0.08	0.16	0.16	0.09	0.38	0.38	0.10	0.37	0.37
Sat Flow, veh/h	1727	1832	1569	1762	1832	1557	1744	3480	1570	1762	3480	1572
Grp Volume(v), veh/h	211	273	212	151	187	142	84	1022	149	147	1202	204
Grp Sat Flow(s),veh/h/ln	1727	1832	1569	1762	1832	1557	1744	1740	1570	1762	1740	1572
Q Serve(g_s), s	6.0	11.8	1.7	5.8	7.7	5.9	3.7	20.7	4.6	6.5	26.6	2.8
Cycle Q Clear(g_c), s	6.0	11.8	1.7	5.8	7.7	5.9	3.7	20.7	4.6	6.5	26.6	2.8
Prop In Lane	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Lane Grp Cap(c), veh/h	283	286	393	230	286	403	164	1317	712	181	1283	698
V/C Ratio(X)	0.75	0.95	0.54	0.66	0.65	0.35	0.51	0.78	0.21	0.81	0.94	0.29
Avail Cap(c_a), veh/h	283	286	393	230	286	403	196	1317	712	198	1283	698
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	1.00	1.00	1.00	1.00	1.00	0.89	0.89	0.89	0.26	0.26	0.26
Uniform Delay (d), s/veh	29.8	33.5	10.2	26.8	31.7	24.2	34.5	21.9	13.2	35.1	24.3	4.0
Incr Delay (d2), s/veh	9.2	41.1	2.2	7.0	6.4	0.9	0.8	4.1	0.6	5.6	4.7	0.3
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	2.5	9.3	2.6	3.2	4.4	2.6	1.8	10.7	2.1	3.5	13.5	1.2
LnGrp Delay(d),s/veh	39.0	74.6	12.5	33.9	38.1	25.1	35.3	25.9	13.8	40.7	29.1	4.3
LnGrp LOS	D	E	B	C	D	C	D	C	B	D	C	A
Approach Vol, veh/h		696			480			1255			1553	
Approach Delay, s/veh		44.9			32.9			25.1			26.9	
Approach LOS		D			C			C			C	

Timer	1	2	3	4	5	6	7	8
Assigned Phs	1	2	3	4	5	6	7	8
Phs Duration (G+Y+Rc), s	14.0	36.0	11.0	19.0	13.2	36.8	11.0	19.0
Change Period (Y+Rc), s	6.5	* 6.5	5.0	6.5	5.0	6.5	5.0	6.5
Max Green Setting (Gmax), s	9.0	* 30	6.0	12.5	9.0	29.5	6.0	12.5
Max Q Clear Time (g_c+I1), s	5.7	28.6	7.8	13.8	8.5	22.7	8.0	9.7
Green Ext Time (p_c), s	2.4	0.8	0.0	0.0	0.0	5.3	0.0	1.6

Intersection Summary	
HCM 2010 Ctrl Delay	30.2
HCM 2010 LOS	C

Notes



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	159	171	12	74	116	54	62	952	69	113	1100	200
Future Volume (veh/h)	159	171	12	74	116	54	62	952	69	113	1100	200
Number	7	4	14	3	8	18	1	6	16	5	2	12
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj Sat Flow, veh/h/ln	1850	1850	1850	1850	1850	1850	1850	1850	1850	1832	1850	1850
Adj Flow Rate, veh/h	206	216	18	88	123	72	83	1070	88	177	1358	282
Adj No. of Lanes	1	1	1	1	1	1	1	2	1	1	2	1
Peak Hour Factor	0.77	0.79	0.65	0.84	0.94	0.75	0.75	0.89	0.78	0.64	0.81	0.71
Percent Heavy Veh, %	0	0	0	0	0	0	0	0	0	1	0	0
Cap, veh/h	271	277	462	202	257	404	254	1705	851	205	1567	806
Arrive On Green	0.07	0.15	0.15	0.06	0.14	0.14	0.29	0.97	0.97	0.04	0.15	0.15
Sat Flow, veh/h	1762	1850	1572	1762	1850	1572	1762	3515	1572	1744	3515	1572
Grp Volume(v), veh/h	206	216	18	88	123	72	83	1070	88	177	1358	282
Grp Sat Flow(s),veh/h/ln	1762	1850	1572	1762	1850	1572	1762	1758	1572	1744	1758	1572
Q Serve(g_s), s	8.0	13.5	0.1	5.1	7.4	4.3	4.4	2.8	0.2	12.1	45.3	7.6
Cycle Q Clear(g_c), s	8.0	13.5	0.1	5.1	7.4	4.3	4.4	2.8	0.2	12.1	45.3	7.6
Prop In Lane	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Lane Grp Cap(c), veh/h	271	277	462	202	257	404	254	1705	851	205	1567	806
V/C Ratio(X)	0.76	0.78	0.04	0.44	0.48	0.18	0.33	0.63	0.10	0.86	0.87	0.35
Avail Cap(c_a), veh/h	271	393	561	221	393	519	254	1705	851	247	1567	806
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	2.00	2.00	2.00	0.33	0.33	0.33
Upstream Filter(I)	1.00	1.00	1.00	1.00	1.00	1.00	0.91	0.91	0.91	0.85	0.85	0.85
Uniform Delay (d), s/veh	46.1	49.1	15.8	41.6	47.6	34.7	38.1	1.0	0.7	56.7	47.7	10.6
Incr Delay (d2), s/veh	10.6	9.1	0.1	1.8	2.4	0.4	0.2	1.6	0.2	17.5	5.8	1.0
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	3.7	7.6	0.3	2.6	3.9	1.9	2.2	1.2	0.1	6.9	23.3	3.5
LnGrp Delay(d),s/veh	56.7	58.2	15.8	43.4	50.0	35.1	38.4	2.6	1.0	74.2	53.5	11.6
LnGrp LOS	E	E	B	D	D	D	D	A	A	E	D	B
Approach Vol, veh/h		440			283			1241			1817	
Approach Delay, s/veh		55.8			44.1			4.9			49.0	
Approach LOS		E			D			A			D	

Timer	1	2	3	4	5	6	7	8
Assigned Phs	1	2	3	4	5	6	7	8
Phs Duration (G+Y+Rc), s	23.8	60.0	11.7	24.5	19.1	64.7	13.0	23.2
Change Period (Y+Rc), s	6.5	* 6.5	5.0	6.5	5.0	6.5	5.0	6.5
Max Green Setting (Gmax), s	10.0	* 54	8.0	25.5	17.0	46.5	8.0	25.5
Max Q Clear Time (g_c+I1), s	5.4	47.3	7.1	15.5	14.1	4.8	10.0	9.4
Green Ext Time (p_c), s	0.2	5.5	0.0	2.5	0.0	19.0	0.0	3.3

Intersection Summary	
HCM 2010 Ctrl Delay	34.9
HCM 2010 LOS	C

Notes



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	27	137	62	31	44	90	20	269	16	133	336	27
Future Volume (veh/h)	27	137	62	31	44	90	20	269	16	133	336	27
Number	7	4	14	3	8	18	5	2	12	1	6	16
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj Sat Flow, veh/h/ln	1814	1814	1814	1814	1814	1814	1814	1814	1850	1814	1814	1814
Adj Flow Rate, veh/h	29	149	67	34	48	98	22	292	17	145	365	29
Adj No. of Lanes	1	1	1	1	1	1	1	2	0	1	2	1
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	2	2	2	2	2	2	2	2	2	2	2	2
Cap, veh/h	46	259	220	53	266	226	37	1139	66	183	1478	661
Arrive On Green	0.03	0.14	0.14	0.03	0.15	0.15	0.02	0.34	0.34	0.11	0.43	0.43
Sat Flow, veh/h	1727	1814	1542	1727	1814	1542	1727	3311	192	1727	3446	1542
Grp Volume(v), veh/h	29	149	67	34	48	98	22	151	158	145	365	29
Grp Sat Flow(s),veh/h/ln	1727	1814	1542	1727	1814	1542	1727	1723	1780	1727	1723	1542
Q Serve(g_s), s	0.8	3.6	1.8	0.9	1.1	2.7	0.6	2.9	3.0	3.8	3.1	0.5
Cycle Q Clear(g_c), s	0.8	3.6	1.8	0.9	1.1	2.7	0.6	2.9	3.0	3.8	3.1	0.5
Prop In Lane	1.00		1.00	1.00		1.00	1.00		0.11	1.00		1.00
Lane Grp Cap(c), veh/h	46	259	220	53	266	226	37	593	612	183	1478	661
V/C Ratio(X)	0.62	0.58	0.30	0.64	0.18	0.43	0.60	0.26	0.26	0.79	0.25	0.04
Avail Cap(c_a), veh/h	149	624	530	149	624	530	149	593	612	241	1478	661
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	22.4	18.6	17.9	22.3	17.4	18.1	22.6	11.0	11.0	20.3	8.5	7.7
Incr Delay (d2), s/veh	13.0	2.0	0.8	12.4	0.3	1.3	14.6	1.0	1.0	12.3	0.4	0.1
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	0.5	1.9	0.8	0.6	0.6	1.2	0.4	1.6	1.6	2.4	1.6	0.2
LnGrp Delay(d),s/veh	35.3	20.6	18.6	34.6	17.7	19.4	37.2	12.0	12.0	32.5	8.9	7.9
LnGrp LOS	D	C	B	C	B	B	D	B	B	C	A	A
Approach Vol, veh/h		245			180			331			539	
Approach Delay, s/veh		21.8			21.8			13.7			15.2	
Approach LOS		C			C			B			B	

Timer	1	2	3	4	5	6	7	8
Assigned Phs	1	2	3	4	5	6	7	8
Phs Duration (G+Y+Rc), s	9.4	20.0	5.9	11.1	5.5	23.9	5.7	11.3
Change Period (Y+Rc), s	4.5	4.0	4.5	4.5	4.5	4.0	4.5	4.5
Max Green Setting (Gmax), s	4.5	16.0	4.0	16.0	4.0	18.5	4.0	16.0
Max Q Clear Time (g_c+I1), s	5.8	5.0	2.9	5.6	2.6	5.1	2.8	4.7
Green Ext Time (p_c), s	0.0	3.2	0.0	1.1	0.0	3.5	0.0	1.2

Intersection Summary		
HCM 2010 Ctrl Delay		17.0
HCM 2010 LOS		B

Intersection	
Intersection Delay, s/veh	14.5
Intersection LOS	B

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Vol, veh/h	33	229	37	109	136	4	19	136	80	4	210	33
Future Vol, veh/h	33	229	37	109	136	4	19	136	80	4	210	33
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	36	249	40	118	148	4	21	148	87	4	228	36
Number of Lanes	1	1	0	1	1	0	0	1	0	0	1	0

Approach	EB	WB	NB	SB
Opposing Approach	WB	EB	SB	NB
Opposing Lanes	2	2	1	1
Conflicting Approach Left	SB	NB	EB	WB
Conflicting Lanes Left	1	1	2	2
Conflicting Approach Right	NB	SB	WB	EB
Conflicting Lanes Right	1	1	2	2
HCM Control Delay	16.2	12.4	14.2	14.9
HCM LOS	C	B	B	B

Lane	NBLn1	EBLn1	EBLn2	WBLn1	WBLn2	SBLn1
Vol Left, %	8%	100%	0%	100%	0%	2%
Vol Thru, %	58%	0%	86%	0%	97%	85%
Vol Right, %	34%	0%	14%	0%	3%	13%
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop
Traffic Vol by Lane	235	33	266	109	140	247
LT Vol	19	33	0	109	0	4
Through Vol	136	0	229	0	136	210
RT Vol	80	0	37	0	4	33
Lane Flow Rate	255	36	289	118	152	268
Geometry Grp	2	7	7	7	7	2
Degree of Util (X)	0.443	0.073	0.536	0.243	0.29	0.471
Departure Headway (Hd)	6.243	7.279	6.668	7.395	6.862	6.313
Convergence, Y/N	Yes	Yes	Yes	Yes	Yes	Yes
Cap	577	492	541	486	523	569
Service Time	4.29	5.025	4.413	5.145	4.612	4.359
HCM Lane V/C Ratio	0.442	0.073	0.534	0.243	0.291	0.471
HCM Control Delay	14.2	10.6	16.9	12.5	12.4	14.9
HCM Lane LOS	B	B	C	B	B	B
HCM 95th-tile Q	2.3	0.2	3.1	0.9	1.2	2.5

Intersection	
Int Delay, s/veh	2.1

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	58	35	24	229	346	73
Future Vol, veh/h	58	35	24	229	346	73
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	-	-	-	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	63	38	26	249	376	79

Major/Minor	Minor2		Major1		Major2	
Conflicting Flow All	717	416	455	0	-	0
Stage 1	416	-	-	-	-	-
Stage 2	301	-	-	-	-	-
Critical Hdwy	6.42	6.22	4.12	-	-	-
Critical Hdwy Stg 1	5.42	-	-	-	-	-
Critical Hdwy Stg 2	5.42	-	-	-	-	-
Follow-up Hdwy	3.518	3.318	2.218	-	-	-
Pot Cap-1 Maneuver	396	637	1106	-	-	-
Stage 1	666	-	-	-	-	-
Stage 2	751	-	-	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	385	637	1106	-	-	-
Mov Cap-2 Maneuver	385	-	-	-	-	-
Stage 1	666	-	-	-	-	-
Stage 2	731	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s	15.2	0.8	0
HCM LOS	C		

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	SBT	SBR
Capacity (veh/h)	1106	-	452	-	-
HCM Lane V/C Ratio	0.024	-	0.224	-	-
HCM Control Delay (s)	8.3	0	15.2	-	-
HCM Lane LOS	A	A	C	-	-
HCM 95th %tile Q(veh)	0.1	-	0.8	-	-

Intersection	
Intersection Delay, s/veh	11.9
Intersection LOS	B

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Vol, veh/h	134	31	42	7	15	2	48	156	6	7	214	139
Future Vol, veh/h	134	31	42	7	15	2	48	156	6	7	214	139
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	146	34	46	8	16	2	52	170	7	8	233	151
Number of Lanes	0	1	0	0	1	0	0	1	0	0	1	0

Approach	EB	WB	NB	SB
Opposing Approach	WB	EB	SB	NB
Opposing Lanes	1	1	1	1
Conflicting Approach Left	SB	NB	EB	WB
Conflicting Lanes Left	1	1	1	1
Conflicting Approach Right	NB	SB	WB	EB
Conflicting Lanes Right	1	1	1	1
HCM Control Delay	11.4	9.2	10.8	12.9
HCM LOS	B	A	B	B

Lane	NBLn1	EBLn1	WBLn1	SBLn1
Vol Left, %	23%	65%	29%	2%
Vol Thru, %	74%	15%	62%	59%
Vol Right, %	3%	20%	8%	39%
Sign Control	Stop	Stop	Stop	Stop
Traffic Vol by Lane	210	207	24	360
LT Vol	48	134	7	7
Through Vol	156	31	15	214
RT Vol	6	42	2	139
Lane Flow Rate	228	225	26	391
Geometry Grp	1	1	1	1
Degree of Util (X)	0.331	0.345	0.043	0.521
Departure Headway (Hd)	5.214	5.518	5.92	4.791
Convergence, Y/N	Yes	Yes	Yes	Yes
Cap	689	652	604	759
Service Time	3.243	3.552	3.967	2.791
HCM Lane V/C Ratio	0.331	0.345	0.043	0.515
HCM Control Delay	10.8	11.4	9.2	12.9
HCM Lane LOS	B	B	A	B
HCM 95th-tile Q	1.4	1.5	0.1	3.1

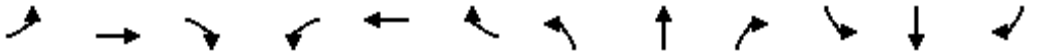
Intersection	
Int Delay, s/veh	5.3

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Vol, veh/h	61	23	134	4	6	3	51	97	5	7	117	77
Future Vol, veh/h	61	23	134	4	6	3	51	97	5	7	117	77
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Free	Free	Free	Free	Free	Free
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	0	-	-	-	-	-	-	-	-	-	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	92	92	92	92	92	92	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	66	25	146	4	7	3	55	105	5	8	127	84

Major/Minor	Minor2			Minor1			Major1			Major2		
Conflicting Flow All	408	406	169	489	445	108	211	0	0	111	0	0
Stage 1	184	184	-	219	219	-	-	-	-	-	-	-
Stage 2	224	222	-	270	226	-	-	-	-	-	-	-
Critical Hdwy	7.12	6.52	6.22	7.12	6.52	6.22	4.12	-	-	4.12	-	-
Critical Hdwy Stg 1	6.12	5.52	-	6.12	5.52	-	-	-	-	-	-	-
Critical Hdwy Stg 2	6.12	5.52	-	6.12	5.52	-	-	-	-	-	-	-
Follow-up Hdwy	3.518	4.018	3.318	3.518	4.018	3.318	2.218	-	-	2.218	-	-
Pot Cap-1 Maneuver	554	534	875	489	508	946	1360	-	-	1479	-	-
Stage 1	818	747	-	783	722	-	-	-	-	-	-	-
Stage 2	779	720	-	736	717	-	-	-	-	-	-	-
Platoon blocked, %								-	-		-	-
Mov Cap-1 Maneuver	526	508	875	378	483	946	1360	-	-	1479	-	-
Mov Cap-2 Maneuver	526	508	-	378	483	-	-	-	-	-	-	-
Stage 1	783	743	-	749	691	-	-	-	-	-	-	-
Stage 2	736	689	-	589	713	-	-	-	-	-	-	-

Approach	EB	WB	NB	SB
HCM Control Delay, s	11.4	12.5	2.6	0.3
HCM LOS	B	B		

Minor Lane/Major Mvmt	NBL	NBT	NBR	EBLn1	EBLn2	WBLn1	SBL	SBT	SBR
Capacity (veh/h)	1360	-	-	526	791	497	1479	-	-
HCM Lane V/C Ratio	0.041	-	-	0.126	0.216	0.028	0.005	-	-
HCM Control Delay (s)	7.8	0	-	12.8	10.8	12.5	7.4	0	-
HCM Lane LOS	A	A	-	B	B	B	A	A	-
HCM 95th %tile Q(veh)	0.1	-	-	0.4	0.8	0.1	0	-	-



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	210	544	293	510	609	104	120	751	396	106	1047	211
Future Volume (veh/h)	210	544	293	510	609	104	120	751	396	106	1047	211
Number	3	8	18	7	4	14	1	6	16	5	2	12
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj Sat Flow, veh/h/ln	1832	1832	1850	1832	1832	1832	1832	1814	1814	1832	1832	1832
Adj Flow Rate, veh/h	223	625	0	586	812	0	152	816	0	123	1151	0
Adj No. of Lanes	2	2	1	2	2	1	1	2	1	1	2	1
Peak Hour Factor	0.94	0.87	0.69	0.87	0.75	0.44	0.79	0.92	0.87	0.86	0.91	0.81
Percent Heavy Veh, %	1	1	0	1	1	1	1	2	2	1	1	1
Cap, veh/h	334	638	288	602	894	400	198	1155	517	280	1160	519
Arrive On Green	0.10	0.18	0.00	0.18	0.26	0.00	0.07	0.34	0.00	0.06	0.33	0.00
Sat Flow, veh/h	3384	3480	1572	3384	3480	1557	1744	3446	1542	1744	3480	1557
Grp Volume(v), veh/h	223	625	0	586	812	0	152	816	0	123	1151	0
Grp Sat Flow(s),veh/h/ln	1692	1740	1572	1692	1740	1557	1744	1723	1542	1744	1740	1557
Q Serve(g_s), s	5.7	16.1	0.0	15.5	20.4	0.0	5.2	18.6	0.0	4.1	29.6	0.0
Cycle Q Clear(g_c), s	5.7	16.1	0.0	15.5	20.4	0.0	5.2	18.6	0.0	4.1	29.6	0.0
Prop In Lane	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Lane Grp Cap(c), veh/h	334	638	288	602	894	400	198	1155	517	280	1160	519
V/C Ratio(X)	0.67	0.98	0.00	0.97	0.91	0.00	0.77	0.71	0.00	0.44	0.99	0.00
Avail Cap(c_a), veh/h	338	638	288	602	909	407	198	1155	517	283	1160	519
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	0.39	0.39	0.00	1.00	1.00	0.00	0.59	0.59	0.00	0.85	0.85	0.00
Uniform Delay (d), s/veh	39.1	36.6	0.0	36.8	32.4	0.0	22.7	26.1	0.0	19.8	29.9	0.0
Incr Delay (d2), s/veh	1.5	17.6	0.0	30.0	13.1	0.0	9.3	2.2	0.0	0.3	22.5	0.0
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	2.7	9.3	0.0	9.7	11.3	0.0	3.0	9.2	0.0	2.0	17.9	0.0
LnGrp Delay(d),s/veh	40.7	54.2	0.0	66.8	45.6	0.0	32.0	28.2	0.0	20.2	52.4	0.0
LnGrp LOS	D	D		E	D		C	C		C	D	
Approach Vol, veh/h		848			1398			968			1274	
Approach Delay, s/veh		50.6			54.4			28.8			49.3	
Approach LOS		D			D			C			D	

Timer	1	2	3	4	5	6	7	8
Assigned Phs	1	2	3	4	5	6	7	8
Phs Duration (G+Y+Rc), s	11.0	36.0	14.4	28.6	10.8	36.2	21.0	22.0
Change Period (Y+Rc), s	5.0	6.0	5.5	* 5.5	5.0	6.0	5.0	5.5
Max Green Setting (Gmax), s	6.0	30.0	9.0	* 24	6.0	30.0	16.0	16.5
Max Q Clear Time (g_c+I1), s	7.2	31.6	7.7	22.4	6.1	20.6	17.5	18.1
Green Ext Time (p_c), s	0.0	0.0	0.7	0.8	0.0	8.6	0.0	0.0

Intersection Summary	
HCM 2010 Ctrl Delay	46.7
HCM 2010 LOS	D

Notes



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	118	10	393	0	3	5	112	181	1	8	403	154
Future Volume (veh/h)	118	10	393	0	3	5	112	181	1	8	403	154
Number	7	4	14	3	8	18	5	2	12	1	6	16
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj Sat Flow, veh/h/ln	1850	1814	1814	1850	1814	1850	1814	1814	1850	1814	1814	1814
Adj Flow Rate, veh/h	128	11	0	0	3	5	122	197	1	9	438	0
Adj No. of Lanes	0	1	1	0	1	0	1	1	0	1	1	1
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	2	2	2	2	2	2	2	2	2	2	2	2
Cap, veh/h	376	14	199	0	79	132	662	1074	5	864	1081	918
Arrive On Green	0.13	0.13	0.00	0.00	0.13	0.13	0.60	0.60	0.60	0.60	0.60	0.00
Sat Flow, veh/h	1271	109	1542	0	613	1021	947	1803	9	1180	1814	1542
Grp Volume(v), veh/h	139	0	0	0	0	8	122	0	198	9	438	0
Grp Sat Flow(s),veh/h/ln	1380	0	1542	0	0	1634	947	0	1812	1180	1814	1542
Q Serve(g_s), s	3.1	0.0	0.0	0.0	0.0	0.1	2.6	0.0	1.6	0.1	4.2	0.0
Cycle Q Clear(g_c), s	3.2	0.0	0.0	0.0	0.0	0.1	6.8	0.0	1.6	1.7	4.2	0.0
Prop In Lane	0.92		1.00	0.00		0.62	1.00		0.01	1.00		1.00
Lane Grp Cap(c), veh/h	390	0	199	0	0	211	662	0	1080	864	1081	918
V/C Ratio(X)	0.36	0.00	0.00	0.00	0.00	0.04	0.18	0.00	0.18	0.01	0.41	0.00
Avail Cap(c_a), veh/h	925	0	777	0	0	823	662	0	1080	864	1081	918
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	0.00	0.00	0.00	1.00	1.00	0.00	1.00	1.00	1.00	0.00
Uniform Delay (d), s/veh	13.9	0.0	0.0	0.0	0.0	12.5	5.3	0.0	3.0	3.4	3.5	0.0
Incr Delay (d2), s/veh	0.6	0.0	0.0	0.0	0.0	0.1	0.6	0.0	0.4	0.0	1.1	0.0
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	1.3	0.0	0.0	0.0	0.0	0.1	0.8	0.0	0.9	0.0	2.4	0.0
LnGrp Delay(d),s/veh	14.4	0.0	0.0	0.0	0.0	12.5	5.9	0.0	3.4	3.4	4.7	0.0
LnGrp LOS	B					B	A		A	A	A	
Approach Vol, veh/h		139			8			320			447	
Approach Delay, s/veh		14.4			12.5			4.4			4.6	
Approach LOS		B			B			A			A	

Timer	1	2	3	4	5	6	7	8
Assigned Phs		2		4		6		8
Phs Duration (G+Y+Rc), s		24.0		8.7		24.0		8.7
Change Period (Y+Rc), s		4.5		4.5		4.5		4.5
Max Green Setting (Gmax), s		19.5		16.5		19.5		16.5
Max Q Clear Time (g_c+I1), s		8.8		5.2		6.2		2.1
Green Ext Time (p_c), s		3.5		0.5		3.9		0.6

Intersection Summary		
HCM 2010 Ctrl Delay		6.1
HCM 2010 LOS		A

Intersection	
Int Delay, s/veh	4.7

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Vol, veh/h	9	5	21	51	5	27	13	137	8	78	86	14
Future Vol, veh/h	9	5	21	51	5	27	13	137	8	78	86	14
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Free	Free	Free	Free	Free	Free
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	-	-	-	-	-	-	110	-	-	110	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	92	92	92	92	92	92	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	10	5	23	55	5	29	14	149	9	85	93	15

Major/Minor	Minor2			Minor1			Major1			Major2		
Conflicting Flow All	470	457	101	467	460	153	109	0	0	158	0	0
Stage 1	271	271	-	182	182	-	-	-	-	-	-	-
Stage 2	199	186	-	285	278	-	-	-	-	-	-	-
Critical Hdwy	7.12	6.52	6.22	7.12	6.52	6.22	4.12	-	-	4.12	-	-
Critical Hdwy Stg 1	6.12	5.52	-	6.12	5.52	-	-	-	-	-	-	-
Critical Hdwy Stg 2	6.12	5.52	-	6.12	5.52	-	-	-	-	-	-	-
Follow-up Hdwy	3.518	4.018	3.318	3.518	4.018	3.318	2.218	-	-	2.218	-	-
Pot Cap-1 Maneuver	504	500	954	506	498	893	1481	-	-	1422	-	-
Stage 1	735	685	-	820	749	-	-	-	-	-	-	-
Stage 2	803	746	-	722	680	-	-	-	-	-	-	-
Platoon blocked, %								-	-		-	-
Mov Cap-1 Maneuver	458	466	954	464	464	893	1481	-	-	1422	-	-
Mov Cap-2 Maneuver	458	466	-	464	464	-	-	-	-	-	-	-
Stage 1	728	644	-	812	742	-	-	-	-	-	-	-
Stage 2	764	739	-	657	639	-	-	-	-	-	-	-

Approach	EB	WB	NB	SB
HCM Control Delay, s	10.7	12.8	0.6	3.4
HCM LOS	B	B		

Minor Lane/Major Mvmt	NBL	NBT	NBR	EBLn1	WBLn1	SBL	SBT	SBR
Capacity (veh/h)	1481	-	-	668	550	1422	-	-
HCM Lane V/C Ratio	0.01	-	-	0.057	0.164	0.06	-	-
HCM Control Delay (s)	7.5	-	-	10.7	12.8	7.7	-	-
HCM Lane LOS	A	-	-	B	B	A	-	-
HCM 95th %tile Q(veh)	0	-	-	0.2	0.6	0.2	-	-

Intersection	
Int Delay, s/veh	4.5

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Vol, veh/h	6	9	13	3	39	23
Future Vol, veh/h	6	9	13	3	39	23
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	-	-	-	-
Veh in Median Storage, #	0	-	0	-	-	0
Grade, %	0	-	0	-	-	0
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	7	10	14	3	42	25

Major/Minor	Minor1		Major1		Major2	
Conflicting Flow All	126	16	0	0	17	0
Stage 1	16	-	-	-	-	-
Stage 2	110	-	-	-	-	-
Critical Hdwy	6.42	6.22	-	-	4.12	-
Critical Hdwy Stg 1	5.42	-	-	-	-	-
Critical Hdwy Stg 2	5.42	-	-	-	-	-
Follow-up Hdwy	3.518	3.318	-	-	2.218	-
Pot Cap-1 Maneuver	869	1063	-	-	1600	-
Stage 1	1007	-	-	-	-	-
Stage 2	915	-	-	-	-	-
Platoon blocked, %			-	-		-
Mov Cap-1 Maneuver	846	1063	-	-	1600	-
Mov Cap-2 Maneuver	846	-	-	-	-	-
Stage 1	1007	-	-	-	-	-
Stage 2	890	-	-	-	-	-

Approach	WB	NB	SB
HCM Control Delay, s	8.8	0	4.6
HCM LOS	A		

Minor Lane/Major Mvmt	NBT	NBR	WBLn1	SBL	SBT
Capacity (veh/h)	-	-	964	1600	-
HCM Lane V/C Ratio	-	-	0.017	0.026	-
HCM Control Delay (s)	-	-	8.8	7.3	0
HCM Lane LOS	-	-	A	A	A
HCM 95th %tile Q(veh)	-	-	0.1	0.1	-

Intersection	
Int Delay, s/veh	2.5

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	89	23	15	267	287	82
Future Vol, veh/h	89	23	15	267	287	82
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	-	-	-	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	97	25	16	290	312	89

Major/Minor	Minor2		Major1		Major2	
Conflicting Flow All	680	357	401	0	-	0
Stage 1	357	-	-	-	-	-
Stage 2	323	-	-	-	-	-
Critical Hdwy	6.42	6.22	4.12	-	-	-
Critical Hdwy Stg 1	5.42	-	-	-	-	-
Critical Hdwy Stg 2	5.42	-	-	-	-	-
Follow-up Hdwy	3.518	3.318	2.218	-	-	-
Pot Cap-1 Maneuver	417	687	1158	-	-	-
Stage 1	708	-	-	-	-	-
Stage 2	734	-	-	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	410	687	1158	-	-	-
Mov Cap-2 Maneuver	410	-	-	-	-	-
Stage 1	708	-	-	-	-	-
Stage 2	722	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s	16	0.4	0
HCM LOS	C		

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	SBT	SBR
Capacity (veh/h)	1158	-	447	-	-
HCM Lane V/C Ratio	0.014	-	0.272	-	-
HCM Control Delay (s)	8.2	0	16	-	-
HCM Lane LOS	A	A	C	-	-
HCM 95th %tile Q(veh)	0	-	1.1	-	-

Intersection	
Intersection Delay, s/veh	12.2
Intersection LOS	B

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Vol, veh/h	12	11	356	14	13	403
Future Vol, veh/h	12	11	356	14	13	403
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	13	12	387	15	14	438
Number of Lanes	1	0	1	0	0	1

Approach	WB	NB	SB
Opposing Approach		SB	NB
Opposing Lanes	0	1	1
Conflicting Approach Left	NB		WB
Conflicting Lanes Left	1	0	1
Conflicting Approach Right	SB	WB	
Conflicting Lanes Right	1	1	0
HCM Control Delay	8.8	11.8	12.8
HCM LOS	A	B	B

Lane	NBLn1	WBLn1	SBLn1
Vol Left, %	0%	52%	3%
Vol Thru, %	96%	0%	97%
Vol Right, %	4%	48%	0%
Sign Control	Stop	Stop	Stop
Traffic Vol by Lane	370	23	416
LT Vol	0	12	13
Through Vol	356	0	403
RT Vol	14	11	0
Lane Flow Rate	402	25	452
Geometry Grp	1	1	1
Degree of Util (X)	0.496	0.039	0.555
Departure Headway (Hd)	4.438	5.561	4.418
Convergence, Y/N	Yes	Yes	Yes
Cap	812	642	818
Service Time	2.459	3.613	2.438
HCM Lane V/C Ratio	0.495	0.039	0.553
HCM Control Delay	11.8	8.8	12.8
HCM Lane LOS	B	A	B
HCM 95th-tile Q	2.8	0.1	3.5

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	465	350	285	40	235	75	365	1015	70	125	1120	640
Future Volume (veh/h)	465	350	285	40	235	75	365	1015	70	125	1120	640
Number	7	4	14	3	8	18	1	6	16	5	2	12
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj Sat Flow, veh/h/ln	1832	1850	1832	1779	1832	1814	1814	1814	1779	1814	1832	1832
Adj Flow Rate, veh/h	596	402	0	89	276	0	480	1285	0	179	1273	0
Adj No. of Lanes	2	1	1	1	1	1	2	2	1	1	2	1
Peak Hour Factor	0.78	0.87	0.96	0.45	0.85	0.75	0.76	0.79	0.75	0.70	0.88	0.97
Percent Heavy Veh, %	1	0	1	4	1	2	2	2	4	2	1	1
Cap, veh/h	552	495	417	109	309	260	464	1383	607	179	1250	559
Arrive On Green	0.16	0.27	0.00	0.06	0.17	0.00	0.14	0.40	0.00	0.10	0.36	0.00
Sat Flow, veh/h	3384	1850	1557	1694	1832	1542	3351	3446	1512	1727	3480	1557
Grp Volume(v), veh/h	596	402	0	89	276	0	480	1285	0	179	1273	0
Grp Sat Flow(s),veh/h/ln	1692	1850	1557	1694	1832	1542	1676	1723	1512	1727	1740	1557
Q Serve(g_s), s	22.0	27.5	0.0	7.0	19.9	0.0	18.7	48.0	0.0	14.0	48.5	0.0
Cycle Q Clear(g_c), s	22.0	27.5	0.0	7.0	19.9	0.0	18.7	48.0	0.0	14.0	48.5	0.0
Prop In Lane	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Lane Grp Cap(c), veh/h	552	495	417	109	309	260	464	1383	607	179	1250	559
V/C Ratio(X)	1.08	0.81	0.00	0.82	0.89	0.00	1.03	0.93	0.00	1.00	1.02	0.00
Avail Cap(c_a), veh/h	552	495	417	125	326	274	464	1383	607	179	1250	559
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	1.00	0.00	1.00	1.00	0.00	0.90	0.90	0.00	0.84	0.84	0.00
Uniform Delay (d), s/veh	56.5	46.3	0.0	62.4	54.9	0.0	58.2	38.6	0.0	60.5	43.3	0.0
Incr Delay (d2), s/veh	61.9	11.1	0.0	25.9	26.1	0.0	48.8	11.3	0.0	61.5	28.0	0.0
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	15.0	15.6	0.0	4.1	12.3	0.0	11.8	25.0	0.0	9.7	28.1	0.0
LnGrp Delay(d),s/veh	118.4	57.4	0.0	88.3	81.0	0.0	106.9	49.9	0.0	122.0	71.3	0.0
LnGrp LOS	F	E		F	F		F	D		F	F	
Approach Vol, veh/h		998			365			1765			1452	
Approach Delay, s/veh		93.8			82.8			65.4			77.5	
Approach LOS		F			F			E			E	

Timer	1	2	3	4	5	6	7	8
Assigned Phs	1	2	3	4	5	6	7	8
Phs Duration (G+Y+Rc), s	24.2	54.5	13.7	42.6	19.0	59.7	27.0	29.3
Change Period (Y+Rc), s	5.5	* 6	5.0	6.5	5.0	5.5	5.0	6.5
Max Green Setting (Gmax), s	18.0	* 49	10.0	36.0	14.0	53.0	22.0	24.0
Max Q Clear Time (g_c+I1), s	20.7	50.5	9.0	29.5	16.0	50.0	24.0	21.9
Green Ext Time (p_c), s	0.0	0.0	0.0	2.8	0.0	2.7	0.0	0.9

Intersection Summary	
HCM 2010 Ctrl Delay	76.8
HCM 2010 LOS	E

Notes



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	90	705	75	95	760	45	150	190	60	60	250	70
Future Volume (veh/h)	90	705	75	95	760	45	150	190	60	60	250	70
Number	7	4	14	3	8	18	5	2	12	1	6	16
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj Sat Flow, veh/h/ln	1814	1814	1814	1814	1814	1814	1814	1814	1814	1814	1814	1814
Adj Flow Rate, veh/h	98	766	82	103	826	49	163	207	65	65	272	76
Adj No. of Lanes	1	1	1	1	1	1	1	1	1	1	1	1
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	2	2	2	2	2	2	2	2	2	2	2	2
Cap, veh/h	228	995	845	261	995	845	304	547	465	353	547	465
Arrive On Green	0.55	0.55	0.55	0.55	0.55	0.55	0.30	0.30	0.30	0.30	0.30	0.30
Sat Flow, veh/h	631	1814	1542	647	1814	1542	1029	1814	1542	1103	1814	1542
Grp Volume(v), veh/h	98	766	82	103	826	49	163	207	65	65	272	76
Grp Sat Flow(s),veh/h/ln	631	1814	1542	647	1814	1542	1029	1814	1542	1103	1814	1542
Q Serve(g_s), s	9.1	19.8	1.5	8.9	22.7	0.9	9.3	5.4	1.8	3.0	7.4	2.2
Cycle Q Clear(g_c), s	31.8	19.8	1.5	28.7	22.7	0.9	16.7	5.4	1.8	8.4	7.4	2.2
Prop In Lane	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Lane Grp Cap(c), veh/h	228	995	845	261	995	845	304	547	465	353	547	465
V/C Ratio(X)	0.43	0.77	0.10	0.39	0.83	0.06	0.54	0.38	0.14	0.18	0.50	0.16
Avail Cap(c_a), veh/h	228	995	845	261	995	845	304	547	465	353	547	465
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	24.4	10.6	6.5	21.8	11.2	6.3	24.1	16.5	15.3	19.8	17.2	15.4
Incr Delay (d2), s/veh	5.8	5.7	0.2	4.4	8.0	0.1	6.7	2.0	0.6	1.1	3.2	0.8
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	1.9	11.4	0.7	1.9	13.2	0.4	3.2	3.0	0.9	1.0	4.2	1.0
LnGrp Delay(d),s/veh	30.3	16.3	6.7	26.2	19.3	6.5	30.7	18.5	15.9	21.0	20.4	16.1
LnGrp LOS	C	B	A	C	B	A	C	B	B	C	C	B
Approach Vol, veh/h		946			978			435			413	
Approach Delay, s/veh		16.9			19.4			22.7			19.7	
Approach LOS		B			B			C			B	

Timer	1	2	3	4	5	6	7	8
Assigned Phs		2		4		6		8
Phs Duration (G+Y+Rc), s		22.6		37.4		22.6		37.4
Change Period (Y+Rc), s		4.5		4.5		4.5		4.5
Max Green Setting (Gmax), s		18.1		32.9		18.1		32.9
Max Q Clear Time (g_c+I1), s		18.7		33.8		10.4		30.7
Green Ext Time (p_c), s		0.0		0.0		2.7		2.0

Intersection Summary	
HCM 2010 Ctrl Delay	19.1
HCM 2010 LOS	B



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	205	235	200	140	185	140	90	1260	135	125	1420	220
Future Volume (veh/h)	205	235	200	140	185	140	90	1260	135	125	1420	220
Number	7	4	14	3	8	18	1	6	16	5	2	12
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj Sat Flow, veh/h/ln	1814	1832	1850	1850	1832	1832	1832	1832	1850	1850	1832	1850
Adj Flow Rate, veh/h	236	305	233	165	203	152	108	1340	196	184	1527	259
Adj No. of Lanes	1	1	1	1	1	1	1	2	1	1	2	1
Peak Hour Factor	0.87	0.77	0.86	0.85	0.91	0.92	0.83	0.94	0.69	0.68	0.93	0.85
Percent Heavy Veh, %	2	1	0	0	1	1	1	1	0	0	1	0
Cap, veh/h	253	295	412	197	295	424	177	1474	770	196	1450	760
Arrive On Green	0.07	0.16	0.16	0.07	0.16	0.16	0.10	0.42	0.42	0.11	0.42	0.42
Sat Flow, veh/h	1727	1832	1570	1762	1832	1557	1744	3480	1571	1762	3480	1572
Grp Volume(v), veh/h	236	305	233	165	203	152	108	1340	196	184	1527	259
Grp Sat Flow(s),veh/h/ln	1727	1832	1570	1762	1832	1557	1744	1740	1571	1762	1740	1572
Q Serve(g_s), s	6.0	14.5	1.9	6.0	9.4	7.1	5.3	32.5	6.5	9.3	37.5	4.1
Cycle Q Clear(g_c), s	6.0	14.5	1.9	6.0	9.4	7.1	5.3	32.5	6.5	9.3	37.5	4.1
Prop In Lane	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Lane Grp Cap(c), veh/h	253	295	412	197	295	424	177	1474	770	196	1450	760
V/C Ratio(X)	0.93	1.03	0.57	0.84	0.69	0.36	0.61	0.91	0.25	0.94	1.05	0.34
Avail Cap(c_a), veh/h	253	295	412	197	295	424	177	1474	770	196	1450	760
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	1.00	1.00	1.00	1.00	1.00	0.89	0.89	0.89	0.26	0.26	0.26
Uniform Delay (d), s/veh	35.8	37.8	13.4	32.5	35.6	26.4	38.7	24.3	13.4	39.7	26.3	4.6
Incr Delay (d2), s/veh	38.3	61.3	2.5	26.0	7.7	0.9	4.0	8.9	0.7	19.6	29.2	0.3
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	5.7	12.3	3.5	2.6	5.4	3.1	2.8	17.3	3.0	5.6	23.8	1.8
LnGrp Delay(d),s/veh	74.1	99.1	16.0	58.5	43.4	27.3	42.7	33.3	14.1	59.3	55.5	4.9
LnGrp LOS	E	F	B	E	D	C	D	C	B	E	F	A
Approach Vol, veh/h		774			520			1644			1970	
Approach Delay, s/veh		66.4			43.5			31.6			49.2	
Approach LOS		E			D			C			D	

Timer	1	2	3	4	5	6	7	8
Assigned Phs	1	2	3	4	5	6	7	8
Phs Duration (G+Y+Rc), s	15.7	44.0	11.0	21.0	15.0	44.7	11.0	21.0
Change Period (Y+Rc), s	6.5	* 6.5	5.0	6.5	5.0	6.5	5.0	6.5
Max Green Setting (Gmax), s	9.0	* 38	6.0	14.5	10.0	36.5	6.0	14.5
Max Q Clear Time (g_c+I1), s	11.3	39.5	8.0	16.5	11.3	34.5	8.0	11.4
Green Ext Time (p_c), s	0.8	0.0	0.0	0.0	0.0	1.9	0.0	1.9

Intersection Summary	
HCM 2010 Ctrl Delay	45.4
HCM 2010 LOS	D

Notes



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	170	185	15	85	135	65	105	1590	115	155	1510	275
Future Volume (veh/h)	170	185	15	85	135	65	105	1590	115	155	1510	275
Number	7	4	14	3	8	18	1	6	16	5	2	12
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj Sat Flow, veh/h/ln	1850	1850	1850	1850	1850	1850	1850	1850	1850	1832	1850	1850
Adj Flow Rate, veh/h	221	234	23	101	144	87	140	1787	147	242	1864	387
Adj No. of Lanes	1	1	1	1	1	1	1	2	1	1	2	1
Peak Hour Factor	0.77	0.79	0.65	0.84	0.94	0.75	0.75	0.89	0.78	0.64	0.81	0.71
Percent Heavy Veh, %	0	0	0	0	0	0	0	0	0	1	0	0
Cap, veh/h	226	235	694	164	235	417	554	2592	1256	242	1933	962
Arrive On Green	0.06	0.13	0.13	0.06	0.13	0.13	0.31	0.74	0.74	0.14	0.55	0.55
Sat Flow, veh/h	1762	1850	1572	1762	1850	1572	1762	3515	1572	1744	3515	1572
Grp Volume(v), veh/h	221	234	23	101	144	87	140	1787	147	242	1864	387
Grp Sat Flow(s),veh/h/ln	1762	1850	1572	1762	1850	1572	1762	1758	1572	1744	1758	1572
Q Serve(g_s), s	8.0	16.4	0.2	6.4	9.6	5.6	7.7	35.3	2.7	18.0	66.0	15.0
Cycle Q Clear(g_c), s	8.0	16.4	0.2	6.4	9.6	5.6	7.7	35.3	2.7	18.0	66.0	15.0
Prop In Lane	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Lane Grp Cap(c), veh/h	226	235	694	164	235	417	554	2592	1256	242	1933	962
V/C Ratio(X)	0.98	1.00	0.03	0.61	0.61	0.21	0.25	0.69	0.12	1.00	0.96	0.40
Avail Cap(c_a), veh/h	226	235	694	164	235	417	554	2592	1256	242	1933	962
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	1.00	1.00	1.00	1.00	1.00	0.91	0.91	0.91	0.85	0.85	0.85
Uniform Delay (d), s/veh	54.0	56.7	24.4	46.5	53.7	37.1	33.2	9.1	2.9	56.0	28.0	19.5
Incr Delay (d2), s/veh	53.3	57.7	0.0	7.2	6.0	0.4	0.1	1.4	0.2	54.0	12.2	1.1
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	7.4	12.2	0.5	3.4	5.3	2.5	3.7	17.4	1.2	12.3	35.1	6.7
LnGrp Delay(d),s/veh	107.2	114.5	24.4	53.7	59.8	37.6	33.3	10.5	3.1	110.0	40.2	20.6
LnGrp LOS	F	F	C	D	E	D	C	B	A	F	D	C
Approach Vol, veh/h		478			332			2074			2493	
Approach Delay, s/veh		106.8			52.1			11.5			43.9	
Approach LOS		F			D			B			D	

Timer	1	2	3	4	5	6	7	8
Assigned Phs	1	2	3	4	5	6	7	8
Phs Duration (G+Y+Rc), s	17.6	78.0	13.0	23.0	23.0	102.6	13.0	23.0
Change Period (Y+Rc), s	6.5	* 6.5	5.0	6.5	5.0	6.5	5.0	6.5
Max Green Setting (Gmax), s	11.0	* 72	8.0	16.5	18.0	64.5	8.0	16.5
Max Q Clear Time (g_c+I1), s	10.0	68.0	8.4	18.4	20.0	37.3	10.0	11.6
Green Ext Time (p_c), s	0.1	3.4	0.0	0.0	0.0	23.7	0.0	1.7

Intersection Summary	
HCM 2010 Ctrl Delay	37.5
HCM 2010 LOS	D

Notes



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	75	370	165	30	45	90	75	980	60	380	965	80
Future Volume (veh/h)	75	370	165	30	45	90	75	980	60	380	965	80
Number	7	4	14	3	8	18	5	2	12	1	6	16
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj Sat Flow, veh/h/ln	1814	1814	1814	1814	1814	1814	1814	1814	1850	1814	1814	1814
Adj Flow Rate, veh/h	82	402	179	33	49	98	82	1065	65	413	1049	87
Adj No. of Lanes	1	1	1	1	1	1	1	2	0	1	2	1
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	2	2	2	2	2	2	2	2	2	2	2	2
Cap, veh/h	104	411	349	41	344	293	104	1143	70	422	1829	818
Arrive On Green	0.06	0.23	0.23	0.02	0.19	0.19	0.06	0.35	0.35	0.24	0.53	0.53
Sat Flow, veh/h	1727	1814	1542	1727	1814	1542	1727	3300	201	1727	3446	1542
Grp Volume(v), veh/h	82	402	179	33	49	98	82	556	574	413	1049	87
Grp Sat Flow(s),veh/h/ln	1727	1814	1542	1727	1814	1542	1727	1723	1778	1727	1723	1542
Q Serve(g_s), s	5.2	24.2	11.2	2.1	2.5	6.0	5.2	34.3	34.3	26.1	22.6	3.1
Cycle Q Clear(g_c), s	5.2	24.2	11.2	2.1	2.5	6.0	5.2	34.3	34.3	26.1	22.6	3.1
Prop In Lane	1.00		1.00	1.00		1.00	1.00		0.11	1.00		1.00
Lane Grp Cap(c), veh/h	104	411	349	41	344	293	104	597	616	422	1829	818
V/C Ratio(X)	0.79	0.98	0.51	0.81	0.14	0.33	0.79	0.93	0.93	0.98	0.57	0.11
Avail Cap(c_a), veh/h	187	411	349	64	344	293	184	597	616	422	1829	818
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.90	0.90	0.90
Uniform Delay (d), s/veh	51.0	42.3	37.2	53.5	37.1	38.6	51.0	34.7	34.7	41.3	17.4	12.8
Incr Delay (d2), s/veh	12.4	38.8	1.3	32.0	0.2	0.7	12.4	23.3	22.9	35.7	1.2	0.2
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	2.8	16.6	4.9	1.4	1.3	2.6	2.8	20.1	20.7	16.6	10.9	1.4
LnGrp Delay(d),s/veh	63.4	81.1	38.5	85.5	37.3	39.2	63.4	58.0	57.6	77.0	18.6	13.1
LnGrp LOS	E	F	D	F	D	D	E	E	E	E	B	B
Approach Vol, veh/h		663			180			1212			1549	
Approach Delay, s/veh		67.4			47.2			58.2			33.9	
Approach LOS		E			D			E			C	

Timer	1	2	3	4	5	6	7	8
Assigned Phs	1	2	3	4	5	6	7	8
Phs Duration (G+Y+Rc), s	31.4	42.1	7.1	29.4	11.1	62.4	11.1	25.4
Change Period (Y+Rc), s	4.5	4.0	4.5	4.5	4.5	4.0	4.5	4.5
Max Green Setting (Gmax), s	26.9	36.6	4.1	24.9	11.7	51.8	11.9	17.1
Max Q Clear Time (g_c+I1), s	28.1	36.3	4.1	26.2	7.2	24.6	7.2	8.0
Green Ext Time (p_c), s	0.0	0.3	0.0	0.0	0.1	18.3	0.1	2.4

Intersection Summary	
HCM 2010 Ctrl Delay	48.9
HCM 2010 LOS	D

Intersection	
Intersection Delay, s/veh	69
Intersection LOS	F

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Vol, veh/h	50	335	55	210	260	10	30	230	135	5	270	40
Future Vol, veh/h	50	335	55	210	260	10	30	230	135	5	270	40
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	54	364	60	228	283	11	33	250	147	5	293	43
Number of Lanes	1	1	0	1	1	0	0	1	0	0	1	0

Approach	EB	WB	NB	SB
Opposing Approach	WB	EB	SB	NB
Opposing Lanes	2	2	1	1
Conflicting Approach Left	SB	NB	EB	WB
Conflicting Lanes Left	1	1	2	2
Conflicting Approach Right	NB	SB	WB	EB
Conflicting Lanes Right	1	1	2	2
HCM Control Delay	93.1	35	95.2	54.4
HCM LOS	F	D	F	F

Lane	NBLn1	EBLn1	EBLn2	WBLn1	WBLn2	SBLn1
Vol Left, %	8%	100%	0%	100%	0%	2%
Vol Thru, %	58%	0%	86%	0%	96%	86%
Vol Right, %	34%	0%	14%	0%	4%	13%
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop
Traffic Vol by Lane	395	50	390	210	270	315
LT Vol	30	50	0	210	0	5
Through Vol	230	0	335	0	260	270
RT Vol	135	0	55	0	10	40
Lane Flow Rate	429	54	424	228	293	342
Geometry Grp	2	7	7	7	7	2
Degree of Util (X)	1.065	0.148	1.087	0.63	0.767	0.882
Departure Headway (Hd)	9.294	10.23	9.6	10.574	10.019	9.906
Convergence, Y/N	Yes	Yes	Yes	Yes	Yes	Yes
Cap	395	353	382	345	364	370
Service Time	7.294	7.93	7.3	8.274	7.719	7.906
HCM Lane V/C Ratio	1.086	0.153	1.11	0.661	0.805	0.924
HCM Control Delay	95.2	14.7	103.1	29.7	39.1	54.4
HCM Lane LOS	F	B	F	D	E	F
HCM 95th-tile Q	14.1	0.5	14.6	4.1	6.2	8.6

Intersection	
Int Delay, s/veh	2.7

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	65	40	35	360	525	110
Future Vol, veh/h	65	40	35	360	525	110
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	-	-	-	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	71	43	38	391	571	120

Major/Minor	Minor2		Major1		Major2	
Conflicting Flow All	1097	630	690	0	-	0
Stage 1	630	-	-	-	-	-
Stage 2	467	-	-	-	-	-
Critical Hdwy	6.42	6.22	4.12	-	-	-
Critical Hdwy Stg 1	5.42	-	-	-	-	-
Critical Hdwy Stg 2	5.42	-	-	-	-	-
Follow-up Hdwy	3.518	3.318	2.218	-	-	-
Pot Cap-1 Maneuver	236	482	905	-	-	-
Stage 1	531	-	-	-	-	-
Stage 2	631	-	-	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	223	482	905	-	-	-
Mov Cap-2 Maneuver	223	-	-	-	-	-
Stage 1	531	-	-	-	-	-
Stage 2	597	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s	26.4	0.8	0
HCM LOS	D		

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	SBT	SBR
Capacity (veh/h)	905	-	280	-	-
HCM Lane V/C Ratio	0.042	-	0.408	-	-
HCM Control Delay (s)	9.2	0	26.4	-	-
HCM Lane LOS	A	A	D	-	-
HCM 95th %tile Q(veh)	0.1	-	1.9	-	-

Intersection	
Intersection Delay, s/veh	54.6
Intersection LOS	F

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Vol, veh/h	210	50	65	5	15	5	80	260	10	10	375	245
Future Vol, veh/h	210	50	65	5	15	5	80	260	10	10	375	245
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	228	54	71	5	16	5	87	283	11	11	408	266
Number of Lanes	0	1	0	0	1	0	0	1	0	0	1	0

Approach	EB	WB	NB	SB
Opposing Approach	WB	EB	SB	NB
Opposing Lanes	1	1	1	1
Conflicting Approach Left	SB	NB	EB	WB
Conflicting Lanes Left	1	1	1	1
Conflicting Approach Right	NB	SB	WB	EB
Conflicting Lanes Right	1	1	1	1
HCM Control Delay	22.7	11.9	22.3	90.8
HCM LOS	C	B	C	F

Lane	NBLn1	EBLn1	WBLn1	SBLn1
Vol Left, %	23%	65%	20%	2%
Vol Thru, %	74%	15%	60%	60%
Vol Right, %	3%	20%	20%	39%
Sign Control	Stop	Stop	Stop	Stop
Traffic Vol by Lane	350	325	25	630
LT Vol	80	210	5	10
Through Vol	260	50	15	375
RT Vol	10	65	5	245
Lane Flow Rate	380	353	27	685
Geometry Grp	1	1	1	1
Degree of Util (X)	0.674	0.661	0.059	1.103
Departure Headway (Hd)	6.655	7.051	8.355	5.798
Convergence, Y/N	Yes	Yes	Yes	Yes
Cap	548	516	431	623
Service Time	4.655	5.051	6.355	3.882
HCM Lane V/C Ratio	0.693	0.684	0.063	1.1
HCM Control Delay	22.3	22.7	11.9	90.8
HCM Lane LOS	C	C	B	F
HCM 95th-tile Q	5	4.8	0.2	20.3

Intersection	
Int Delay, s/veh	7.3

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Vol, veh/h	95	35	205	10	10	5	90	170	10	15	210	140
Future Vol, veh/h	95	35	205	10	10	5	90	170	10	15	210	140
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Free	Free	Free	Free	Free	Free
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	0	-	-	-	-	-	-	-	-	-	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	92	92	92	92	92	92	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	103	38	223	11	11	5	98	185	11	16	228	152

Major/Minor	Minor2			Minor1			Major1			Major2		
Conflicting Flow All	731	728	304	853	799	190	380	0	0	196	0	0
Stage 1	337	337	-	386	386	-	-	-	-	-	-	-
Stage 2	394	391	-	467	413	-	-	-	-	-	-	-
Critical Hdwy	7.12	6.52	6.22	7.12	6.52	6.22	4.12	-	-	4.12	-	-
Critical Hdwy Stg 1	6.12	5.52	-	6.12	5.52	-	-	-	-	-	-	-
Critical Hdwy Stg 2	6.12	5.52	-	6.12	5.52	-	-	-	-	-	-	-
Follow-up Hdwy	3.518	4.018	3.318	3.518	4.018	3.318	2.218	-	-	2.218	-	-
Pot Cap-1 Maneuver	337	350	736	279	319	852	1178	-	-	1377	-	-
Stage 1	677	641	-	637	610	-	-	-	-	-	-	-
Stage 2	631	607	-	576	594	-	-	-	-	-	-	-
Platoon blocked, %								-	-		-	-
Mov Cap-1 Maneuver	299	313	736	162	285	852	1178	-	-	1377	-	-
Mov Cap-2 Maneuver	299	313	-	162	285	-	-	-	-	-	-	-
Stage 1	614	631	-	578	553	-	-	-	-	-	-	-
Stage 2	557	551	-	372	585	-	-	-	-	-	-	-

Approach	EB	WB	NB	SB
HCM Control Delay, s	17.4	21.7	2.8	0.3
HCM LOS	C	C		

Minor Lane/Major Mvmt	NBL	NBT	NBR	EBLn1	EBLn2	WBLn1	SBL	SBT	SBR
Capacity (veh/h)	1178	-	-	299	615	243	1377	-	-
HCM Lane V/C Ratio	0.083	-	-	0.345	0.424	0.112	0.012	-	-
HCM Control Delay (s)	8.3	0	-	23.3	15.1	21.7	7.6	0	-
HCM Lane LOS	A	A	-	C	C	C	A	A	-
HCM 95th %tile Q(veh)	0.3	-	-	1.5	2.1	0.4	0	-	-

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	260	680	365	705	840	145	145	920	485	120	1195	240
Future Volume (veh/h)	260	680	365	705	840	145	145	920	485	120	1195	240
Number	3	8	18	7	4	14	1	6	16	5	2	12
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj Sat Flow, veh/h/ln	1832	1832	1850	1832	1832	1832	1832	1814	1814	1832	1832	1832
Adj Flow Rate, veh/h	277	782	0	810	1120	0	184	1000	0	140	1313	0
Adj No. of Lanes	2	2	1	2	2	1	1	2	1	1	2	1
Peak Hour Factor	0.94	0.87	0.69	0.87	0.75	0.44	0.79	0.92	0.87	0.86	0.91	0.81
Percent Heavy Veh, %	1	1	0	1	1	1	1	2	2	1	1	1
Cap, veh/h	291	790	357	703	1200	537	136	1219	546	187	1231	551
Arrive On Green	0.09	0.23	0.00	0.21	0.34	0.00	0.05	0.35	0.00	0.05	0.35	0.00
Sat Flow, veh/h	3384	3480	1572	3384	3480	1557	1744	3446	1542	1744	3480	1557
Grp Volume(v), veh/h	277	782	0	810	1120	0	184	1000	0	140	1313	0
Grp Sat Flow(s),veh/h/ln	1692	1740	1572	1692	1740	1557	1744	1723	1542	1744	1740	1557
Q Serve(g_s), s	10.6	29.1	0.0	27.0	40.4	0.0	6.0	34.3	0.0	6.0	46.0	0.0
Cycle Q Clear(g_c), s	10.6	29.1	0.0	27.0	40.4	0.0	6.0	34.3	0.0	6.0	46.0	0.0
Prop In Lane	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Lane Grp Cap(c), veh/h	291	790	357	703	1200	537	136	1219	546	187	1231	551
V/C Ratio(X)	0.95	0.99	0.00	1.15	0.93	0.00	1.35	0.82	0.00	0.75	1.07	0.00
Avail Cap(c_a), veh/h	291	790	357	703	1218	545	136	1219	546	187	1231	551
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	0.39	0.39	0.00	1.00	1.00	0.00	0.59	0.59	0.00	0.85	0.85	0.00
Uniform Delay (d), s/veh	59.1	50.1	0.0	51.5	41.2	0.0	36.0	38.2	0.0	34.7	42.0	0.0
Incr Delay (d2), s/veh	21.5	17.7	0.0	84.3	13.2	0.0	185.1	3.8	0.0	11.9	43.5	0.0
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	5.8	15.9	0.0	20.8	21.6	0.0	7.0	16.9	0.0	2.8	29.5	0.0
LnGrp Delay(d),s/veh	80.7	67.8	0.0	135.8	54.3	0.0	221.1	42.0	0.0	46.6	85.5	0.0
LnGrp LOS	F	E		F	D		F	D		D	F	
Approach Vol, veh/h		1059			1930			1184			1453	
Approach Delay, s/veh		71.1			88.5			69.9			81.7	
Approach LOS		E			F			E			F	

Timer	1	2	3	4	5	6	7	8
Assigned Phs	1	2	3	4	5	6	7	8
Phs Duration (G+Y+Rc), s	11.0	52.0	16.7	50.3	11.0	52.0	32.0	35.0
Change Period (Y+Rc), s	5.0	6.0	5.5	* 5.5	5.0	6.0	5.0	5.5
Max Green Setting (Gmax), s	6.0	46.0	11.0	* 46	6.0	46.0	27.0	29.5
Max Q Clear Time (g_c+I1), s	8.0	48.0	12.6	42.4	8.0	36.3	29.0	31.1
Green Ext Time (p_c), s	0.0	0.0	0.0	2.4	0.0	9.2	0.0	0.0

Intersection Summary	
HCM 2010 Ctrl Delay	79.6
HCM 2010 LOS	E

Notes



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	205	15	680	0	5	5	145	230	5	10	515	195
Future Volume (veh/h)	205	15	680	0	5	5	145	230	5	10	515	195
Number	7	4	14	3	8	18	5	2	12	1	6	16
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj Sat Flow, veh/h/ln	1850	1814	1814	1850	1814	1850	1814	1814	1850	1814	1814	1814
Adj Flow Rate, veh/h	223	16	0	0	5	5	158	250	5	11	560	0
Adj No. of Lanes	0	1	1	0	1	0	1	1	0	1	1	1
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	2	2	2	2	2	2	2	2	2	2	2	2
Cap, veh/h	407	20	338	0	183	183	511	1103	22	754	1129	960
Arrive On Green	0.22	0.22	0.00	0.00	0.22	0.22	0.62	0.62	0.62	0.62	0.62	0.00
Sat Flow, veh/h	1297	93	1542	0	833	833	846	1772	35	1120	1814	1542
Grp Volume(v), veh/h	239	0	0	0	0	10	158	0	255	11	560	0
Grp Sat Flow(s),veh/h/ln	1390	0	1542	0	0	1667	846	0	1807	1120	1814	1542
Q Serve(g_s), s	9.1	0.0	0.0	0.0	0.0	0.3	7.1	0.0	3.5	0.2	9.6	0.0
Cycle Q Clear(g_c), s	9.3	0.0	0.0	0.0	0.0	0.3	16.8	0.0	3.5	3.8	9.6	0.0
Prop In Lane	0.93		1.00	0.00		0.50	1.00		0.02	1.00		1.00
Lane Grp Cap(c), veh/h	427	0	338	0	0	366	511	0	1126	754	1129	960
V/C Ratio(X)	0.56	0.00	0.00	0.00	0.00	0.03	0.31	0.00	0.23	0.01	0.50	0.00
Avail Cap(c_a), veh/h	1000	0	960	0	0	1038	511	0	1126	754	1129	960
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	0.00	0.00	0.00	1.00	1.00	0.00	1.00	1.00	1.00	0.00
Uniform Delay (d), s/veh	21.1	0.0	0.0	0.0	0.0	17.5	10.4	0.0	4.7	5.6	5.9	0.0
Incr Delay (d2), s/veh	1.2	0.0	0.0	0.0	0.0	0.0	1.6	0.0	0.5	0.0	1.6	0.0
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	3.7	0.0	0.0	0.0	0.0	0.1	1.9	0.0	1.8	0.1	5.2	0.0
LnGrp Delay(d),s/veh	22.3	0.0	0.0	0.0	0.0	17.5	12.0	0.0	5.2	5.6	7.4	0.0
LnGrp LOS	C					B	B		A	A	A	
Approach Vol, veh/h		239			10			413			571	
Approach Delay, s/veh		22.3			17.5			7.8			7.4	
Approach LOS		C			B			A			A	

Timer	1	2	3	4	5	6	7	8
Assigned Phs		2		4		6		8
Phs Duration (G+Y+Rc), s		40.0		17.0		40.0		17.0
Change Period (Y+Rc), s		4.5		4.5		4.5		4.5
Max Green Setting (Gmax), s		35.5		35.5		35.5		35.5
Max Q Clear Time (g_c+I1), s		18.8		11.3		11.6		2.3
Green Ext Time (p_c), s		5.9		1.4		6.9		1.5

Intersection Summary		
HCM 2010 Ctrl Delay		10.5
HCM 2010 LOS		B

Intersection	
Int Delay, s/veh	20.9

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Vol, veh/h	15	10	40	125	55	90	30	320	20	105	120	20
Future Vol, veh/h	15	10	40	125	55	90	30	320	20	105	120	20
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Free	Free	Free	Free	Free	Free
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	-	-	-	-	-	-	110	-	-	110	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	92	92	92	92	92	92	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	16	11	43	136	60	98	33	348	22	114	130	22

Major/Minor	Minor2			Minor1			Major1			Major2		
Conflicting Flow All	873	805	141	821	804	359	152	0	0	370	0	0
Stage 1	370	370	-	424	424	-	-	-	-	-	-	-
Stage 2	503	435	-	397	380	-	-	-	-	-	-	-
Critical Hdwy	7.12	6.52	6.22	7.12	6.52	6.22	4.12	-	-	4.12	-	-
Critical Hdwy Stg 1	6.12	5.52	-	6.12	5.52	-	-	-	-	-	-	-
Critical Hdwy Stg 2	6.12	5.52	-	6.12	5.52	-	-	-	-	-	-	-
Follow-up Hdwy	3.518	4.018	3.318	3.518	4.018	3.318	2.218	-	-	2.218	-	-
Pot Cap-1 Maneuver	271	316	907	293	316	685	1429	-	-	1189	-	-
Stage 1	650	620	-	608	587	-	-	-	-	-	-	-
Stage 2	551	580	-	629	614	-	-	-	-	-	-	-
Platoon blocked, %								-	-		-	-
Mov Cap-1 Maneuver	177	279	907	247	279	685	1429	-	-	1189	-	-
Mov Cap-2 Maneuver	177	279	-	247	279	-	-	-	-	-	-	-
Stage 1	635	561	-	594	573	-	-	-	-	-	-	-
Stage 2	413	567	-	531	555	-	-	-	-	-	-	-

Approach	EB	WB	NB	SB
HCM Control Delay, s	16.1	65.5	0.6	3.6
HCM LOS	C	F		

Minor Lane/Major Mvmt	NBL	NBT	NBR	EBLn1	WBLn1	SBL	SBT	SBR
Capacity (veh/h)	1429	-	-	395	324	1189	-	-
HCM Lane V/C Ratio	0.023	-	-	0.179	0.906	0.096	-	-
HCM Control Delay (s)	7.6	-	-	16.1	65.5	8.3	-	-
HCM Lane LOS	A	-	-	C	F	A	-	-
HCM 95th %tile Q(veh)	0.1	-	-	0.6	8.8	0.3	-	-

Intersection	
Int Delay, s/veh	5.6

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Vol, veh/h	25	35	20	5	50	30
Future Vol, veh/h	25	35	20	5	50	30
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	-	-	-	-
Veh in Median Storage, #	0	-	0	-	-	0
Grade, %	0	-	0	-	-	0
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	27	38	22	5	54	33

Major/Minor	Minor1		Major1		Major2	
Conflicting Flow All	165	24	0	0	27	0
Stage 1	24	-	-	-	-	-
Stage 2	141	-	-	-	-	-
Critical Hdwy	6.42	6.22	-	-	4.12	-
Critical Hdwy Stg 1	5.42	-	-	-	-	-
Critical Hdwy Stg 2	5.42	-	-	-	-	-
Follow-up Hdwy	3.518	3.318	-	-	2.218	-
Pot Cap-1 Maneuver	826	1052	-	-	1587	-
Stage 1	999	-	-	-	-	-
Stage 2	886	-	-	-	-	-
Platoon blocked, %			-	-		-
Mov Cap-1 Maneuver	797	1052	-	-	1587	-
Mov Cap-2 Maneuver	797	-	-	-	-	-
Stage 1	999	-	-	-	-	-
Stage 2	855	-	-	-	-	-

Approach	WB	NB	SB
HCM Control Delay, s	9.2	0	4.6
HCM LOS	A		

Minor Lane/Major Mvmt	NBT	NBR	WBLn1	SBL	SBT
Capacity (veh/h)	-	-	928	1587	-
HCM Lane V/C Ratio	-	-	0.07	0.034	-
HCM Control Delay (s)	-	-	9.2	7.3	0
HCM Lane LOS	-	-	A	A	A
HCM 95th %tile Q(veh)	-	-	0.2	0.1	-

Intersection	
Int Delay, s/veh	2.7

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	80	20	25	430	435	125
Future Vol, veh/h	80	20	25	430	435	125
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	-	-	-	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	87	22	27	467	473	136

Major/Minor	Minor2		Major1		Major2	
Conflicting Flow All	1063	541	609	0	-	0
Stage 1	541	-	-	-	-	-
Stage 2	522	-	-	-	-	-
Critical Hdwy	6.42	6.22	4.12	-	-	-
Critical Hdwy Stg 1	5.42	-	-	-	-	-
Critical Hdwy Stg 2	5.42	-	-	-	-	-
Follow-up Hdwy	3.518	3.318	2.218	-	-	-
Pot Cap-1 Maneuver	247	541	970	-	-	-
Stage 1	583	-	-	-	-	-
Stage 2	595	-	-	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	238	541	970	-	-	-
Mov Cap-2 Maneuver	238	-	-	-	-	-
Stage 1	583	-	-	-	-	-
Stage 2	572	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s	27.3	0.5	0
HCM LOS	D		

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	SBT	SBR
Capacity (veh/h)	970	-	268	-	-
HCM Lane V/C Ratio	0.028	-	0.406	-	-
HCM Control Delay (s)	8.8	0	27.3	-	-
HCM Lane LOS	A	A	D	-	-
HCM 95th %tile Q(veh)	0.1	-	1.9	-	-

Intersection	
Intersection Delay, s/veh	20.8
Intersection LOS	C

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Vol, veh/h	15	10	545	20	15	510
Future Vol, veh/h	15	10	545	20	15	510
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	16	11	592	22	16	554
Number of Lanes	1	0	1	0	0	1

Approach	WB	NB	SB
Opposing Approach		SB	NB
Opposing Lanes	0	1	1
Conflicting Approach Left	NB		WB
Conflicting Lanes Left	1	0	1
Conflicting Approach Right	SB	WB	
Conflicting Lanes Right	1	1	0
HCM Control Delay	9.7	22.3	19.8
HCM LOS	A	C	C

Lane	NBLn1	WBLn1	SBLn1
Vol Left, %	0%	60%	3%
Vol Thru, %	96%	0%	97%
Vol Right, %	4%	40%	0%
Sign Control	Stop	Stop	Stop
Traffic Vol by Lane	565	25	525
LT Vol	0	15	15
Through Vol	545	0	510
RT Vol	20	10	0
Lane Flow Rate	614	27	571
Geometry Grp	1	1	1
Degree of Util (X)	0.784	0.048	0.739
Departure Headway (Hd)	4.597	6.39	4.661
Convergence, Y/N	Yes	Yes	Yes
Cap	786	564	776
Service Time	2.638	4.39	2.703
HCM Lane V/C Ratio	0.781	0.048	0.736
HCM Control Delay	22.3	9.7	19.8
HCM Lane LOS	C	A	C
HCM 95th-tile Q	7.9	0.2	6.7

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	440	330	270	45	245	75	340	950	65	120	1065	610
Future Volume (veh/h)	440	330	270	45	245	75	340	950	65	120	1065	610
Number	7	4	14	3	8	18	1	6	16	5	2	12
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj Sat Flow, veh/h/ln	1832	1850	1832	1779	1832	1814	1814	1814	1779	1814	1832	1832
Adj Flow Rate, veh/h	564	379	0	100	288	0	447	1203	0	171	1210	0
Adj No. of Lanes	2	1	1	1	1	1	2	2	1	1	2	1
Peak Hour Factor	0.78	0.87	0.96	0.45	0.85	0.75	0.76	0.79	0.75	0.70	0.88	0.97
Percent Heavy Veh, %	1	0	1	4	1	2	2	2	4	2	1	1
Cap, veh/h	541	429	361	124	266	224	987	1876	823	173	1183	529
Arrive On Green	0.16	0.23	0.00	0.07	0.14	0.00	0.29	0.54	0.00	0.10	0.34	0.00
Sat Flow, veh/h	3384	1850	1557	1694	1832	1542	3351	3446	1512	1727	3480	1557
Grp Volume(v), veh/h	564	379	0	100	288	0	447	1203	0	171	1210	0
Grp Sat Flow(s),veh/h/ln	1692	1850	1557	1694	1832	1542	1676	1723	1512	1727	1740	1557
Q Serve(g_s), s	16.0	19.8	0.0	5.8	14.5	0.0	10.9	24.4	0.0	9.9	34.0	0.0
Cycle Q Clear(g_c), s	16.0	19.8	0.0	5.8	14.5	0.0	10.9	24.4	0.0	9.9	34.0	0.0
Prop In Lane	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Lane Grp Cap(c), veh/h	541	429	361	124	266	224	987	1876	823	173	1183	529
V/C Ratio(X)	1.04	0.88	0.00	0.80	1.08	0.00	0.45	0.64	0.00	0.99	1.02	0.00
Avail Cap(c_a), veh/h	541	429	361	152	266	224	987	1876	823	173	1183	529
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	1.00	0.00	1.00	1.00	0.00	0.90	0.90	0.00	0.84	0.84	0.00
Uniform Delay (d), s/veh	42.0	37.1	0.0	45.6	42.8	0.0	28.7	15.9	0.0	44.9	33.0	0.0
Incr Delay (d2), s/veh	49.9	20.3	0.0	18.1	79.5	0.0	0.1	1.5	0.0	59.7	29.9	0.0
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	11.2	12.5	0.0	3.3	13.2	0.0	5.0	11.9	0.0	7.6	21.2	0.0
LnGrp Delay(d),s/veh	91.9	57.4	0.0	63.7	122.3	0.0	28.8	17.5	0.0	104.7	62.9	0.0
LnGrp LOS	F	E		E	F		C	B		F	F	
Approach Vol, veh/h		943			388			1650			1381	
Approach Delay, s/veh		78.0			107.2			20.5			68.1	
Approach LOS		E			F			C			E	

Timer	1	2	3	4	5	6	7	8
Assigned Phs	1	2	3	4	5	6	7	8
Phs Duration (G+Y+Rc), s	35.3	40.0	12.3	29.7	15.0	60.3	21.0	21.0
Change Period (Y+Rc), s	5.5	* 6	5.0	6.5	5.0	5.5	5.0	6.5
Max Green Setting (Gmax), s	13.0	* 34	9.0	21.5	10.0	37.5	16.0	14.5
Max Q Clear Time (g_c+I1), s	12.9	36.0	7.8	21.8	11.9	26.4	18.0	16.5
Green Ext Time (p_c), s	0.0	0.0	0.0	0.0	0.0	9.1	0.0	0.0

Intersection Summary	
HCM 2010 Ctrl Delay	55.7
HCM 2010 LOS	E

Notes



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	80	645	65	90	715	45	135	170	55	55	235	65
Future Volume (veh/h)	80	645	65	90	715	45	135	170	55	55	235	65
Number	7	4	14	3	8	18	5	2	12	1	6	16
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj Sat Flow, veh/h/ln	1814	1814	1814	1814	1814	1814	1814	1814	1814	1814	1814	1814
Adj Flow Rate, veh/h	87	701	71	98	777	49	147	185	60	60	255	71
Adj No. of Lanes	1	1	1	1	1	1	1	1	1	1	1	1
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	2	2	2	2	2	2	2	2	2	2	2	2
Cap, veh/h	270	1013	861	315	1013	861	305	529	450	359	529	450
Arrive On Green	0.56	0.56	0.56	0.56	0.56	0.56	0.29	0.29	0.29	0.29	0.29	0.29
Sat Flow, veh/h	661	1814	1542	695	1814	1542	1050	1814	1542	1130	1814	1542
Grp Volume(v), veh/h	87	701	71	98	777	49	147	185	60	60	255	71
Grp Sat Flow(s),veh/h/ln	661	1814	1542	695	1814	1542	1050	1814	1542	1130	1814	1542
Q Serve(g_s), s	7.0	16.7	1.3	7.1	19.9	0.9	8.1	4.8	1.7	2.7	7.0	2.1
Cycle Q Clear(g_c), s	26.9	16.7	1.3	23.8	19.9	0.9	15.0	4.8	1.7	7.5	7.0	2.1
Prop In Lane	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Lane Grp Cap(c), veh/h	270	1013	861	315	1013	861	305	529	450	359	529	450
V/C Ratio(X)	0.32	0.69	0.08	0.31	0.77	0.06	0.48	0.35	0.13	0.17	0.48	0.16
Avail Cap(c_a), veh/h	270	1013	861	315	1013	861	305	529	450	359	529	450
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	20.6	9.5	6.1	18.1	10.2	6.0	23.7	16.8	15.7	19.7	17.5	15.8
Incr Delay (d2), s/veh	3.1	3.9	0.2	2.6	5.6	0.1	5.4	1.8	0.6	1.0	3.1	0.7
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	1.5	9.3	0.6	1.6	11.3	0.4	2.8	2.7	0.8	0.9	3.9	1.0
LnGrp Delay(d),s/veh	23.8	13.4	6.3	20.7	15.8	6.2	29.1	18.6	16.3	20.7	20.6	16.5
LnGrp LOS	C	B	A	C	B	A	C	B	B	C	C	B
Approach Vol, veh/h		859			924			392			386	
Approach Delay, s/veh		13.9			15.8			22.2			19.9	
Approach LOS		B			B			C			B	

Timer	1	2	3	4	5	6	7	8
Assigned Phs		2		4		6		8
Phs Duration (G+Y+Rc), s		22.0		38.0		22.0		38.0
Change Period (Y+Rc), s		4.5		4.5		4.5		4.5
Max Green Setting (Gmax), s		17.5		33.5		17.5		33.5
Max Q Clear Time (g_c+I1), s		17.0		28.9		9.5		25.8
Green Ext Time (p_c), s		0.2		3.8		2.6		6.0

Intersection Summary		
HCM 2010 Ctrl Delay		16.8
HCM 2010 LOS		B



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	210	240	210	165	220	170	85	1135	120	110	1235	190
Future Volume (veh/h)	210	240	210	165	220	170	85	1135	120	110	1235	190
Number	7	4	14	3	8	18	1	6	16	5	2	12
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj Sat Flow, veh/h/ln	1814	1832	1850	1850	1832	1832	1832	1832	1850	1850	1832	1850
Adj Flow Rate, veh/h	241	312	244	194	242	185	102	1207	174	162	1328	224
Adj No. of Lanes	1	1	1	1	1	1	1	2	1	1	2	1
Peak Hour Factor	0.87	0.77	0.86	0.85	0.91	0.92	0.83	0.94	0.69	0.68	0.93	0.85
Percent Heavy Veh, %	2	1	0	0	1	1	1	1	0	0	1	0
Cap, veh/h	239	315	425	199	315	424	171	1463	765	176	1411	743
Arrive On Green	0.07	0.17	0.17	0.07	0.17	0.17	0.10	0.42	0.42	0.10	0.41	0.41
Sat Flow, veh/h	1727	1832	1570	1762	1832	1557	1744	3480	1571	1762	3480	1572
Grp Volume(v), veh/h	241	312	244	194	242	185	102	1207	174	162	1328	224
Grp Sat Flow(s),veh/h/ln	1727	1832	1570	1762	1832	1557	1744	1740	1571	1762	1740	1572
Q Serve(g_s), s	6.0	15.3	2.0	6.0	11.3	8.8	5.0	27.7	5.8	8.2	33.0	3.7
Cycle Q Clear(g_c), s	6.0	15.3	2.0	6.0	11.3	8.8	5.0	27.7	5.8	8.2	33.0	3.7
Prop In Lane	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Lane Grp Cap(c), veh/h	239	315	425	199	315	424	171	1463	765	176	1411	743
V/C Ratio(X)	1.01	0.99	0.57	0.97	0.77	0.44	0.60	0.82	0.23	0.92	0.94	0.30
Avail Cap(c_a), veh/h	239	315	425	199	315	424	174	1463	765	176	1411	743
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	1.00	1.00	1.00	1.00	1.00	0.89	0.89	0.89	0.26	0.26	0.26
Uniform Delay (d), s/veh	35.7	37.2	13.0	33.8	35.5	27.0	38.9	23.1	13.3	40.1	25.7	4.7
Incr Delay (d2), s/veh	59.9	47.6	2.6	55.8	11.9	1.2	3.2	4.9	0.6	17.7	4.6	0.3
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	7.1	11.9	3.7	5.0	6.8	3.9	2.6	14.2	2.6	4.9	16.6	1.6
LnGrp Delay(d),s/veh	95.7	84.8	15.6	89.6	47.5	28.3	42.1	28.0	13.9	57.8	30.3	4.9
LnGrp LOS	F	F	B	F	D	C	D	C	B	E	C	A
Approach Vol, veh/h		797			621			1483			1714	
Approach Delay, s/veh		66.9			54.9			27.3			29.6	
Approach LOS		E			D			C			C	

Timer	1	2	3	4	5	6	7	8
Assigned Phs	1	2	3	4	5	6	7	8
Phs Duration (G+Y+Rc), s	15.4	43.0	11.0	22.0	14.0	44.4	11.0	22.0
Change Period (Y+Rc), s	6.5	* 6.5	5.0	6.5	5.0	6.5	5.0	6.5
Max Green Setting (Gmax), s	9.0	* 37	6.0	15.5	9.0	36.5	6.0	15.5
Max Q Clear Time (g_c+I1), s	17.0	35.0	8.0	17.3	10.2	29.7	8.0	13.3
Green Ext Time (p_c), s	1.2	1.4	0.0	0.0	0.0	5.8	0.0	1.5

Intersection Summary	
HCM 2010 Ctrl Delay	38.7
HCM 2010 LOS	D

Notes



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	165	180	15	110	175	80	100	1505	110	140	1370	250
Future Volume (veh/h)	165	180	15	110	175	80	100	1505	110	140	1370	250
Number	7	4	14	3	8	18	1	6	16	5	2	12
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj Sat Flow, veh/h/ln	1850	1850	1850	1850	1850	1850	1850	1850	1850	1832	1850	1850
Adj Flow Rate, veh/h	214	228	23	131	186	107	133	1691	141	219	1691	352
Adj No. of Lanes	1	1	1	1	1	1	1	2	1	1	2	1
Peak Hour Factor	0.77	0.79	0.65	0.84	0.94	0.75	0.75	0.89	0.78	0.64	0.81	0.71
Percent Heavy Veh, %	0	0	0	0	0	0	0	0	0	1	0	0
Cap, veh/h	221	227	750	194	227	393	624	2651	1300	222	1805	922
Arrive On Green	0.07	0.12	0.12	0.07	0.12	0.12	0.35	0.75	0.75	0.13	0.51	0.51
Sat Flow, veh/h	1762	1850	1572	1762	1850	1572	1762	3515	1572	1744	3515	1572
Grp Volume(v), veh/h	214	228	23	131	186	107	133	1691	141	219	1691	352
Grp Sat Flow(s),veh/h/ln	1762	1850	1572	1762	1850	1572	1762	1758	1572	1744	1758	1572
Q Serve(g_s), s	8.0	13.5	0.2	7.1	10.8	6.0	5.8	25.1	1.9	13.8	49.6	10.9
Cycle Q Clear(g_c), s	8.0	13.5	0.2	7.1	10.8	6.0	5.8	25.1	1.9	13.8	49.6	10.9
Prop In Lane	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Lane Grp Cap(c), veh/h	221	227	750	194	227	393	624	2651	1300	222	1805	922
V/C Ratio(X)	0.97	1.00	0.03	0.68	0.82	0.27	0.21	0.64	0.11	0.99	0.94	0.38
Avail Cap(c_a), veh/h	221	227	750	194	227	393	624	2651	1300	222	1805	922
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	1.00	1.00	1.00	1.00	1.00	0.91	0.91	0.91	0.85	0.85	0.85
Uniform Delay (d), s/veh	44.3	48.3	19.1	39.3	47.1	33.2	24.8	6.4	1.8	47.9	25.1	18.6
Incr Delay (d2), s/veh	51.4	60.8	0.0	9.5	21.9	0.6	0.1	1.1	0.2	51.7	9.4	1.0
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	5.7	10.7	0.4	4.0	6.9	2.7	2.8	12.4	0.8	9.8	26.3	4.9
LnGrp Delay(d),s/veh	95.7	109.1	19.1	48.8	68.9	33.8	24.9	7.5	2.0	99.6	34.5	19.6
LnGrp LOS	F	F	B	D	E	C	C	A	A	F	C	B
Approach Vol, veh/h		465			424			1965			2262	
Approach Delay, s/veh		98.5			53.9			8.3			38.5	
Approach LOS		F			D			A			D	

Timer	1	2	3	4	5	6	7	8
Assigned Phs	1	2	3	4	5	6	7	8
Phs Duration (G+Y+Rc), s	15.7	63.0	13.0	20.0	19.0	89.7	13.0	20.0
Change Period (Y+Rc), s	6.5	* 6.5	5.0	6.5	5.0	6.5	5.0	6.5
Max Green Setting (Gmax), s	9.0	* 57	8.0	13.5	14.0	51.5	8.0	13.5
Max Q Clear Time (g_c+I1), s	12.8	51.6	9.1	15.5	15.8	27.1	10.0	12.8
Green Ext Time (p_c), s	0.1	4.7	0.0	0.0	0.0	20.9	0.0	0.3

Intersection Summary	
HCM 2010 Ctrl Delay	33.6
HCM 2010 LOS	C

Notes



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	75	390	175	30	45	90	65	860	50	350	885	70
Future Volume (veh/h)	75	390	175	30	45	90	65	860	50	350	885	70
Number	7	4	14	3	8	18	5	2	12	1	6	16
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj Sat Flow, veh/h/ln	1814	1814	1814	1814	1814	1814	1814	1814	1850	1814	1814	1814
Adj Flow Rate, veh/h	82	424	190	33	49	98	71	935	54	380	962	76
Adj No. of Lanes	1	1	1	1	1	1	1	2	0	1	2	1
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	2	2	2	2	2	2	2	2	2	2	2	2
Cap, veh/h	104	437	372	43	373	317	91	1032	60	393	1678	751
Arrive On Green	0.06	0.24	0.24	0.02	0.21	0.21	0.05	0.31	0.31	0.23	0.49	0.49
Sat Flow, veh/h	1727	1814	1542	1727	1814	1542	1727	3312	191	1727	3446	1542
Grp Volume(v), veh/h	82	424	190	33	49	98	71	486	503	380	962	76
Grp Sat Flow(s),veh/h/ln	1727	1814	1542	1727	1814	1542	1727	1723	1780	1727	1723	1542
Q Serve(g_s), s	4.2	20.8	9.6	1.7	2.0	4.9	3.7	24.4	24.4	19.6	17.9	2.4
Cycle Q Clear(g_c), s	4.2	20.8	9.6	1.7	2.0	4.9	3.7	24.4	24.4	19.6	17.9	2.4
Prop In Lane	1.00		1.00	1.00		1.00	1.00		0.11	1.00		1.00
Lane Grp Cap(c), veh/h	104	437	372	43	373	317	91	537	555	393	1678	751
V/C Ratio(X)	0.79	0.97	0.51	0.77	0.13	0.31	0.78	0.91	0.91	0.97	0.57	0.10
Avail Cap(c_a), veh/h	154	437	372	77	373	317	178	537	555	393	1678	751
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.90	0.90	0.90
Uniform Delay (d), s/veh	41.7	33.8	29.6	43.6	29.2	30.3	42.1	29.7	29.7	34.4	16.4	12.5
Incr Delay (d2), s/veh	14.8	35.1	1.2	24.0	0.2	0.5	13.6	21.4	20.9	34.2	1.3	0.2
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	2.4	14.6	4.2	1.1	1.0	2.1	2.1	14.7	15.1	13.0	8.7	1.1
LnGrp Delay(d),s/veh	56.5	68.9	30.7	67.6	29.3	30.9	55.7	51.1	50.6	68.6	17.7	12.7
LnGrp LOS	E	E	C	E	C	C	E	D	D	E	B	B
Approach Vol, veh/h		696			180			1060			1418	
Approach Delay, s/veh		57.0			37.2			51.2			31.1	
Approach LOS		E			D			D			C	

Timer	1	2	3	4	5	6	7	8
Assigned Phs	1	2	3	4	5	6	7	8
Phs Duration (G+Y+Rc), s	15.0	32.1	6.7	26.2	9.2	47.8	9.9	23.0
Change Period (Y+Rc), s	4.5	4.0	4.5	4.5	4.5	4.0	4.5	4.5
Max Green Setting (Gmax), s	10.5	26.3	4.0	21.7	9.3	37.5	8.0	17.7
Max Q Clear Time (g_c+I1), s	11.6	26.4	3.7	22.8	5.7	19.9	6.2	6.9
Green Ext Time (p_c), s	0.0	0.0	0.0	0.0	0.0	12.1	0.0	2.8

Intersection Summary	
HCM 2010 Ctrl Delay	43.1
HCM 2010 LOS	D

Intersection	
Intersection Delay, s/veh	15.3
Intersection LOS	C

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Vol, veh/h	30	205	35	100	125	5	20	160	95	5	240	35
Future Vol, veh/h	30	205	35	100	125	5	20	160	95	5	240	35
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	33	223	38	109	136	5	22	174	103	5	261	38
Number of Lanes	1	1	0	1	1	0	0	1	0	0	1	0

Approach	EB	WB	NB	SB
Opposing Approach	WB	EB	SB	NB
Opposing Lanes	2	2	1	1
Conflicting Approach Left	SB	NB	EB	WB
Conflicting Lanes Left	1	1	2	2
Conflicting Approach Right	NB	SB	WB	EB
Conflicting Lanes Right	1	1	2	2
HCM Control Delay	15.8	12.6	15.8	16.4
HCM LOS	C	B	C	C

Lane	NBLn1	EBLn1	EBLn2	WBLn1	WBLn2	SBLn1
Vol Left, %	7%	100%	0%	100%	0%	2%
Vol Thru, %	58%	0%	85%	0%	96%	86%
Vol Right, %	35%	0%	15%	0%	4%	12%
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop
Traffic Vol by Lane	275	30	240	100	130	280
LT Vol	20	30	0	100	0	5
Through Vol	160	0	205	0	125	240
RT Vol	95	0	35	0	5	35
Lane Flow Rate	299	33	261	109	141	304
Geometry Grp	2	7	7	7	7	2
Degree of Util (X)	0.516	0.068	0.5	0.23	0.278	0.534
Departure Headway (Hd)	6.218	7.514	6.896	7.623	7.081	6.315
Convergence, Y/N	Yes	Yes	Yes	Yes	Yes	Yes
Cap	580	476	522	471	506	569
Service Time	4.269	5.268	4.65	5.38	4.839	4.365
HCM Lane V/C Ratio	0.516	0.069	0.5	0.231	0.279	0.534
HCM Control Delay	15.8	10.8	16.4	12.7	12.6	16.4
HCM Lane LOS	C	B	C	B	B	C
HCM 95th-tile Q	2.9	0.2	2.8	0.9	1.1	3.1

Intersection	
Int Delay, s/veh	909.7

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		⇕			⇕			⇕			⇕	
Traffic Vol, veh/h	85	45	55	205	45	150	45	415	205	150	415	85
Future Vol, veh/h	85	45	55	205	45	150	45	415	205	150	415	85
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Free	Free	Free	Free	Free	Free
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	-	-	-	-	-	-	-	-	-	-	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	92	92	92	92	92	92	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	92	49	60	223	49	163	49	451	223	163	451	92

Major/Minor	Minor2			Minor1			Major1			Major2		
Conflicting Flow All	1589	1595	497	1538	1530	563	543	0	0	674	0	0
Stage 1	823	823	-	660	660	-	-	-	-	-	-	-
Stage 2	766	772	-	878	870	-	-	-	-	-	-	-
Critical Hdwy	7.12	6.52	6.22	7.12	6.52	6.22	4.12	-	-	4.12	-	-
Critical Hdwy Stg 1	6.12	5.52	-	6.12	5.52	-	-	-	-	-	-	-
Critical Hdwy Stg 2	6.12	5.52	-	6.12	5.52	-	-	-	-	-	-	-
Follow-up Hdwy	3.518	4.018	3.318	3.518	4.018	3.318	2.218	-	-	2.218	-	-
Pot Cap-1 Maneuver	~ 87	107	573	~ 94	117	526	1026	-	-	917	-	-
Stage 1	368	388	-	452	460	-	-	-	-	-	-	-
Stage 2	395	409	-	343	369	-	-	-	-	-	-	-
Platoon blocked, %								-	-		-	-
Mov Cap-1 Maneuver	~ 24	73	573	~ 30	80	526	1026	-	-	917	-	-
Mov Cap-2 Maneuver	~ 24	73	-	~ 30	80	-	-	-	-	-	-	-
Stage 1	339	288	-	416	424	-	-	-	-	-	-	-
Stage 2	222	377	-	~ 189	274	-	-	-	-	-	-	-

Approach	EB	WB	NB	SB
HCM Control Delay, s	$ 1843.5	$ 3463.6	0.6	2.3
HCM LOS	F	F		

Minor Lane/Major Mvmt	NBL	NBT	NBR	EBLn1	WBLn1	SBL	SBT	SBR
Capacity (veh/h)	1026	-	-	43	52	917	-	-
HCM Lane V/C Ratio	0.048	-	-	4.676	8.361	0.178	-	-
HCM Control Delay (s)	8.7	0	-	$ 1843.5	$ 3463.6	9.8	0	-
HCM Lane LOS	A	A	-	F	F	A	A	-
HCM 95th %tile Q(veh)	0.1	-	-	23	51	0.6	-	-

Notes			
~: Volume exceeds capacity	$: Delay exceeds 300s	+: Computation Not Defined	*: All major volume in platoon

Intersection	
Intersection Delay, s/veh	51.8
Intersection LOS	F

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Vol, veh/h	215	50	70	5	15	5	75	250	10	10	370	240
Future Vol, veh/h	215	50	70	5	15	5	75	250	10	10	370	240
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	234	54	76	5	16	5	82	272	11	11	402	261
Number of Lanes	0	1	0	0	1	0	0	1	0	0	1	0

Approach	EB	WB	NB	SB
Opposing Approach	WB	EB	SB	NB
Opposing Lanes	1	1	1	1
Conflicting Approach Left	SB	NB	EB	WB
Conflicting Lanes Left	1	1	1	1
Conflicting Approach Right	NB	SB	WB	EB
Conflicting Lanes Right	1	1	1	1
HCM Control Delay	23.4	11.8	21.1	85.3
HCM LOS	C	B	C	F

Lane	NBLn1	EBLn1	WBLn1	SBLn1
Vol Left, %	22%	64%	20%	2%
Vol Thru, %	75%	15%	60%	60%
Vol Right, %	3%	21%	20%	39%
Sign Control	Stop	Stop	Stop	Stop
Traffic Vol by Lane	335	335	25	620
LT Vol	75	215	5	10
Through Vol	250	50	15	370
RT Vol	10	70	5	240
Lane Flow Rate	364	364	27	674
Geometry Grp	1	1	1	1
Degree of Util (X)	0.648	0.677	0.06	1.086
Departure Headway (Hd)	6.675	6.987	8.297	5.799
Convergence, Y/N	Yes	Yes	Yes	Yes
Cap	546	521	434	620
Service Time	4.675	4.987	6.297	3.891
HCM Lane V/C Ratio	0.667	0.699	0.062	1.087
HCM Control Delay	21.1	23.4	11.8	85.3
HCM Lane LOS	C	C	B	F
HCM 95th-tile Q	4.6	5.1	0.2	19.4

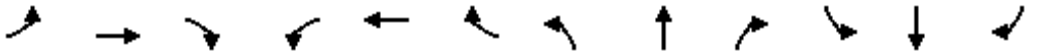
Intersection	
Int Delay, s/veh	6.4

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Vol, veh/h	85	30	185	10	10	5	85	165	10	10	200	130
Future Vol, veh/h	85	30	185	10	10	5	85	165	10	10	200	130
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Free	Free	Free	Free	Free	Free
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	0	-	-	-	-	-	-	-	-	-	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	92	92	92	92	92	92	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	92	33	201	11	11	5	92	179	11	11	217	141

Major/Minor	Minor2			Minor1			Major1			Major2		
Conflicting Flow All	688	685	288	797	750	185	359	0	0	190	0	0
Stage 1	310	310	-	370	370	-	-	-	-	-	-	-
Stage 2	378	375	-	427	380	-	-	-	-	-	-	-
Critical Hdwy	7.12	6.52	6.22	7.12	6.52	6.22	4.12	-	-	4.12	-	-
Critical Hdwy Stg 1	6.12	5.52	-	6.12	5.52	-	-	-	-	-	-	-
Critical Hdwy Stg 2	6.12	5.52	-	6.12	5.52	-	-	-	-	-	-	-
Follow-up Hdwy	3.518	4.018	3.318	3.518	4.018	3.318	2.218	-	-	2.218	-	-
Pot Cap-1 Maneuver	360	371	751	305	340	857	1200	-	-	1384	-	-
Stage 1	700	659	-	650	620	-	-	-	-	-	-	-
Stage 2	644	617	-	606	614	-	-	-	-	-	-	-
Platoon blocked, %								-	-		-	-
Mov Cap-1 Maneuver	323	336	751	192	308	857	1200	-	-	1384	-	-
Mov Cap-2 Maneuver	323	336	-	192	308	-	-	-	-	-	-	-
Stage 1	640	652	-	594	567	-	-	-	-	-	-	-
Stage 2	574	564	-	417	608	-	-	-	-	-	-	-

Approach	EB	WB	NB	SB
HCM Control Delay, s	15.7	19.4	2.7	0.2
HCM LOS	C	C		

Minor Lane/Major Mvmt	NBL	NBT	NBR	EBLn1	EBLn2	WBLn1	SBL	SBT	SBR
Capacity (veh/h)	1200	-	-	323	641	277	1384	-	-
HCM Lane V/C Ratio	0.077	-	-	0.286	0.365	0.098	0.008	-	-
HCM Control Delay (s)	8.2	0	-	20.6	13.8	19.4	7.6	0	-
HCM Lane LOS	A	A	-	C	B	C	A	A	-
HCM 95th %tile Q(veh)	0.2	-	-	1.2	1.7	0.3	0	-	-



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	220	570	310	580	690	120	130	805	425	110	1070	215
Future Volume (veh/h)	220	570	310	580	690	120	130	805	425	110	1070	215
Number	3	8	18	7	4	14	1	6	16	5	2	12
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj Sat Flow, veh/h/ln	1832	1832	1850	1832	1832	1832	1832	1814	1814	1832	1832	1832
Adj Flow Rate, veh/h	234	655	0	667	920	0	165	875	0	128	1176	0
Adj No. of Lanes	2	2	1	2	2	1	1	2	1	1	2	1
Peak Hour Factor	0.94	0.87	0.69	0.87	0.75	0.44	0.79	0.92	0.87	0.86	0.91	0.81
Percent Heavy Veh, %	1	1	0	1	1	1	1	2	2	1	1	1
Cap, veh/h	307	679	307	643	1007	450	178	1172	524	250	1183	529
Arrive On Green	0.09	0.20	0.00	0.19	0.29	0.00	0.06	0.34	0.00	0.06	0.34	0.00
Sat Flow, veh/h	3384	3480	1572	3384	3480	1557	1744	3446	1542	1744	3480	1557
Grp Volume(v), veh/h	234	655	0	667	920	0	165	875	0	128	1176	0
Grp Sat Flow(s),veh/h/ln	1692	1740	1572	1692	1740	1557	1744	1723	1542	1744	1740	1557
Q Serve(g_s), s	6.8	18.7	0.0	19.0	25.5	0.0	6.0	22.5	0.0	4.8	33.7	0.0
Cycle Q Clear(g_c), s	6.8	18.7	0.0	19.0	25.5	0.0	6.0	22.5	0.0	4.8	33.7	0.0
Prop In Lane	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Lane Grp Cap(c), veh/h	307	679	307	643	1007	450	178	1172	524	250	1183	529
V/C Ratio(X)	0.76	0.97	0.00	1.04	0.91	0.00	0.93	0.75	0.00	0.51	0.99	0.00
Avail Cap(c_a), veh/h	307	679	307	643	1027	459	178	1172	524	250	1183	529
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	0.39	0.39	0.00	1.00	1.00	0.00	0.59	0.59	0.00	0.85	0.85	0.00
Uniform Delay (d), s/veh	44.4	39.9	0.0	40.5	34.3	0.0	26.5	29.2	0.0	22.6	32.9	0.0
Incr Delay (d2), s/veh	3.9	14.3	0.0	45.5	12.5	0.0	32.7	2.6	0.0	0.6	22.7	0.0
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	3.3	10.3	0.0	12.9	14.0	0.0	3.3	11.1	0.0	2.3	19.9	0.0
LnGrp Delay(d),s/veh	48.3	54.2	0.0	86.0	46.8	0.0	59.2	31.8	0.0	23.2	55.5	0.0
LnGrp LOS	D	D		F	D		E	C		C	E	
Approach Vol, veh/h		889			1587			1040			1304	
Approach Delay, s/veh		52.7			63.3			36.2			52.4	
Approach LOS		D			E			D			D	

Timer	1	2	3	4	5	6	7	8
Assigned Phs	1	2	3	4	5	6	7	8
Phs Duration (G+Y+Rc), s	11.0	40.0	14.6	34.4	11.0	40.0	24.0	25.0
Change Period (Y+Rc), s	5.0	6.0	5.5	* 5.5	5.0	6.0	5.0	5.5
Max Green Setting (Gmax), s	6.0	34.0	9.0	* 30	6.0	34.0	19.0	19.5
Max Q Clear Time (g_c+I1), s	8.0	35.7	8.8	27.5	6.8	24.5	21.0	20.7
Green Ext Time (p_c), s	0.0	0.0	0.2	1.4	0.0	8.8	0.0	0.0

Intersection Summary	
HCM 2010 Ctrl Delay	52.5
HCM 2010 LOS	D

Notes



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	115	10	390	0	5	5	90	145	5	10	445	170
Future Volume (veh/h)	115	10	390	0	5	5	90	145	5	10	445	170
Number	7	4	14	3	8	18	5	2	12	1	6	16
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj Sat Flow, veh/h/ln	1850	1814	1814	1850	1814	1850	1814	1814	1850	1814	1814	1814
Adj Flow Rate, veh/h	125	11	0	0	5	5	98	158	5	11	484	0
Adj No. of Lanes	0	1	1	0	1	0	1	1	0	1	1	1
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	2	2	2	2	2	2	2	2	2	2	2	2
Cap, veh/h	347	14	199	0	107	107	642	1101	35	915	1142	971
Arrive On Green	0.13	0.13	0.00	0.00	0.13	0.13	0.63	0.63	0.63	0.63	0.63	0.00
Sat Flow, veh/h	1257	111	1542	0	833	833	908	1749	55	1218	1814	1542
Grp Volume(v), veh/h	136	0	0	0	0	10	98	0	163	11	484	0
Grp Sat Flow(s),veh/h/ln	1367	0	1542	0	0	1667	908	0	1804	1218	1814	1542
Q Serve(g_s), s	3.4	0.0	0.0	0.0	0.0	0.2	2.3	0.0	1.4	0.1	5.0	0.0
Cycle Q Clear(g_c), s	3.6	0.0	0.0	0.0	0.0	0.2	7.3	0.0	1.4	1.5	5.0	0.0
Prop In Lane	0.92		1.00	0.00		0.50	1.00		0.03	1.00		1.00
Lane Grp Cap(c), veh/h	361	0	199	0	0	215	642	0	1136	915	1142	971
V/C Ratio(X)	0.38	0.00	0.00	0.00	0.00	0.05	0.15	0.00	0.14	0.01	0.42	0.00
Avail Cap(c_a), veh/h	846	0	723	0	0	782	642	0	1136	915	1142	971
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	0.00	0.00	0.00	1.00	1.00	0.00	1.00	1.00	1.00	0.00
Uniform Delay (d), s/veh	15.8	0.0	0.0	0.0	0.0	14.2	5.3	0.0	2.8	3.1	3.5	0.0
Incr Delay (d2), s/veh	0.6	0.0	0.0	0.0	0.0	0.1	0.5	0.0	0.3	0.0	1.2	0.0
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	1.4	0.0	0.0	0.0	0.0	0.1	0.7	0.0	0.8	0.1	2.8	0.0
LnGrp Delay(d),s/veh	16.5	0.0	0.0	0.0	0.0	14.3	5.8	0.0	3.1	3.1	4.6	0.0
LnGrp LOS	B					B	A		A	A	A	
Approach Vol, veh/h		136			10			261			495	
Approach Delay, s/veh		16.5			14.3			4.1			4.6	
Approach LOS		B			B			A			A	

Timer	1	2	3	4	5	6	7	8
Assigned Phs		2		4		6		8
Phs Duration (G+Y+Rc), s		28.0		9.3		28.0		9.3
Change Period (Y+Rc), s		4.5		4.5		4.5		4.5
Max Green Setting (Gmax), s		23.5		17.5		23.5		17.5
Max Q Clear Time (g_c+I1), s		9.3		5.6		7.0		2.2
Green Ext Time (p_c), s		4.0		0.5		4.3		0.6

Intersection Summary	
HCM 2010 Ctrl Delay	6.4
HCM 2010 LOS	A

Intersection	
Int Delay, s/veh	142.4

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Vol, veh/h	80	85	145	125	55	90	55	605	35	55	65	10
Future Vol, veh/h	80	85	145	125	55	90	55	605	35	55	65	10
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Free	Free	Free	Free	Free	Free
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	-	-	-	-	-	-	110	-	-	110	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	92	92	92	92	92	92	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	87	92	158	136	60	98	60	658	38	60	71	11

Major/Minor	Minor2			Minor1			Major1			Major2		
Conflicting Flow All	1071	1011	76	1117	997	677	82	0	0	696	0	0
Stage 1	196	196	-	796	796	-	-	-	-	-	-	-
Stage 2	875	815	-	321	201	-	-	-	-	-	-	-
Critical Hdwy	7.12	6.52	6.22	7.12	6.52	6.22	4.12	-	-	4.12	-	-
Critical Hdwy Stg 1	6.12	5.52	-	6.12	5.52	-	-	-	-	-	-	-
Critical Hdwy Stg 2	6.12	5.52	-	6.12	5.52	-	-	-	-	-	-	-
Follow-up Hdwy	3.518	4.018	3.318	3.518	4.018	3.318	2.218	-	-	2.218	-	-
Pot Cap-1 Maneuver	198	240	985	185	244	453	1515	-	-	900	-	-
Stage 1	806	739	-	380	399	-	-	-	-	-	-	-
Stage 2	344	391	-	691	735	-	-	-	-	-	-	-
Platoon blocked, %								-	-		-	-
Mov Cap-1 Maneuver	113	215	985	~ 96	219	453	1515	-	-	900	-	-
Mov Cap-2 Maneuver	113	215	-	~ 96	219	-	-	-	-	-	-	-
Stage 1	774	690	-	365	383	-	-	-	-	-	-	-
Stage 2	219	376	-	469	686	-	-	-	-	-	-	-

Approach	EB	WB	NB	SB
HCM Control Delay, s	224.3	$ 480.3	0.6	3.9
HCM LOS	F	F		

Minor Lane/Major Mvmt	NBL	NBT	NBR	EBLn1	WBLn1	SBL	SBT	SBR
Capacity (veh/h)	1515	-	-	248	154	900	-	-
HCM Lane V/C Ratio	0.039	-	-	1.359	1.906	0.066	-	-
HCM Control Delay (s)	7.5	-	-	224.3	$ 480.3	9.3	-	-
HCM Lane LOS	A	-	-	F	F	A	-	-
HCM 95th %tile Q(veh)	0.1	-	-	18.1	22.4	0.2	-	-

Notes			
~: Volume exceeds capacity	$: Delay exceeds 300s	+: Computation Not Defined	*: All major volume in platoon

Intersection	
Int Delay, s/veh	4.6

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Vol, veh/h	55	80	165	40	65	35
Future Vol, veh/h	55	80	165	40	65	35
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	-	-	-	-
Veh in Median Storage, #	0	-	0	-	-	0
Grade, %	0	-	0	-	-	0
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	60	87	179	43	71	38

Major/Minor	Minor1		Major1		Major2	
Conflicting Flow All	380	201	0	0	223	0
Stage 1	201	-	-	-	-	-
Stage 2	179	-	-	-	-	-
Critical Hdwy	6.42	6.22	-	-	4.12	-
Critical Hdwy Stg 1	5.42	-	-	-	-	-
Critical Hdwy Stg 2	5.42	-	-	-	-	-
Follow-up Hdwy	3.518	3.318	-	-	2.218	-
Pot Cap-1 Maneuver	622	840	-	-	1346	-
Stage 1	833	-	-	-	-	-
Stage 2	852	-	-	-	-	-
Platoon blocked, %			-	-		-
Mov Cap-1 Maneuver	588	840	-	-	1346	-
Mov Cap-2 Maneuver	588	-	-	-	-	-
Stage 1	833	-	-	-	-	-
Stage 2	806	-	-	-	-	-

Approach	WB	NB	SB
HCM Control Delay, s	11.3	0	5.1
HCM LOS	B		

Minor Lane/Major Mvmt	NBT	NBR	WBLn1	SBL	SBT
Capacity (veh/h)	-	-	715	1346	-
HCM Lane V/C Ratio	-	-	0.205	0.052	-
HCM Control Delay (s)	-	-	11.3	7.8	0
HCM Lane LOS	-	-	B	A	A
HCM 95th %tile Q(veh)	-	-	0.8	0.2	-

Intersection	
Int Delay, s/veh	17.6

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	175	45	25	415	520	150
Future Vol, veh/h	175	45	25	415	520	150
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	-	-	-	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	190	49	27	451	565	163

Major/Minor	Minor2		Major1		Major2	
Conflicting Flow All	1152	647	728	0	-	0
Stage 1	647	-	-	-	-	-
Stage 2	505	-	-	-	-	-
Critical Hdwy	6.42	6.22	4.12	-	-	-
Critical Hdwy Stg 1	5.42	-	-	-	-	-
Critical Hdwy Stg 2	5.42	-	-	-	-	-
Follow-up Hdwy	3.518	3.318	2.218	-	-	-
Pot Cap-1 Maneuver	219	471	876	-	-	-
Stage 1	521	-	-	-	-	-
Stage 2	606	-	-	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	210	471	876	-	-	-
Mov Cap-2 Maneuver	210	-	-	-	-	-
Stage 1	521	-	-	-	-	-
Stage 2	581	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s	105.3	0.5	0
HCM LOS	F		

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	SBT	SBR
Capacity (veh/h)	876	-	237	-	-
HCM Lane V/C Ratio	0.031	-	1.009	-	-
HCM Control Delay (s)	9.2	0	105.3	-	-
HCM Lane LOS	A	A	F	-	-
HCM 95th %tile Q(veh)	0.1	-	9.6	-	-

Intersection	
Intersection Delay, s/veh	39.1
Intersection LOS	E

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Vol, veh/h	15	10	645	25	20	600
Future Vol, veh/h	15	10	645	25	20	600
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	16	11	701	27	22	652
Number of Lanes	1	0	1	0	0	1

Approach	WB	NB	SB
Opposing Approach		SB	NB
Opposing Lanes	0	1	1
Conflicting Approach Left	NB		WB
Conflicting Lanes Left	1	0	1
Conflicting Approach Right	SB	WB	
Conflicting Lanes Right	1	1	0
HCM Control Delay	10.2	44.1	34.8
HCM LOS	B	E	D

Lane	NBLn1	WBLn1	SBLn1
Vol Left, %	0%	60%	3%
Vol Thru, %	96%	0%	97%
Vol Right, %	4%	40%	0%
Sign Control	Stop	Stop	Stop
Traffic Vol by Lane	670	25	620
LT Vol	0	15	20
Through Vol	645	0	600
RT Vol	25	10	0
Lane Flow Rate	728	27	674
Geometry Grp	1	1	1
Degree of Util (X)	0.955	0.052	0.898
Departure Headway (Hd)	4.723	6.844	4.798
Convergence, Y/N	Yes	Yes	Yes
Cap	765	526	748
Service Time	2.782	4.844	2.859
HCM Lane V/C Ratio	0.952	0.051	0.901
HCM Control Delay	44.1	10.2	34.8
HCM Lane LOS	E	B	D
HCM 95th-tile Q	14.4	0.2	11.8

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	445	335	270	50	280	85	340	950	65	115	1050	600
Future Volume (veh/h)	445	335	270	50	280	85	340	950	65	115	1050	600
Number	7	4	14	3	8	18	1	6	16	5	2	12
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj Sat Flow, veh/h/ln	1832	1850	1832	1779	1832	1814	1814	1814	1779	1814	1832	1832
Adj Flow Rate, veh/h	571	385	0	111	329	0	447	1203	0	164	1193	0
Adj No. of Lanes	2	1	1	1	1	1	2	2	1	1	2	1
Peak Hour Factor	0.78	0.87	0.96	0.45	0.85	0.75	0.76	0.79	0.75	0.70	0.88	0.97
Percent Heavy Veh, %	1	0	1	4	1	2	2	2	4	2	1	1
Cap, veh/h	523	449	378	135	308	259	929	1833	804	173	1202	538
Arrive On Green	0.15	0.24	0.00	0.08	0.17	0.00	0.28	0.53	0.00	0.10	0.35	0.00
Sat Flow, veh/h	3384	1850	1557	1694	1832	1542	3351	3446	1512	1727	3480	1557
Grp Volume(v), veh/h	571	385	0	111	329	0	447	1203	0	164	1193	0
Grp Sat Flow(s),veh/h/ln	1692	1850	1557	1694	1832	1542	1676	1723	1512	1727	1740	1557
Q Serve(g_s), s	17.0	21.9	0.0	7.1	18.5	0.0	12.2	27.6	0.0	10.4	37.6	0.0
Cycle Q Clear(g_c), s	17.0	21.9	0.0	7.1	18.5	0.0	12.2	27.6	0.0	10.4	37.6	0.0
Prop In Lane	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Lane Grp Cap(c), veh/h	523	449	378	135	308	259	929	1833	804	173	1202	538
V/C Ratio(X)	1.09	0.86	0.00	0.82	1.07	0.00	0.48	0.66	0.00	0.95	0.99	0.00
Avail Cap(c_a), veh/h	523	449	378	139	308	259	929	1833	804	173	1202	538
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	1.00	0.00	1.00	1.00	0.00	0.90	0.90	0.00	0.84	0.84	0.00
Uniform Delay (d), s/veh	46.5	39.8	0.0	49.8	45.8	0.0	33.2	18.5	0.0	49.2	35.9	0.0
Incr Delay (d2), s/veh	66.6	16.2	0.0	28.4	70.5	0.0	0.1	1.7	0.0	48.0	22.1	0.0
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	12.8	13.1	0.0	4.4	15.4	0.0	5.7	13.5	0.0	7.3	21.7	0.0
LnGrp Delay(d),s/veh	113.1	56.1	0.0	78.2	116.2	0.0	33.3	20.2	0.0	97.3	57.9	0.0
LnGrp LOS	F	E		E	F		C	C		F	E	
Approach Vol, veh/h		956			440			1650			1357	
Approach Delay, s/veh		90.2			106.6			23.7			62.7	
Approach LOS		F			F			C			E	

Timer	1	2	3	4	5	6	7	8
Assigned Phs	1	2	3	4	5	6	7	8
Phs Duration (G+Y+Rc), s	36.5	44.0	13.8	33.2	16.0	64.5	22.0	25.0
Change Period (Y+Rc), s	5.5	* 6	5.0	6.5	5.0	5.5	5.0	6.5
Max Green Setting (Gmax), s	14.0	* 38	9.0	26.5	11.0	41.5	17.0	18.5
Max Q Clear Time (g_c+I1), s	14.2	39.6	9.1	23.9	12.4	29.6	19.0	20.5
Green Ext Time (p_c), s	0.0	0.0	0.0	1.4	0.0	9.7	0.0	0.0

Intersection Summary	
HCM 2010 Ctrl Delay	58.4
HCM 2010 LOS	E

Notes



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	80	650	70	90	715	45	140	175	55	55	230	65
Future Volume (veh/h)	80	650	70	90	715	45	140	175	55	55	230	65
Number	7	4	14	3	8	18	5	2	12	1	6	16
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj Sat Flow, veh/h/ln	1814	1814	1814	1814	1814	1814	1814	1814	1814	1814	1814	1814
Adj Flow Rate, veh/h	87	707	76	98	777	49	152	190	60	60	250	71
Adj No. of Lanes	1	1	1	1	1	1	1	1	1	1	1	1
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	2	2	2	2	2	2	2	2	2	2	2	2
Cap, veh/h	256	973	827	296	973	827	329	544	462	376	544	462
Arrive On Green	0.54	0.54	0.54	0.54	0.54	0.54	0.30	0.30	0.30	0.30	0.30	0.30
Sat Flow, veh/h	661	1814	1542	688	1814	1542	1054	1814	1542	1125	1814	1542
Grp Volume(v), veh/h	87	707	76	98	777	49	152	190	60	60	250	71
Grp Sat Flow(s),veh/h/ln	661	1814	1542	688	1814	1542	1054	1814	1542	1125	1814	1542
Q Serve(g_s), s	6.8	16.3	1.3	6.9	19.1	0.8	7.5	4.5	1.6	2.4	6.2	1.9
Cycle Q Clear(g_c), s	25.9	16.3	1.3	23.2	19.1	0.8	13.7	4.5	1.6	6.9	6.2	1.9
Prop In Lane	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Lane Grp Cap(c), veh/h	256	973	827	296	973	827	329	544	463	376	544	463
V/C Ratio(X)	0.34	0.73	0.09	0.33	0.80	0.06	0.46	0.35	0.13	0.16	0.46	0.15
Avail Cap(c_a), veh/h	256	973	827	296	973	827	329	544	463	376	544	463
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	20.8	9.7	6.2	18.5	10.3	6.1	21.2	15.1	14.0	17.8	15.6	14.1
Incr Delay (d2), s/veh	3.6	4.7	0.2	3.0	6.8	0.1	4.6	1.8	0.6	0.9	2.8	0.7
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	1.5	9.3	0.6	1.6	11.1	0.4	2.6	2.5	0.7	0.8	3.5	0.9
LnGrp Delay(d),s/veh	24.4	14.4	6.4	21.5	17.2	6.2	25.8	16.8	14.6	18.7	18.4	14.8
LnGrp LOS	C	B	A	C	B	A	C	B	B	B	B	B
Approach Vol, veh/h		870			924			402			381	
Approach Delay, s/veh		14.7			17.0			19.9			17.8	
Approach LOS		B			B			B			B	

Timer	1	2	3	4	5	6	7	8
Assigned Phs		2		4		6		8
Phs Duration (G+Y+Rc), s		21.0		34.0		21.0		34.0
Change Period (Y+Rc), s		4.5		4.5		4.5		4.5
Max Green Setting (Gmax), s		16.5		29.5		16.5		29.5
Max Q Clear Time (g_c+I1), s		15.7		27.9		8.9		25.2
Green Ext Time (p_c), s		0.4		1.4		2.5		3.5

Intersection Summary		
HCM 2010 Ctrl Delay		16.8
HCM 2010 LOS		B



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	190	220	190	135	180	140	80	1090	115	110	1215	190
Future Volume (veh/h)	190	220	190	135	180	140	80	1090	115	110	1215	190
Number	7	4	14	3	8	18	1	6	16	5	2	12
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj Sat Flow, veh/h/ln	1814	1832	1850	1850	1832	1832	1832	1832	1850	1850	1832	1850
Adj Flow Rate, veh/h	218	286	221	159	198	152	96	1160	167	162	1306	224
Adj No. of Lanes	1	1	1	1	1	1	1	2	1	1	2	1
Peak Hour Factor	0.87	0.77	0.86	0.85	0.91	0.92	0.83	0.94	0.69	0.68	0.93	0.85
Percent Heavy Veh, %	2	1	0	0	1	1	1	1	0	0	1	0
Cap, veh/h	269	315	401	215	315	440	145	1375	726	194	1411	743
Arrive On Green	0.07	0.17	0.17	0.07	0.17	0.17	0.08	0.40	0.40	0.11	0.41	0.41
Sat Flow, veh/h	1727	1832	1570	1762	1832	1557	1744	3480	1571	1762	3480	1572
Grp Volume(v), veh/h	218	286	221	159	198	152	96	1160	167	162	1306	224
Grp Sat Flow(s),veh/h/ln	1727	1832	1570	1762	1832	1557	1744	1740	1571	1762	1740	1572
Q Serve(g_s), s	6.0	13.8	1.8	6.0	9.0	7.0	4.8	27.2	5.8	8.1	32.1	3.7
Cycle Q Clear(g_c), s	6.0	13.8	1.8	6.0	9.0	7.0	4.8	27.2	5.8	8.1	32.1	3.7
Prop In Lane	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Lane Grp Cap(c), veh/h	269	315	401	215	315	440	145	1375	726	194	1411	743
V/C Ratio(X)	0.81	0.91	0.55	0.74	0.63	0.35	0.66	0.84	0.23	0.83	0.93	0.30
Avail Cap(c_a), veh/h	269	315	401	215	315	440	174	1375	726	196	1411	743
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	1.00	1.00	1.00	1.00	1.00	0.89	0.89	0.89	0.26	0.26	0.26
Uniform Delay (d), s/veh	34.1	36.5	12.7	31.2	34.6	25.7	40.0	24.7	14.6	39.2	25.5	4.4
Incr Delay (d2), s/veh	15.7	28.9	2.4	13.2	5.0	0.8	3.6	5.8	0.7	7.6	3.8	0.3
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	3.7	9.5	3.3	1.8	5.0	3.1	2.5	14.2	2.6	4.4	16.2	1.6
LnGrp Delay(d),s/veh	49.9	65.5	15.1	44.5	39.5	26.5	43.6	30.5	15.2	46.8	29.2	4.7
LnGrp LOS	D	E	B	D	D	C	D	C	B	D	C	A
Approach Vol, veh/h		725			509			1423			1692	
Approach Delay, s/veh		45.4			37.2			29.6			27.7	
Approach LOS		D			D			C			C	

Timer	1	2	3	4	5	6	7	8
Assigned Phs	1	2	3	4	5	6	7	8
Phs Duration (G+Y+Rc), s	14.0	43.0	11.0	22.0	14.9	42.1	11.0	22.0
Change Period (Y+Rc), s	6.5	* 6.5	5.0	6.5	5.0	6.5	5.0	6.5
Max Green Setting (Gmax), s	9.0	* 37	6.0	15.5	10.0	35.5	6.0	15.5
Max Q Clear Time (g_c+I1), s	5.8	34.1	8.0	15.8	10.1	29.2	8.0	11.0
Green Ext Time (p_c), s	1.5	2.2	0.0	0.0	0.0	5.3	0.0	2.5

Intersection Summary	
HCM 2010 Ctrl Delay	32.4
HCM 2010 LOS	C

Notes



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	165	180	15	110	175	80	95	1490	110	135	1325	240
Future Volume (veh/h)	165	180	15	110	175	80	95	1490	110	135	1325	240
Number	7	4	14	3	8	18	1	6	16	5	2	12
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj Sat Flow, veh/h/ln	1850	1850	1850	1850	1850	1850	1850	1850	1850	1832	1850	1850
Adj Flow Rate, veh/h	214	228	23	131	186	107	127	1674	141	211	1636	338
Adj No. of Lanes	1	1	1	1	1	1	1	2	1	1	2	1
Peak Hour Factor	0.77	0.79	0.65	0.84	0.94	0.75	0.75	0.89	0.78	0.64	0.81	0.71
Percent Heavy Veh, %	0	0	0	0	0	0	0	0	0	1	0	0
Cap, veh/h	231	213	579	213	213	354	446	2261	1137	192	1705	888
Arrive On Green	0.08	0.12	0.12	0.08	0.12	0.12	0.25	0.64	0.64	0.11	0.49	0.49
Sat Flow, veh/h	1762	1850	1572	1762	1850	1572	1762	3515	1572	1744	3515	1572
Grp Volume(v), veh/h	214	228	23	131	186	107	127	1674	141	211	1636	338
Grp Sat Flow(s),veh/h/ln	1762	1850	1572	1762	1850	1572	1762	1758	1572	1744	1758	1572
Q Serve(g_s), s	8.0	11.5	0.2	6.5	9.9	5.7	5.8	32.4	2.7	11.0	44.8	5.6
Cycle Q Clear(g_c), s	8.0	11.5	0.2	6.5	9.9	5.7	5.8	32.4	2.7	11.0	44.8	5.6
Prop In Lane	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Lane Grp Cap(c), veh/h	231	213	579	213	213	354	446	2261	1137	192	1705	888
V/C Ratio(X)	0.93	1.07	0.04	0.62	0.87	0.30	0.28	0.74	0.12	1.10	0.96	0.38
Avail Cap(c_a), veh/h	231	213	579	213	213	354	446	2261	1137	192	1705	888
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	1.00	1.00	1.00	1.00	1.00	0.91	0.91	0.91	0.85	0.85	0.85
Uniform Delay (d), s/veh	39.7	44.3	16.2	35.7	43.5	32.2	30.1	12.2	4.2	44.5	24.8	9.1
Incr Delay (d2), s/veh	39.3	82.0	0.0	5.6	31.7	0.8	0.1	2.0	0.2	89.2	12.6	1.1
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	4.5	10.7	0.4	3.5	6.9	2.5	2.8	16.2	1.2	10.0	24.6	2.7
LnGrp Delay(d),s/veh	79.0	126.3	16.3	41.3	75.3	33.0	30.2	14.2	4.4	133.7	37.4	10.2
LnGrp LOS	E	F	B	D	E	C	C	B	A	F	D	B
Approach Vol, veh/h		465			424			1942			2185	
Approach Delay, s/veh		99.1			54.1			14.5			42.5	
Approach LOS		F			D			B			D	

Timer	1	2	3	4	5	6	7	8
Assigned Phs	1	2	3	4	5	6	7	8
Phs Duration (G+Y+Rc), s	11.9	55.0	13.0	18.0	16.0	70.9	13.0	18.0
Change Period (Y+Rc), s	6.5	* 6.5	5.0	6.5	5.0	6.5	5.0	6.5
Max Green Setting (Gmax), s	9.0	* 49	8.0	11.5	11.0	46.5	8.0	11.5
Max Q Clear Time (g_c+I1), s	7.8	46.8	8.5	13.5	13.0	34.4	10.0	11.9
Green Ext Time (p_c), s	0.1	1.6	0.0	0.0	0.0	10.9	0.0	0.0

Intersection Summary	
HCM 2010 Ctrl Delay	37.9
HCM 2010 LOS	D

Notes



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	80	410	185	30	45	90	65	870	50	355	895	70
Future Volume (veh/h)	80	410	185	30	45	90	65	870	50	355	895	70
Number	7	4	14	3	8	18	5	2	12	1	6	16
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj Sat Flow, veh/h/ln	1814	1814	1814	1814	1814	1814	1814	1814	1850	1814	1814	1814
Adj Flow Rate, veh/h	87	446	201	33	49	98	71	946	54	386	973	76
Adj No. of Lanes	1	1	1	1	1	1	1	2	0	1	2	1
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	2	2	2	2	2	2	2	2	2	2	2	2
Cap, veh/h	110	463	393	41	390	332	91	1031	59	406	1701	761
Arrive On Green	0.06	0.26	0.26	0.02	0.22	0.22	0.05	0.31	0.31	0.23	0.49	0.49
Sat Flow, veh/h	1727	1814	1542	1727	1814	1542	1727	3314	189	1727	3446	1542
Grp Volume(v), veh/h	87	446	201	33	49	98	71	492	508	386	973	76
Grp Sat Flow(s),veh/h/ln	1727	1814	1542	1727	1814	1542	1727	1723	1780	1727	1723	1542
Q Serve(g_s), s	5.0	24.3	11.2	1.9	2.2	5.3	4.1	27.5	27.5	22.0	19.9	2.6
Cycle Q Clear(g_c), s	5.0	24.3	11.2	1.9	2.2	5.3	4.1	27.5	27.5	22.0	19.9	2.6
Prop In Lane	1.00		1.00	1.00		1.00	1.00		0.11	1.00		1.00
Lane Grp Cap(c), veh/h	110	463	393	41	390	332	91	536	554	406	1701	761
V/C Ratio(X)	0.79	0.96	0.51	0.80	0.13	0.30	0.78	0.92	0.92	0.95	0.57	0.10
Avail Cap(c_a), veh/h	187	463	393	71	390	332	168	536	554	406	1701	761
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.90	0.90	0.90
Uniform Delay (d), s/veh	46.1	36.8	31.9	48.6	31.7	32.9	46.8	33.2	33.2	37.7	17.9	13.5
Incr Delay (d2), s/veh	11.7	32.7	1.1	28.0	0.1	0.5	13.6	23.1	22.6	30.2	1.3	0.2
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	2.7	16.3	4.9	1.2	1.1	2.3	2.3	16.6	17.0	13.9	9.8	1.2
LnGrp Delay(d),s/veh	57.8	69.5	33.0	76.6	31.8	33.4	60.4	56.3	55.8	67.9	19.1	13.7
LnGrp LOS	E	E	C	E	C	C	E	E	E	E	B	B
Approach Vol, veh/h		734			180			1071			1435	
Approach Delay, s/veh		58.1			40.9			56.3			32.0	
Approach LOS		E			D			E			C	

Timer	1	2	3	4	5	6	7	8
Assigned Phs	1	2	3	4	5	6	7	8
Phs Duration (G+Y+Rc), s	28.0	35.1	6.9	30.0	9.7	53.4	10.9	26.0
Change Period (Y+Rc), s	4.5	4.0	4.5	4.5	4.5	4.0	4.5	4.5
Max Green Setting (Gmax), s	23.5	29.4	4.1	25.5	9.7	43.2	10.8	18.8
Max Q Clear Time (g_c+I1), s	24.0	29.5	3.9	26.3	6.1	21.9	7.0	7.3
Green Ext Time (p_c), s	0.0	0.0	0.0	0.0	0.0	14.0	0.1	3.1

Intersection Summary	
HCM 2010 Ctrl Delay	45.7
HCM 2010 LOS	D

Intersection	
Intersection Delay, s/veh	14.3
Intersection LOS	B

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Vol, veh/h	30	195	30	90	115	5	20	155	90	5	240	35
Future Vol, veh/h	30	195	30	90	115	5	20	155	90	5	240	35
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	33	212	33	98	125	5	22	168	98	5	261	38
Number of Lanes	1	1	0	1	1	0	0	1	0	0	1	0

Approach	EB	WB	NB	SB
Opposing Approach	WB	EB	SB	NB
Opposing Lanes	2	2	1	1
Conflicting Approach Left	SB	NB	EB	WB
Conflicting Lanes Left	1	1	2	2
Conflicting Approach Right	NB	SB	WB	EB
Conflicting Lanes Right	1	1	2	2
HCM Control Delay	14.6	12	14.6	15.5
HCM LOS	B	B	B	C

Lane	NBLn1	EBLn1	EBLn2	WBLn1	WBLn2	SBLn1
Vol Left, %	8%	100%	0%	100%	0%	2%
Vol Thru, %	58%	0%	87%	0%	96%	86%
Vol Right, %	34%	0%	13%	0%	4%	12%
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop
Traffic Vol by Lane	265	30	225	90	120	280
LT Vol	20	30	0	90	0	5
Through Vol	155	0	195	0	115	240
RT Vol	90	0	30	0	5	35
Lane Flow Rate	288	33	245	98	130	304
Geometry Grp	2	7	7	7	7	2
Degree of Util (X)	0.483	0.067	0.459	0.203	0.251	0.517
Departure Headway (Hd)	6.042	7.369	6.761	7.48	6.937	6.114
Convergence, Y/N	Yes	Yes	Yes	Yes	Yes	Yes
Cap	596	486	533	480	518	590
Service Time	4.081	5.11	4.502	5.225	4.681	4.151
HCM Lane V/C Ratio	0.483	0.068	0.46	0.204	0.251	0.515
HCM Control Delay	14.6	10.6	15.1	12.1	12	15.5
HCM Lane LOS	B	B	C	B	B	C
HCM 95th-tile Q	2.6	0.2	2.4	0.8	1	3

Intersection	
Int Delay, s/veh	2.4

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	65	40	30	270	390	85
Future Vol, veh/h	65	40	30	270	390	85
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	-	-	-	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	71	43	33	293	424	92

Major/Minor	Minor2		Major1		Major2	
Conflicting Flow All	829	470	516	0	-	0
Stage 1	470	-	-	-	-	-
Stage 2	359	-	-	-	-	-
Critical Hdwy	6.42	6.22	4.12	-	-	-
Critical Hdwy Stg 1	5.42	-	-	-	-	-
Critical Hdwy Stg 2	5.42	-	-	-	-	-
Follow-up Hdwy	3.518	3.318	2.218	-	-	-
Pot Cap-1 Maneuver	340	594	1050	-	-	-
Stage 1	629	-	-	-	-	-
Stage 2	707	-	-	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	327	594	1050	-	-	-
Mov Cap-2 Maneuver	327	-	-	-	-	-
Stage 1	629	-	-	-	-	-
Stage 2	680	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s	17.8	0.9	0
HCM LOS	C		

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	SBT	SBR
Capacity (veh/h)	1050	-	395	-	-
HCM Lane V/C Ratio	0.031	-	0.289	-	-
HCM Control Delay (s)	8.5	0	17.8	-	-
HCM Lane LOS	A	A	C	-	-
HCM 95th %tile Q(veh)	0.1	-	1.2	-	-

Intersection	
Intersection Delay, s/veh	112
Intersection LOS	F

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Vol, veh/h	290	65	90	5	15	5	70	230	10	15	425	275
Future Vol, veh/h	290	65	90	5	15	5	70	230	10	15	425	275
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	315	71	98	5	16	5	76	250	11	16	462	299
Number of Lanes	0	1	0	0	1	0	0	1	0	0	1	0

Approach	EB	WB	NB	SB
Opposing Approach	WB	EB	SB	NB
Opposing Lanes	1	1	1	1
Conflicting Approach Left	SB	NB	EB	WB
Conflicting Lanes Left	1	1	1	1
Conflicting Approach Right	NB	SB	WB	EB
Conflicting Lanes Right	1	1	1	1
HCM Control Delay	47.4	13.1	23.6	194
HCM LOS	E	B	C	F

Lane	NBLn1	EBLn1	WBLn1	SBLn1
Vol Left, %	23%	65%	20%	2%
Vol Thru, %	74%	15%	60%	59%
Vol Right, %	3%	20%	20%	38%
Sign Control	Stop	Stop	Stop	Stop
Traffic Vol by Lane	310	445	25	715
LT Vol	70	290	5	15
Through Vol	230	65	15	425
RT Vol	10	90	5	275
Lane Flow Rate	337	484	27	777
Geometry Grp	1	1	1	1
Degree of Util (X)	0.65	0.901	0.064	1.363
Departure Headway (Hd)	7.599	7.442	9.491	6.314
Convergence, Y/N	Yes	Yes	Yes	Yes
Cap	478	493	380	575
Service Time	5.599	5.442	7.491	4.405
HCM Lane V/C Ratio	0.705	0.982	0.071	1.351
HCM Control Delay	23.6	47.4	13.1	194
HCM Lane LOS	C	E	B	F
HCM 95th-tile Q	4.6	10.1	0.2	34

Intersection	
Int Delay, s/veh	6

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Vol, veh/h	75	30	165	10	10	5	85	160	10	10	185	125
Future Vol, veh/h	75	30	165	10	10	5	85	160	10	10	185	125
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Free	Free	Free	Free	Free	Free
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	0	-	-	-	-	-	-	-	-	-	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	92	92	92	92	92	92	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	82	33	179	11	11	5	92	174	11	11	201	136

Major/Minor	Minor2			Minor1			Major1			Major2		
Conflicting Flow All	663	661	269	761	723	179	337	0	0	185	0	0
Stage 1	291	291	-	364	364	-	-	-	-	-	-	-
Stage 2	372	370	-	397	359	-	-	-	-	-	-	-
Critical Hdwy	7.12	6.52	6.22	7.12	6.52	6.22	4.12	-	-	4.12	-	-
Critical Hdwy Stg 1	6.12	5.52	-	6.12	5.52	-	-	-	-	-	-	-
Critical Hdwy Stg 2	6.12	5.52	-	6.12	5.52	-	-	-	-	-	-	-
Follow-up Hdwy	3.518	4.018	3.318	3.518	4.018	3.318	2.218	-	-	2.218	-	-
Pot Cap-1 Maneuver	375	383	770	322	352	864	1222	-	-	1390	-	-
Stage 1	717	672	-	655	624	-	-	-	-	-	-	-
Stage 2	648	620	-	629	627	-	-	-	-	-	-	-
Platoon blocked, %								-	-		-	-
Mov Cap-1 Maneuver	337	347	770	213	319	864	1222	-	-	1390	-	-
Mov Cap-2 Maneuver	337	347	-	213	319	-	-	-	-	-	-	-
Stage 1	657	665	-	600	572	-	-	-	-	-	-	-
Stage 2	579	568	-	454	621	-	-	-	-	-	-	-

Approach	EB	WB	NB	SB
HCM Control Delay, s	14.8	18.3	2.7	0.2
HCM LOS	B	C		

Minor Lane/Major Mvmt	NBL	NBT	NBR	EBLn1	EBLn2	WBLn1	SBL	SBT	SBR
Capacity (veh/h)	1222	-	-	337	648	297	1390	-	-
HCM Lane V/C Ratio	0.076	-	-	0.242	0.327	0.091	0.008	-	-
HCM Control Delay (s)	8.2	0	-	19.1	13.2	18.3	7.6	0	-
HCM Lane LOS	A	A	-	C	B	C	A	A	-
HCM 95th %tile Q(veh)	0.2	-	-	0.9	1.4	0.3	0	-	-

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	215	555	300	570	680	115	130	805	425	105	1060	215
Future Volume (veh/h)	215	555	300	570	680	115	130	805	425	105	1060	215
Number	3	8	18	7	4	14	1	6	16	5	2	12
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj Sat Flow, veh/h/ln	1832	1832	1850	1832	1832	1832	1832	1814	1814	1832	1832	1832
Adj Flow Rate, veh/h	229	638	0	655	907	0	165	875	0	122	1165	0
Adj No. of Lanes	2	2	1	2	2	1	1	2	1	1	2	1
Peak Hour Factor	0.94	0.87	0.69	0.87	0.75	0.44	0.79	0.92	0.87	0.86	0.91	0.81
Percent Heavy Veh, %	1	1	0	1	1	1	1	2	2	1	1	1
Cap, veh/h	320	638	288	639	947	424	196	1129	505	256	1134	507
Arrive On Green	0.09	0.18	0.00	0.19	0.27	0.00	0.07	0.33	0.00	0.06	0.33	0.00
Sat Flow, veh/h	3384	3480	1572	3384	3480	1557	1744	3446	1542	1744	3480	1557
Grp Volume(v), veh/h	229	638	0	655	907	0	165	875	0	122	1165	0
Grp Sat Flow(s),veh/h/ln	1692	1740	1572	1692	1740	1557	1744	1723	1542	1744	1740	1557
Q Serve(g_s), s	5.9	16.5	0.0	17.0	23.1	0.0	5.7	20.6	0.0	4.1	29.3	0.0
Cycle Q Clear(g_c), s	5.9	16.5	0.0	17.0	23.1	0.0	5.7	20.6	0.0	4.1	29.3	0.0
Prop In Lane	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Lane Grp Cap(c), veh/h	320	638	288	639	947	424	196	1129	505	256	1134	507
V/C Ratio(X)	0.72	1.00	0.00	1.02	0.96	0.00	0.84	0.77	0.00	0.48	1.03	0.00
Avail Cap(c_a), veh/h	338	638	288	639	947	424	196	1129	505	259	1134	507
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	0.39	0.39	0.00	1.00	1.00	0.00	0.59	0.59	0.00	0.85	0.85	0.00
Uniform Delay (d), s/veh	39.6	36.7	0.0	36.5	32.2	0.0	23.1	27.3	0.0	20.8	30.3	0.0
Incr Delay (d2), s/veh	2.2	22.0	0.0	42.0	19.8	0.0	16.4	3.2	0.0	0.4	31.8	0.0
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	2.9	9.8	0.0	11.6	13.7	0.0	3.6	10.2	0.0	2.0	19.0	0.0
LnGrp Delay(d),s/veh	41.8	58.8	0.0	78.5	52.1	0.0	39.5	30.4	0.0	21.3	62.1	0.0
LnGrp LOS	D	E		F	D		D	C		C	F	
Approach Vol, veh/h		867			1562			1040			1287	
Approach Delay, s/veh		54.3			63.2			31.9			58.3	
Approach LOS		D			E			C			E	

Timer	1	2	3	4	5	6	7	8
Assigned Phs	1	2	3	4	5	6	7	8
Phs Duration (G+Y+Rc), s	11.0	35.3	14.0	30.0	10.8	35.5	22.0	22.0
Change Period (Y+Rc), s	5.0	6.0	5.5	* 5.5	5.0	6.0	5.0	5.5
Max Green Setting (Gmax), s	6.0	29.0	9.0	* 25	6.0	29.0	17.0	16.5
Max Q Clear Time (g_c+I1), s	7.7	31.3	7.9	25.1	6.1	22.6	19.0	18.5
Green Ext Time (p_c), s	0.0	0.0	0.6	0.0	0.0	6.0	0.0	0.0

Intersection Summary	
HCM 2010 Ctrl Delay	53.4
HCM 2010 LOS	D

Notes



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	115	10	375	0	5	5	95	150	5	10	415	160
Future Volume (veh/h)	115	10	375	0	5	5	95	150	5	10	415	160
Number	7	4	14	3	8	18	5	2	12	1	6	16
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj Sat Flow, veh/h/ln	1850	1814	1814	1850	1814	1850	1814	1814	1850	1814	1814	1814
Adj Flow Rate, veh/h	125	11	0	0	5	5	103	163	5	11	451	0
Adj No. of Lanes	0	1	1	0	1	0	1	1	0	1	1	1
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	2	2	2	2	2	2	2	2	2	2	2	2
Cap, veh/h	372	14	198	0	107	107	654	1044	32	893	1082	920
Arrive On Green	0.13	0.13	0.00	0.00	0.13	0.13	0.60	0.60	0.60	0.60	0.60	0.00
Sat Flow, veh/h	1256	111	1542	0	833	833	936	1751	54	1212	1814	1542
Grp Volume(v), veh/h	136	0	0	0	0	10	103	0	168	11	451	0
Grp Sat Flow(s),veh/h/ln	1367	0	1542	0	0	1667	936	0	1804	1212	1814	1542
Q Serve(g_s), s	3.0	0.0	0.0	0.0	0.0	0.2	2.2	0.0	1.4	0.1	4.4	0.0
Cycle Q Clear(g_c), s	3.2	0.0	0.0	0.0	0.0	0.2	6.5	0.0	1.4	1.5	4.4	0.0
Prop In Lane	0.92		1.00	0.00		0.50	1.00		0.03	1.00		1.00
Lane Grp Cap(c), veh/h	386	0	198	0	0	214	654	0	1076	893	1082	920
V/C Ratio(X)	0.35	0.00	0.00	0.00	0.00	0.05	0.16	0.00	0.16	0.01	0.42	0.00
Avail Cap(c_a), veh/h	923	0	778	0	0	841	654	0	1076	893	1082	920
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	0.00	0.00	0.00	1.00	1.00	0.00	1.00	1.00	1.00	0.00
Uniform Delay (d), s/veh	13.9	0.0	0.0	0.0	0.0	12.5	5.3	0.0	2.9	3.3	3.5	0.0
Incr Delay (d2), s/veh	0.5	0.0	0.0	0.0	0.0	0.1	0.5	0.0	0.3	0.0	1.2	0.0
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	1.2	0.0	0.0	0.0	0.0	0.1	0.6	0.0	0.7	0.0	2.5	0.0
LnGrp Delay(d),s/veh	14.4	0.0	0.0	0.0	0.0	12.6	5.8	0.0	3.2	3.3	4.7	0.0
LnGrp LOS	B					B	A		A	A	A	
Approach Vol, veh/h		136			10			271			462	
Approach Delay, s/veh		14.4			12.6			4.2			4.7	
Approach LOS		B			B			A			A	

Timer	1	2	3	4	5	6	7	8
Assigned Phs		2		4		6		8
Phs Duration (G+Y+Rc), s		24.0		8.7		24.0		8.7
Change Period (Y+Rc), s		4.5		4.5		4.5		4.5
Max Green Setting (Gmax), s		19.5		16.5		19.5		16.5
Max Q Clear Time (g_c+I1), s		8.5		5.2		6.4		2.2
Green Ext Time (p_c), s		3.4		0.5		3.7		0.6

Intersection Summary		
HCM 2010 Ctrl Delay		6.1
HCM 2010 LOS		A

Intersection	
Int Delay, s/veh	51

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Vol, veh/h	55	70	90	125	55	90	45	465	25	65	70	10
Future Vol, veh/h	55	70	90	125	55	90	45	465	25	65	70	10
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Free	Free	Free	Free	Free	Free
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	-	-	-	-	-	-	110	-	-	110	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	92	92	92	92	92	92	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	60	76	98	136	60	98	49	505	27	71	76	11

Major/Minor	Minor2			Minor1			Major1			Major2		
Conflicting Flow All	919	853	82	927	845	519	87	0	0	533	0	0
Stage 1	223	223	-	617	617	-	-	-	-	-	-	-
Stage 2	696	630	-	310	228	-	-	-	-	-	-	-
Critical Hdwy	7.12	6.52	6.22	7.12	6.52	6.22	4.12	-	-	4.12	-	-
Critical Hdwy Stg 1	6.12	5.52	-	6.12	5.52	-	-	-	-	-	-	-
Critical Hdwy Stg 2	6.12	5.52	-	6.12	5.52	-	-	-	-	-	-	-
Follow-up Hdwy	3.518	4.018	3.318	3.518	4.018	3.318	2.218	-	-	2.218	-	-
Pot Cap-1 Maneuver	252	296	978	249	300	557	1509	-	-	1035	-	-
Stage 1	780	719	-	477	481	-	-	-	-	-	-	-
Stage 2	432	475	-	700	715	-	-	-	-	-	-	-
Platoon blocked, %								-	-		-	-
Mov Cap-1 Maneuver	160	267	978	162	270	557	1509	-	-	1035	-	-
Mov Cap-2 Maneuver	160	267	-	162	270	-	-	-	-	-	-	-
Stage 1	755	670	-	462	465	-	-	-	-	-	-	-
Stage 2	300	460	-	520	666	-	-	-	-	-	-	-

Approach	EB	WB	NB	SB
HCM Control Delay, s	45.7	180.3	0.6	3.9
HCM LOS	E	F		

Minor Lane/Major Mvmt	NBL	NBT	NBR	EBLn1	WBLn1	SBL	SBT	SBR
Capacity (veh/h)	1509	-	-	308	237	1035	-	-
HCM Lane V/C Ratio	0.032	-	-	0.759	1.238	0.068	-	-
HCM Control Delay (s)	7.5	-	-	45.7	180.3	8.7	-	-
HCM Lane LOS	A	-	-	E	F	A	-	-
HCM 95th %tile Q(veh)	0.1	-	-	5.8	14.6	0.2	-	-

Intersection	
Int Delay, s/veh	4.7

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Vol, veh/h	55	80	160	35	65	40
Future Vol, veh/h	55	80	160	35	65	40
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	-	-	-	-
Veh in Median Storage, #	0	-	0	-	-	0
Grade, %	0	-	0	-	-	0
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	60	87	174	38	71	43

Major/Minor	Minor1		Major1		Major2	
Conflicting Flow All	378	193	0	0	212	0
Stage 1	193	-	-	-	-	-
Stage 2	185	-	-	-	-	-
Critical Hdwy	6.42	6.22	-	-	4.12	-
Critical Hdwy Stg 1	5.42	-	-	-	-	-
Critical Hdwy Stg 2	5.42	-	-	-	-	-
Follow-up Hdwy	3.518	3.318	-	-	2.218	-
Pot Cap-1 Maneuver	624	849	-	-	1358	-
Stage 1	840	-	-	-	-	-
Stage 2	847	-	-	-	-	-
Platoon blocked, %			-	-		-
Mov Cap-1 Maneuver	590	849	-	-	1358	-
Mov Cap-2 Maneuver	590	-	-	-	-	-
Stage 1	840	-	-	-	-	-
Stage 2	801	-	-	-	-	-

Approach	WB	NB	SB
HCM Control Delay, s	11.3	0	4.8
HCM LOS	B		

Minor Lane/Major Mvmt	NBT	NBR	WBLn1	SBL	SBT
Capacity (veh/h)	-	-	720	1358	-
HCM Lane V/C Ratio	-	-	0.204	0.052	-
HCM Control Delay (s)	-	-	11.3	7.8	0
HCM Lane LOS	-	-	B	A	A
HCM 95th %tile Q(veh)	-	-	0.8	0.2	-

Intersection	
Int Delay, s/veh	92.2

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	240	60	25	480	675	190
Future Vol, veh/h	240	60	25	480	675	190
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	-	-	-	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	261	65	27	522	734	207

Major/Minor	Minor2		Major1		Major2	
Conflicting Flow All	1413	837	940	0	-	0
Stage 1	837	-	-	-	-	-
Stage 2	576	-	-	-	-	-
Critical Hdwy	6.42	6.22	4.12	-	-	-
Critical Hdwy Stg 1	5.42	-	-	-	-	-
Critical Hdwy Stg 2	5.42	-	-	-	-	-
Follow-up Hdwy	3.518	3.318	2.218	-	-	-
Pot Cap-1 Maneuver	~ 152	367	729	-	-	-
Stage 1	425	-	-	-	-	-
Stage 2	562	-	-	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	~ 144	367	729	-	-	-
Mov Cap-2 Maneuver	~ 144	-	-	-	-	-
Stage 1	425	-	-	-	-	-
Stage 2	533	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s	$ 512.2	0.5	0
HCM LOS	F		

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	SBT	SBR
Capacity (veh/h)	729	-	164	-	-
HCM Lane V/C Ratio	0.037	-	1.988	-	-
HCM Control Delay (s)	10.1	0	$ 512.2	-	-
HCM Lane LOS	B	A	F	-	-
HCM 95th %tile Q(veh)	0.1	-	25.1	-	-

Notes			
~: Volume exceeds capacity	$: Delay exceeds 300s	+: Computation Not Defined	*: All major volume in platoon

Intersection	
Intersection Delay, s/veh	229.5
Intersection LOS	F

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Vol, veh/h	255	225	700	170	150	385
Future Vol, veh/h	255	225	700	170	150	385
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	277	245	761	185	163	418
Number of Lanes	1	0	1	0	0	1

Approach	WB	NB	SB
Opposing Approach		SB	NB
Opposing Lanes	0	1	1
Conflicting Approach Left	NB		WB
Conflicting Lanes Left	1	0	1
Conflicting Approach Right	SB	WB	
Conflicting Lanes Right	1	1	0
HCM Control Delay	67	389.6	114.8
HCM LOS	F	F	F

Lane	NBLn1	WBLn1	SBLn1
Vol Left, %	0%	53%	28%
Vol Thru, %	80%	0%	72%
Vol Right, %	20%	47%	0%
Sign Control	Stop	Stop	Stop
Traffic Vol by Lane	870	480	535
LT Vol	0	255	150
Through Vol	700	0	385
RT Vol	170	225	0
Lane Flow Rate	946	522	582
Geometry Grp	1	1	1
Degree of Util (X)	1.809	0.982	1.14
Departure Headway (Hd)	7.178	8.102	8.195
Convergence, Y/N	Yes	Yes	Yes
Cap	520	454	448
Service Time	5.178	6.102	6.195
HCM Lane V/C Ratio	1.819	1.15	1.299
HCM Control Delay	389.6	67	114.8
HCM Lane LOS	F	F	F
HCM 95th-tile Q	56.7	12.3	18.1

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	510	380	310	65	375	120	360	1005	70	120	1095	625
Future Volume (veh/h)	510	380	310	65	375	120	360	1005	70	120	1095	625
Number	7	4	14	3	8	18	1	6	16	5	2	12
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj Sat Flow, veh/h/ln	1832	1850	1832	1779	1832	1814	1814	1814	1779	1814	1832	1832
Adj Flow Rate, veh/h	654	437	0	144	441	0	474	1272	0	171	1244	0
Adj No. of Lanes	2	1	1	1	1	1	2	2	1	1	2	1
Peak Hour Factor	0.78	0.87	0.96	0.45	0.85	0.75	0.76	0.79	0.75	0.70	0.88	0.97
Percent Heavy Veh, %	1	0	1	4	1	2	2	2	4	2	1	1
Cap, veh/h	587	542	456	165	397	334	793	1666	731	161	1160	519
Arrive On Green	0.17	0.29	0.00	0.10	0.22	0.00	0.24	0.48	0.00	0.09	0.33	0.00
Sat Flow, veh/h	3384	1850	1557	1694	1832	1542	3351	3446	1512	1727	3480	1557
Grp Volume(v), veh/h	654	437	0	144	441	0	474	1272	0	171	1244	0
Grp Sat Flow(s),veh/h/ln	1692	1850	1557	1694	1832	1542	1676	1723	1512	1727	1740	1557
Q Serve(g_s), s	26.0	32.8	0.0	12.6	32.5	0.0	18.9	45.3	0.0	14.0	50.0	0.0
Cycle Q Clear(g_c), s	26.0	32.8	0.0	12.6	32.5	0.0	18.9	45.3	0.0	14.0	50.0	0.0
Prop In Lane	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Lane Grp Cap(c), veh/h	587	542	456	165	397	334	793	1666	731	161	1160	519
V/C Ratio(X)	1.11	0.81	0.00	0.88	1.11	0.00	0.60	0.76	0.00	1.06	1.07	0.00
Avail Cap(c_a), veh/h	587	542	456	181	397	334	793	1666	731	161	1160	519
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	1.00	0.00	1.00	1.00	0.00	0.90	0.90	0.00	0.84	0.84	0.00
Uniform Delay (d), s/veh	62.0	49.1	0.0	66.8	58.8	0.0	50.9	31.7	0.0	68.0	50.0	0.0
Incr Delay (d2), s/veh	72.8	9.9	0.0	31.0	78.8	0.0	0.8	3.1	0.0	82.0	46.2	0.0
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	18.1	18.2	0.0	7.3	25.1	0.0	8.8	22.3	0.0	10.3	31.5	0.0
LnGrp Delay(d),s/veh	134.8	59.0	0.0	97.8	137.6	0.0	51.7	34.8	0.0	150.0	96.2	0.0
LnGrp LOS	F	E		F	F		D	C		F	F	
Approach Vol, veh/h		1091			585			1746			1415	
Approach Delay, s/veh		104.4			127.8			39.4			102.7	
Approach LOS		F			F			D			F	

Timer	1	2	3	4	5	6	7	8
Assigned Phs	1	2	3	4	5	6	7	8
Phs Duration (G+Y+Rc), s	41.5	56.0	19.6	50.4	19.0	78.5	31.0	39.0
Change Period (Y+Rc), s	5.5	* 6	5.0	6.5	5.0	5.5	5.0	6.5
Max Green Setting (Gmax), s	19.0	* 50	16.0	42.5	14.0	55.5	26.0	32.5
Max Q Clear Time (g_c+I1), s	20.9	52.0	14.6	34.8	16.0	47.3	28.0	34.5
Green Ext Time (p_c), s	0.0	0.0	0.0	4.1	0.0	7.1	0.0	0.0

Intersection Summary	
HCM 2010 Ctrl Delay	83.3
HCM 2010 LOS	F

Notes



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	85	665	70	90	725	45	140	180	55	55	245	65
Future Volume (veh/h)	85	665	70	90	725	45	140	180	55	55	245	65
Number	7	4	14	3	8	18	5	2	12	1	6	16
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj Sat Flow, veh/h/ln	1814	1814	1814	1814	1814	1814	1814	1814	1814	1814	1814	1814
Adj Flow Rate, veh/h	92	723	76	98	788	49	152	196	60	60	266	71
Adj No. of Lanes	1	1	1	1	1	1	1	1	1	1	1	1
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	2	2	2	2	2	2	2	2	2	2	2	2
Cap, veh/h	249	973	827	286	973	827	318	544	462	372	544	462
Arrive On Green	0.54	0.54	0.54	0.54	0.54	0.54	0.30	0.30	0.30	0.30	0.30	0.30
Sat Flow, veh/h	654	1814	1542	678	1814	1542	1039	1814	1542	1119	1814	1542
Grp Volume(v), veh/h	92	723	76	98	788	49	152	196	60	60	266	71
Grp Sat Flow(s),veh/h/ln	654	1814	1542	678	1814	1542	1039	1814	1542	1119	1814	1542
Q Serve(g_s), s	7.4	16.9	1.3	7.2	19.6	0.8	7.7	4.7	1.6	2.4	6.6	1.9
Cycle Q Clear(g_c), s	27.0	16.9	1.3	24.1	19.6	0.8	14.3	4.7	1.6	7.1	6.6	1.9
Prop In Lane	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Lane Grp Cap(c), veh/h	249	973	827	286	973	827	318	544	463	372	544	463
V/C Ratio(X)	0.37	0.74	0.09	0.34	0.81	0.06	0.48	0.36	0.13	0.16	0.49	0.15
Avail Cap(c_a), veh/h	249	973	827	286	973	827	318	544	463	372	544	463
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	21.5	9.8	6.2	19.1	10.5	6.1	21.7	15.1	14.0	17.9	15.8	14.1
Incr Delay (d2), s/veh	4.2	5.1	0.2	3.2	7.3	0.1	5.1	1.9	0.6	0.9	3.1	0.7
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	1.6	9.6	0.6	1.6	11.6	0.4	2.6	2.6	0.7	0.8	3.7	0.9
LnGrp Delay(d),s/veh	25.7	15.0	6.4	22.4	17.7	6.2	26.8	17.0	14.6	18.8	18.9	14.8
LnGrp LOS	C	B	A	C	B	A	C	B	B	B	B	B
Approach Vol, veh/h		891			935			408			397	
Approach Delay, s/veh		15.3			17.6			20.3			18.2	
Approach LOS		B			B			C			B	

Timer	1	2	3	4	5	6	7	8
Assigned Phs		2		4		6		8
Phs Duration (G+Y+Rc), s		21.0		34.0		21.0		34.0
Change Period (Y+Rc), s		4.5		4.5		4.5		4.5
Max Green Setting (Gmax), s		16.5		29.5		16.5		29.5
Max Q Clear Time (g_c+I1), s		16.3		29.0		9.1		26.1
Green Ext Time (p_c), s		0.1		0.5		2.5		2.9

Intersection Summary	
HCM 2010 Ctrl Delay	17.3
HCM 2010 LOS	B



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	210	235	205	145	190	145	85	1190	130	120	1345	210
Future Volume (veh/h)	210	235	205	145	190	145	85	1190	130	120	1345	210
Number	7	4	14	3	8	18	1	6	16	5	2	12
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj Sat Flow, veh/h/ln	1814	1832	1850	1850	1832	1832	1832	1832	1850	1850	1832	1850
Adj Flow Rate, veh/h	241	305	238	171	209	158	102	1266	188	176	1446	247
Adj No. of Lanes	1	1	1	1	1	1	1	2	1	1	2	1
Peak Hour Factor	0.87	0.77	0.86	0.85	0.91	0.92	0.83	0.94	0.69	0.68	0.93	0.85
Percent Heavy Veh, %	2	1	0	0	1	1	1	1	0	0	1	0
Cap, veh/h	249	295	407	197	295	424	171	1463	765	196	1450	760
Arrive On Green	0.07	0.16	0.16	0.07	0.16	0.16	0.10	0.42	0.42	0.11	0.42	0.42
Sat Flow, veh/h	1727	1832	1570	1762	1832	1557	1744	3480	1571	1762	3480	1572
Grp Volume(v), veh/h	241	305	238	171	209	158	102	1266	188	176	1446	247
Grp Sat Flow(s),veh/h/ln	1727	1832	1570	1762	1832	1557	1744	1740	1571	1762	1740	1572
Q Serve(g_s), s	6.0	14.5	2.0	6.0	9.7	7.4	5.0	29.8	6.3	8.9	37.3	3.9
Cycle Q Clear(g_c), s	6.0	14.5	2.0	6.0	9.7	7.4	5.0	29.8	6.3	8.9	37.3	3.9
Prop In Lane	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Lane Grp Cap(c), veh/h	249	295	407	197	295	424	171	1463	765	196	1450	760
V/C Ratio(X)	0.97	1.03	0.58	0.87	0.71	0.37	0.60	0.87	0.25	0.90	1.00	0.32
Avail Cap(c_a), veh/h	249	295	407	197	295	424	174	1463	765	196	1450	760
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	1.00	1.00	1.00	1.00	1.00	0.89	0.89	0.89	0.26	0.26	0.26
Uniform Delay (d), s/veh	36.1	37.8	13.5	33.0	35.7	26.5	38.9	23.8	13.5	39.5	26.2	4.5
Incr Delay (d2), s/veh	47.9	61.3	2.9	31.1	8.8	0.9	3.2	6.4	0.7	13.6	11.5	0.3
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	6.4	12.3	3.7	3.0	5.7	3.3	2.6	15.5	2.9	5.0	20.2	1.7
LnGrp Delay(d),s/veh	84.0	99.1	16.4	64.1	44.5	27.5	42.1	30.2	14.1	53.1	37.7	4.8
LnGrp LOS	F	F	B	E	D	C	D	C	B	D	D	A
Approach Vol, veh/h		784			538			1556			1869	
Approach Delay, s/veh		69.4			45.7			29.0			34.8	
Approach LOS		E			D			C			C	

Timer	1	2	3	4	5	6	7	8
Assigned Phs	1	2	3	4	5	6	7	8
Phs Duration (G+Y+Rc), s	15.4	44.0	11.0	21.0	15.0	44.4	11.0	21.0
Change Period (Y+Rc), s	6.5	* 6.5	5.0	6.5	5.0	6.5	5.0	6.5
Max Green Setting (Gmax), s	9.0	* 38	6.0	14.5	10.0	36.5	6.0	14.5
Max Q Clear Time (g_c+I1), s	11.0	39.3	8.0	16.5	10.9	31.8	8.0	11.7
Green Ext Time (p_c), s	1.2	0.0	0.0	0.0	0.0	4.1	0.0	1.7

Intersection Summary	
HCM 2010 Ctrl Delay	39.9
HCM 2010 LOS	D

Notes



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	170	185	15	95	145	70	100	1545	110	150	1450	265
Future Volume (veh/h)	170	185	15	95	145	70	100	1545	110	150	1450	265
Number	7	4	14	3	8	18	1	6	16	5	2	12
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj Sat Flow, veh/h/ln	1850	1850	1850	1850	1850	1850	1850	1850	1850	1832	1850	1850
Adj Flow Rate, veh/h	221	234	23	113	154	93	133	1736	141	234	1790	373
Adj No. of Lanes	1	1	1	1	1	1	1	2	1	1	2	1
Peak Hour Factor	0.77	0.79	0.65	0.84	0.94	0.75	0.75	0.89	0.78	0.64	0.81	0.71
Percent Heavy Veh, %	0	0	0	0	0	0	0	0	0	1	0	0
Cap, veh/h	241	227	719	191	224	391	590	2583	1267	222	1805	922
Arrive On Green	0.07	0.12	0.12	0.07	0.12	0.12	0.33	0.73	0.73	0.13	0.51	0.51
Sat Flow, veh/h	1762	1850	1572	1762	1850	1572	1762	3515	1572	1744	3515	1572
Grp Volume(v), veh/h	221	234	23	113	154	93	133	1736	141	234	1790	373
Grp Sat Flow(s),veh/h/ln	1762	1850	1572	1762	1850	1572	1762	1758	1572	1744	1758	1572
Q Serve(g_s), s	8.0	13.5	0.2	6.1	8.8	5.2	6.0	28.5	2.1	14.0	55.5	11.6
Cycle Q Clear(g_c), s	8.0	13.5	0.2	6.1	8.8	5.2	6.0	28.5	2.1	14.0	55.5	11.6
Prop In Lane	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Lane Grp Cap(c), veh/h	241	227	719	191	224	391	590	2583	1267	222	1805	922
V/C Ratio(X)	0.92	1.03	0.03	0.59	0.69	0.24	0.23	0.67	0.11	1.05	0.99	0.40
Avail Cap(c_a), veh/h	241	227	719	194	227	393	590	2583	1267	222	1805	922
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	1.00	1.00	1.00	1.00	1.00	0.91	0.91	0.91	0.85	0.85	0.85
Uniform Delay (d), s/veh	44.5	48.3	19.1	39.1	46.3	33.0	26.3	7.6	2.3	48.0	26.5	17.7
Incr Delay (d2), s/veh	35.5	67.9	0.0	5.1	9.8	0.5	0.1	1.3	0.2	70.7	17.6	1.1
Initial Q Delay(d3),s/veh	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	5.2	11.2	0.4	3.2	5.1	2.3	2.9	14.0	1.0	11.1	31.0	5.3
LnGrp Delay(d),s/veh	80.0	116.2	19.1	44.3	56.1	33.5	26.4	8.9	2.4	118.7	44.2	18.8
LnGrp LOS	E	F	B	D	E	C	C	A	A	F	D	B
Approach Vol, veh/h		478			360			2010			2397	
Approach Delay, s/veh		94.8			46.6			9.6			47.5	
Approach LOS		F			D			A			D	

Timer	1	2	3	4	5	6	7	8
Assigned Phs	1	2	3	4	5	6	7	8
Phs Duration (G+Y+Rc), s	13.5	63.0	12.8	20.0	19.0	87.5	13.0	19.8
Change Period (Y+Rc), s	6.5	* 6.5	5.0	6.5	5.0	6.5	5.0	6.5
Max Green Setting (Gmax), s	9.0	* 57	8.0	13.5	14.0	51.5	8.0	13.5
Max Q Clear Time (g_c+I1), s	8.0	57.5	8.1	15.5	16.0	30.5	10.0	10.8
Green Ext Time (p_c), s	0.1	0.0	0.0	0.0	0.0	18.5	0.0	1.0

Intersection Summary	
HCM 2010 Ctrl Delay	37.2
HCM 2010 LOS	D

Notes



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	85	420	190	30	45	90	65	870	50	365	925	75
Future Volume (veh/h)	85	420	190	30	45	90	65	870	50	365	925	75
Number	7	4	14	3	8	18	5	2	12	1	6	16
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj Sat Flow, veh/h/ln	1814	1814	1814	1814	1814	1814	1814	1814	1850	1814	1814	1814
Adj Flow Rate, veh/h	92	457	207	33	49	98	71	946	54	397	1005	82
Adj No. of Lanes	1	1	1	1	1	1	1	2	0	1	2	1
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	2	2	2	2	2	2	2	2	2	2	2	2
Cap, veh/h	117	463	393	41	384	326	91	1031	59	406	1701	761
Arrive On Green	0.07	0.26	0.26	0.02	0.21	0.21	0.05	0.31	0.31	0.23	0.49	0.49
Sat Flow, veh/h	1727	1814	1542	1727	1814	1542	1727	3314	189	1727	3446	1542
Grp Volume(v), veh/h	92	457	207	33	49	98	71	492	508	397	1005	82
Grp Sat Flow(s),veh/h/ln	1727	1814	1542	1727	1814	1542	1727	1723	1780	1727	1723	1542
Q Serve(g_s), s	5.2	25.1	11.6	1.9	2.2	5.4	4.1	27.5	27.5	22.8	20.9	2.8
Cycle Q Clear(g_c), s	5.2	25.1	11.6	1.9	2.2	5.4	4.1	27.5	27.5	22.8	20.9	2.8
Prop In Lane	1.00		1.00	1.00		1.00	1.00		0.11	1.00		1.00
Lane Grp Cap(c), veh/h	117	463	393	41	384	326	91	536	554	406	1701	761
V/C Ratio(X)	0.79	0.99	0.53	0.80	0.13	0.30	0.78	0.92	0.92	0.98	0.59	0.11
Avail Cap(c_a), veh/h	207	463	393	71	384	326	168	536	554	406	1701	761
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.90	0.90	0.90
Uniform Delay (d), s/veh	45.9	37.1	32.1	48.6	31.9	33.2	46.8	33.2	33.2	38.0	18.1	13.5
Incr Delay (d2), s/veh	11.2	38.6	1.3	28.0	0.1	0.5	13.6	23.1	22.6	36.6	1.4	0.3
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	2.9	17.5	5.1	1.2	1.1	2.3	2.3	16.6	17.0	15.0	10.2	1.3
LnGrp Delay(d),s/veh	57.1	75.7	33.4	76.6	32.1	33.7	60.4	56.3	55.8	74.6	19.5	13.8
LnGrp LOS	E	E	C	E	C	C	E	E	E	E	B	B
Approach Vol, veh/h		756			180			1071			1484	
Approach Delay, s/veh		61.9			41.1			56.3			33.9	
Approach LOS		E			D			E			C	

Timer	1	2	3	4	5	6	7	8
Assigned Phs	1	2	3	4	5	6	7	8
Phs Duration (G+Y+Rc), s	28.0	35.1	6.9	30.0	9.7	53.4	11.2	25.7
Change Period (Y+Rc), s	4.5	4.0	4.5	4.5	4.5	4.0	4.5	4.5
Max Green Setting (Gmax), s	23.5	29.4	4.1	25.5	9.7	43.2	12.0	17.6
Max Q Clear Time (g_c+I1), s	24.8	29.5	3.9	27.1	6.1	22.9	7.2	7.4
Green Ext Time (p_c), s	0.0	0.0	0.0	0.0	0.0	13.8	0.1	3.0

Intersection Summary	
HCM 2010 Ctrl Delay	47.2
HCM 2010 LOS	D

Intersection	
Intersection Delay, s/veh	18.6
Intersection LOS	C

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Vol, veh/h	35	225	35	115	140	5	25	180	105	5	260	40
Future Vol, veh/h	35	225	35	115	140	5	25	180	105	5	260	40
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	38	245	38	125	152	5	27	196	114	5	283	43
Number of Lanes	1	1	0	1	1	0	0	1	0	0	1	0

Approach	EB	WB	NB	SB
Opposing Approach	WB	EB	SB	NB
Opposing Lanes	2	2	1	1
Conflicting Approach Left	SB	NB	EB	WB
Conflicting Lanes Left	1	1	2	2
Conflicting Approach Right	NB	SB	WB	EB
Conflicting Lanes Right	1	1	2	2
HCM Control Delay	18.9	14.1	20.3	20.6
HCM LOS	C	B	C	C

Lane	NBLn1	EBLn1	EBLn2	WBLn1	WBLn2	SBLn1
Vol Left, %	8%	100%	0%	100%	0%	2%
Vol Thru, %	58%	0%	87%	0%	97%	85%
Vol Right, %	34%	0%	13%	0%	3%	13%
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop
Traffic Vol by Lane	310	35	260	115	145	305
LT Vol	25	35	0	115	0	5
Through Vol	180	0	225	0	140	260
RT Vol	105	0	35	0	5	40
Lane Flow Rate	337	38	283	125	158	332
Geometry Grp	2	7	7	7	7	2
Degree of Util (X)	0.624	0.084	0.579	0.282	0.331	0.624
Departure Headway (Hd)	6.664	7.983	7.371	8.11	7.569	6.776
Convergence, Y/N	Yes	Yes	Yes	Yes	Yes	Yes
Cap	539	446	486	440	471	530
Service Time	4.751	5.775	5.162	5.909	5.368	4.865
HCM Lane V/C Ratio	0.625	0.085	0.582	0.284	0.335	0.626
HCM Control Delay	20.3	11.5	19.9	14.1	14.1	20.6
HCM Lane LOS	C	B	C	B	B	C
HCM 95th-tile Q	4.3	0.3	3.6	1.1	1.4	4.2

Intersection	
Int Delay, s/veh	2.5

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	65	40	30	305	440	95
Future Vol, veh/h	65	40	30	305	440	95
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	-	-	-	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	71	43	33	332	478	103

Major/Minor	Minor2		Major1		Major2	
Conflicting Flow All	927	530	582	0	-	0
Stage 1	530	-	-	-	-	-
Stage 2	397	-	-	-	-	-
Critical Hdwy	6.42	6.22	4.12	-	-	-
Critical Hdwy Stg 1	5.42	-	-	-	-	-
Critical Hdwy Stg 2	5.42	-	-	-	-	-
Follow-up Hdwy	3.518	3.318	2.218	-	-	-
Pot Cap-1 Maneuver	298	549	992	-	-	-
Stage 1	590	-	-	-	-	-
Stage 2	679	-	-	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	286	549	992	-	-	-
Mov Cap-2 Maneuver	286	-	-	-	-	-
Stage 1	590	-	-	-	-	-
Stage 2	651	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s	20.2	0.8	0
HCM LOS	C		

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	SBT	SBR
Capacity (veh/h)	992	-	350	-	-
HCM Lane V/C Ratio	0.033	-	0.326	-	-
HCM Control Delay (s)	8.8	0	20.2	-	-
HCM Lane LOS	A	A	C	-	-
HCM 95th %tile Q(veh)	0.1	-	1.4	-	-

Intersection	
Intersection Delay, s/veh	301.4
Intersection LOS	F

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Vol, veh/h	355	205	145	120	205	85	80	200	75	50	280	210
Future Vol, veh/h	355	205	145	120	205	85	80	200	75	50	280	210
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	386	223	158	130	223	92	87	217	82	54	304	228
Number of Lanes	0	1	0	0	1	0	0	1	0	0	1	0

Approach	EB	WB	NB	SB
Opposing Approach	WB	EB	SB	NB
Opposing Lanes	1	1	1	1
Conflicting Approach Left	SB	NB	EB	WB
Conflicting Lanes Left	1	1	1	1
Conflicting Approach Right	NB	SB	WB	EB
Conflicting Lanes Right	1	1	1	1
HCM Control Delay	498.9	153	107.9	283.5
HCM LOS	F	F	F	F

Lane	NBLn1	EBLn1	WBLn1	SBLn1
Vol Left, %	23%	50%	29%	9%
Vol Thru, %	56%	29%	50%	52%
Vol Right, %	21%	21%	21%	39%
Sign Control	Stop	Stop	Stop	Stop
Traffic Vol by Lane	355	705	410	540
LT Vol	80	355	120	50
Through Vol	200	205	205	280
RT Vol	75	145	85	210
Lane Flow Rate	386	766	446	587
Geometry Grp	1	1	1	1
Degree of Util (X)	1.024	2.026	1.173	1.521
Departure Headway (Hd)	15.321	11.851	14.731	12.945
Convergence, Y/N	Yes	Yes	Yes	Yes
Cap	239	314	250	288
Service Time	13.321	9.851	12.731	10.945
HCM Lane V/C Ratio	1.615	2.439	1.784	2.038
HCM Control Delay	107.9	498.9	153	283.5
HCM Lane LOS	F	F	F	F
HCM 95th-tile Q	9.9	44.2	13.3	24.6

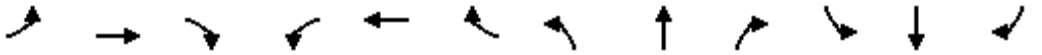
Intersection	
Int Delay, s/veh	6.6

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Vol, veh/h	85	30	185	10	10	5	90	170	10	15	215	140
Future Vol, veh/h	85	30	185	10	10	5	90	170	10	15	215	140
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Free	Free	Free	Free	Free	Free
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	0	-	-	-	-	-	-	-	-	-	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	92	92	92	92	92	92	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	92	33	201	11	11	5	98	185	11	16	234	152

Major/Minor	Minor2			Minor1			Major1			Major2		
Conflicting Flow All	736	733	310	845	804	190	386	0	0	196	0	0
Stage 1	342	342	-	386	386	-	-	-	-	-	-	-
Stage 2	394	391	-	459	418	-	-	-	-	-	-	-
Critical Hdwy	7.12	6.52	6.22	7.12	6.52	6.22	4.12	-	-	4.12	-	-
Critical Hdwy Stg 1	6.12	5.52	-	6.12	5.52	-	-	-	-	-	-	-
Critical Hdwy Stg 2	6.12	5.52	-	6.12	5.52	-	-	-	-	-	-	-
Follow-up Hdwy	3.518	4.018	3.318	3.518	4.018	3.318	2.218	-	-	2.218	-	-
Pot Cap-1 Maneuver	335	348	730	283	316	852	1172	-	-	1377	-	-
Stage 1	673	638	-	637	610	-	-	-	-	-	-	-
Stage 2	631	607	-	582	591	-	-	-	-	-	-	-
Platoon blocked, %								-	-		-	-
Mov Cap-1 Maneuver	297	311	730	173	282	852	1172	-	-	1377	-	-
Mov Cap-2 Maneuver	297	311	-	173	282	-	-	-	-	-	-	-
Stage 1	610	628	-	577	553	-	-	-	-	-	-	-
Stage 2	557	550	-	394	582	-	-	-	-	-	-	-

Approach	EB	WB	NB	SB
HCM Control Delay, s	16.7	21	2.8	0.3
HCM LOS	C	C		

Minor Lane/Major Mvmt	NBL	NBT	NBR	EBLn1	EBLn2	WBLn1	SBL	SBT	SBR
Capacity (veh/h)	1172	-	-	297	614	252	1377	-	-
HCM Lane V/C Ratio	0.083	-	-	0.311	0.381	0.108	0.012	-	-
HCM Control Delay (s)	8.4	0	-	22.5	14.4	21	7.6	0	-
HCM Lane LOS	A	A	-	C	B	C	A	A	-
HCM 95th %tile Q(veh)	0.3	-	-	1.3	1.8	0.4	0	-	-



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	240	625	335	625	745	130	140	875	460	120	1175	235
Future Volume (veh/h)	240	625	335	625	745	130	140	875	460	120	1175	235
Number	3	8	18	7	4	14	1	6	16	5	2	12
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj Sat Flow, veh/h/ln	1832	1832	1850	1832	1832	1832	1832	1814	1814	1832	1832	1832
Adj Flow Rate, veh/h	255	718	0	718	993	0	177	951	0	140	1291	0
Adj No. of Lanes	2	2	1	2	2	1	1	2	1	1	2	1
Peak Hour Factor	0.94	0.87	0.69	0.87	0.75	0.44	0.79	0.92	0.87	0.86	0.91	0.81
Percent Heavy Veh, %	1	1	0	1	1	1	1	2	2	1	1	1
Cap, veh/h	325	740	334	677	1087	486	147	1235	552	207	1247	558
Arrive On Green	0.16	0.35	0.00	0.20	0.31	0.00	0.03	0.24	0.00	0.03	0.24	0.00
Sat Flow, veh/h	3384	3480	1572	3384	3480	1557	1744	3446	1542	1744	3480	1557
Grp Volume(v), veh/h	255	718	0	718	993	0	177	951	0	140	1291	0
Grp Sat Flow(s),veh/h/ln	1692	1740	1572	1692	1740	1557	1744	1723	1542	1744	1740	1557
Q Serve(g_s), s	8.7	24.4	0.0	24.0	32.9	0.0	6.0	30.9	0.0	6.0	43.0	0.0
Cycle Q Clear(g_c), s	8.7	24.4	0.0	24.0	32.9	0.0	6.0	30.9	0.0	6.0	43.0	0.0
Prop In Lane	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Lane Grp Cap(c), veh/h	325	740	334	677	1087	486	147	1235	552	207	1247	558
V/C Ratio(X)	0.79	0.97	0.00	1.06	0.91	0.00	1.20	0.77	0.00	0.68	1.04	0.00
Avail Cap(c_a), veh/h	325	740	334	677	1117	500	147	1235	552	207	1247	558
HCM Platoon Ratio	1.67	1.67	1.67	1.00	1.00	1.00	0.67	0.67	0.67	0.67	0.67	0.67
Upstream Filter(I)	0.39	0.39	0.00	1.00	1.00	0.00	0.59	0.59	0.00	0.85	0.85	0.00
Uniform Delay (d), s/veh	49.2	38.3	0.0	48.0	39.7	0.0	33.0	41.0	0.0	29.0	45.6	0.0
Incr Delay (d2), s/veh	4.5	14.4	0.0	51.8	11.6	0.0	122.9	2.8	0.0	5.9	33.1	0.0
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	4.3	13.1	0.0	16.1	17.6	0.0	7.0	15.2	0.0	2.0	26.4	0.0
LnGrp Delay(d),s/veh	53.7	52.8	0.0	99.8	51.3	0.0	155.9	43.8	0.0	35.0	78.7	0.0
LnGrp LOS	D	D		F	D		F	D		C	F	
Approach Vol, veh/h		973			1711			1128			1431	
Approach Delay, s/veh		53.0			71.7			61.4			74.4	
Approach LOS		D			E			E			E	

Timer	1	2	3	4	5	6	7	8
Assigned Phs	1	2	3	4	5	6	7	8
Phs Duration (G+Y+Rc), s	11.0	49.0	17.0	43.0	11.0	49.0	29.0	31.0
Change Period (Y+Rc), s	5.0	6.0	5.5	* 5.5	5.0	6.0	5.0	5.5
Max Green Setting (Gmax), s	6.0	43.0	11.0	* 39	6.0	43.0	24.0	25.5
Max Q Clear Time (g_c+I1), s	8.0	45.0	10.7	34.9	8.0	32.9	26.0	26.4
Green Ext Time (p_c), s	0.0	0.0	0.2	2.5	0.0	9.5	0.0	0.0

Intersection Summary	
HCM 2010 Ctrl Delay	66.7
HCM 2010 LOS	E

Notes



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	125	10	420	0	5	5	100	165	5	10	450	170
Future Volume (veh/h)	125	10	420	0	5	5	100	165	5	10	450	170
Number	7	4	14	3	8	18	5	2	12	1	6	16
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj Sat Flow, veh/h/ln	1850	1814	1814	1850	1814	1850	1814	1814	1850	1814	1814	1814
Adj Flow Rate, veh/h	136	11	0	0	5	5	109	179	5	11	489	0
Adj No. of Lanes	0	1	1	0	1	0	1	1	0	1	1	1
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	2	2	2	2	2	2	2	2	2	2	2	2
Cap, veh/h	360	14	215	0	116	116	627	1093	31	883	1128	959
Arrive On Green	0.14	0.14	0.00	0.00	0.14	0.14	0.62	0.62	0.62	0.62	0.62	0.00
Sat Flow, veh/h	1268	103	1542	0	833	833	904	1756	49	1195	1814	1542
Grp Volume(v), veh/h	147	0	0	0	0	10	109	0	184	11	489	0
Grp Sat Flow(s),veh/h/ln	1370	0	1542	0	0	1667	904	0	1805	1195	1814	1542
Q Serve(g_s), s	3.8	0.0	0.0	0.0	0.0	0.2	2.7	0.0	1.6	0.1	5.3	0.0
Cycle Q Clear(g_c), s	4.0	0.0	0.0	0.0	0.0	0.2	7.9	0.0	1.6	1.8	5.3	0.0
Prop In Lane	0.93		1.00	0.00		0.50	1.00		0.03	1.00		1.00
Lane Grp Cap(c), veh/h	375	0	215	0	0	233	627	0	1123	883	1128	959
V/C Ratio(X)	0.39	0.00	0.00	0.00	0.00	0.04	0.17	0.00	0.16	0.01	0.43	0.00
Avail Cap(c_a), veh/h	836	0	714	0	0	772	627	0	1123	883	1128	959
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	0.00	0.00	0.00	1.00	1.00	0.00	1.00	1.00	1.00	0.00
Uniform Delay (d), s/veh	15.8	0.0	0.0	0.0	0.0	14.1	5.7	0.0	3.0	3.4	3.7	0.0
Incr Delay (d2), s/veh	0.7	0.0	0.0	0.0	0.0	0.1	0.6	0.0	0.3	0.0	1.2	0.0
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	1.5	0.0	0.0	0.0	0.0	0.1	0.8	0.0	0.9	0.1	3.0	0.0
LnGrp Delay(d),s/veh	16.5	0.0	0.0	0.0	0.0	14.1	6.4	0.0	3.3	3.4	4.9	0.0
LnGrp LOS	B					B	A		A	A	A	
Approach Vol, veh/h		147			10			293			500	
Approach Delay, s/veh		16.5			14.1			4.4			4.9	
Approach LOS		B			B			A			A	

Timer	1	2	3	4	5	6	7	8
Assigned Phs		2		4		6		8
Phs Duration (G+Y+Rc), s		28.0		9.8		28.0		9.8
Change Period (Y+Rc), s		4.5		4.5		4.5		4.5
Max Green Setting (Gmax), s		23.5		17.5		23.5		17.5
Max Q Clear Time (g_c+I1), s		9.9		6.0		7.3		2.2
Green Ext Time (p_c), s		4.2		0.6		4.5		0.7

Intersection Summary	
HCM 2010 Ctrl Delay	6.6
HCM 2010 LOS	A

Intersection	
Int Delay, s/veh	11.7

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Vol, veh/h	25	15	65	125	55	90	25	240	15	65	70	10
Future Vol, veh/h	25	15	65	125	55	90	25	240	15	65	70	10
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Free	Free	Free	Free	Free	Free
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	-	-	-	-	-	-	110	-	-	110	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	92	92	92	92	92	92	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	27	16	71	136	60	98	27	261	16	71	76	11

Major/Minor	Minor2			Minor1			Major1			Major2		
Conflicting Flow All	625	555	82	589	551	269	87	0	0	277	0	0
Stage 1	223	223	-	323	323	-	-	-	-	-	-	-
Stage 2	402	332	-	266	228	-	-	-	-	-	-	-
Critical Hdwy	7.12	6.52	6.22	7.12	6.52	6.22	4.12	-	-	4.12	-	-
Critical Hdwy Stg 1	6.12	5.52	-	6.12	5.52	-	-	-	-	-	-	-
Critical Hdwy Stg 2	6.12	5.52	-	6.12	5.52	-	-	-	-	-	-	-
Follow-up Hdwy	3.518	4.018	3.318	3.518	4.018	3.318	2.218	-	-	2.218	-	-
Pot Cap-1 Maneuver	397	440	978	420	442	770	1509	-	-	1286	-	-
Stage 1	780	719	-	689	650	-	-	-	-	-	-	-
Stage 2	625	644	-	739	715	-	-	-	-	-	-	-
Platoon blocked, %								-	-		-	-
Mov Cap-1 Maneuver	291	408	978	357	410	770	1509	-	-	1286	-	-
Mov Cap-2 Maneuver	291	408	-	357	410	-	-	-	-	-	-	-
Stage 1	766	679	-	677	638	-	-	-	-	-	-	-
Stage 2	486	632	-	632	676	-	-	-	-	-	-	-

Approach	EB	WB	NB	SB
HCM Control Delay, s	13.2	26.9	0.7	3.6
HCM LOS	B	D		

Minor Lane/Major Mvmt	NBL	NBT	NBR	EBLn1	WBLn1	SBL	SBT	SBR
Capacity (veh/h)	1509	-	-	555	449	1286	-	-
HCM Lane V/C Ratio	0.018	-	-	0.206	0.654	0.055	-	-
HCM Control Delay (s)	7.4	-	-	13.2	26.9	8	-	-
HCM Lane LOS	A	-	-	B	D	A	-	-
HCM 95th %tile Q(veh)	0.1	-	-	0.8	4.6	0.2	-	-

Intersection	
Int Delay, s/veh	4.1

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Vol, veh/h	30	50	105	25	70	45
Future Vol, veh/h	30	50	105	25	70	45
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	-	-	-	-
Veh in Median Storage, #	0	-	0	-	-	0
Grade, %	0	-	0	-	-	0
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	33	54	114	27	76	49

Major/Minor	Minor1		Major1		Major2	
Conflicting Flow All	329	128	0	0	141	0
Stage 1	128	-	-	-	-	-
Stage 2	201	-	-	-	-	-
Critical Hdwy	6.42	6.22	-	-	4.12	-
Critical Hdwy Stg 1	5.42	-	-	-	-	-
Critical Hdwy Stg 2	5.42	-	-	-	-	-
Follow-up Hdwy	3.518	3.318	-	-	2.218	-
Pot Cap-1 Maneuver	665	922	-	-	1442	-
Stage 1	898	-	-	-	-	-
Stage 2	833	-	-	-	-	-
Platoon blocked, %			-	-		-
Mov Cap-1 Maneuver	629	922	-	-	1442	-
Mov Cap-2 Maneuver	629	-	-	-	-	-
Stage 1	898	-	-	-	-	-
Stage 2	788	-	-	-	-	-

Approach	WB	NB	SB
HCM Control Delay, s	10.2	0	4.6
HCM LOS	B		

Minor Lane/Major Mvmt	NBT	NBR	WBLn1	SBL	SBT
Capacity (veh/h)	-	-	785	1442	-
HCM Lane V/C Ratio	-	-	0.111	0.053	-
HCM Control Delay (s)	-	-	10.2	7.6	0
HCM Lane LOS	-	-	B	A	A
HCM 95th %tile Q(veh)	-	-	0.4	0.2	-

Intersection	
Int Delay, s/veh	2.5

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	85	20	20	375	355	100
Future Vol, veh/h	85	20	20	375	355	100
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	-	-	-	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	92	22	22	408	386	109

Major/Minor	Minor2		Major1		Major2	
Conflicting Flow All	891	440	495	0	-	0
Stage 1	440	-	-	-	-	-
Stage 2	451	-	-	-	-	-
Critical Hdwy	6.42	6.22	4.12	-	-	-
Critical Hdwy Stg 1	5.42	-	-	-	-	-
Critical Hdwy Stg 2	5.42	-	-	-	-	-
Follow-up Hdwy	3.518	3.318	2.218	-	-	-
Pot Cap-1 Maneuver	313	617	1069	-	-	-
Stage 1	649	-	-	-	-	-
Stage 2	642	-	-	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	305	617	1069	-	-	-
Mov Cap-2 Maneuver	305	-	-	-	-	-
Stage 1	649	-	-	-	-	-
Stage 2	625	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s	21	0.4	0
HCM LOS	C		

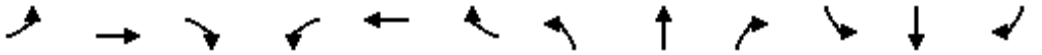
Minor Lane/Major Mvmt	NBL	NBT	EBLn1	SBT	SBR
Capacity (veh/h)	1069	-	338	-	-
HCM Lane V/C Ratio	0.02	-	0.338	-	-
HCM Control Delay (s)	8.4	0	21	-	-
HCM Lane LOS	A	A	C	-	-
HCM 95th %tile Q(veh)	0.1	-	1.5	-	-

Intersection	
Intersection Delay, s/veh	14
Intersection LOS	B

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Vol, veh/h	15	10	445	15	15	410
Future Vol, veh/h	15	10	445	15	15	410
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	16	11	484	16	16	446
Number of Lanes	1	0	1	0	0	1

Approach	WB	NB	SB
Opposing Approach		SB	NB
Opposing Lanes	0	1	1
Conflicting Approach Left	NB		WB
Conflicting Lanes Left	1	0	1
Conflicting Approach Right	SB	WB	
Conflicting Lanes Right	1	1	0
HCM Control Delay	9.2	14.6	13.7
HCM LOS	A	B	B

Lane	NBLn1	WBLn1	SBLn1
Vol Left, %	0%	60%	4%
Vol Thru, %	97%	0%	96%
Vol Right, %	3%	40%	0%
Sign Control	Stop	Stop	Stop
Traffic Vol by Lane	460	25	425
LT Vol	0	15	15
Through Vol	445	0	410
RT Vol	15	10	0
Lane Flow Rate	500	27	462
Geometry Grp	1	1	1
Degree of Util (X)	0.621	0.044	0.581
Departure Headway (Hd)	4.469	5.845	4.528
Convergence, Y/N	Yes	Yes	Yes
Cap	810	609	799
Service Time	2.496	3.913	2.557
HCM Lane V/C Ratio	0.617	0.044	0.578
HCM Control Delay	14.6	9.2	13.7
HCM Lane LOS	B	A	B
HCM 95th-tile Q	4.4	0.1	3.8



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	475	355	285	40	240	75	375	1050	70	120	1085	620
Future Volume (veh/h)	475	355	285	40	240	75	375	1050	70	120	1085	620
Number	7	4	14	3	8	18	1	6	16	5	2	12
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj Sat Flow, veh/h/ln	1832	1850	1832	1779	1832	1814	1814	1814	1779	1814	1832	1832
Adj Flow Rate, veh/h	609	408	0	89	282	0	493	1329	0	171	1233	0
Adj No. of Lanes	2	1	1	1	1	1	2	2	1	1	2	1
Peak Hour Factor	0.78	0.87	0.96	0.45	0.85	0.75	0.76	0.79	0.75	0.70	0.88	0.97
Percent Heavy Veh, %	1	0	1	4	1	2	2	2	4	2	1	1
Cap, veh/h	592	489	411	110	282	238	936	1824	800	173	1189	532
Arrive On Green	0.06	0.09	0.00	0.07	0.15	0.00	0.28	0.53	0.00	0.03	0.11	0.00
Sat Flow, veh/h	3384	1850	1557	1694	1832	1542	3351	3446	1512	1727	3480	1557
Grp Volume(v), veh/h	609	408	0	89	282	0	493	1329	0	171	1233	0
Grp Sat Flow(s),veh/h/ln	1692	1850	1557	1694	1832	1542	1676	1723	1512	1727	1740	1557
Q Serve(g_s), s	21.0	26.1	0.0	6.2	18.5	0.0	14.9	35.5	0.0	11.9	41.0	0.0
Cycle Q Clear(g_c), s	21.0	26.1	0.0	6.2	18.5	0.0	14.9	35.5	0.0	11.9	41.0	0.0
Prop In Lane	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Lane Grp Cap(c), veh/h	592	489	411	110	282	238	936	1824	800	173	1189	532
V/C Ratio(X)	1.03	0.83	0.00	0.81	1.00	0.00	0.53	0.73	0.00	0.99	1.04	0.00
Avail Cap(c_a), veh/h	592	489	411	127	282	238	936	1824	800	173	1189	532
HCM Platoon Ratio	0.33	0.33	0.33	1.00	1.00	1.00	1.00	1.00	1.00	0.33	0.33	0.33
Upstream Filter(I)	1.00	1.00	0.00	1.00	1.00	0.00	0.90	0.90	0.00	0.84	0.84	0.00
Uniform Delay (d), s/veh	56.5	52.2	0.0	55.4	50.7	0.0	36.6	21.7	0.0	58.0	53.2	0.0
Incr Delay (d2), s/veh	44.4	13.0	0.0	24.1	53.2	0.0	0.3	2.3	0.0	59.7	34.1	0.0
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	13.5	15.2	0.0	3.7	13.5	0.0	6.9	17.4	0.0	8.6	25.4	0.0
LnGrp Delay(d),s/veh	100.9	65.2	0.0	79.5	103.9	0.0	36.8	24.0	0.0	117.7	87.3	0.0
LnGrp LOS	F	E		E	F		D	C		F	F	
Approach Vol, veh/h		1017			371			1822			1404	
Approach Delay, s/veh		86.6			98.0			27.5			91.0	
Approach LOS		F			F			C			F	

Timer	1	2	3	4	5	6	7	8
Assigned Phs	1	2	3	4	5	6	7	8
Phs Duration (G+Y+Rc), s	39.4	47.0	12.8	38.2	17.0	69.4	26.0	25.0
Change Period (Y+Rc), s	5.5	* 6	5.0	6.5	5.0	5.5	5.0	6.5
Max Green Setting (Gmax), s	17.0	* 41	9.0	30.5	12.0	46.5	21.0	18.5
Max Q Clear Time (g_c+I1), s	16.9	43.0	8.2	28.1	13.9	37.5	23.0	20.5
Green Ext Time (p_c), s	0.0	0.0	0.0	1.2	0.0	8.0	0.0	0.0

Intersection Summary	
HCM 2010 Ctrl Delay	65.5
HCM 2010 LOS	E

Notes



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	85	675	70	90	735	45	145	180	55	55	240	65
Future Volume (veh/h)	85	675	70	90	735	45	145	180	55	55	240	65
Number	7	4	14	3	8	18	5	2	12	1	6	16
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj Sat Flow, veh/h/ln	1814	1814	1814	1814	1814	1814	1814	1814	1814	1814	1814	1814
Adj Flow Rate, veh/h	92	734	76	98	799	49	158	196	60	60	261	71
Adj No. of Lanes	1	1	1	1	1	1	1	1	1	1	1	1
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	2	2	2	2	2	2	2	2	2	2	2	2
Cap, veh/h	242	973	827	279	973	827	321	544	462	372	544	462
Arrive On Green	0.54	0.54	0.54	0.54	0.54	0.54	0.30	0.30	0.30	0.30	0.30	0.30
Sat Flow, veh/h	647	1814	1542	671	1814	1542	1044	1814	1542	1119	1814	1542
Grp Volume(v), veh/h	92	734	76	98	799	49	158	196	60	60	261	71
Grp Sat Flow(s),veh/h/ln	647	1814	1542	671	1814	1542	1044	1814	1542	1119	1814	1542
Q Serve(g_s), s	7.6	17.3	1.3	7.3	20.1	0.8	8.0	4.7	1.6	2.4	6.5	1.9
Cycle Q Clear(g_c), s	27.6	17.3	1.3	24.7	20.1	0.8	14.5	4.7	1.6	7.1	6.5	1.9
Prop In Lane	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Lane Grp Cap(c), veh/h	242	973	827	279	973	827	321	544	463	372	544	463
V/C Ratio(X)	0.38	0.75	0.09	0.35	0.82	0.06	0.49	0.36	0.13	0.16	0.48	0.15
Avail Cap(c_a), veh/h	242	973	827	279	973	827	321	544	463	372	544	463
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	22.0	9.9	6.2	19.5	10.6	6.1	21.7	15.1	14.0	17.9	15.7	14.1
Incr Delay (d2), s/veh	4.5	5.4	0.2	3.4	7.8	0.1	5.3	1.9	0.6	0.9	3.0	0.7
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	1.6	10.0	0.6	1.6	11.9	0.4	2.8	2.6	0.7	0.8	3.6	0.9
LnGrp Delay(d),s/veh	26.5	15.4	6.4	23.0	18.3	6.2	27.0	17.0	14.6	18.8	18.8	14.8
LnGrp LOS	C	B	A	C	B	A	C	B	B	B	B	B
Approach Vol, veh/h		902			946			414			392	
Approach Delay, s/veh		15.7			18.2			20.4			18.1	
Approach LOS		B			B			C			B	

Timer	1	2	3	4	5	6	7	8
Assigned Phs		2		4		6		8
Phs Duration (G+Y+Rc), s		21.0		34.0		21.0		34.0
Change Period (Y+Rc), s		4.5		4.5		4.5		4.5
Max Green Setting (Gmax), s		16.5		29.5		16.5		29.5
Max Q Clear Time (g_c+I1), s		16.5		29.6		9.1		26.7
Green Ext Time (p_c), s		0.0		0.0		2.5		2.5

Intersection Summary		
HCM 2010 Ctrl Delay		17.7
HCM 2010 LOS		B



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	205	230	200	140	185	145	85	1195	130	120	1360	210
Future Volume (veh/h)	205	230	200	140	185	145	85	1195	130	120	1360	210
Number	7	4	14	3	8	18	1	6	16	5	2	12
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj Sat Flow, veh/h/ln	1814	1832	1850	1850	1832	1832	1832	1832	1850	1850	1832	1850
Adj Flow Rate, veh/h	236	299	233	165	203	158	102	1271	188	176	1462	247
Adj No. of Lanes	1	1	1	1	1	1	1	2	1	1	2	1
Peak Hour Factor	0.87	0.77	0.86	0.85	0.91	0.92	0.83	0.94	0.69	0.68	0.93	0.85
Percent Heavy Veh, %	2	1	0	0	1	1	1	1	0	0	1	0
Cap, veh/h	253	295	407	197	295	424	171	1463	765	196	1450	760
Arrive On Green	0.07	0.16	0.16	0.07	0.16	0.16	0.10	0.42	0.42	0.11	0.42	0.42
Sat Flow, veh/h	1727	1832	1570	1762	1832	1557	1744	3480	1571	1762	3480	1572
Grp Volume(v), veh/h	236	299	233	165	203	158	102	1271	188	176	1462	247
Grp Sat Flow(s),veh/h/ln	1727	1832	1570	1762	1832	1557	1744	1740	1571	1762	1740	1572
Q Serve(g_s), s	6.0	14.5	1.9	6.0	9.4	7.4	5.0	30.0	6.3	8.9	37.5	3.9
Cycle Q Clear(g_c), s	6.0	14.5	1.9	6.0	9.4	7.4	5.0	30.0	6.3	8.9	37.5	3.9
Prop In Lane	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Lane Grp Cap(c), veh/h	253	295	407	197	295	424	171	1463	765	196	1450	760
V/C Ratio(X)	0.93	1.01	0.57	0.84	0.69	0.37	0.60	0.87	0.25	0.90	1.01	0.32
Avail Cap(c_a), veh/h	253	295	407	197	295	424	174	1463	765	196	1450	760
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	1.00	1.00	1.00	1.00	1.00	0.89	0.89	0.89	0.26	0.26	0.26
Uniform Delay (d), s/veh	35.8	37.8	13.4	32.5	35.6	26.5	38.9	23.8	13.5	39.5	26.3	4.5
Incr Delay (d2), s/veh	38.6	55.8	2.7	26.0	7.7	0.9	3.2	6.6	0.7	13.6	14.2	0.3
Initial Q Delay(d3),s/veh	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	5.7	11.9	3.5	2.6	5.4	3.3	2.6	15.6	2.9	5.0	20.8	1.7
LnGrp Delay(d),s/veh	74.4	93.6	16.1	58.5	43.4	27.5	42.1	30.4	14.1	53.1	40.5	4.8
LnGrp LOS	E	F	B	E	D	C	D	C	B	D	F	A
Approach Vol, veh/h		768			526			1561			1885	
Approach Delay, s/veh		64.2			43.3			29.2			37.0	
Approach LOS		E			D			C			D	

Timer	1	2	3	4	5	6	7	8
Assigned Phs	1	2	3	4	5	6	7	8
Phs Duration (G+Y+Rc), s	15.4	44.0	11.0	21.0	15.0	44.4	11.0	21.0
Change Period (Y+Rc), s	6.5	* 6.5	5.0	6.5	5.0	6.5	5.0	6.5
Max Green Setting (Gmax), s	9.0	* 38	6.0	14.5	10.0	36.5	6.0	14.5
Max Q Clear Time (g_c+I1), s	17.0	39.5	8.0	16.5	10.9	32.0	8.0	11.4
Green Ext Time (p_c), s	1.2	0.0	0.0	0.0	0.0	4.0	0.0	1.9

Intersection Summary	
HCM 2010 Ctrl Delay	39.5
HCM 2010 LOS	D

Notes



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	180	195	15	90	140	65	100	1525	110	150	1455	265
Future Volume (veh/h)	180	195	15	90	140	65	100	1525	110	150	1455	265
Number	7	4	14	3	8	18	1	6	16	5	2	12
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj Sat Flow, veh/h/ln	1850	1850	1850	1850	1850	1850	1850	1850	1850	1832	1850	1850
Adj Flow Rate, veh/h	234	247	23	107	149	87	133	1713	141	234	1796	373
Adj No. of Lanes	1	1	1	1	1	1	1	2	1	1	2	1
Peak Hour Factor	0.77	0.79	0.65	0.84	0.94	0.75	0.75	0.89	0.78	0.64	0.81	0.71
Percent Heavy Veh, %	0	0	0	0	0	0	0	0	0	1	0	0
Cap, veh/h	239	239	516	177	239	413	351	2136	1060	233	1860	937
Arrive On Green	0.07	0.13	0.13	0.07	0.13	0.13	0.40	1.00	1.00	0.04	0.17	0.17
Sat Flow, veh/h	1762	1850	1572	1762	1850	1572	1762	3515	1572	1744	3515	1572
Grp Volume(v), veh/h	234	247	23	107	149	87	133	1713	141	234	1796	373
Grp Sat Flow(s),veh/h/ln	1762	1850	1572	1762	1850	1572	1762	1758	1572	1744	1758	1572
Q Serve(g_s), s	8.0	15.5	0.2	6.2	9.2	5.2	6.4	0.0	0.0	16.0	60.9	18.6
Cycle Q Clear(g_c), s	8.0	15.5	0.2	6.2	9.2	5.2	6.4	0.0	0.0	16.0	60.9	18.6
Prop In Lane	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Lane Grp Cap(c), veh/h	239	239	516	177	239	413	351	2136	1060	233	1860	937
V/C Ratio(X)	0.98	1.03	0.04	0.60	0.62	0.21	0.38	0.80	0.13	1.01	0.97	0.40
Avail Cap(c_a), veh/h	239	239	516	177	239	413	351	2136	1060	233	1860	937
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	2.00	2.00	2.00	0.33	0.33	0.33
Upstream Filter(I)	1.00	1.00	1.00	1.00	1.00	1.00	0.91	0.91	0.91	0.85	0.85	0.85
Uniform Delay (d), s/veh	49.4	52.2	21.4	42.3	49.5	34.5	30.8	0.0	0.0	57.4	48.4	24.9
Incr Delay (d2), s/veh	52.1	67.2	0.1	6.2	6.3	0.4	0.2	3.0	0.2	56.0	12.7	1.1
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	7.3	12.4	0.5	3.3	5.1	2.3	3.1	0.9	0.1	11.4	33.0	8.4
LnGrp Delay(d),s/veh	101.4	119.5	21.5	48.5	55.8	35.0	31.1	3.0	0.2	113.4	61.2	26.0
LnGrp LOS	F	F	C	D	E	C	C	A	A	F	E	C
Approach Vol, veh/h		504			343			1987			2403	
Approach Delay, s/veh		106.7			48.2			4.7			60.8	
Approach LOS		F			D			A			E	

Timer	1	2	3	4	5	6	7	8
Assigned Phs	1	2	3	4	5	6	7	8
Phs Duration (G+Y+Rc), s	30.5	70.0	13.0	22.0	21.0	79.5	13.0	22.0
Change Period (Y+Rc), s	6.5	* 6.5	5.0	6.5	5.0	6.5	5.0	6.5
Max Green Setting (Gmax), s	10.0	* 64	8.0	15.5	16.0	57.5	8.0	15.5
Max Q Clear Time (g_c+I1), s	8.4	62.9	8.2	17.5	18.0	2.0	10.0	11.2
Green Ext Time (p_c), s	0.3	0.6	0.0	0.0	0.0	41.2	0.0	1.6

Intersection Summary	
HCM 2010 Ctrl Delay	43.1
HCM 2010 LOS	D

Notes



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	85	430	195	55	80	165	65	895	55	390	990	80
Future Volume (veh/h)	85	430	195	55	80	165	65	895	55	390	990	80
Number	7	4	14	3	8	18	5	2	12	1	6	16
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj Sat Flow, veh/h/ln	1814	1814	1814	1814	1814	1814	1814	1814	1850	1814	1814	1814
Adj Flow Rate, veh/h	92	467	212	60	87	179	71	973	60	424	1076	87
Adj No. of Lanes	1	1	1	1	1	1	1	2	0	1	2	1
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	2	2	2	2	2	2	2	2	2	2	2	2
Cap, veh/h	115	467	397	73	423	360	151	1017	63	425	1608	719
Arrive On Green	0.07	0.26	0.26	0.04	0.23	0.23	0.09	0.31	0.31	0.25	0.47	0.47
Sat Flow, veh/h	1727	1814	1542	1727	1814	1542	1727	3298	203	1727	3446	1542
Grp Volume(v), veh/h	92	467	212	60	87	179	71	508	525	424	1076	87
Grp Sat Flow(s),veh/h/ln	1727	1814	1542	1727	1814	1542	1727	1723	1778	1727	1723	1542
Q Serve(g_s), s	6.3	30.9	11.1	4.1	4.6	7.0	4.7	34.7	34.7	29.4	29.1	2.8
Cycle Q Clear(g_c), s	6.3	30.9	11.1	4.1	4.6	7.0	4.7	34.7	34.7	29.4	29.1	2.8
Prop In Lane	1.00		1.00	1.00		1.00	1.00		0.11	1.00		1.00
Lane Grp Cap(c), veh/h	115	467	397	73	423	360	151	531	548	425	1608	719
V/C Ratio(X)	0.80	1.00	0.53	0.82	0.21	0.50	0.47	0.96	0.96	1.00	0.67	0.12
Avail Cap(c_a), veh/h	189	467	397	73	423	360	151	531	548	425	1608	719
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.90	0.90	0.90
Uniform Delay (d), s/veh	55.2	44.5	23.4	57.0	37.0	13.5	52.1	40.7	40.7	45.2	24.8	10.0
Incr Delay (d2), s/veh	12.0	41.6	1.4	49.0	0.2	1.1	2.3	29.7	29.2	41.1	2.0	0.3
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	3.4	20.8	4.8	3.0	2.3	3.1	2.3	20.9	21.5	18.9	14.2	1.3
LnGrp Delay(d),s/veh	67.2	86.2	24.8	106.0	37.3	14.5	54.4	70.4	69.9	86.3	26.8	10.3
LnGrp LOS	E	F	C	F	D	B	D	E	E	F	C	B
Approach Vol, veh/h		771			326			1104			1587	
Approach Delay, s/veh		67.0			37.4			69.1			41.8	
Approach LOS		E			D			E			D	

Timer	1	2	3	4	5	6	7	8
Assigned Phs	1	2	3	4	5	6	7	8
Phs Duration (G+Y+Rc), s	14.0	41.0	9.6	35.4	15.0	60.0	12.5	32.5
Change Period (Y+Rc), s	4.5	4.0	4.5	4.5	4.5	4.0	4.5	4.5
Max Green Setting (Gmax), s	29.5	37.0	5.1	30.9	10.5	56.0	13.1	22.9
Max Q Clear Time (g_c+I1), s	11.4	36.7	6.1	32.9	6.7	31.1	8.3	9.0
Green Ext Time (p_c), s	0.0	0.2	0.0	0.0	0.6	9.1	0.1	3.9

Intersection Summary	
HCM 2010 Ctrl Delay	54.5
HCM 2010 LOS	D

Intersection	
Intersection Delay, s/veh	23.4
Intersection LOS	C

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Vol, veh/h	40	270	45	140	170	5	25	175	100	5	255	40
Future Vol, veh/h	40	270	45	140	170	5	25	175	100	5	255	40
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	43	293	49	152	185	5	27	190	109	5	277	43
Number of Lanes	1	1	0	1	1	0	0	1	0	0	1	0

Approach	EB	WB	NB	SB
Opposing Approach	WB	EB	SB	NB
Opposing Lanes	2	2	1	1
Conflicting Approach Left	SB	NB	EB	WB
Conflicting Lanes Left	1	1	2	2
Conflicting Approach Right	NB	SB	WB	EB
Conflicting Lanes Right	1	1	2	2
HCM Control Delay	27.6	16.5	24.1	24.8
HCM LOS	D	C	C	C

Lane	NBLn1	EBLn1	EBLn2	WBLn1	WBLn2	SBLn1
Vol Left, %	8%	100%	0%	100%	0%	2%
Vol Thru, %	58%	0%	86%	0%	97%	85%
Vol Right, %	33%	0%	14%	0%	3%	13%
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop
Traffic Vol by Lane	300	40	315	140	175	300
LT Vol	25	40	0	140	0	5
Through Vol	175	0	270	0	170	255
RT Vol	100	0	45	0	5	40
Lane Flow Rate	326	43	342	152	190	326
Geometry Grp	2	7	7	7	7	2
Degree of Util (X)	0.667	0.101	0.739	0.363	0.425	0.676
Departure Headway (Hd)	7.368	8.396	7.775	8.584	8.045	7.461
Convergence, Y/N	Yes	Yes	Yes	Yes	Yes	Yes
Cap	489	426	466	418	447	483
Service Time	5.433	6.158	5.536	6.354	5.814	5.526
HCM Lane V/C Ratio	0.667	0.101	0.734	0.364	0.425	0.675
HCM Control Delay	24.1	12.1	29.6	16.2	16.7	24.8
HCM Lane LOS	C	B	D	C	C	C
HCM 95th-tile Q	4.8	0.3	6.1	1.6	2.1	5

Intersection	
Int Delay, s/veh	2.4

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	65	40	30	295	435	90
Future Vol, veh/h	65	40	30	295	435	90
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	-	-	-	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	71	43	33	321	473	98

Major/Minor	Minor2		Major1		Major2	
Conflicting Flow All	908	522	571	0	-	0
Stage 1	522	-	-	-	-	-
Stage 2	386	-	-	-	-	-
Critical Hdwy	6.42	6.22	4.12	-	-	-
Critical Hdwy Stg 1	5.42	-	-	-	-	-
Critical Hdwy Stg 2	5.42	-	-	-	-	-
Follow-up Hdwy	3.518	3.318	2.218	-	-	-
Pot Cap-1 Maneuver	306	555	1002	-	-	-
Stage 1	595	-	-	-	-	-
Stage 2	687	-	-	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	294	555	1002	-	-	-
Mov Cap-2 Maneuver	294	-	-	-	-	-
Stage 1	595	-	-	-	-	-
Stage 2	660	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s	19.7	0.8	0
HCM LOS	C		

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	SBT	SBR
Capacity (veh/h)	1002	-	358	-	-
HCM Lane V/C Ratio	0.033	-	0.319	-	-
HCM Control Delay (s)	8.7	0	19.7	-	-
HCM Lane LOS	A	A	C	-	-
HCM 95th %tile Q(veh)	0.1	-	1.3	-	-

Intersection	
Intersection Delay, s/veh	24.6
Intersection LOS	C

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Vol, veh/h	205	50	65	5	15	5	65	215	10	10	300	195
Future Vol, veh/h	205	50	65	5	15	5	65	215	10	10	300	195
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	223	54	71	5	16	5	71	234	11	11	326	212
Number of Lanes	0	1	0	0	1	0	0	1	0	0	1	0

Approach	EB	WB	NB	SB
Opposing Approach	WB	EB	SB	NB
Opposing Lanes	1	1	1	1
Conflicting Approach Left	SB	NB	EB	WB
Conflicting Lanes Left	1	1	1	1
Conflicting Approach Right	NB	SB	WB	EB
Conflicting Lanes Right	1	1	1	1
HCM Control Delay	19.6	10.9	16.5	33
HCM LOS	C	B	C	D

Lane	NBLn1	EBLn1	WBLn1	SBLn1
Vol Left, %	22%	64%	20%	2%
Vol Thru, %	74%	16%	60%	59%
Vol Right, %	3%	20%	20%	39%
Sign Control	Stop	Stop	Stop	Stop
Traffic Vol by Lane	290	320	25	505
LT Vol	65	205	5	10
Through Vol	215	50	15	300
RT Vol	10	65	5	195
Lane Flow Rate	315	348	27	549
Geometry Grp	1	1	1	1
Degree of Util (X)	0.544	0.623	0.056	0.856
Departure Headway (Hd)	6.21	6.443	7.373	5.616
Convergence, Y/N	Yes	Yes	Yes	Yes
Cap	580	560	483	648
Service Time	4.262	4.47	5.452	3.642
HCM Lane V/C Ratio	0.543	0.621	0.056	0.847
HCM Control Delay	16.5	19.6	10.9	33
HCM Lane LOS	C	C	B	D
HCM 95th-tile Q	3.3	4.3	0.2	9.7

Intersection	
Int Delay, s/veh	0.7

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Vol, veh/h	240	220	395	150	220	150	85	160	100	100	165	110
Future Vol, veh/h	240	220	395	150	220	150	85	160	100	100	165	110
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Free	Free	Free	Free	Free	Free
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	0	-	-	-	-	-	-	-	-	-	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	92	92	92	92	92	92	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	261	239	429	163	239	163	92	174	109	109	179	120

Major/Minor	Minor2			Minor1			Major1			Major2		
Conflicting Flow All	1071	924	239	1204	929	228	299	0	0	283	0	0
Stage 1	457	457	-	413	413	-	-	-	-	-	-	-
Stage 2	614	467	-	791	516	-	-	-	-	-	-	-
Critical Hdwy	7.12	6.52	6.22	7.12	6.52	6.22	4.12	-	-	4.12	-	-
Critical Hdwy Stg 1	6.12	5.52	-	6.12	5.52	-	-	-	-	-	-	-
Critical Hdwy Stg 2	6.12	5.52	-	6.12	5.52	-	-	-	-	-	-	-
Follow-up Hdwy	3.518	4.018	3.318	3.518	4.018	3.318	2.218	-	-	2.218	-	-
Pot Cap-1 Maneuver	~ 198	269	800	~ 161	268	811	1262	-	-	1279	-	-
Stage 1	583	568	-	616	594	-	-	-	-	-	-	-
Stage 2	479	562	-	383	534	-	-	-	-	-	-	-
Platoon blocked, %								-	-		-	-
Mov Cap-1 Maneuver	-	~ 220	800	-	~ 219	811	1262	-	-	1279	-	-
Mov Cap-2 Maneuver	-	~ 220	-	-	~ 219	-	-	-	-	-	-	-
Stage 1	532	509	-	562	542	-	-	-	-	-	-	-
Stage 2	~ 195	513	-	~ 84	478	-	-	-	-	-	-	-

Approach	EB	WB	NB	SB
HCM Control Delay, s			2	2.2
HCM LOS	-	-		

Minor Lane/Major Mvmt	NBL	NBT	NBR	EBLn1	EBLn2	WBLn1	SBL	SBT	SBR
Capacity (veh/h)	1262	-	-	-	412	-	1279	-	-
HCM Lane V/C Ratio	0.073	-	-	-	1.623	-	0.085	-	-
HCM Control Delay (s)	8.1	0	-	-	$ 315	-	8.1	0	-
HCM Lane LOS	A	A	-	-	F	-	A	A	-
HCM 95th %tile Q(veh)	0.2	-	-	-	38.6	-	0.3	-	-

Notes			
~: Volume exceeds capacity	$: Delay exceeds 300s	+: Computation Not Defined	*: All major volume in platoon

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	245	640	345	650	775	130	140	880	465	120	1170	235
Future Volume (veh/h)	245	640	345	650	775	130	140	880	465	120	1170	235
Number	3	8	18	7	4	14	1	6	16	5	2	12
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj Sat Flow, veh/h/ln	1832	1832	1850	1832	1832	1832	1832	1814	1814	1832	1832	1832
Adj Flow Rate, veh/h	261	736	0	747	1033	0	177	957	0	140	1286	0
Adj No. of Lanes	2	2	1	2	2	1	1	2	1	1	2	1
Peak Hour Factor	0.94	0.87	0.69	0.87	0.75	0.44	0.79	0.92	0.87	0.86	0.91	0.81
Percent Heavy Veh, %	1	1	0	1	1	1	1	2	2	1	1	1
Cap, veh/h	331	769	347	705	1139	509	147	1177	527	194	1189	532
Arrive On Green	0.16	0.37	0.00	0.21	0.33	0.00	0.03	0.23	0.00	0.03	0.23	0.00
Sat Flow, veh/h	3384	3480	1572	3384	3480	1557	1744	3446	1542	1744	3480	1557
Grp Volume(v), veh/h	261	736	0	747	1033	0	177	957	0	140	1286	0
Grp Sat Flow(s),veh/h/ln	1692	1740	1572	1692	1740	1557	1744	1723	1542	1744	1740	1557
Q Serve(g_s), s	8.9	24.8	0.0	25.0	34.1	0.0	6.0	31.6	0.0	6.0	41.0	0.0
Cycle Q Clear(g_c), s	8.9	24.8	0.0	25.0	34.1	0.0	6.0	31.6	0.0	6.0	41.0	0.0
Prop In Lane	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Lane Grp Cap(c), veh/h	331	769	347	705	1139	509	147	1177	527	194	1189	532
V/C Ratio(X)	0.79	0.96	0.00	1.06	0.91	0.00	1.20	0.81	0.00	0.72	1.08	0.00
Avail Cap(c_a), veh/h	331	769	347	705	1175	525	147	1177	527	194	1189	532
HCM Platoon Ratio	1.67	1.67	1.67	1.00	1.00	1.00	0.67	0.67	0.67	0.67	0.67	0.67
Upstream Filter(I)	0.39	0.39	0.00	1.00	1.00	0.00	0.59	0.59	0.00	0.85	0.85	0.00
Uniform Delay (d), s/veh	49.0	37.3	0.0	47.5	38.6	0.0	34.2	42.6	0.0	31.3	46.3	0.0
Incr Delay (d2), s/veh	4.6	12.0	0.0	50.8	10.5	0.0	122.9	3.8	0.0	9.4	49.3	0.0
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	4.4	13.0	0.0	16.6	18.0	0.0	7.0	15.7	0.0	2.3	27.9	0.0
LnGrp Delay(d),s/veh	53.6	49.3	0.0	98.3	49.1	0.0	157.1	46.4	0.0	40.7	95.6	0.0
LnGrp LOS	D	D		F	D		F	D		D	F	
Approach Vol, veh/h		997			1780			1134			1426	
Approach Delay, s/veh		50.4			69.7			63.7			90.2	
Approach LOS		D			E			E			F	

Timer	1	2	3	4	5	6	7	8
Assigned Phs	1	2	3	4	5	6	7	8
Phs Duration (G+Y+Rc), s	11.0	47.0	17.2	44.8	11.0	47.0	30.0	32.0
Change Period (Y+Rc), s	5.0	6.0	5.5	* 5.5	5.0	6.0	5.0	5.5
Max Green Setting (Gmax), s	6.0	41.0	11.0	* 41	6.0	41.0	25.0	26.5
Max Q Clear Time (g_c+I1), s	8.0	43.0	10.9	36.1	8.0	33.6	27.0	26.8
Green Ext Time (p_c), s	0.0	0.0	0.1	3.2	0.0	7.1	0.0	0.0

Intersection Summary	
HCM 2010 Ctrl Delay	70.3
HCM 2010 LOS	E

Notes



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	145	10	485	0	5	5	120	195	5	10	455	175
Future Volume (veh/h)	145	10	485	0	5	5	120	195	5	10	455	175
Number	7	4	14	3	8	18	5	2	12	1	6	16
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj Sat Flow, veh/h/ln	1850	1814	1814	1850	1814	1850	1814	1814	1850	1814	1814	1814
Adj Flow Rate, veh/h	158	11	0	0	5	5	130	212	5	11	495	0
Adj No. of Lanes	0	1	1	0	1	0	1	1	0	1	1	1
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	2	2	2	2	2	2	2	2	2	2	2	2
Cap, veh/h	411	14	247	0	134	134	585	1014	24	811	1042	886
Arrive On Green	0.16	0.16	0.00	0.00	0.16	0.16	0.57	0.57	0.57	0.57	0.57	0.00
Sat Flow, veh/h	1286	90	1542	0	833	833	899	1765	42	1160	1814	1542
Grp Volume(v), veh/h	169	0	0	0	0	10	130	0	217	11	495	0
Grp Sat Flow(s),veh/h/ln	1375	0	1542	0	0	1667	899	0	1806	1160	1814	1542
Q Serve(g_s), s	3.9	0.0	0.0	0.0	0.0	0.2	3.4	0.0	2.0	0.2	5.4	0.0
Cycle Q Clear(g_c), s	4.0	0.0	0.0	0.0	0.0	0.2	8.8	0.0	2.0	2.1	5.4	0.0
Prop In Lane	0.93		1.00	0.00		0.50	1.00		0.02	1.00		1.00
Lane Grp Cap(c), veh/h	426	0	247	0	0	267	585	0	1038	811	1042	886
V/C Ratio(X)	0.40	0.00	0.00	0.00	0.00	0.04	0.22	0.00	0.21	0.01	0.48	0.00
Avail Cap(c_a), veh/h	888	0	749	0	0	810	585	0	1038	811	1042	886
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	0.00	0.00	0.00	1.00	1.00	0.00	1.00	1.00	1.00	0.00
Uniform Delay (d), s/veh	13.7	0.0	0.0	0.0	0.0	12.0	6.8	0.0	3.5	4.0	4.2	0.0
Incr Delay (d2), s/veh	0.6	0.0	0.0	0.0	0.0	0.1	0.9	0.0	0.5	0.0	1.6	0.0
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	1.6	0.0	0.0	0.0	0.0	0.1	1.0	0.0	1.1	0.1	3.1	0.0
LnGrp Delay(d),s/veh	14.3	0.0	0.0	0.0	0.0	12.1	7.7	0.0	4.0	4.0	5.8	0.0
LnGrp LOS	B					B	A		A	A	A	
Approach Vol, veh/h		169			10			347			506	
Approach Delay, s/veh		14.3			12.1			5.3			5.7	
Approach LOS		B			B			A			A	

Timer	1	2	3	4	5	6	7	8
Assigned Phs		2		4		6		8
Phs Duration (G+Y+Rc), s		24.0		9.9		24.0		9.9
Change Period (Y+Rc), s		4.5		4.5		4.5		4.5
Max Green Setting (Gmax), s		19.5		16.5		19.5		16.5
Max Q Clear Time (g_c+I1), s		10.8		6.0		7.4		2.2
Green Ext Time (p_c), s		3.5		0.6		4.2		0.8

Intersection Summary		
HCM 2010 Ctrl Delay		7.1
HCM 2010 LOS		A

Intersection	
Int Delay, s/veh	13.6

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Vol, veh/h	20	10	50	125	55	90	25	270	15	85	90	15
Future Vol, veh/h	20	10	50	125	55	90	25	270	15	85	90	15
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Free	Free	Free	Free	Free	Free
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	-	-	-	-	-	-	110	-	-	110	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	92	92	92	92	92	92	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	22	11	54	136	60	98	27	293	16	92	98	16

Major/Minor	Minor2			Minor1			Major1			Major2		
Conflicting Flow All	726	655	106	679	655	302	114	0	0	310	0	0
Stage 1	291	291	-	356	356	-	-	-	-	-	-	-
Stage 2	435	364	-	323	299	-	-	-	-	-	-	-
Critical Hdwy	7.12	6.52	6.22	7.12	6.52	6.22	4.12	-	-	4.12	-	-
Critical Hdwy Stg 1	6.12	5.52	-	6.12	5.52	-	-	-	-	-	-	-
Critical Hdwy Stg 2	6.12	5.52	-	6.12	5.52	-	-	-	-	-	-	-
Follow-up Hdwy	3.518	4.018	3.318	3.518	4.018	3.318	2.218	-	-	2.218	-	-
Pot Cap-1 Maneuver	340	386	948	366	386	738	1475	-	-	1250	-	-
Stage 1	717	672	-	661	629	-	-	-	-	-	-	-
Stage 2	600	624	-	689	666	-	-	-	-	-	-	-
Platoon blocked, %								-	-		-	-
Mov Cap-1 Maneuver	239	351	948	314	351	738	1475	-	-	1250	-	-
Mov Cap-2 Maneuver	239	351	-	314	351	-	-	-	-	-	-	-
Stage 1	704	623	-	649	617	-	-	-	-	-	-	-
Stage 2	461	613	-	591	617	-	-	-	-	-	-	-

Approach	EB	WB	NB	SB
HCM Control Delay, s	14	35.3	0.6	3.6
HCM LOS	B	E		

Minor Lane/Major Mvmt	NBL	NBT	NBR	EBLn1	WBLn1	SBL	SBT	SBR
Capacity (veh/h)	1475	-	-	485	399	1250	-	-
HCM Lane V/C Ratio	0.018	-	-	0.179	0.736	0.074	-	-
HCM Control Delay (s)	7.5	-	-	14	35.3	8.1	-	-
HCM Lane LOS	A	-	-	B	E	A	-	-
HCM 95th %tile Q(veh)	0.1	-	-	0.6	5.8	0.2	-	-

Intersection	
Int Delay, s/veh	4.4

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Vol, veh/h	30	45	80	20	65	40
Future Vol, veh/h	30	45	80	20	65	40
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	-	-	-	-
Veh in Median Storage, #	0	-	0	-	-	0
Grade, %	0	-	0	-	-	0
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	33	49	87	22	71	43

Major/Minor	Minor1		Major1		Major2	
Conflicting Flow All	283	98	0	0	109	0
Stage 1	98	-	-	-	-	-
Stage 2	185	-	-	-	-	-
Critical Hdwy	6.42	6.22	-	-	4.12	-
Critical Hdwy Stg 1	5.42	-	-	-	-	-
Critical Hdwy Stg 2	5.42	-	-	-	-	-
Follow-up Hdwy	3.518	3.318	-	-	2.218	-
Pot Cap-1 Maneuver	707	958	-	-	1481	-
Stage 1	926	-	-	-	-	-
Stage 2	847	-	-	-	-	-
Platoon blocked, %			-	-		-
Mov Cap-1 Maneuver	672	958	-	-	1481	-
Mov Cap-2 Maneuver	672	-	-	-	-	-
Stage 1	926	-	-	-	-	-
Stage 2	805	-	-	-	-	-

Approach	WB	NB	SB
HCM Control Delay, s	9.9	0	4.7
HCM LOS	A		

Minor Lane/Major Mvmt	NBT	NBR	WBLn1	SBL	SBT
Capacity (veh/h)	-	-	819	1481	-
HCM Lane V/C Ratio	-	-	0.1	0.048	-
HCM Control Delay (s)	-	-	9.9	7.6	0
HCM Lane LOS	-	-	A	A	A
HCM 95th %tile Q(veh)	-	-	0.3	0.1	-

Intersection	
Int Delay, s/veh	2.2

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	75	20	20	350	340	95
Future Vol, veh/h	75	20	20	350	340	95
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	-	-	-	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	82	22	22	380	370	103

Major/Minor	Minor2		Major1		Major2	
Conflicting Flow All	845	421	473	0	-	0
Stage 1	421	-	-	-	-	-
Stage 2	424	-	-	-	-	-
Critical Hdwy	6.42	6.22	4.12	-	-	-
Critical Hdwy Stg 1	5.42	-	-	-	-	-
Critical Hdwy Stg 2	5.42	-	-	-	-	-
Follow-up Hdwy	3.518	3.318	2.218	-	-	-
Pot Cap-1 Maneuver	333	632	1089	-	-	-
Stage 1	662	-	-	-	-	-
Stage 2	660	-	-	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	324	632	1089	-	-	-
Mov Cap-2 Maneuver	324	-	-	-	-	-
Stage 1	662	-	-	-	-	-
Stage 2	643	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s	18.9	0.5	0
HCM LOS	C		

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	SBT	SBR
Capacity (veh/h)	1089	-	361	-	-
HCM Lane V/C Ratio	0.02	-	0.286	-	-
HCM Control Delay (s)	8.4	0	18.9	-	-
HCM Lane LOS	A	A	C	-	-
HCM 95th %tile Q(veh)	0.1	-	1.2	-	-

Intersection	
Intersection Delay, s/veh	13.1
Intersection LOS	B

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Vol, veh/h	15	10	420	15	15	390
Future Vol, veh/h	15	10	420	15	15	390
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	16	11	457	16	16	424
Number of Lanes	1	0	1	0	0	1

Approach	WB	NB	SB
Opposing Approach		SB	NB
Opposing Lanes	0	1	1
Conflicting Approach Left	NB		WB
Conflicting Lanes Left	1	0	1
Conflicting Approach Right	SB	WB	
Conflicting Lanes Right	1	1	0
HCM Control Delay	9.1	13.5	12.9
HCM LOS	A	B	B

Lane	NBLn1	WBLn1	SBLn1
Vol Left, %	0%	60%	4%
Vol Thru, %	97%	0%	96%
Vol Right, %	3%	40%	0%
Sign Control	Stop	Stop	Stop
Traffic Vol by Lane	435	25	405
LT Vol	0	15	15
Through Vol	420	0	390
RT Vol	15	10	0
Lane Flow Rate	473	27	440
Geometry Grp	1	1	1
Degree of Util (X)	0.584	0.043	0.55
Departure Headway (Hd)	4.443	5.745	4.499
Convergence, Y/N	Yes	Yes	Yes
Cap	813	620	801
Service Time	2.466	3.808	2.523
HCM Lane V/C Ratio	0.582	0.044	0.549
HCM Control Delay	13.5	9.1	12.9
HCM Lane LOS	B	A	B
HCM 95th-tile Q	3.9	0.1	3.4

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	460	345	280	40	240	75	355	995	70	120	1100	630
Future Volume (veh/h)	460	345	280	40	240	75	355	995	70	120	1100	630
Number	7	4	14	3	8	18	1	6	16	5	2	12
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj Sat Flow, veh/h/ln	1832	1850	1832	1779	1832	1814	1814	1814	1779	1814	1832	1832
Adj Flow Rate, veh/h	590	397	0	89	282	0	467	1259	0	171	1250	0
Adj No. of Lanes	2	1	1	1	1	1	2	2	1	1	2	1
Peak Hour Factor	0.78	0.87	0.96	0.45	0.85	0.75	0.76	0.79	0.75	0.70	0.88	0.97
Percent Heavy Veh, %	1	0	1	4	1	2	2	2	4	2	1	1
Cap, veh/h	564	473	398	110	282	238	908	1852	813	173	1247	558
Arrive On Green	0.06	0.08	0.00	0.07	0.15	0.00	0.27	0.54	0.00	0.03	0.12	0.00
Sat Flow, veh/h	3384	1850	1557	1694	1832	1542	3351	3446	1512	1727	3480	1557
Grp Volume(v), veh/h	590	397	0	89	282	0	467	1259	0	171	1250	0
Grp Sat Flow(s),veh/h/ln	1692	1850	1557	1694	1832	1542	1676	1723	1512	1727	1740	1557
Q Serve(g_s), s	20.0	25.4	0.0	6.2	18.5	0.0	14.2	31.9	0.0	11.9	43.0	0.0
Cycle Q Clear(g_c), s	20.0	25.4	0.0	6.2	18.5	0.0	14.2	31.9	0.0	11.9	43.0	0.0
Prop In Lane	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Lane Grp Cap(c), veh/h	564	473	398	110	282	238	908	1852	813	173	1247	558
V/C Ratio(X)	1.05	0.84	0.00	0.81	1.00	0.00	0.51	0.68	0.00	0.99	1.00	0.00
Avail Cap(c_a), veh/h	564	473	398	127	282	238	908	1852	813	173	1247	558
HCM Platoon Ratio	0.33	0.33	0.33	1.00	1.00	1.00	1.00	1.00	1.00	0.33	0.33	0.33
Upstream Filter(I)	1.00	1.00	0.00	1.00	1.00	0.00	0.90	0.90	0.00	0.84	0.84	0.00
Uniform Delay (d), s/veh	56.7	52.5	0.0	55.4	50.7	0.0	37.1	20.2	0.0	58.0	52.9	0.0
Incr Delay (d2), s/veh	50.5	13.8	0.0	24.1	53.2	0.0	0.2	1.8	0.0	59.7	24.0	0.0
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	13.3	14.8	0.0	3.7	13.5	0.0	6.6	15.5	0.0	8.6	24.9	0.0
LnGrp Delay(d),s/veh	107.2	66.3	0.0	79.5	103.9	0.0	37.3	22.1	0.0	117.7	76.9	0.0
LnGrp LOS	F	E		E	F		D	C		F	F	
Approach Vol, veh/h		987			371			1726			1421	
Approach Delay, s/veh		90.7			98.0			26.2			81.8	
Approach LOS		F			F			C			F	

Timer	1	2	3	4	5	6	7	8
Assigned Phs	1	2	3	4	5	6	7	8
Phs Duration (G+Y+Rc), s	38.5	49.0	12.8	37.2	17.0	70.5	25.0	25.0
Change Period (Y+Rc), s	5.5	* 6	5.0	6.5	5.0	5.5	5.0	6.5
Max Green Setting (Gmax), s	16.0	* 43	9.0	29.5	12.0	47.5	20.0	18.5
Max Q Clear Time (g_c+I1), s	16.2	45.0	8.2	27.4	13.9	33.9	22.0	20.5
Green Ext Time (p_c), s	0.0	0.0	0.0	1.1	0.0	11.2	0.0	0.0

Intersection Summary	
HCM 2010 Ctrl Delay	63.8
HCM 2010 LOS	E

Notes



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	90	695	70	95	745	45	150	195	60	55	240	65
Future Volume (veh/h)	90	695	70	95	745	45	150	195	60	55	240	65
Number	7	4	14	3	8	18	5	2	12	1	6	16
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj Sat Flow, veh/h/ln	1814	1814	1814	1814	1814	1814	1814	1814	1814	1814	1814	1814
Adj Flow Rate, veh/h	98	755	76	103	810	49	163	212	65	60	261	71
Adj No. of Lanes	1	1	1	1	1	1	1	1	1	1	1	1
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	2	2	2	2	2	2	2	2	2	2	2	2
Cap, veh/h	239	979	832	270	979	832	317	538	457	354	538	457
Arrive On Green	0.54	0.54	0.54	0.54	0.54	0.54	0.30	0.30	0.30	0.30	0.30	0.30
Sat Flow, veh/h	641	1814	1542	658	1814	1542	1044	1814	1542	1098	1814	1542
Grp Volume(v), veh/h	98	755	76	103	810	49	163	212	65	60	261	71
Grp Sat Flow(s),veh/h/ln	641	1814	1542	658	1814	1542	1044	1814	1542	1098	1814	1542
Q Serve(g_s), s	8.3	18.0	1.3	8.0	20.4	0.8	8.4	5.1	1.7	2.5	6.5	1.9
Cycle Q Clear(g_c), s	28.7	18.0	1.3	26.1	20.4	0.8	14.9	5.1	1.7	7.7	6.5	1.9
Prop In Lane	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Lane Grp Cap(c), veh/h	239	979	833	270	979	833	317	538	457	354	538	457
V/C Ratio(X)	0.41	0.77	0.09	0.38	0.83	0.06	0.51	0.39	0.14	0.17	0.49	0.16
Avail Cap(c_a), veh/h	239	979	833	270	979	833	317	538	457	354	538	457
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	22.4	10.0	6.1	20.2	10.5	6.0	22.0	15.4	14.2	18.5	15.9	14.3
Incr Delay (d2), s/veh	5.1	5.9	0.2	4.0	8.0	0.1	5.9	2.2	0.7	1.0	3.1	0.7
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	1.8	10.4	0.6	1.8	12.1	0.4	2.9	2.9	0.8	0.9	3.7	0.9
LnGrp Delay(d),s/veh	27.6	15.8	6.3	24.3	18.5	6.1	27.9	17.6	14.9	19.5	19.0	15.0
LnGrp LOS	C	B	A	C	B	A	C	B	B	B	B	B
Approach Vol, veh/h		929			962			440			392	
Approach Delay, s/veh		16.3			18.5			21.0			18.4	
Approach LOS		B			B			C			B	

Timer	1	2	3	4	5	6	7	8
Assigned Phs		2		4		6		8
Phs Duration (G+Y+Rc), s		20.8		34.2		20.8		34.2
Change Period (Y+Rc), s		4.5		4.5		4.5		4.5
Max Green Setting (Gmax), s		16.3		29.7		16.3		29.7
Max Q Clear Time (g_c+I1), s		16.9		30.7		9.7		28.1
Green Ext Time (p_c), s		0.0		0.0		2.4		1.4

Intersection Summary	
HCM 2010 Ctrl Delay	18.1
HCM 2010 LOS	B



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	210	235	205	140	190	145	90	1220	130	125	1385	215
Future Volume (veh/h)	210	235	205	140	190	145	90	1220	130	125	1385	215
Number	7	4	14	3	8	18	1	6	16	5	2	12
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj Sat Flow, veh/h/ln	1814	1832	1850	1850	1832	1832	1832	1832	1850	1850	1832	1850
Adj Flow Rate, veh/h	241	305	238	165	209	158	108	1298	188	184	1489	253
Adj No. of Lanes	1	1	1	1	1	1	1	2	1	1	2	1
Peak Hour Factor	0.87	0.77	0.86	0.85	0.91	0.92	0.83	0.94	0.69	0.68	0.93	0.85
Percent Heavy Veh, %	2	1	0	0	1	1	1	1	0	0	1	0
Cap, veh/h	249	295	413	197	295	424	177	1476	771	196	1450	760
Arrive On Green	0.07	0.16	0.16	0.07	0.16	0.16	0.10	0.42	0.42	0.11	0.42	0.42
Sat Flow, veh/h	1727	1832	1570	1762	1832	1557	1744	3480	1571	1762	3480	1572
Grp Volume(v), veh/h	241	305	238	165	209	158	108	1298	188	184	1489	253
Grp Sat Flow(s),veh/h/ln	1727	1832	1570	1762	1832	1557	1744	1740	1571	1762	1740	1572
Q Serve(g_s), s	6.0	14.5	2.0	6.0	9.7	7.4	5.3	30.8	6.2	9.3	37.5	4.0
Cycle Q Clear(g_c), s	6.0	14.5	2.0	6.0	9.7	7.4	5.3	30.8	6.2	9.3	37.5	4.0
Prop In Lane	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Lane Grp Cap(c), veh/h	249	295	413	197	295	424	177	1476	771	196	1450	760
V/C Ratio(X)	0.97	1.03	0.58	0.84	0.71	0.37	0.61	0.88	0.24	0.94	1.03	0.33
Avail Cap(c_a), veh/h	249	295	413	197	295	424	177	1476	771	196	1450	760
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	1.00	1.00	1.00	1.00	1.00	0.89	0.89	0.89	0.26	0.26	0.26
Uniform Delay (d), s/veh	36.1	37.8	13.5	32.5	35.7	26.5	38.7	23.8	13.3	39.7	26.3	4.5
Incr Delay (d2), s/veh	47.9	61.3	2.7	26.0	8.8	0.9	3.9	7.1	0.7	19.6	19.8	0.3
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	6.4	12.3	3.7	2.6	5.7	3.3	2.8	16.2	2.9	5.6	21.9	1.8
LnGrp Delay(d),s/veh	84.0	99.1	16.2	58.5	44.5	27.5	42.6	30.9	13.9	59.3	46.0	4.9
LnGrp LOS	F	F	B	E	D	C	D	C	B	E	F	A
Approach Vol, veh/h		784			532			1594			1926	
Approach Delay, s/veh		69.3			43.8			29.7			41.9	
Approach LOS		E			D			C			D	

Timer	1	2	3	4	5	6	7	8
Assigned Phs	1	2	3	4	5	6	7	8
Phs Duration (G+Y+Rc), s	15.7	44.0	11.0	21.0	15.0	44.7	11.0	21.0
Change Period (Y+Rc), s	6.5	* 6.5	5.0	6.5	5.0	6.5	5.0	6.5
Max Green Setting (Gmax), s	9.0	* 38	6.0	14.5	10.0	36.5	6.0	14.5
Max Q Clear Time (g_c+I1), s	11.3	39.5	8.0	16.5	11.3	32.8	8.0	11.7
Green Ext Time (p_c), s	0.8	0.0	0.0	0.0	0.0	3.3	0.0	1.7

Intersection Summary	
HCM 2010 Ctrl Delay	42.5
HCM 2010 LOS	D

Notes



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	175	190	15	85	135	60	100	1550	110	150	1485	270
Future Volume (veh/h)	175	190	15	85	135	60	100	1550	110	150	1485	270
Number	7	4	14	3	8	18	1	6	16	5	2	12
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj Sat Flow, veh/h/ln	1850	1850	1850	1850	1850	1850	1850	1850	1850	1832	1850	1850
Adj Flow Rate, veh/h	227	241	23	101	144	80	133	1742	141	234	1833	380
Adj No. of Lanes	1	1	1	1	1	1	1	2	1	1	2	1
Peak Hour Factor	0.77	0.79	0.65	0.84	0.94	0.75	0.75	0.89	0.78	0.64	0.81	0.71
Percent Heavy Veh, %	0	0	0	0	0	0	0	0	0	1	0	0
Cap, veh/h	239	239	479	172	233	408	309	2053	1018	233	1860	937
Arrive On Green	0.07	0.13	0.13	0.06	0.13	0.13	0.35	1.00	1.00	0.09	0.35	0.35
Sat Flow, veh/h	1762	1850	1572	1762	1850	1572	1762	3515	1572	1744	3515	1572
Grp Volume(v), veh/h	227	241	23	101	144	80	133	1742	141	234	1833	380
Grp Sat Flow(s),veh/h/ln	1762	1850	1572	1762	1850	1572	1762	1758	1572	1744	1758	1572
Q Serve(g_s), s	8.0	15.5	0.2	5.9	8.9	4.8	6.9	0.0	0.0	16.0	62.1	13.1
Cycle Q Clear(g_c), s	8.0	15.5	0.2	5.9	8.9	4.8	6.9	0.0	0.0	16.0	62.1	13.1
Prop In Lane	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Lane Grp Cap(c), veh/h	239	239	479	172	233	408	309	2053	1018	233	1860	937
V/C Ratio(X)	0.95	1.01	0.05	0.59	0.62	0.20	0.43	0.85	0.14	1.01	0.99	0.41
Avail Cap(c_a), veh/h	239	239	479	177	239	413	309	2053	1018	233	1860	937
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	2.00	2.00	2.00	0.67	0.67	0.67
Upstream Filter(I)	1.00	1.00	1.00	1.00	1.00	1.00	0.91	0.91	0.91	0.85	0.85	0.85
Uniform Delay (d), s/veh	49.2	52.2	21.4	42.7	49.7	34.7	34.3	0.0	0.0	54.6	38.3	14.1
Incr Delay (d2), s/veh	43.9	60.4	0.1	5.2	6.0	0.4	0.3	4.2	0.3	56.0	16.1	1.1
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	6.6	11.9	0.5	3.1	4.9	2.1	3.3	1.2	0.1	11.3	34.4	5.9
LnGrp Delay(d),s/veh	93.1	112.7	21.5	48.0	55.7	35.1	34.6	4.2	0.3	110.7	54.4	15.2
LnGrp LOS	F	F	C	D	E	D	C	A	A	F	D	B
Approach Vol, veh/h		491			325			2016			2447	
Approach Delay, s/veh		99.4			48.2			5.9			53.7	
Approach LOS		F			D			A			D	

Timer	1	2	3	4	5	6	7	8
Assigned Phs	1	2	3	4	5	6	7	8
Phs Duration (G+Y+Rc), s	27.6	70.0	12.6	22.0	21.0	76.6	13.0	21.6
Change Period (Y+Rc), s	6.5	* 6.5	5.0	6.5	5.0	6.5	5.0	6.5
Max Green Setting (Gmax), s	10.0	* 64	8.0	15.5	16.0	57.5	8.0	15.5
Max Q Clear Time (g_c+I1), s	8.9	64.1	7.9	17.5	18.0	2.0	10.0	10.9
Green Ext Time (p_c), s	0.1	0.0	0.0	0.0	0.0	41.9	0.0	1.6

Intersection Summary	
HCM 2010 Ctrl Delay	39.4
HCM 2010 LOS	D

Notes



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	80	415	190	30	45	90	65	860	50	360	910	75
Future Volume (veh/h)	80	415	190	30	45	90	65	860	50	360	910	75
Number	7	4	14	3	8	18	5	2	12	1	6	16
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj Sat Flow, veh/h/ln	1814	1814	1814	1814	1814	1814	1814	1814	1850	1814	1814	1814
Adj Flow Rate, veh/h	87	451	207	33	49	98	71	935	54	391	989	82
Adj No. of Lanes	1	1	1	1	1	1	1	2	0	1	2	1
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	2	2	2	2	2	2	2	2	2	2	2	2
Cap, veh/h	111	455	387	43	384	327	91	992	57	397	1644	735
Arrive On Green	0.06	0.25	0.25	0.02	0.21	0.21	0.05	0.30	0.30	0.23	0.48	0.48
Sat Flow, veh/h	1727	1814	1542	1727	1814	1542	1727	3312	191	1727	3446	1542
Grp Volume(v), veh/h	87	451	207	33	49	98	71	486	503	391	989	82
Grp Sat Flow(s),veh/h/ln	1727	1814	1542	1727	1814	1542	1727	1723	1780	1727	1723	1542
Q Serve(g_s), s	4.5	22.3	10.5	1.7	2.0	4.8	3.7	24.8	24.8	20.3	18.9	2.6
Cycle Q Clear(g_c), s	4.5	22.3	10.5	1.7	2.0	4.8	3.7	24.8	24.8	20.3	18.9	2.6
Prop In Lane	1.00		1.00	1.00		1.00	1.00		0.11	1.00		1.00
Lane Grp Cap(c), veh/h	111	455	387	43	384	327	91	516	533	397	1644	735
V/C Ratio(X)	0.78	0.99	0.53	0.77	0.13	0.30	0.78	0.94	0.94	0.98	0.60	0.11
Avail Cap(c_a), veh/h	196	455	387	77	384	327	178	516	533	397	1644	735
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.90	0.90	0.90
Uniform Delay (d), s/veh	41.5	33.6	29.2	43.6	28.7	29.8	42.1	30.8	30.8	34.5	17.3	13.0
Incr Delay (d2), s/veh	11.4	39.5	1.4	24.0	0.1	0.5	13.6	27.7	27.1	38.6	1.5	0.3
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	2.5	16.1	4.6	1.1	1.0	2.1	2.1	15.7	16.2	13.9	9.3	1.2
LnGrp Delay(d),s/veh	52.9	73.1	30.6	67.6	28.9	30.4	55.7	58.5	57.9	73.1	18.7	13.3
LnGrp LOS	D	E	C	E	C	C	E	E	E	E	B	B
Approach Vol, veh/h		745			180			1060			1462	
Approach Delay, s/veh		58.9			36.8			58.0			33.0	
Approach LOS		E			D			E			C	

Timer	1	2	3	4	5	6	7	8
Assigned Phs	1	2	3	4	5	6	7	8
Phs Duration (G+Y+Rc), s	5.2	31.0	6.7	27.1	9.2	46.9	10.3	23.6
Change Period (Y+Rc), s	4.5	4.0	4.5	4.5	4.5	4.0	4.5	4.5
Max Green Setting (Gmax), s	0.7	25.2	4.0	22.6	9.3	36.6	10.2	16.4
Max Q Clear Time (g_c+I1), s	2.3	26.8	3.7	24.3	5.7	20.9	6.5	6.8
Green Ext Time (p_c), s	0.0	0.0	0.0	0.0	0.0	11.2	0.1	2.8

Intersection Summary	
HCM 2010 Ctrl Delay	46.5
HCM 2010 LOS	D

Intersection	
Intersection Delay, s/veh	54
Intersection LOS	F

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Vol, veh/h	45	305	50	175	220	5	30	215	125	5	270	40
Future Vol, veh/h	45	305	50	175	220	5	30	215	125	5	270	40
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	49	332	54	190	239	5	33	234	136	5	293	43
Number of Lanes	1	1	0	1	1	0	0	1	0	0	1	0

Approach	EB	WB	NB	SB
Opposing Approach	WB	EB	SB	NB
Opposing Lanes	2	2	1	1
Conflicting Approach Left	SB	NB	EB	WB
Conflicting Lanes Left	1	1	2	2
Conflicting Approach Right	NB	SB	WB	EB
Conflicting Lanes Right	1	1	2	2
HCM Control Delay	67.9	26.7	71.1	50.8
HCM LOS	F	D	F	F

Lane	NBLn1	EBLn1	EBLn2	WBLn1	WBLn2	SBLn1
Vol Left, %	8%	100%	0%	100%	0%	2%
Vol Thru, %	58%	0%	86%	0%	98%	86%
Vol Right, %	34%	0%	14%	0%	2%	13%
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop
Traffic Vol by Lane	370	45	355	175	225	315
LT Vol	30	45	0	175	0	5
Through Vol	215	0	305	0	220	270
RT Vol	125	0	50	0	5	40
Lane Flow Rate	402	49	386	190	245	342
Geometry Grp	2	7	7	7	7	2
Degree of Util (X)	0.984	0.134	0.993	0.535	0.651	0.875
Departure Headway (Hd)	8.812	9.888	9.26	10.129	9.586	9.196
Convergence, Y/N	Yes	Yes	Yes	Yes	Yes	Yes
Cap	410	365	394	356	377	394
Service Time	6.887	7.588	6.96	7.906	7.363	7.274
HCM Lane V/C Ratio	0.98	0.134	0.98	0.534	0.65	0.868
HCM Control Delay	71.1	14.1	74.7	24.1	28.7	50.8
HCM Lane LOS	F	B	F	C	D	F
HCM 95th-tile Q	11.8	0.5	11.9	3	4.4	8.7

Intersection	
Int Delay, s/veh	2.6

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	65	40	35	340	490	105
Future Vol, veh/h	65	40	35	340	490	105
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	-	-	-	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	71	43	38	370	533	114

Major/Minor	Minor2		Major1		Major2	
Conflicting Flow All	1036	590	647	0	-	0
Stage 1	590	-	-	-	-	-
Stage 2	446	-	-	-	-	-
Critical Hdwy	6.42	6.22	4.12	-	-	-
Critical Hdwy Stg 1	5.42	-	-	-	-	-
Critical Hdwy Stg 2	5.42	-	-	-	-	-
Follow-up Hdwy	3.518	3.318	2.218	-	-	-
Pot Cap-1 Maneuver	256	508	939	-	-	-
Stage 1	554	-	-	-	-	-
Stage 2	645	-	-	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	243	508	939	-	-	-
Mov Cap-2 Maneuver	243	-	-	-	-	-
Stage 1	554	-	-	-	-	-
Stage 2	612	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s	23.9	0.8	0
HCM LOS	C		

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	SBT	SBR
Capacity (veh/h)	939	-	303	-	-
HCM Lane V/C Ratio	0.041	-	0.377	-	-
HCM Control Delay (s)	9	0	23.9	-	-
HCM Lane LOS	A	A	C	-	-
HCM 95th %tile Q(veh)	0.1	-	1.7	-	-

Intersection	
Intersection Delay, s/veh	47
Intersection LOS	E

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Vol, veh/h	215	50	70	5	15	5	75	240	10	10	355	230
Future Vol, veh/h	215	50	70	5	15	5	75	240	10	10	355	230
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	234	54	76	5	16	5	82	261	11	11	386	250
Number of Lanes	0	1	0	0	1	0	0	1	0	0	1	0

Approach	EB	WB	NB	SB
Opposing Approach	WB	EB	SB	NB
Opposing Lanes	1	1	1	1
Conflicting Approach Left	SB	NB	EB	WB
Conflicting Lanes Left	1	1	1	1
Conflicting Approach Right	NB	SB	WB	EB
Conflicting Lanes Right	1	1	1	1
HCM Control Delay	23.5	11.7	20.5	76.1
HCM LOS	C	B	C	F

Lane	NBLn1	EBLn1	WBLn1	SBLn1
Vol Left, %	23%	64%	20%	2%
Vol Thru, %	74%	15%	60%	60%
Vol Right, %	3%	21%	20%	39%
Sign Control	Stop	Stop	Stop	Stop
Traffic Vol by Lane	325	335	25	595
LT Vol	75	215	5	10
Through Vol	240	50	15	355
RT Vol	10	70	5	230
Lane Flow Rate	353	364	27	647
Geometry Grp	1	1	1	1
Degree of Util (X)	0.634	0.682	0.059	1.057
Departure Headway (Hd)	6.651	6.921	8.213	5.884
Convergence, Y/N	Yes	Yes	Yes	Yes
Cap	548	524	439	621
Service Time	4.651	4.921	6.213	3.884
HCM Lane V/C Ratio	0.644	0.695	0.062	1.042
HCM Control Delay	20.5	23.5	11.7	76.1
HCM Lane LOS	C	C	B	F
HCM 95th-tile Q	4.4	5.2	0.2	17.9

Intersection	
Int Delay, s/veh	5.9

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Vol, veh/h	75	30	165	5	10	5	85	160	10	10	185	125
Future Vol, veh/h	75	30	165	5	10	5	85	160	10	10	185	125
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Free	Free	Free	Free	Free	Free
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	0	-	-	-	-	-	-	-	-	-	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	92	92	92	92	92	92	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	82	33	179	5	11	5	92	174	11	11	201	136

Major/Minor	Minor2			Minor1			Major1			Major2		
Conflicting Flow All	663	661	269	761	723	179	337	0	0	185	0	0
Stage 1	291	291	-	364	364	-	-	-	-	-	-	-
Stage 2	372	370	-	397	359	-	-	-	-	-	-	-
Critical Hdwy	7.12	6.52	6.22	7.12	6.52	6.22	4.12	-	-	4.12	-	-
Critical Hdwy Stg 1	6.12	5.52	-	6.12	5.52	-	-	-	-	-	-	-
Critical Hdwy Stg 2	6.12	5.52	-	6.12	5.52	-	-	-	-	-	-	-
Follow-up Hdwy	3.518	4.018	3.318	3.518	4.018	3.318	2.218	-	-	2.218	-	-
Pot Cap-1 Maneuver	375	383	770	322	352	864	1222	-	-	1390	-	-
Stage 1	717	672	-	655	624	-	-	-	-	-	-	-
Stage 2	648	620	-	629	627	-	-	-	-	-	-	-
Platoon blocked, %								-	-		-	-
Mov Cap-1 Maneuver	337	347	770	213	319	864	1222	-	-	1390	-	-
Mov Cap-2 Maneuver	337	347	-	213	319	-	-	-	-	-	-	-
Stage 1	657	665	-	600	572	-	-	-	-	-	-	-
Stage 2	579	568	-	454	621	-	-	-	-	-	-	-

Approach	EB	WB	NB	SB
HCM Control Delay, s	14.8	16.7	2.7	0.2
HCM LOS	B	C		

Minor Lane/Major Mvmt	NBL	NBT	NBR	EBLn1	EBLn2	WBLn1	SBL	SBT	SBR
Capacity (veh/h)	1222	-	-	337	648	330	1390	-	-
HCM Lane V/C Ratio	0.076	-	-	0.242	0.327	0.066	0.008	-	-
HCM Control Delay (s)	8.2	0	-	19.1	13.2	16.7	7.6	0	-
HCM Lane LOS	A	A	-	C	B	C	A	A	-
HCM 95th %tile Q(veh)	0.2	-	-	0.9	1.4	0.2	0	-	-

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	255	655	355	685	815	140	145	895	470	120	1190	240
Future Volume (veh/h)	255	655	355	685	815	140	145	895	470	120	1190	240
Number	3	8	18	7	4	14	1	6	16	5	2	12
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj Sat Flow, veh/h/ln	1832	1832	1850	1832	1832	1832	1832	1814	1814	1832	1832	1832
Adj Flow Rate, veh/h	271	753	0	787	1087	0	184	973	0	140	1308	0
Adj No. of Lanes	2	2	1	2	2	1	1	2	1	1	2	1
Peak Hour Factor	0.94	0.87	0.69	0.87	0.75	0.44	0.79	0.92	0.87	0.86	0.91	0.81
Percent Heavy Veh, %	1	1	0	1	1	1	1	2	2	1	1	1
Cap, veh/h	282	769	347	677	1161	519	147	1221	546	199	1233	552
Arrive On Green	0.14	0.37	0.00	0.20	0.33	0.00	0.03	0.24	0.00	0.03	0.24	0.00
Sat Flow, veh/h	3384	3480	1572	3384	3480	1557	1744	3446	1542	1744	3480	1557
Grp Volume(v), veh/h	271	753	0	787	1087	0	184	973	0	140	1308	0
Grp Sat Flow(s),veh/h/ln	1692	1740	1572	1692	1740	1557	1744	1723	1542	1744	1740	1557
Q Serve(g_s), s	9.5	25.7	0.0	24.0	36.3	0.0	6.0	31.9	0.0	6.0	42.5	0.0
Cycle Q Clear(g_c), s	9.5	25.7	0.0	24.0	36.3	0.0	6.0	31.9	0.0	6.0	42.5	0.0
Prop In Lane	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Lane Grp Cap(c), veh/h	282	769	347	677	1161	519	147	1221	546	199	1233	552
V/C Ratio(X)	0.96	0.98	0.00	1.16	0.94	0.00	1.25	0.80	0.00	0.70	1.06	0.00
Avail Cap(c_a), veh/h	282	769	347	677	1175	525	147	1221	546	199	1233	552
HCM Platoon Ratio	1.67	1.67	1.67	1.00	1.00	1.00	0.67	0.67	0.67	0.67	0.67	0.67
Upstream Filter(I)	0.39	0.39	0.00	1.00	1.00	0.00	0.59	0.59	0.00	0.85	0.85	0.00
Uniform Delay (d), s/veh	51.5	37.6	0.0	48.0	38.8	0.0	33.3	41.7	0.0	29.9	45.8	0.0
Incr Delay (d2), s/veh	24.0	15.6	0.0	88.9	13.9	0.0	141.0	3.3	0.0	7.9	41.5	0.0
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	5.4	13.9	0.0	19.5	19.6	0.0	7.8	15.8	0.0	2.2	27.5	0.0
LnGrp Delay(d),s/veh	75.4	53.2	0.0	136.9	52.7	0.0	174.3	45.0	0.0	37.8	87.2	0.0
LnGrp LOS	E	D		F	D		F	D		D	F	
Approach Vol, veh/h		1024			1874			1157			1448	
Approach Delay, s/veh		59.1			88.1			65.6			82.5	
Approach LOS		E			F			E			F	

Timer	1	2	3	4	5	6	7	8
Assigned Phs	1	2	3	4	5	6	7	8
Phs Duration (G+Y+Rc), s	11.0	48.5	15.5	45.5	11.0	48.5	29.0	32.0
Change Period (Y+Rc), s	5.0	6.0	5.5	* 5.5	5.0	6.0	5.0	5.5
Max Green Setting (Gmax), s	6.0	42.0	10.0	* 41	6.0	42.0	24.0	26.5
Max Q Clear Time (g_c+I1), s	8.0	44.5	11.5	38.3	8.0	33.9	26.0	27.7
Green Ext Time (p_c), s	0.0	0.0	0.0	1.7	0.0	7.7	0.0	0.0

Intersection Summary	
HCM 2010 Ctrl Delay	76.5
HCM 2010 LOS	E

Notes



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	180	15	590	0	5	5	135	220	5	10	465	180
Future Volume (veh/h)	180	15	590	0	5	5	135	220	5	10	465	180
Number	7	4	14	3	8	18	5	2	12	1	6	16
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj Sat Flow, veh/h/ln	1850	1814	1814	1850	1814	1850	1814	1814	1850	1814	1814	1814
Adj Flow Rate, veh/h	196	16	0	0	5	5	147	239	5	11	505	0
Adj No. of Lanes	0	1	1	0	1	0	1	1	0	1	1	1
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	2	2	2	2	2	2	2	2	2	2	2	2
Cap, veh/h	422	21	312	0	169	169	549	1039	22	760	1065	905
Arrive On Green	0.20	0.20	0.00	0.00	0.20	0.20	0.59	0.59	0.59	0.59	0.59	0.00
Sat Flow, veh/h	1285	105	1542	0	833	833	890	1770	37	1131	1814	1542
Grp Volume(v), veh/h	212	0	0	0	0	10	147	0	244	11	505	0
Grp Sat Flow(s),veh/h/ln	1390	0	1542	0	0	1667	890	0	1807	1131	1814	1542
Q Serve(g_s), s	6.0	0.0	0.0	0.0	0.0	0.2	4.8	0.0	2.8	0.2	6.8	0.0
Cycle Q Clear(g_c), s	6.2	0.0	0.0	0.0	0.0	0.2	11.7	0.0	2.8	3.0	6.8	0.0
Prop In Lane	0.92		1.00	0.00		0.50	1.00		0.02	1.00		1.00
Lane Grp Cap(c), veh/h	443	0	312	0	0	337	549	0	1061	760	1065	905
V/C Ratio(X)	0.48	0.00	0.00	0.00	0.00	0.03	0.27	0.00	0.23	0.01	0.47	0.00
Avail Cap(c_a), veh/h	1018	0	934	0	0	1010	549	0	1061	760	1065	905
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	0.00	0.00	0.00	1.00	1.00	0.00	1.00	1.00	1.00	0.00
Uniform Delay (d), s/veh	16.2	0.0	0.0	0.0	0.0	13.7	8.4	0.0	4.2	4.9	5.1	0.0
Incr Delay (d2), s/veh	0.8	0.0	0.0	0.0	0.0	0.0	1.2	0.0	0.5	0.0	1.5	0.0
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	2.5	0.0	0.0	0.0	0.0	0.1	1.4	0.0	1.5	0.1	3.8	0.0
LnGrp Delay(d),s/veh	17.0	0.0	0.0	0.0	0.0	13.7	9.6	0.0	4.7	5.0	6.6	0.0
LnGrp LOS	B					B	A		A	A	A	
Approach Vol, veh/h		212			10			391			516	
Approach Delay, s/veh		17.0			13.7			6.5			6.5	
Approach LOS		B			B			A			A	

Timer	1	2	3	4	5	6	7	8
Assigned Phs		2		4		6		8
Phs Duration (G+Y+Rc), s		29.6		13.2		29.6		13.2
Change Period (Y+Rc), s		4.5		4.5		4.5		4.5
Max Green Setting (Gmax), s		25.1		25.9		25.1		25.9
Max Q Clear Time (g_c+I1), s		13.7		8.2		8.8		2.2
Green Ext Time (p_c), s		4.4		1.1		5.3		1.2

Intersection Summary	
HCM 2010 Ctrl Delay	8.6
HCM 2010 LOS	A

Intersection	
Int Delay, s/veh	20.2

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Vol, veh/h	15	10	40	125	55	90	30	330	20	100	110	20
Future Vol, veh/h	15	10	40	125	55	90	30	330	20	100	110	20
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Free	Free	Free	Free	Free	Free
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	-	-	-	-	-	-	110	-	-	110	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	92	92	92	92	92	92	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	16	11	43	136	60	98	33	359	22	109	120	22

Major/Minor	Minor2			Minor1			Major1			Major2		
Conflicting Flow All	862	794	130	810	794	370	141	0	0	380	0	0
Stage 1	348	348	-	435	435	-	-	-	-	-	-	-
Stage 2	514	446	-	375	359	-	-	-	-	-	-	-
Critical Hdwy	7.12	6.52	6.22	7.12	6.52	6.22	4.12	-	-	4.12	-	-
Critical Hdwy Stg 1	6.12	5.52	-	6.12	5.52	-	-	-	-	-	-	-
Critical Hdwy Stg 2	6.12	5.52	-	6.12	5.52	-	-	-	-	-	-	-
Follow-up Hdwy	3.518	4.018	3.318	3.518	4.018	3.318	2.218	-	-	2.218	-	-
Pot Cap-1 Maneuver	275	321	920	298	321	676	1442	-	-	1178	-	-
Stage 1	668	634	-	600	580	-	-	-	-	-	-	-
Stage 2	543	574	-	646	627	-	-	-	-	-	-	-
Platoon blocked, %								-	-		-	-
Mov Cap-1 Maneuver	181	285	920	252	285	676	1442	-	-	1178	-	-
Mov Cap-2 Maneuver	181	285	-	252	285	-	-	-	-	-	-	-
Stage 1	653	575	-	586	567	-	-	-	-	-	-	-
Stage 2	406	561	-	548	569	-	-	-	-	-	-	-

Approach	EB	WB	NB	SB
HCM Control Delay, s	15.8	62.9	0.6	3.6
HCM LOS	C	F		

Minor Lane/Major Mvmt	NBL	NBT	NBR	EBLn1	WBLn1	SBL	SBT	SBR
Capacity (veh/h)	1442	-	-	403	328	1178	-	-
HCM Lane V/C Ratio	0.023	-	-	0.175	0.895	0.092	-	-
HCM Control Delay (s)	7.6	-	-	15.8	62.9	8.4	-	-
HCM Lane LOS	A	-	-	C	F	A	-	-
HCM 95th %tile Q(veh)	0.1	-	-	0.6	8.6	0.3	-	-

Intersection	
Int Delay, s/veh	5.6

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Vol, veh/h	25	35	20	5	50	30
Future Vol, veh/h	25	35	20	5	50	30
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	-	-	-	-
Veh in Median Storage, #	0	-	0	-	-	0
Grade, %	0	-	0	-	-	0
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	27	38	22	5	54	33

Major/Minor	Minor1		Major1		Major2	
Conflicting Flow All	165	24	0	0	27	0
Stage 1	24	-	-	-	-	-
Stage 2	141	-	-	-	-	-
Critical Hdwy	6.42	6.22	-	-	4.12	-
Critical Hdwy Stg 1	5.42	-	-	-	-	-
Critical Hdwy Stg 2	5.42	-	-	-	-	-
Follow-up Hdwy	3.518	3.318	-	-	2.218	-
Pot Cap-1 Maneuver	826	1052	-	-	1587	-
Stage 1	999	-	-	-	-	-
Stage 2	886	-	-	-	-	-
Platoon blocked, %			-	-		-
Mov Cap-1 Maneuver	797	1052	-	-	1587	-
Mov Cap-2 Maneuver	797	-	-	-	-	-
Stage 1	999	-	-	-	-	-
Stage 2	855	-	-	-	-	-

Approach	WB	NB	SB
HCM Control Delay, s	9.2	0	4.6
HCM LOS	A		

Minor Lane/Major Mvmt	NBT	NBR	WBLn1	SBL	SBT
Capacity (veh/h)	-	-	928	1587	-
HCM Lane V/C Ratio	-	-	0.07	0.034	-
HCM Control Delay (s)	-	-	9.2	7.3	0
HCM Lane LOS	-	-	A	A	A
HCM 95th %tile Q(veh)	-	-	0.2	0.1	-

Intersection	
Int Delay, s/veh	2.4

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	75	20	25	400	410	115
Future Vol, veh/h	75	20	25	400	410	115
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	-	-	-	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	82	22	27	435	446	125

Major/Minor	Minor2		Major1		Major2	
Conflicting Flow All	997	508	571	0	-	0
Stage 1	508	-	-	-	-	-
Stage 2	489	-	-	-	-	-
Critical Hdwy	6.42	6.22	4.12	-	-	-
Critical Hdwy Stg 1	5.42	-	-	-	-	-
Critical Hdwy Stg 2	5.42	-	-	-	-	-
Follow-up Hdwy	3.518	3.318	2.218	-	-	-
Pot Cap-1 Maneuver	271	565	1002	-	-	-
Stage 1	604	-	-	-	-	-
Stage 2	616	-	-	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	261	565	1002	-	-	-
Mov Cap-2 Maneuver	261	-	-	-	-	-
Stage 1	604	-	-	-	-	-
Stage 2	594	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s	23.7	0.5	0
HCM LOS	C		

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	SBT	SBR
Capacity (veh/h)	1002	-	294	-	-
HCM Lane V/C Ratio	0.027	-	0.351	-	-
HCM Control Delay (s)	8.7	0	23.7	-	-
HCM Lane LOS	A	A	C	-	-
HCM 95th %tile Q(veh)	0.1	-	1.5	-	-

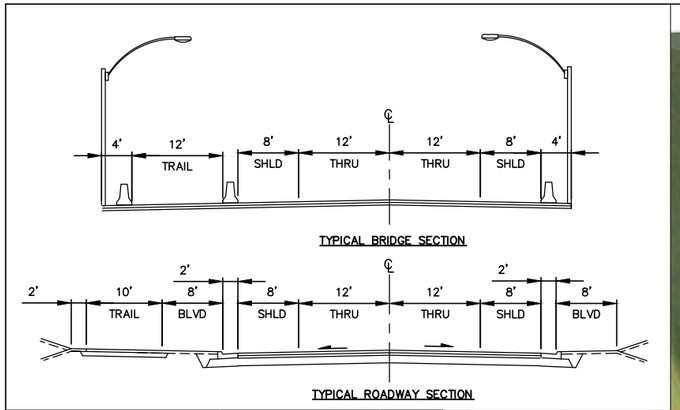
Intersection	
Intersection Delay, s/veh	17.6
Intersection LOS	C

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Vol, veh/h	15	10	505	20	15	475
Future Vol, veh/h	15	10	505	20	15	475
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	16	11	549	22	16	516
Number of Lanes	1	0	1	0	0	1

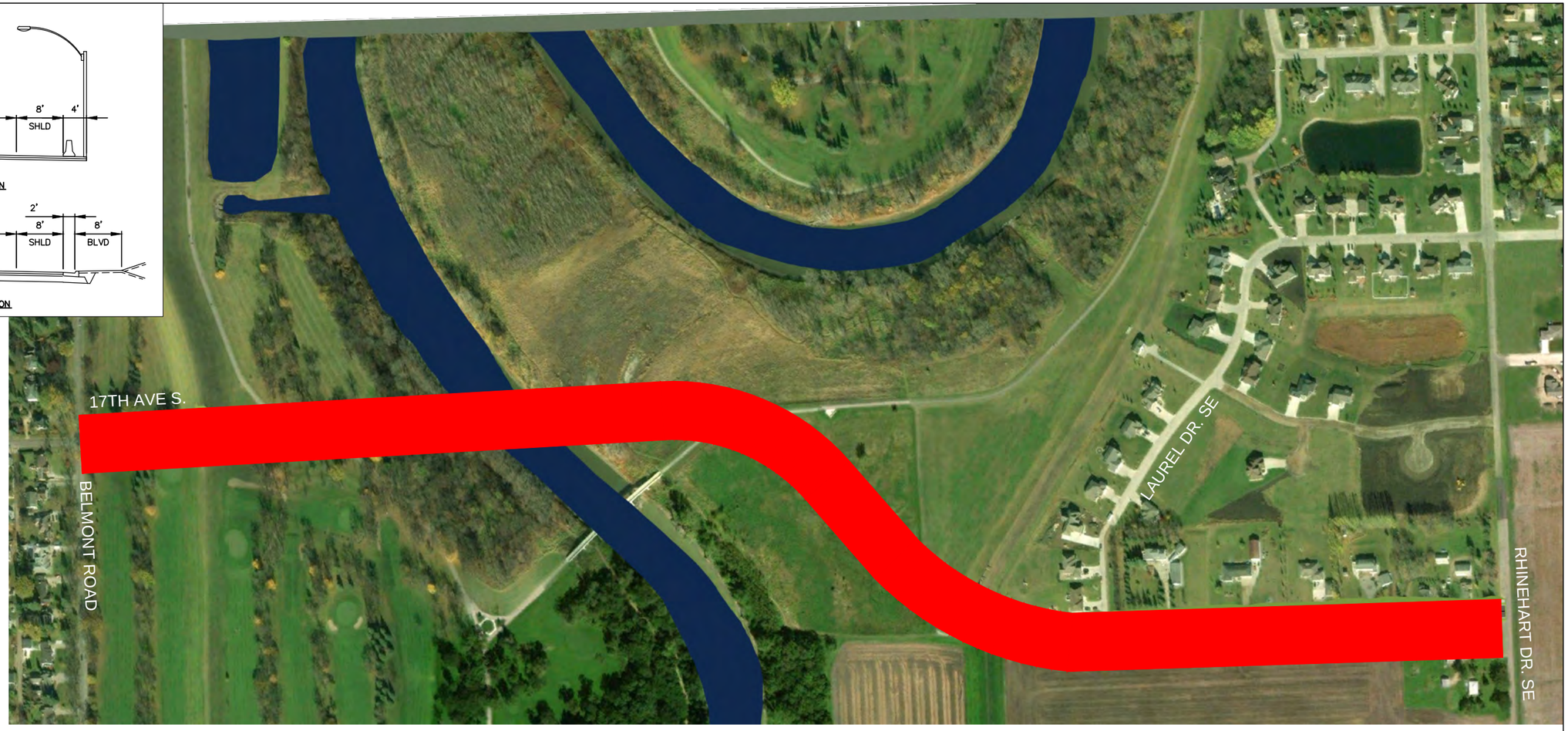
Approach	WB	NB	SB
Opposing Approach		SB	NB
Opposing Lanes	0	1	1
Conflicting Approach Left	NB		WB
Conflicting Lanes Left	1	0	1
Conflicting Approach Right	SB	WB	
Conflicting Lanes Right	1	1	0
HCM Control Delay	9.5	18.5	17
HCM LOS	A	C	C

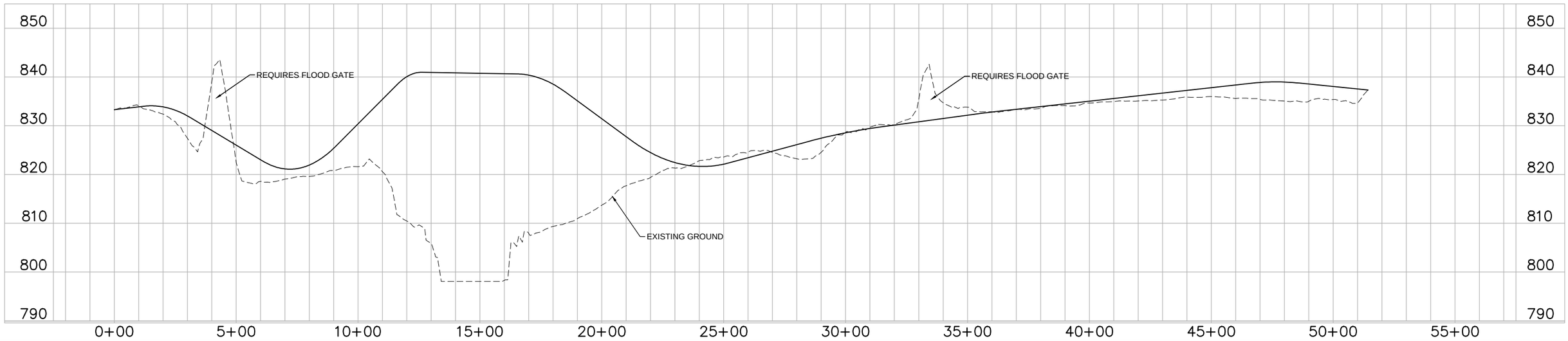
Lane	NBLn1	WBLn1	SBLn1
Vol Left, %	0%	60%	3%
Vol Thru, %	96%	0%	97%
Vol Right, %	4%	40%	0%
Sign Control	Stop	Stop	Stop
Traffic Vol by Lane	525	25	490
LT Vol	0	15	15
Through Vol	505	0	475
RT Vol	20	10	0
Lane Flow Rate	571	27	533
Geometry Grp	1	1	1
Degree of Util (X)	0.721	0.046	0.682
Departure Headway (Hd)	4.549	6.129	4.611
Convergence, Y/N	Yes	Yes	Yes
Cap	793	580	783
Service Time	2.583	4.216	2.645
HCM Lane V/C Ratio	0.72	0.047	0.681
HCM Control Delay	18.5	9.5	17
HCM Lane LOS	C	A	C
HCM 95th-tile Q	6.3	0.1	5.5

Appendix B: River Crossing Concept Drawings



QUANTITIES		
ITEM		UNIT
COMMON EX.	12500	CY
COMMON FILL	22300	CY
WALK	56500	SF
BITUMINTUS	205800	SF
CURB AND GUTTER	6800	LF
BRIDGE	1200	LF





PLANNING CONCEPTS ONLY.
NOT FOR CONSTRUCTION.

GRAND FORKS
17TH AVENUE RIVER CROSSING
LOW BRIDGE OPTION WITH FLOOD GATE

NORTH

0 200 400
HORIZONTAL SCALE IN FEET

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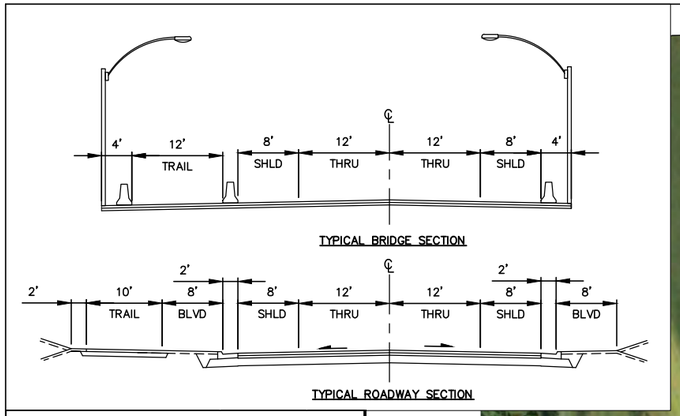

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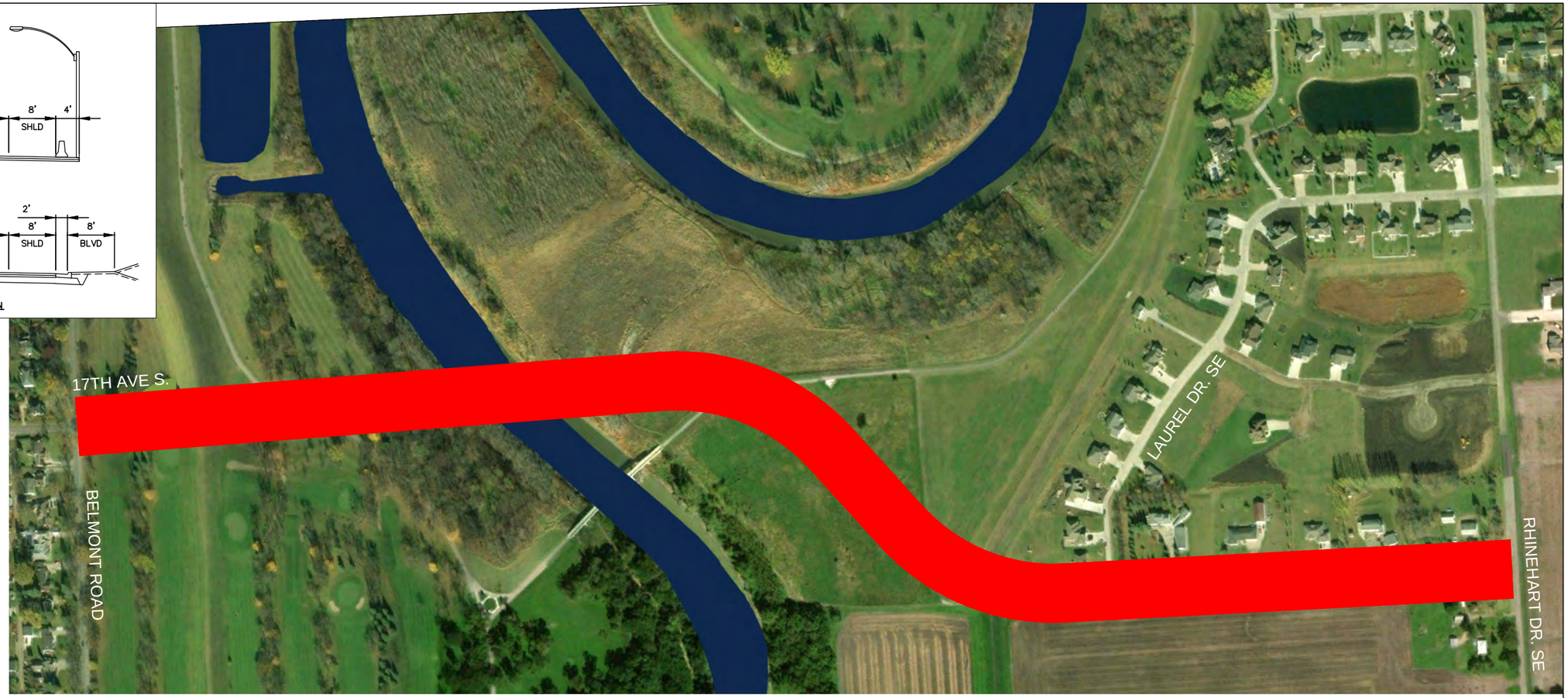
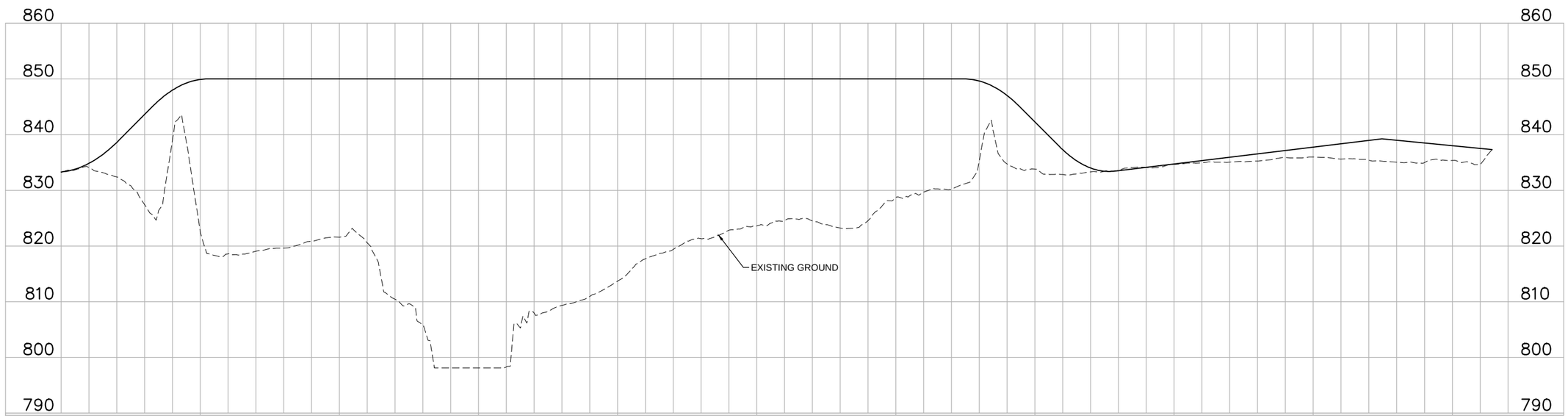
CURB AND GUTTER	2900	LF
BRIDGE	3100	LF





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GRAND FORKS
17TH AVENUE RIVER CROSSING
HIGH BRIDGE OPTION

NORTH

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HORIZONTAL
SCALE IN FEET

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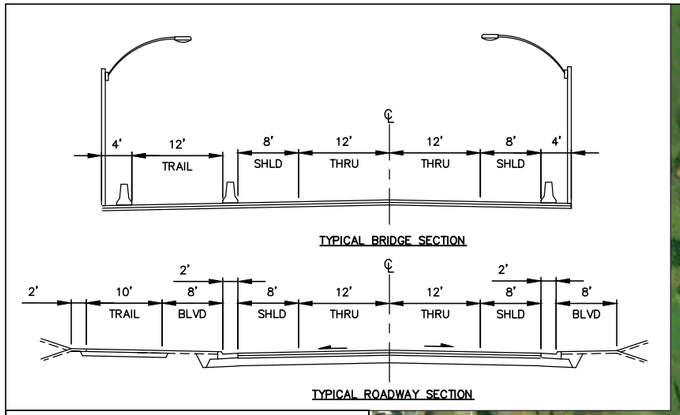

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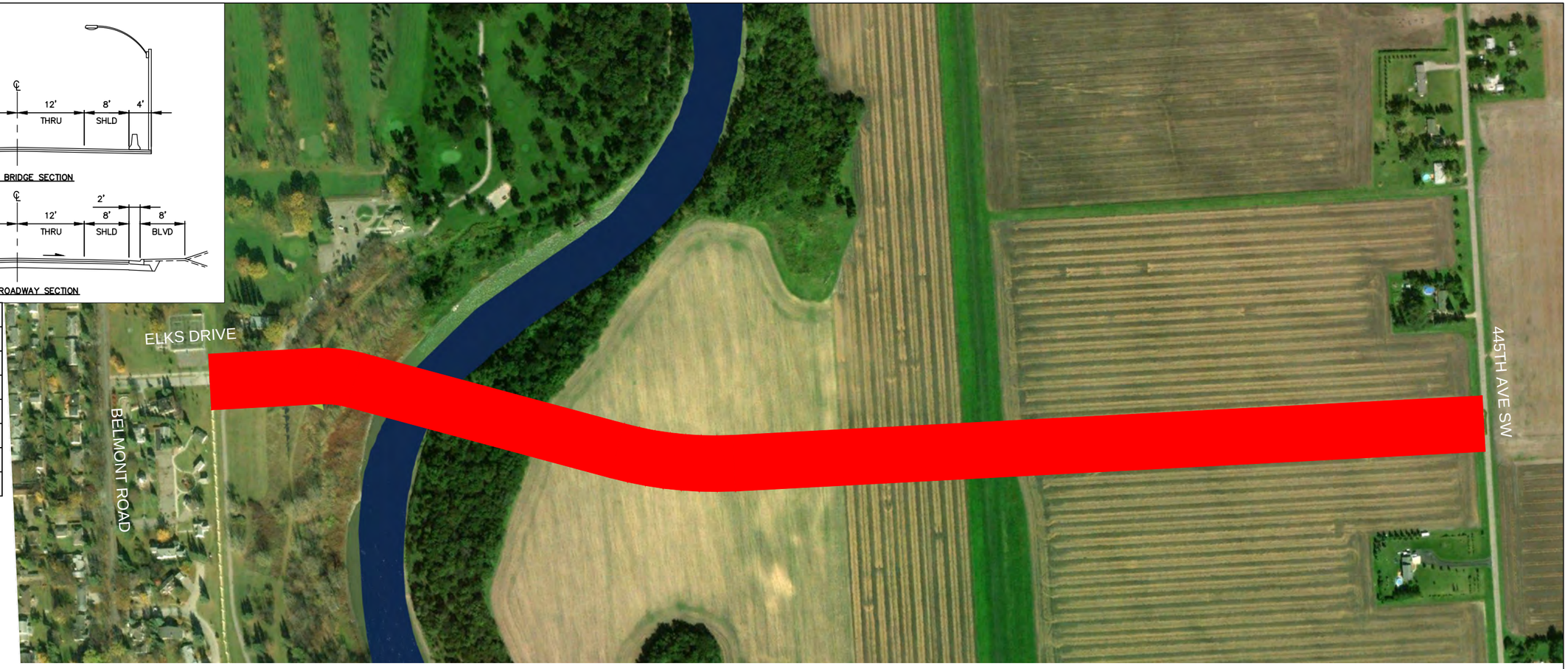

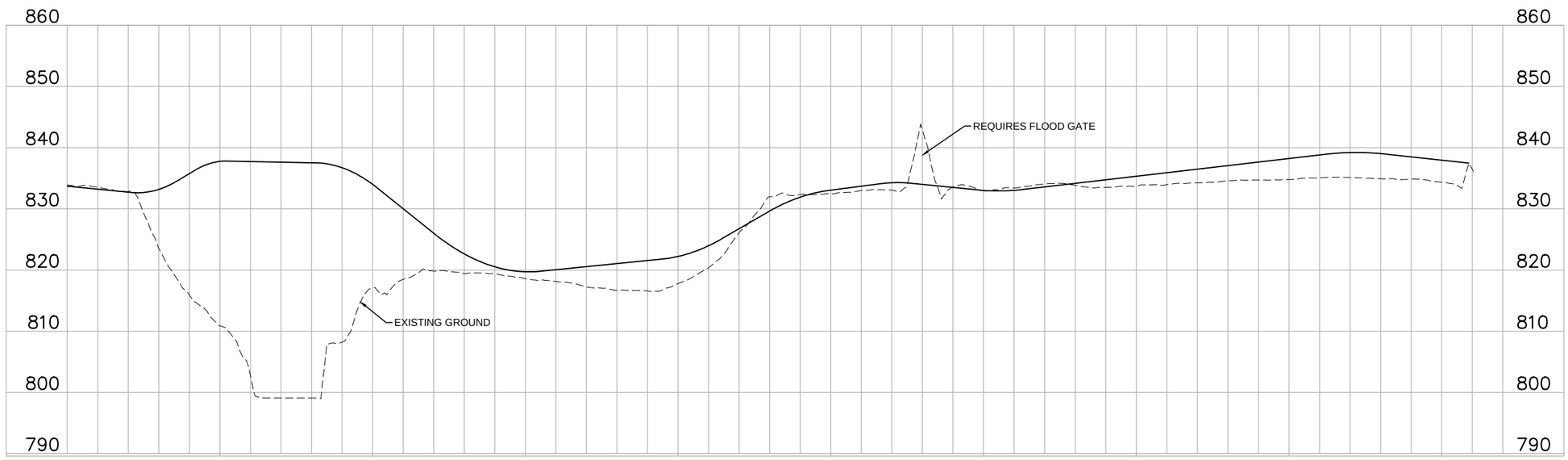

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GRAND FORKS

ELKS DRIVE RIVER CROSSING

LOW BRIDGE WITH FLOOD GATE

NORTH

0 200 400

HORIZONTAL SCALE IN FEET

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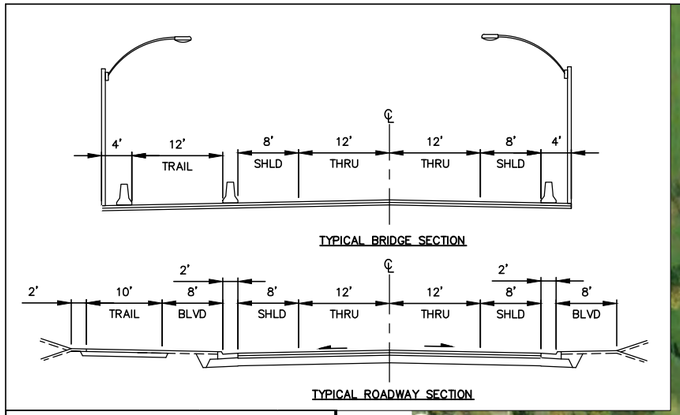

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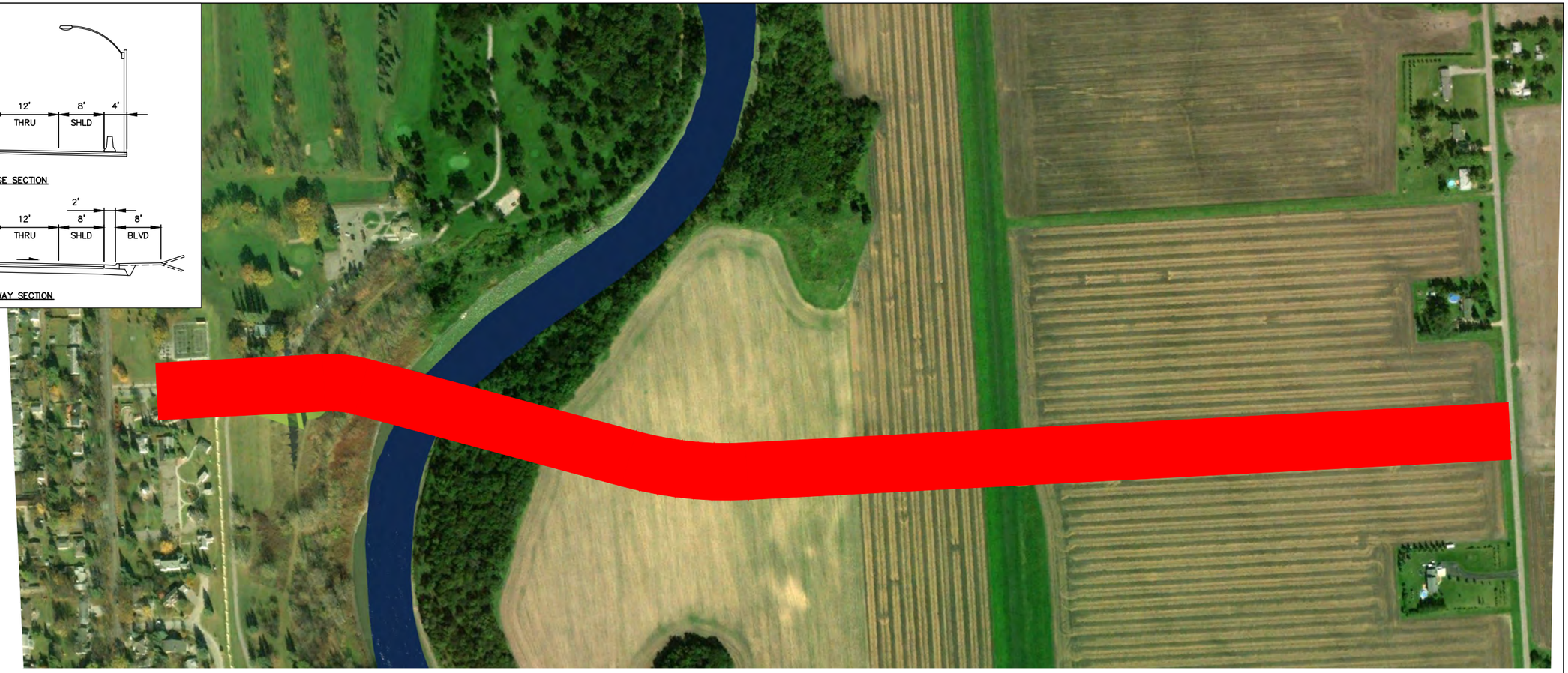
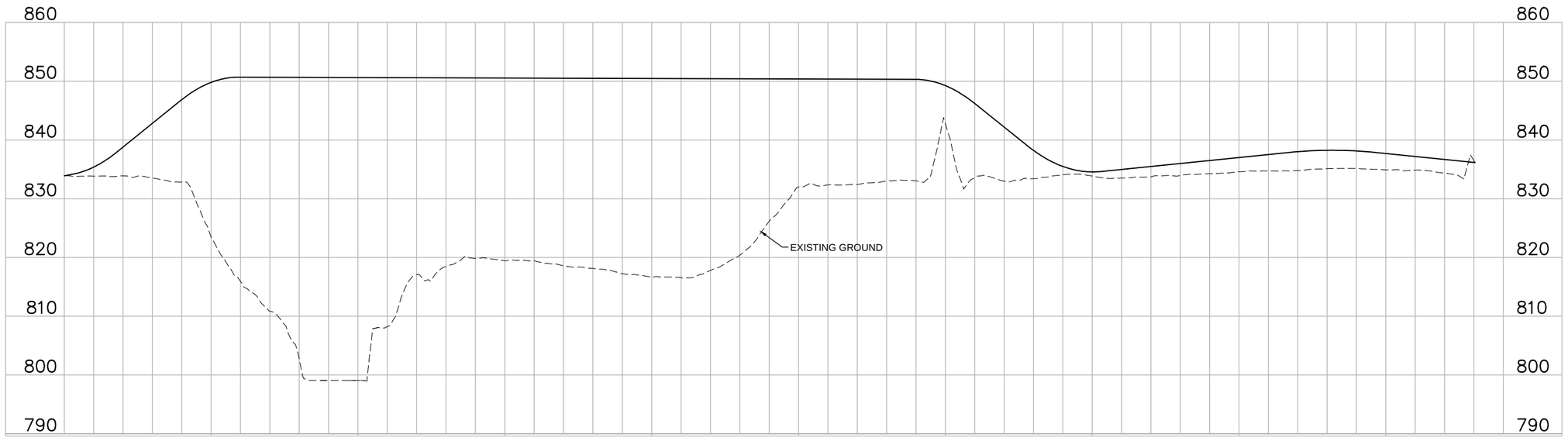
BRIDGE	2500	LF





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GRAND FORKS
ELKS DRIVE RIVER CROSSING
HIGH BRIDGE

NORTH

0 200 400
HORIZONTAL
SCALE IN FEET

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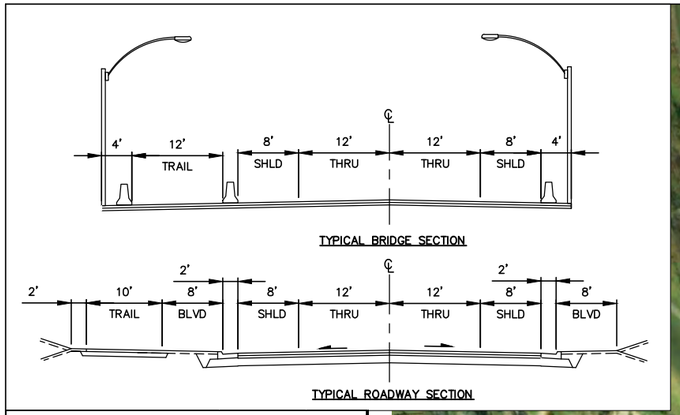

QUANTITIES

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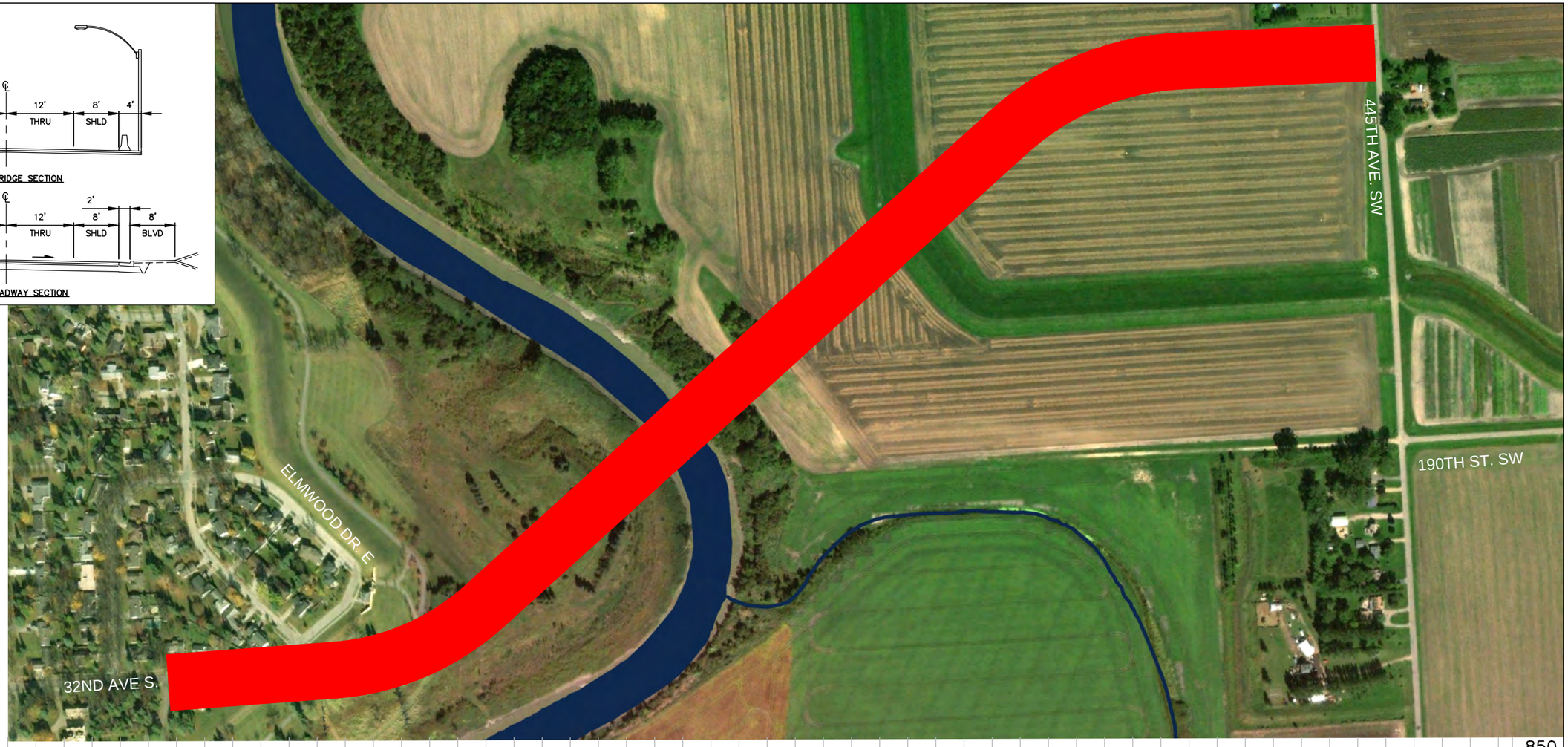

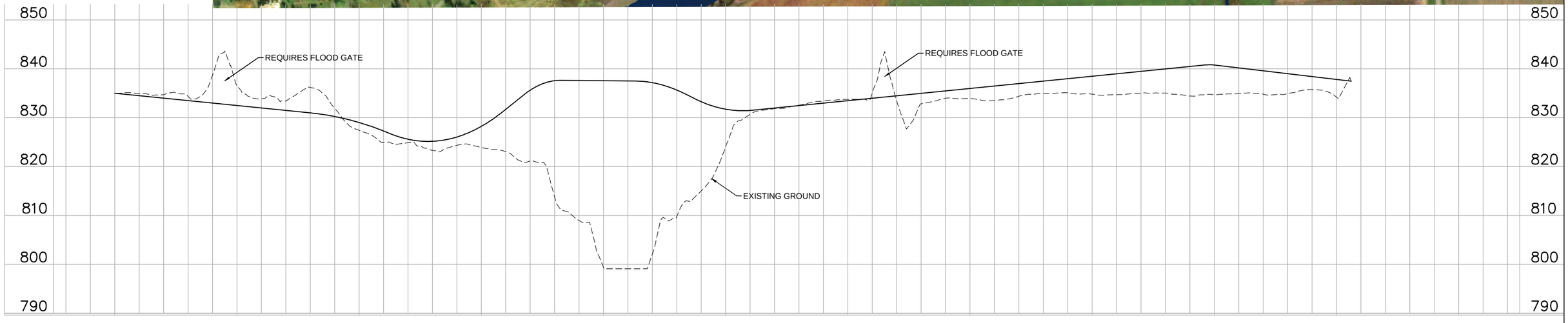

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GRAND FORKS
32ND AVENUE RIVER CROSSING
LOW BRIDGE WITH FLOOD GATES

NORTH

0 200 400
HORIZONTAL SCALE IN FEET

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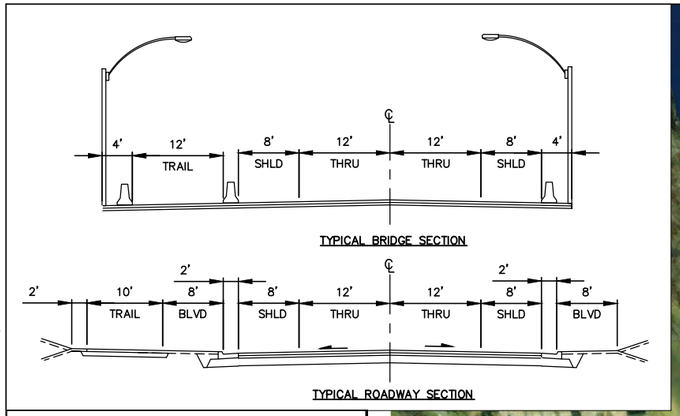

QUANTITIES		
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COMMON FILL	53700	CY
WALK	50900	SF
BITUMINTUS	203000	SF
CURB AND GUTTER	5200	LF
BRIDGE	2500	LF





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GRAND FORKS
32ND AVENUE RIVER CROSSING
HIGH BRIDGE

NORTH

0 200 400
HORIZONTAL
SCALE IN FEET

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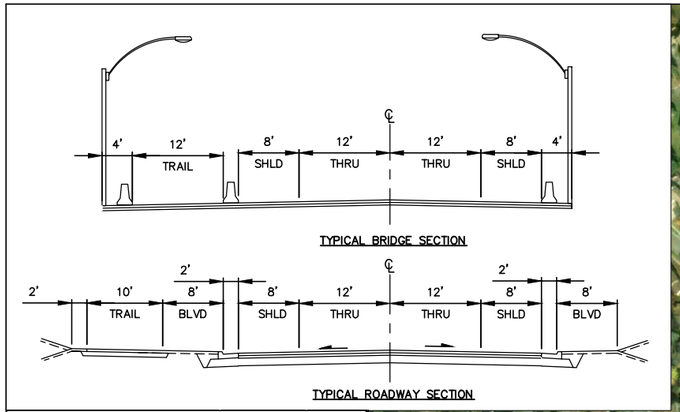

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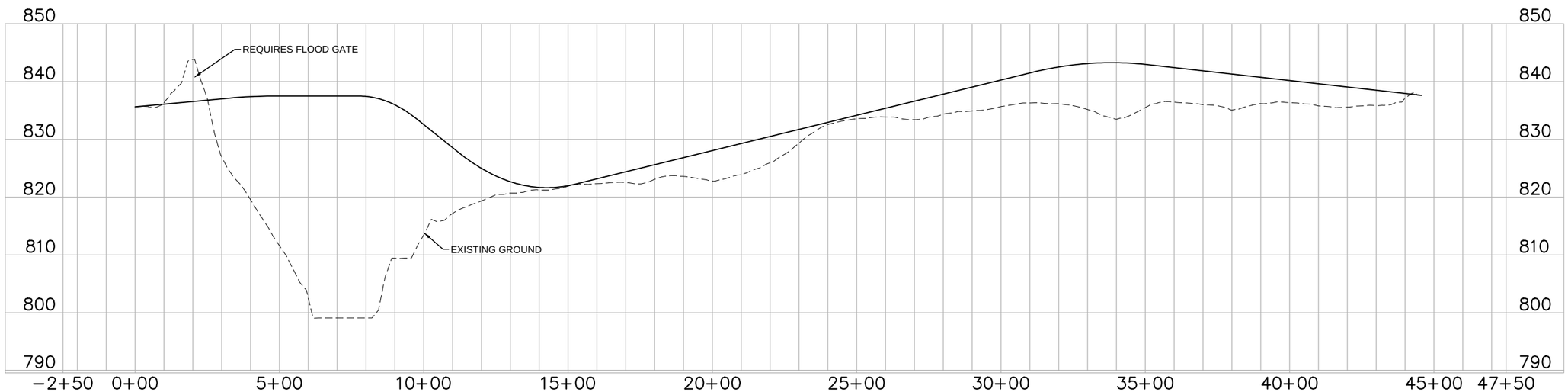

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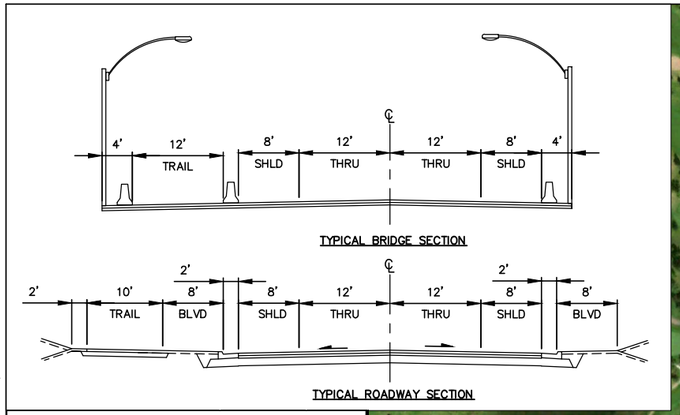
GRAND FORKS
47TH AVENUE RIVER CROSSING

NORTH

0 200 400
HORIZONTAL
SCALE IN FEET



QUANTITIES		
ITEM		UNIT
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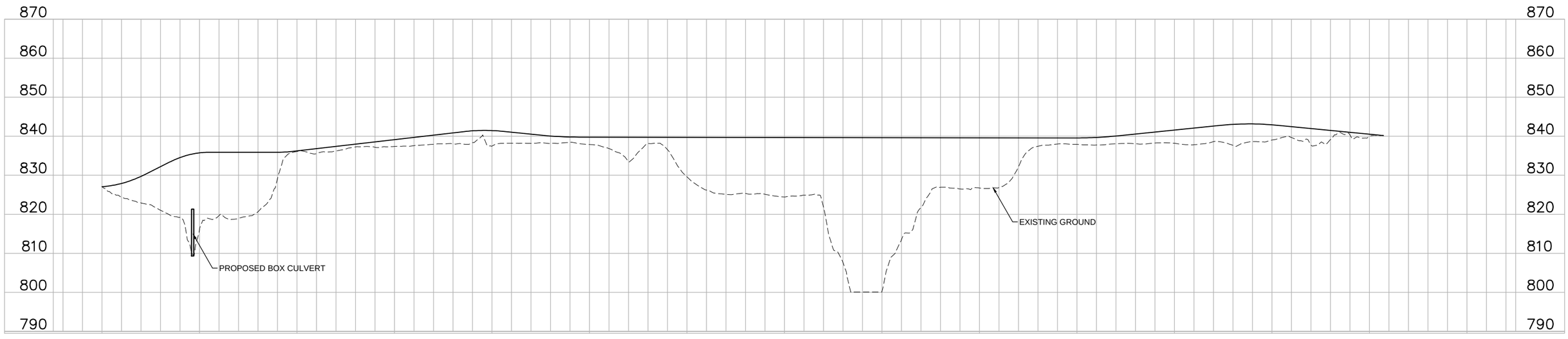

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GRAND FORKS
MERRIFIELD ROAD RIVER CROSSING

NORTH

0 250 500
HORIZONTAL
SCALE IN FEET

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Appendix D

Regional Travel Demand Forecast Model Technical Report

NDSU UPPER GREAT PLAINS TRANSPORTATION INSTITUTE

ATAC ADVANCED TRAFFIC ANALYSIS CENTER

GRAND FORKS EAST GRAND FORKS 2015 TRAVEL DEMAND MODEL UPDATE

FINAL REPORT

To the Grand Forks East Grand Forks MPO

October 2017

Diomo Motuba, PhD & Muhammad Asif Khan (PhD Candidate)
Advanced Traffic Analysis Center

Upper Great Plains Transportation Institute

North Dakota State University

Fargo, North Dakota 58102

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1. INTRODUCTION

The Grand Forks East Grand Forks MPO's (The GF-EGF MPO) Travel Demand Model (TDM) is updated every five years to reflect new ground truths/data and the advancements in the state-of-the-art in transportation modeling techniques and methods. The current update reflects base year 2015 data. The model is a four-step TDM including trip generations, trip distributions, modal split and trip assignment. The update process involves calibrating the model input parameters and validating the model output with ground truths. The model calibration is a cyclical process as shown in Figure 1.

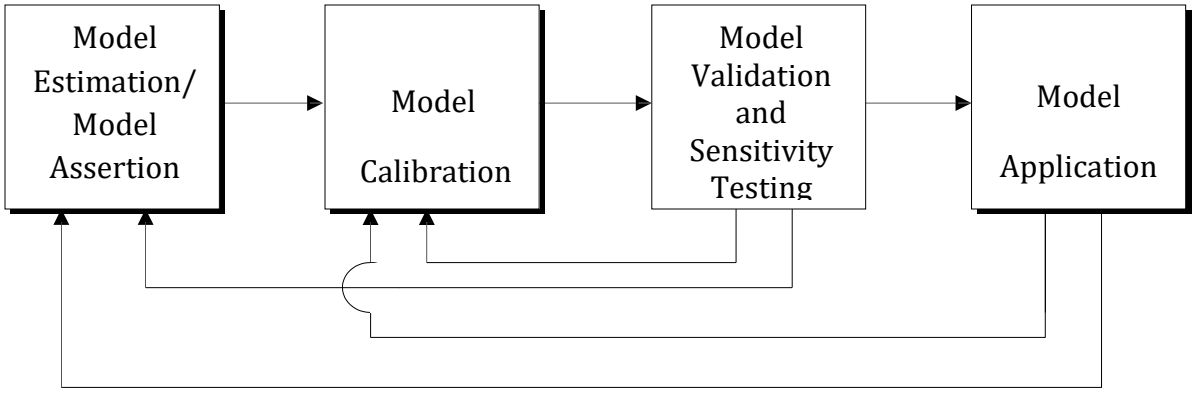


Figure 1 GF-EGF TDM Calibration Flow Chart

The rest of this document describes the model update process including the data, methods and models that were used to update the model. Chapter 2 discusses the improvements made to the 2015 TDM; Chapter 3 discusses the capacity calculation methodology; Chapter 4 discusses the input data used in the model; Chapter 5 summarizes the trip generation models and methods; Chapter 6 discusses the trip distribution step; Chapter 7 discusses the trip assignment step; Chapter 8 discusses the model calibration, validation and output.

2. IMPROVEMENTS TO THE 2015 TDM

For the 2015 base year model, several updates were made to the model to reflect the availability of new and improved data, new and advanced methods in modeling software and the inclusion of long-haul freight movements as part of the model. New data that was used for 2015 model update included: Origin Destination Data (Obtained from Airsage), the traffic analysis tool data, incorporation of truck counts and FAF data to model freights.

2.1. Origin Destination Data Obtained from Airsage

Origin-destination (OD) data were obtained from a commercial vendor Airsage. Airsage is a company that aggregates cell phone cellular-signal data points anonymously in partnership with the nation's largest wireless carriers. Origin Destination data were collected for the entire North Dakota and external locations rather than for the GF/EGF MPO area only. Overall, a total of 301 OD TAZs were used. OD TAZs are defined as TAZS that were used in the OD survey data collection. Of the 301 OD TAZs, 61 were TAZs internal to the GF/EGF MPO area. The internal OD TAZs were an aggregation of the TAZs in the GF/EGF TDM which had a total of 584 TAZs. Figure 2 shows the overall OD TAZs and the GF/EGF MPO TAZs geographies.

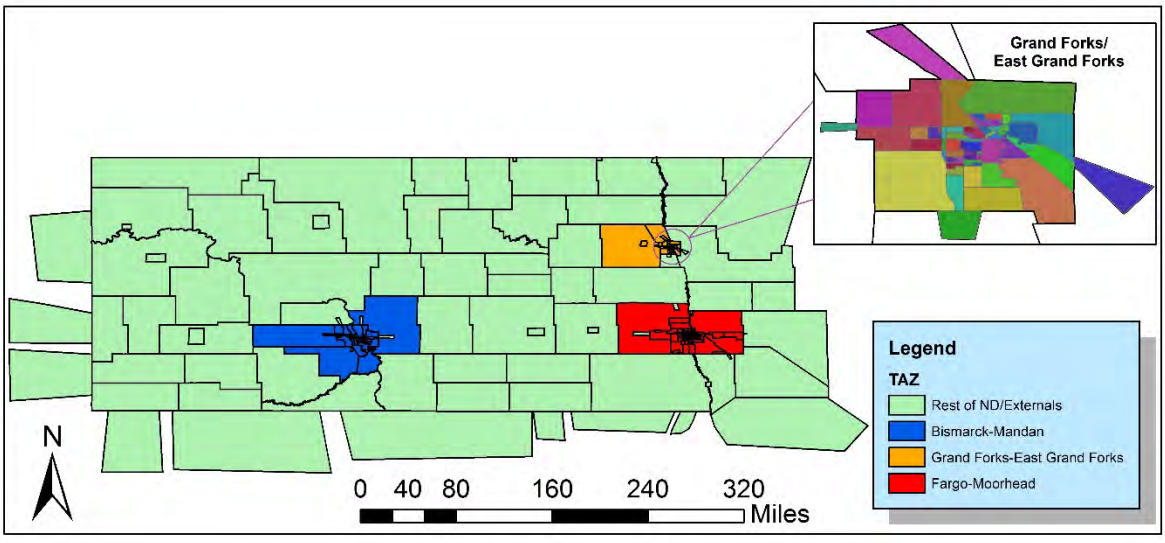


Figure 2 OD TAZs

Different datasets were provided by Airsage reflecting temporal, socioeconomic and weekday/weekend data and included the following tables:

Average Weekday 24 Hour trip matrix reflecting the total 24-hour Origin-Destination by trip purposes (HBW, HBO, NHB). Three Matrices were provided for different socioeconomic variables including age (5 year cohorts), income ($10,000 increments), and vehicle attributes (0->5 for rent/owner households).

Average Weekday Peak Hour matrices (7:00AM-10:00AM, 10:00AM-4:00PM, 4:00PM-7:00PM) by trip purposes. Three Matrices were provided for different socioeconomic variables including age (5 year cohorts), income ($10,000 increments), and vehicle attributes (0->5 for rent/owner households).

1. Weekend matrices for each of the weekends of October 2015 by trip purposes (HBW, HBO, NHB). Three Matrices were provided for different socioeconomic variables including age (5 year cohorts), income ($10,000 increments), and vehicle attributes (0->5 for rent/owner households) for each weekend.
2. Long Distance ODs, showing external-external trips for the full day for both weekday averages and each weekend for HBW, HBO and NBH trips. No socioeconomic data were provided for these matrices.

The OD data is very useful in differentiating trips that are internal to the GF-EGF MPO area: internal-internal (II) trips, trips that pass through the GF-EGF MPO area: external-external (E-E) trips, and trips that start/end in the MPO area with the other end outside the MPO area: internal-external/external-internal (IE/EI) trips.

2.1.1. Internal-Internal OD Trip Summary

Table 1 summarizes the OD data by trip purpose and by time periods. For HBW trips for the GF/EGF MPO TAZs, the late-morning to early-evening period had the highest proportion of trips (30%) followed by the AM Peak and Night periods (25% each) and the PM Peak period (20%). The late-morning to early-evening period had the highest proportion of HBO trips (36%), followed by the Night period (27%), PM peak (21%) and AM Peak (17%). This is expected and possibly because fewer non-work trips originate from homes during the morning peak period. Trip activity locations such as malls, schools, walk-in hospitals, banks, typically open after 8:00AM. For NHB trips, the late-morning to early-evening period again has the highest proportion of trips (45%), followed by the PM Peak (23%), AM Peak (17%) and the Night period (16%).

The % overall column reflects the percentage of trips that had at least one end in the Grand Forks East Grand Forks MPO area with respect to the entire dataset. 23% of HBW, 14 % of HBO, and 9% of NHB, of total trips in the overall North Dakota data had trip ends in the GF-EGF MPO area. The data shows the trip purposes by time of day, Peak AM, Peak Afternoon, Peak PM and Night trips.

Table 1 Summary of Internal-Internal OD Data from Airsage

Grand Forks/East Grand Forks MPO TAZ OD Trips						
	7-10AM	**10AM-4PM**	**4-7PM**	**Night**	**Total**	**% of Overall**
HBW	11,206	13,594	8,938	10,965	44,703	23%
HBO	18,554	38,865	22,485	28,979	108,883	14%
NHB	16,482	43,878	22,195	15,373	97,928	9%
Total	46,242	96,337	53,618	55,317	251,514	12%

Proportions by Trip Purpose and Time of Day, GF/EGF MPO TAZs Only						
	7-10AM	**10AM-4PM**	**4-7PM**	**Night**	**Total**	**% of Overall**
HBW	25%	30%	20%	25%	100%	23%
HBO	17%	36%	21%	27%	100%	14%
NHB	17%	45%	23%	16%	100%	9%
NHCRP 718 Time-of-day Distributions by Purpose						
	7-10AM	**10AM-4PM**	**4-7PM**	**Night**	**Total**	
HBW	25%	22%	26%	27%	100%	
HBO	15%	38%	26%	21%	100%	
NHB	15%	53%	21%	11%	100%	

2.1.2. Internal-External/External-Internal Origin Destination Data

The data were further disaggregated to reflect the different proportions of trips by purpose and type for different external locations. The external locations were distinguished as North, South, East and West with Interstate 94 and U.S. Highway 2 are the main highway trips used for entry/exit to the GF/EGF MPO area. This was done to evaluate whether trips from the North (which included trips from Canada) had different Peak AM proportions for HBW for example.

Table 2 shows the IE and EI trip data and the proportions of IE/EI trips to the total trips for each trip purpose and time period. The table shows OD trips that had at least one trip end in the study area. IE/EI trips made up 15% of the total trips. For HBW trip purpose, the proportion of EI/IE is 12% of the total trips and ranged from 10% to 15% for the different time periods. For HBO trips, the IE/EI made up 13% of total trips and ranged from 11% to 15% for the different time periods. The NHB trips for IE/EI where 18% of the total GF/EGF NHB trips and ranged from 17% to 22% for the different time periods.

Table 2 IE and EI Trips from OD Data for the GF-EGF MPO Area

Total IE Trips					
	7-10AM	**10AM-4PM**	**4-7PM**	**Night**	**Total**
HBW	1,313	1,384	984	1,627	5,308
HBO	2,316	4,465	2,793	4,484	14,058
NHB	3,556	7,549	3,687	2,767	17,559
Total	7,185	13,398	7,464	8,878	36,925
Percentage of IE Trips to Total Trips for GF/EGF Data					
	7-10AM	**10AM-4PM**	**4-7PM**	**Night**	**Total**
HBW	12%	10%	11%	15%	12%
HBO	12%	11%	12%	15%	13%
NHB	22%	17%	17%	18%	18%
Total	16%	14%	14%	16%	15%

2.1.3. External-External OD Data

External-External (EE) OD data shows the trips that pass through the GF/EGF MPO area without stopping. Transient locations were not included in the OD dataset provided by Airsage which would have simplified the task of obtaining EE trips. The data itself does not inform us if a trip between two OD pairs possibly passed through the GF/EGF MPO area. The implication was that EE data had to be estimated using an algorithm that took into account the possibility that trips between OD pairs passed through the GF/EGF MPO area. The methodology developed incorporated the use of real time travel data between OD pairs and was developed using an online mapping application APIs. The method assumed that trips between OD pairs will use the shortest travel time path between the OD pairs. The methodology to estimate EE OD pairs that passed through the GF/EGF MPO is as follows

1. Select all OD pairs that are not part of the internal GF/EGF MPO OD TAZs i.e. not part of the 61 GF/EGF OD TAZs. Remaining 240 OD TAZs fit this category.
2. Calculate average shortest travel path between all OD pairs using API algorithm developed for online mapping application for each time period.
3. Evaluate whether any portion of the route between each OD pair included a spatial location point within the GF/EGF MPO area (longitude/latitude).
4. If yes to 3, trips between those OD pairs were considered as EE trips for the GF/EGF MPO area.

Table 3 shows the percentages of EE trips that pass through the GF/EGF MPO area by trip type and by trip purpose. Table 3 also shows the proportion of each EE trip type as the overall proportion of EE and EI trips. Overall, EE trips made up about 17% of total EE and EI/IE trips. This was a lot higher than the typically used 10-12% through trip percentages.

The percentage of EE only trips ranged from 21% for the AM Peak period to 37% for the late-morning to early-afternoon period. For HBW, the majority of trips occurred during the Night period (30%) with the least amount of trips occurring during the PM Peak period (17%). This could be because this time period includes the early morning (6:00AM to 7:00 AM) and late evening (7:00PM to 9:00PM) trips. Trips passing through the GF/EGF MPO area for work may typically leave early and arrive later due to comparatively longer travel times. For HBO trips, the pattern is similar to the HBW trips with 35% of trips occurring at night and 17% of trips occurring during the AM Peak period. For NHB trips, the late-morning to early-afternoon period had the highest percentage of trips (43%) followed by the AM Peak period (23%), and the Peak PM and Night periods (17% each).

Table 3 EE Trips from OD Data

EE Trips passing through GF-EGF MPO					
	7-10AM	**10AM-4PM**	**4-7PM**	**Night**	**Total**
HBW	148	186	110	194	638
HBO	351	571	380	708	2,010
NHB	814	1,540	613	595	3,562
Total	1,313	2,297	1,103	1,497	6,210
Percentage of EE Trips passing through GF-EGF MPO					
	7-10AM	**10AM-4PM**	**4-7PM**	**Night**	**Total**
HBW	23%	29%	17%	30%	100%
HBO	17%	28%	19%	35%	100%
NHB	23%	43%	17%	17%	100%
Total	21%	37%	18%	24%	100%
Percentage of EE Trips to Total EE/EI Trips					
	7-10AM	**10AM-4PM**	**4-7PM**	**Night**	**Total**
HBW	11%	13%	11%	12%	12%
HBO	15%	13%	14%	16%	14%
NHB	23%	20%	17%	21%	20%
Total	18%	17%	15%	17%	17%

2.1.4. Use of Airsage OD Data in the TDM

The OD data were used to calibrate and validate the trip generation and trip distribution steps of the model. Prior models could not distinguish between EE trips for HBW and HBO trips for the AM Peak period for example. Ultimately, it leads to more precise and accurate models.

2.1.4.1. Trip Generation

For trip generation, the data were used primarily to disaggregate daily trips into peak and off peak periods for the different trip purposes and for different trip types (II/IE/EI and EE trips). UND trips were also enhanced and developed using the OD data. This created a more refined and more accurate output that was used for later parts of the model. The refinement greatly enhanced the ability of the model to replicate ground truths.

2.1.4.2. Trip Distribution

Trip distribution assigns trips generated in the trip generation step between origin and destination pairs. The typical output of the trip distribution step in TDMs is a matrix showing the origin and destination of each trip. For the GF/EGF MPO TDM, the gravity model was used to distribute trips. The gravity model uses the trip generation outputs (productions and attractions by trip purpose for each zone), a measure of travel impedance

between each zonal pair (travel time), and socioeconomic/area characteristic variables ("K-factor") variables as input. The K-factor is used to account for the effects of variables other than travel impedance in the model. The OD data were used to develop K-factor matrices imputed in the gravity model that were used for distributing trips for each time period and purpose.

2.1.5. Evaluating the OD Data for Major Trip Generators

UND, Columbia Mall and the Altru Hospital are some of the "Special" trip generators within the GF-EGF MPO area. An analysis of the OD data for trips attracted to these TAZS was performed to show how the data can be used to visually show the OD data. Figures 3, 4 and 5 show trip attractions to UND, the mall and the Altru Hospital.

Figure 3 shows the weekday trip attractions to UND for 18-24 year olds. It shows that most trips that end up in UND for this age group originate from within the UND TAZs (10-25%). TAZs South of Demers, East of Washington, North of 32nd Ave S and East of the River produced between 5-10% of trips made by 18-24 year olds that end in the UND TAZs. The Grand Forks Air force base (TAZ) to the West of the Metro area produces between 1 and 3 % of trips that were attracted to UND. Figure 4 shows the percentage of trips attracted to the mall for the different TAZs. TAZs around UND generates the highest percentage of trips that end up in the mall (5-10%). TAZs South of Demers, East of Washington, North of 32nd Ave S and East of the River again generate a good proportion of trips that end up at the Columbia Mall (3-5%). The rest of the trips are fairly evenly distributed amongst the other TAZs. Figure 5 shows the trips that are attracted to the zone that includes the Altru Hospital. Zones around UND provide the highest number of trips to the Altru hospital. The Grand Forks Air Force Base generates a good proportion of trips that end up in the Hospital. TAZs South of Demers, East of Washington, North of 32nd Ave S and East of the River produced between 0.5 and 1% of trips that ended at the Altru Hospital. Overall, the data shows some interesting trends with respect to where trips originate and terminate for some of the major trip generators in the area.

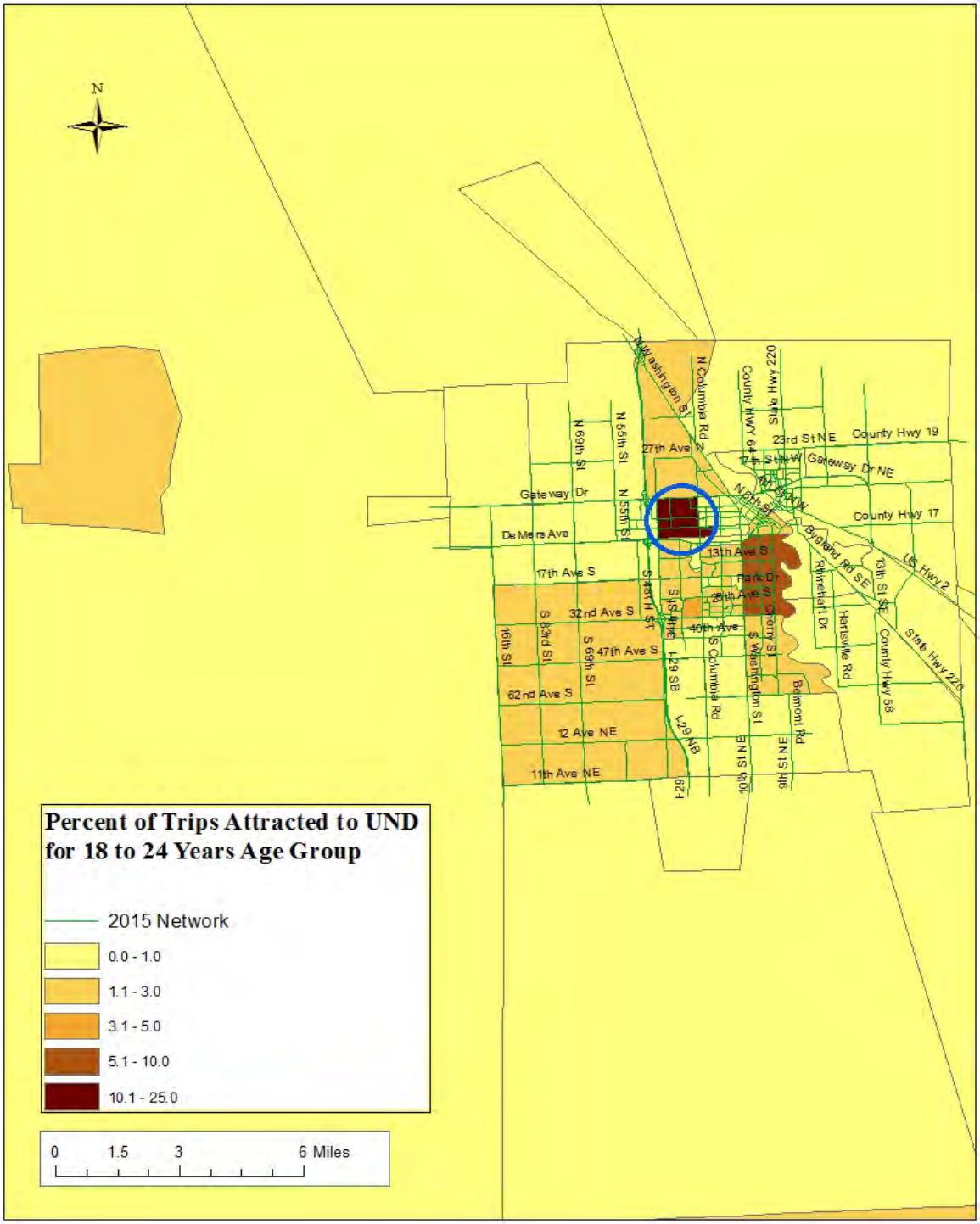


Figure 3 Origin Percent of Trips Attracted to UND for 18-24 Year Olds from Airsage OD Data

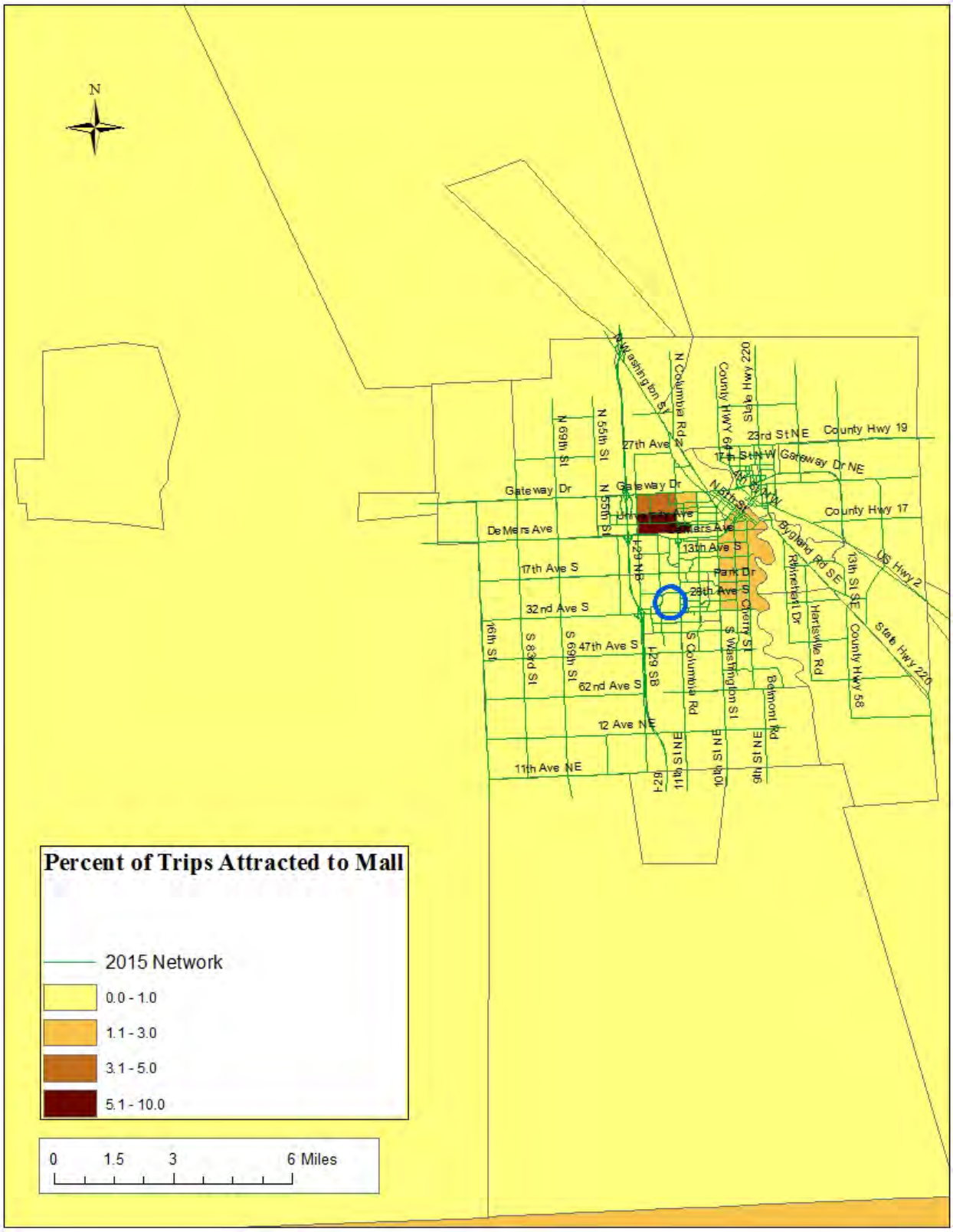


Figure 4 Origin Percent of Trips Attracted to the Columbia Mall from Airsage OD Data

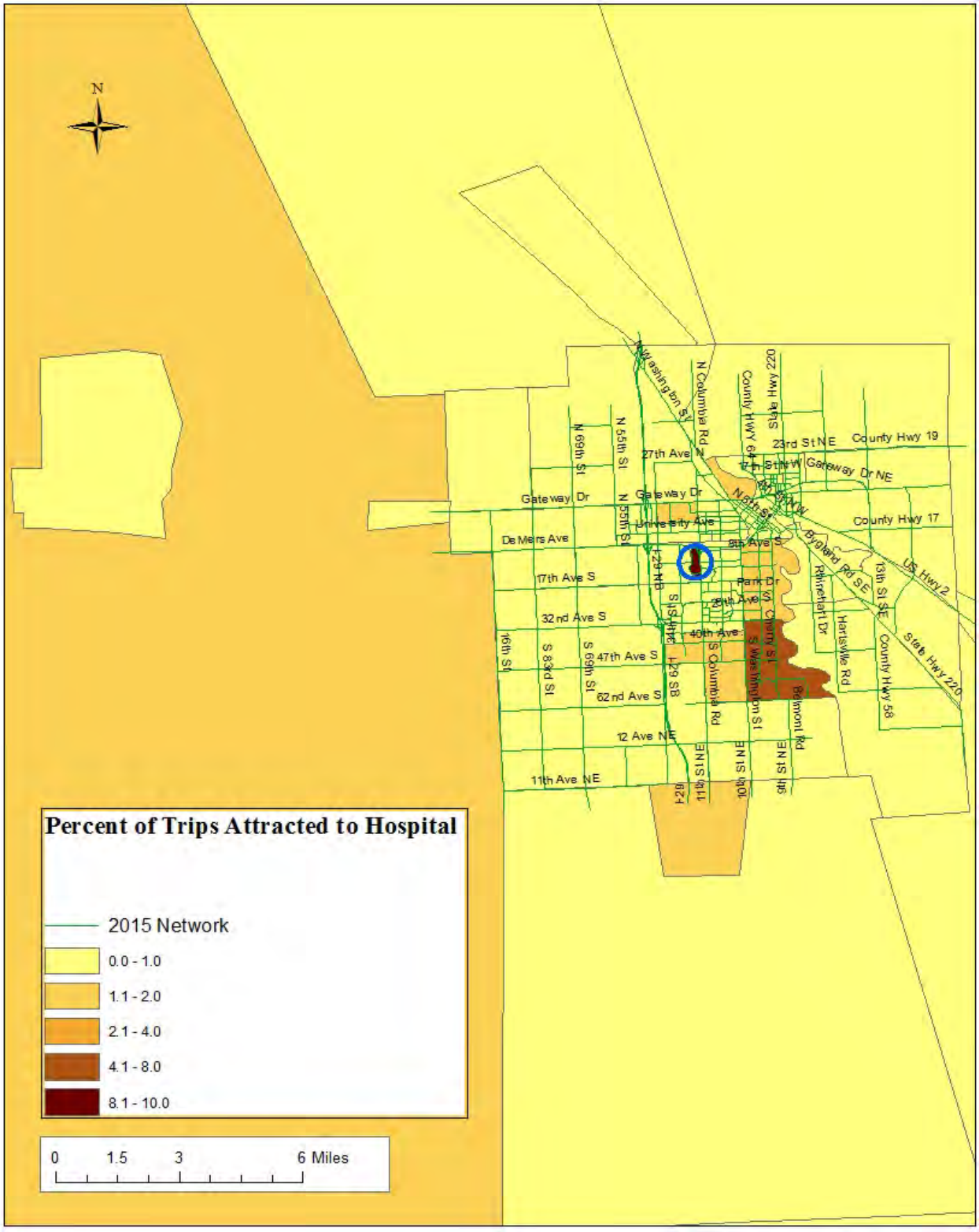


Figure 5 Origin Percent of Trips Attracted to the Altru Hospital TAZ from Airsage OD Data

2.1.6. Comparing Peak AM and Peak PM Data to the Traffic Data Analysis Tool

To validate the OD data with locally collected data it was compared to the Traffic Data Analysis tool which collect traffic volumes for several intersections in the City of Grand Forks. Table 1 shows the percentage of AM, Afternoon, PM and Night periods for the OD data and the traffic data analysis intersection tool data from October 2010. The difference ranged from -3% for the Afternoon and PM Peak periods to 3.3% for the AM peak period. Overall, the OD data seems to fairly reflect observed data.

Table 4 Comparison of Temporal Airsage OD Data and Traffic Analysis Intersection Data

	7AM-10AM	10AM-4PM	4PM-7PM	7PM-7AM	Total
Airsage OD	18.5%	39.0%	21.8%	20.7%	100%
Intersection Tool Data	15.2%	42.0%	24.7%	18.0%	100%
Difference	3.3%	-3.0%	-3.0%	2.6%	0%

For visualization purposes, Figure 6 shows the comparison of the Airsage OD data and the Traffic Analysis Intersection Data. The percentage differences are very small and the OD data is representative of the intersection data. The only difference is that the OD data can be differentiated into trip purposes whereas the intersection data contains overall trips. The OD data can be used to however differentiate the intersection data into different trip purposes.

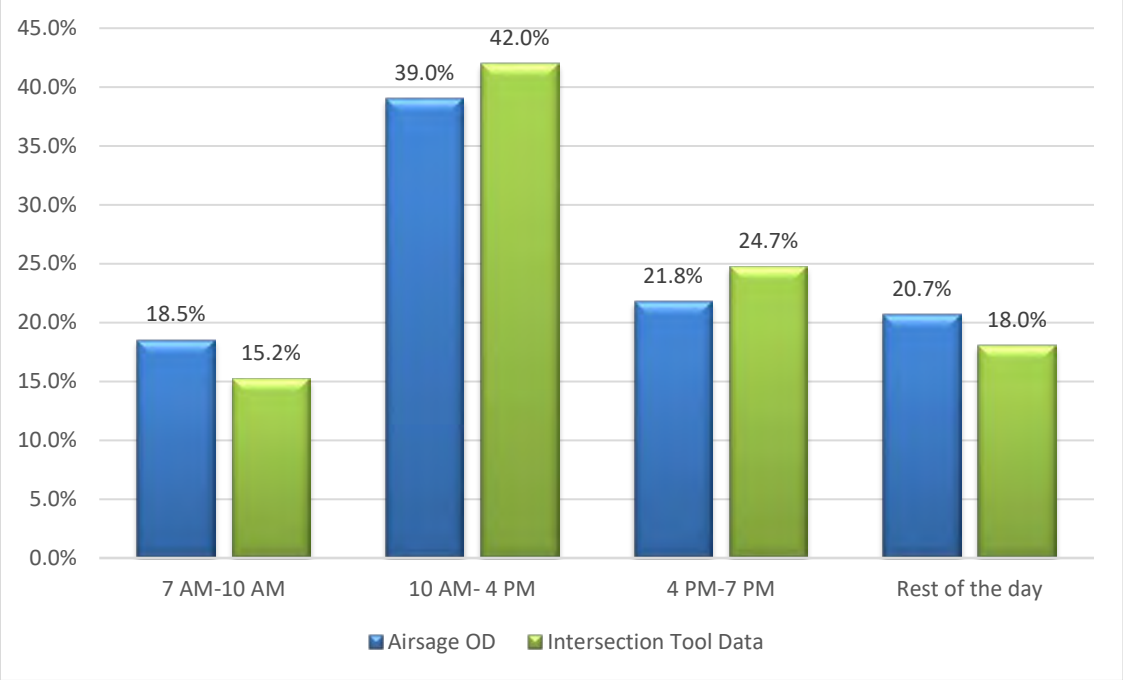


Figure 6 Comparison of Temporal Airsage OD Data and Traffic Analysis Intersection Data

2.1.7. Potential Shortcomings of the OD Data

Although the OD data provides unique opportunities to improve on the TDM, there were some deficiencies in the data.

1. By nature of the data being collected on cell phone tower pings, some zones did not show any ODs. For example, the Grand Forks Airport did not attract or produce any trips. This is because all of the trips to the Grand Forks Airport were shown in the TAZ East and Adjacent to the airport.
2. The data did not show transient locations between Origins and Destinations. Paths between OD pairs can be estimated using network data.
3. The data does not include all cell phone networks and could suffer from cell phone provide biases. For example, low income earners might use different networks from the major networks for cost savings.
4. The raw data collected is anonymous and does not contain the demographic data that is provided with the dataset. The provider uses an algorithm to create the profile for average users (age, gender etc) based on their socioeconomic data. We cannot verify the veracity of the algorithm or the socioeconomic data that was used for this process.
5. The data does not distinguish between truck and passenger vehicles.

2.2. Freight Analysis Framework Data

The Freight Analysis Framework (FAF) data integrates data from various sources to create a comprehensive freight movement data among states and major metropolitan areas for all transportation modes. The data provides estimates for tonnage (thousand tons) and value (million dollars) by regions of origins and destinations, commodity type, and mode. Data are available for the 2012 base years, years 2012-2015, and forecasts from 2020 to 2045 in five-year increments.

The FAF data for North Dakota is aggregated for the entire state. For Minnesota, the data is aggregated into two zones: The twin Cities Metropolitan area and the rest of the state. A methodology was necessary to disaggregate the data to the MPO level. Data for Grand Forks came from the North Dakota FAF aggregate data while data for East Grand Forks came from the aggregate Minnesota FAF Data. A regression model was developed to disaggregate the statewide data to the MPO level. The model used the employments as the explanatory variable. Overall, the model had very good fit with R-square ranges from 65-95 %.

The output of the regression models were the tonnage of freight produced and attracted to each of the Cities in the MPO (Grand Forks and East Grand Forks respectively). The Tonnage was then distributed to each TAZ proportionally based on the employment for

that TAZ. Tonnages were then converted to truck trips using the commodity type characteristics (typical weight and size).

2.3. Traffic Analysis Intersection Data Archival

The Grand Forks-East Grand Forks MPO (MPO) and the City of Grand Forks (City) intend to utilize the already existing traffic detection cameras for traffic data collection. The intersection turning movement counts when collected over significant amount of time (e.g. a year) can be then used in various traffic operations, transportation planning, and highway design applications. This data is being used as an additional tool to validate AM and PM model output and turning movement output of the model.

3. CAPACITY CALCULATIONS

Capacities play a critical role in TDM as they are not only used to measure the Level of Service but are also critical in the assignment step. Traffic is assigned based on the saturation (Volume to Capacity) of each link, which will result in traffic being moved to other links as this value increases. The Transportation Research Board 2010 defined capacity as follows: "The capacity of a system element is the maximum sustainable hourly flow rate which persons or vehicles reasonably can be expected to travers a point or a uniform section of a lane or roadway during a given time period under prevailing roadway, environmental, traffic, and control conditions. Capacity analysis examine roadway elements under uniform traffic, roadway, and control conditions."

NCHRP 716 on the other hand define the "Capacity" in a traffic engineering sense is not necessarily the same as the capacity variable used in travel demand model networks. In early travel models, the capacity variable used in such volume-delay functions as the BPR formula represented the volume at Level of Service (LOS) C; whereas, in traffic engineering, the term "capacity" traditionally referred to the volume at LOS E."

Link capacities are a function of the number of lanes on a link; however, lane capacities can also be specified by facility and area type combinations. Several factors are typically used to account for the variation in per-lane capacity in a highway network, including:

- Lane and shoulder widths;
- Peak-hour factors;
- Transit stops;
- Percentage of trucks
- Median treatments (raised, two-way left turn, absent, etc.);
- Access control;
- Type of intersection control;
- Provision of turning lanes at intersections and the amount of turning traffic; and
- Signal timing and phasing at signalized intersections.

Some networks combine link capacity and node capacity to better define the characteristics of a link (Kurth et al., 1996). This approach allows for a more refined definition of capacity and speed by direction on each link based on the characteristics of the intersection being approached.

To update the model capacity calculations, first a literature review was performed among similar type of MPO outside of North Dakota-Minnesota (Lincoln-NE, Des Moines Area-IA, Syracuse Metropolitan Transportation Council-NY, Chattanooga-Hamilton County Regional Planning Agency-TN, Knoxville Regional Transportation Planning Organization-TN, Tulare County Associations of Governments-CA); larger MPO than FM Metro COG (Atlanta Regional Commission-GA, Dallas-Fort Worth-TX, Chicago Metropolitan Agency for Planning-IL, Capital Area-MO. The assumptions of similar MPOs or larger MPOs came from the population's threshold value defined by NCHRP 716. Table 5 summarizes the literature review used in different MPO planning models for capacity calculations.

Table 5 Summary of Capacity Calculations for MPO Planning Models

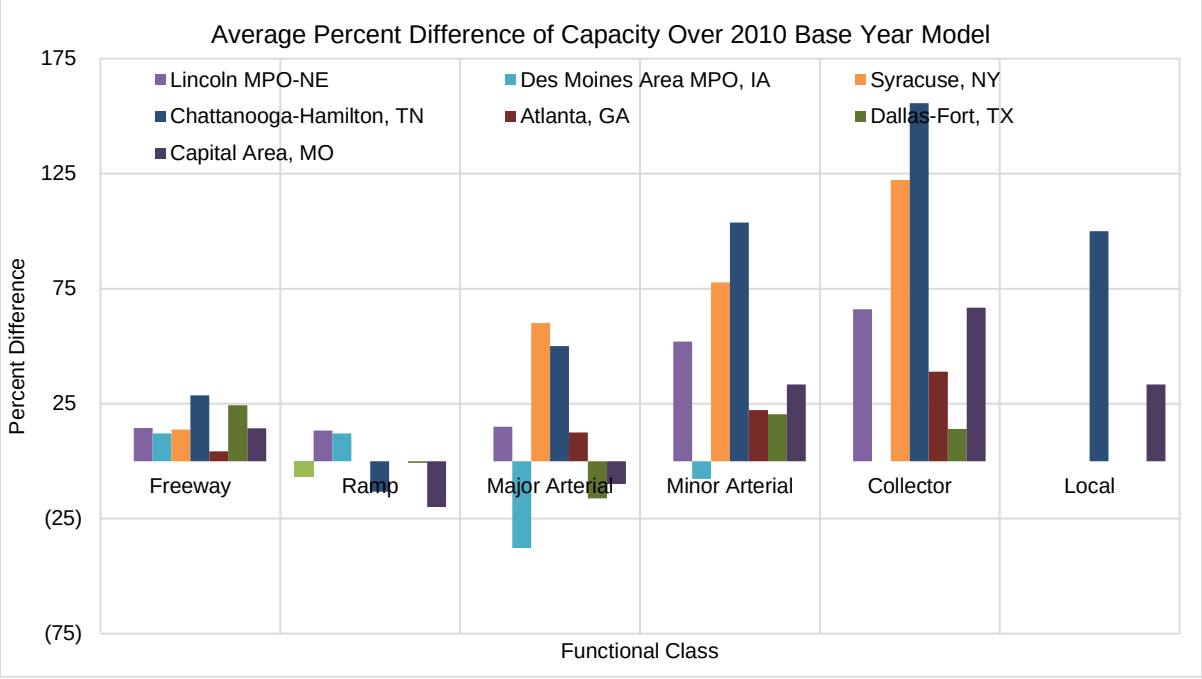
Lincoln MPO-NE, 2006	For the Lincoln MPO model, capacity at Level of Service (LOS) C was used as the threshold capacity. Highway Capacity Manual (HCM) 2000 procedures were used for estimating the capacity for each combination of functional class and area type. First, peak hour lane capacity was calculated after the effects of percent green time, and peak hour factor. Second, the 24 hour lane capacity was calculated using peak hour lane capacity and percent of traffic in the peak hour. Finally, threshold capacity at LOS C was assumed to be 75% of the 24 hour lane capacity. Reference: LIMA & Associates, 2006 http://www.princeton.edu/~alaink/Orf467F12/LincolnTravelDemandModel.pdf
VDOT, 2014	For all model regions, it is acceptable practice and recommended practice to use the most recent version Highway Capacity Manual (HCM) as the basis for roadway capacities. It is not acceptable to use older versions of the HCM or arbitrary figures for roadway capacities. Based on functional class and land use/area type Tabulation process Reference: http://www.virginiadot.org/projects/resources/vtm/vtm_policy_manual.pdf
ODOT, 1995	The procedure used to estimate free flow speed and capacity is a detailed methodology that utilizes the maximum amount of information from the network and "connects" this data with information from the Highway Capacity Manual. http://www.oregon.gov/ODOT/TD/TP/docs/reports/guidex.pdf
Memphis MPO-TN	Hourly capacities were developed for the Memphis model in order to use collected street data. This provides the most accurate representation of actual capacity (levels of service A through E) on an individual link. These capacities — detailed in the Technical Memorandum #8(b) – Capacity Development — are implemented using an equation which takes into account functional classification, speed limit, lanes, signal density, median treatment, area type, average lane width, and average shoulder width. The capacity equations are built into the model process as a TransCAD lookup table, so modifications to network attributes automatically update the capacity in subsequent runs Since the model is based on four multi-hour time periods, a conversion factor must be used to create a time period capacity for each of the four time periods. The capacity factors below are based on hourly traffic count data and the Memphis household travel survey http://www.memphismpo.org/sites/default/files/public/documents/lrtp/appendix-g-travel-demand-model.pdf
GDOT, 2013	Facility type and area type are used in combination to determine free-flow speeds and capacities. Link capacities for the model network are obtained from a lookup table of per-lane hourly capacities based on facility type and area type. The final link capacity is calculated by multiplying the hourly capacity per lane by the number of lanes, which is automatically added to the links during the model application. http://www.dot.ga.gov/BuildSmart/Programs/Documents/TravelDemandModel/GDOT%20Model%20Users%20Gude_050813.pdf
MassDOT, 2013	The coding of the EMME/2 highway network basically follows the hierarchy of the functional classification system. Expressways, other than those passing through denser urban areas, are generally coded for 60 mph speeds and hourly capacity per lane of 1,950. Higher-level arterials are coded for speeds ranging from 45 to 50 mph and corresponding capacities of 1,050 to 1,100. Lower-level arterials and major collectors range from 35 mph to 40 mph, with capacities of 950 to 1,000. Minor collectors and local streets that are not in urban centers range from 23 mph to 30 mph, with capacity generally at 800. Streets in urban centers can have substantially lower speeds and capacities. https://www.massdot.state.ma.us/theurbanring/downloads/CTPS_Travel_Demand_Modeling_Methodology.pdf

Syracuse Metropolitan Transportation Council, NY, 2012	The speed and capacity values are stored in lookup tables and automatically imported to the network each time the model runs. The main benefits of importing these data from a lookup table, as opposed to maintaining an explicit speed and capacity for every link within the highway network, are that the user has less data to manage and can easily quote values. However, there are some links in the SMTC network that warrant special attention because their actual speed or capacity is substantially different from what the lookup tables say. Therefore, the SMTC model also supports the ability to code a speed or capacity for each link by entering a value into the "TOTAL_HCAP_FIXED" or "SPEED_FIXED" fields on the network http://www.thei81challenge.org/cm/ResourceFiles/resources/SMTC%20Model%20Version%203.023%20Documentation.pdf
Atlanta Regional Commission (ARC), GA, 2011	By area type and facility type Tabulation method 20 facility type and 7 area type Total link capacity (1Hr- LOS E) http://www.atlantaregional.com/transportation/travel-demand-model
Capital Area MPO (CAMPO)-MO, 2013	The model computes link capacities at run time. Capacities are initially based on functional class and number of lanes, adjusted based on directionality, median type, and roadway slope. Capacity is expressed in terms of vehicles per day for each link by direction. http://www.jeffersoncitymo.gov/11Jan2013CAMPOTDMDocumentation.pdf
Champaign-Urbana Urbanized Area Transportation Study (CUUATS), IL	The daily capacity for each link in the Champaign County model network was calculated based on its facility type and area type. If a Two-Way Left Turn Lane (TWLTL) was present, the link capacity was increased by 30%. The lookup table was included in the model script to uniformly assign the capacity on the model network. The centroid connectors have high capacity and very low speed (15mph).
Chattanooga-Hamilton County Regional Planning Agency, TN, 2013	Using the collected street data, the proposed capacity calculation for Chattanooga model will be implemented using an equation which takes into account data such as functional classification, speed limit, lanes, median treatment, area type, average lane width, and average shoulder width. Traffic signal delays and impact of steep grades may also be considered. The equations were originally developed using the Highway Capacity Manual (HCM) and analysis performed by the Indiana Department of Transportation in 1997 for the Indiana State Highway Congestion Analysis Plan. KHA successfully applied this method in other urban area models, in conjunction with analysis performed using North Carolina DOT's Level of Service (LOS) software. http://www.chcrpa.org/2040RTP/2040RTP_Draft_Plan/Volume_III_Travel_Demand_Model.pdf
Dallas-Fort Worth (DF): North Centeral Texas COG, TX, 2009	Hourly Capacity Per Lane (Divided or One-Way Roads) – The hourly capacity per lane for divided roads is given by area type and functional class. AMFactor, PMFactor, OPFactor – These factors are used in the conversion of capacity from hourly to time period. Factors are defined by functional class 1-8 http://www.nctcog.org/trans/modeling/documentation/DFWRTMModelDescription.pdf
San Diego Association of Governments, CA, 2011	Two capacities are calculated for each direction of a hhghway link: 1. Intersection and mid-link Hourly basis Time category Factored Future ramp metering improved the capacity grow in 10 percent . See the equations http://www.sandag.org/uploads/publicationid/publicationid_1624_13779.pdf
Chicago Metropolitan Agency for Planning, IL, 2014	Zonal capacity system Capacity represented within the link travel time function is approximately the service volume at level of service C. It is calculated as 75 percent of the level of service E time period link capacity. Note that link capacity is calculated by multiplying the hourly lane capacity by the number of lanes and the number of hours in the assignment time period
Omaha-Council Bluffs Metropolitan Area Planning Agency (MAPA), NE, 2010	The daily capacity is based on the hourly ultimate capacity, that is, the point at which the Level of Service (LOS) changes from an "E" to an "F" as defined by the Highway Capacity Manual. To support the daily model, the hourly capacity is multiplied by a factor of 10, which represents a typical ratio of peak hour to daily traffic. Capacity varies by functional class, presence of turn lanes, the number of lanes, and whether the road is divided or undivided. The capacities are based on those used in Des Moines, Iowa. The capacities vary by side friction to take into account differences in driveway density. MAPA is currently comparing the capacities with other sources such as the capacity tables developed by the Florida DOT. The model does not include intersection delay separately from link delay. MAPA has attempted to represent intersection delay using downward adjustments to free flow speeds https://www.fhwa.dot.gov/planning/tmip/resources/peer_review_program/mapa/mapa_report.pdf
Des Moines Area MPO, IA, 2006	Daily directional capacity of a link Divided or undivided Number of lanes Access condition

	Facility coding http://www.ctre.iastate.edu/educweb/ce451/LABS/Lab%2012/DSM_Documentation.pdf
KYOVA Interstate Planning Commission, WV, 2013	Capacity based on area and functional class Tabulation and look up method http://www.kyovaipc.org/2040MTP/documents/KYOVA2040_ModelDocumentation_121213_withFigures.pdf
Knoxville Regional Transportation Planning Organization, TN, 2010	Peak hour capacities of the roadway network were estimated using Highway Capacity Manual 2000 procedures, which results in much more precise estimates of capacity verses traditional methods used in models that entail using a lookup table based on functional class and area type. http://www.knoxtrans.org/plans/mobilityplan/cndetern.pdf
Tulare County Association of Governments, CA, 2015	Link capacity is defined as the number of vehicles that can pass a point on a roadway at free-flow speed in an hour. One important reason for using link capacity as a model input is for congestion impact; which can be estimated as the additional vehicle -hours of delay based on the 2000 Highway Capacity Manual (2000 HCM). The capacity assumption used in the TCAG model of each road segment in the network is based on the terrain, facility type, and area type, which is consistent with the methodology suggested in the 2000 HCM http://www.arb.ca.gov/cc/sb375/tcag_scs_staff_report_final.pdf

Figure 7 shows the comparison of the base 2010 GF-EGF MPO planning model capacity calculations to reviewed capacities for several different MPOs. The capacities for freeways are very similar to the capacities for the base 2010 GF-EGF model. For ramps, the capacities for other MPO areas were typically lower in comparison to the 2010 GF-EGF model. For major arterials, minor arterials, collectors and locals, the capacity calculations were typically higher for the MPOs compared. Most of these MPOs used a Level of Service E for capacity calculations, reason why their capacities were higher.

Figure 7 Capacity Comparisons to Grand Forks East Grand Forks MPO 2010 Base Year Model



For the 2015 base year model, network-wide capacities were updated to reflect the most recent Highway Capacity Manual HCM 6th Edition and capacities estimated in other recent literature. The calculation of capacities took into account several variables including the functional classification, the number of through links, the number of turn lanes, the location of the intersection (rural, urban, CBD, suburban), the intersection control and effective green ratios, heavy vehicle adjustment factors and the speeds. The capacities used for the 2015 model were slightly different from the 2010 models and represent the state-of-the-art in capacity calculations in TDM. The next subsections discuss the capacity calculations for different types of intersections.

3.1. Capacity Calculations for Signalized intersections

For signalized intersections a step by step procedure was used to estimate the capacities.

3.1.1. Step 1: Develop Lane Groups for each Link

The first step defined the lane groups for each link. For the 2015 network, lane groups are defined by the Attribute Linkgrp1. Table 6 shows the codes for each link group. The lane group describes the geometry at the B-node of each link including the number of through lanes, the number of right turn lanes and the number of left turn lanes. The first Number in the linkgroup1 category shows the number of through lanes while the second number represents the number of turn lanes for either right or left turns as shown in Table 6. For example, if Linkgroup1 for a link was 20, it meant that link had two through lanes with no turn lanes. Similarly, if the Linkgroup1 code was 35, it means the link had three through lanes, with two right turn lanes.

Table 6 Lane Group Classification (Linkgroup 1)

Code	Lane Group Description
N0	N through lanes and no turn lane
N1	N through lanes and single exclusive left turn lane
N2	N through lanes and two exclusive left turn lanes
N3	N through lanes and continuous exclusive left turn lane from intersection to intersection
N4	N through lanes and single exclusive right turn lane
N5	N through lanes and two exclusive right turn lanes
N6	N through lanes and continuous exclusive right turn lane from intersection to intersection
N7	N through lanes, single exclusive left turn lane and single exclusive right turn lane
N8	N through lanes, two exclusive left turn lanes and single exclusive right turn lane
N9	N through lanes, two exclusive right turn lanes and single exclusive left turn lane

3.1.2. Step 2: Determining saturation flow rate (S_i) for each lane group:

Step 2 included determining the saturation flow rate *(S_i)* for each Lanegroup using Equation 1. It is important to note that not all the parameters in Equation 1 were used for the model. Some of the parameters like the lane width and approach grades are not used in calculating the saturation flow rate. If the data is however available, say for a subarea study, these paramters can potentially be used to estimate capcities. The parameters were developed from different sources including HPMS and HCM6.

Equation 1

$$S_i = S_0 \times N \times f_W \times f_{HV} \times f_g \times f_p \times f_{bb} \times f_a \times f_{LU} \times f_{LT} \times f_{RT} \times f_{Lpb} \times f_{Rpb} \times PHF$$

Where:

S_i	=	Saturation flow rate for subject lane group, expressed as a total for all lanes in lane group (vph)
S_O	=	Base saturation flow rate per lane (pcphpln)
N	=	Number of lanes in lane group
f_W	=	Adjustment factor for lane width
f_{HV}	=	Adjustment factor for heavy vehicles in traffic stream
f_g	=	Adjustment factor for approach grade
f_p	=	Adjustment factor for existence of a parking lane and parking activity adjacent to lane group
f_{bb}	=	Adjustment factor for blocking effect of local buses that stop within intersection area
f_a	=	Adjustment factor for area type
f_{LU}	=	Adjustment factor for lane utilization
f_{LT}	=	Adjustment factor for left turns in lane group
f_{RT}	=	Adjustment factor for right turns in lane group
f_{Lpb}	=	Pedestrian-bicycle adjustment factor for left turn movements
f_{Rpb}	=	Pedestrian-bicycle adjustment factor for right turn movements
PHF	=	Peak Hour Factor

The formulas for calculating the parameters in equation 1 from the HPMS are show next:

1. Base Saturation Flow Rate, So

Following the HPMS procedure, the base saturation flow rate was set at 1,900 passenger car per hour per lane (pcphpl).

2. Adjustment Factor for Lane Width, f_W

Using HPMS lane adjustment factors, Equation 2 was used to calculate the adjustment for lane widths,

Equation 2

$$\boldsymbol{f_W = 1 + \frac{(W-12)}{30}}$$

Where:

W = Lane width, minimum of 8ft and maximum of 16ft.

3. Heavy Vehicle Adjustment Factor, f_{HV}

Equation 3 was used to calculate the heavy vehicle adjustment factor.

Equation 3

$$f_{HV} = \frac{100}{100 + HV(E_T - 1)}$$

Where:

HV = percent heavy vehicles

E_T = passenger car equivalent

4. Adjustment for Grade, f_g

Due to lack of grade information on urban minor arterials and collectors, HPMS uses f_g as 1.0.

5. Adjustment for Parking, f_p

For parking adjustment, Equation 4 is used to calculate the capacity adjustment.

Equation 4

$$f_p = \frac{N - 0.1 - \frac{18N_m}{3{,}600}}{N}$$

Where:

f_p = Parking adjustment factor

N = Number of lanes in group

N_m = Number of parking maneuvers per hour (6 for two-way streets with parking one side, 12 for two-way streets with parking both sides or one-way streets with parking one side, 24 for one-way streets with parking on both sides)

If no parking space or parking data is available, then f_p is set equal to 1.0.

6. Adjustment for Bus Blockage, f_{bb}

Due to non-availability of bus routes data, f_{bb} is set to 1.0. Also default values of f_{bb} used in HCM 2000 for bus routes are close to one.

7. Type of Area Adjustment, f_a

According to HCM 6, f_a is set to 0.9 for CBDs and 1 elsewhere.

8. Lane Utilization Adjustment, f_{LU}

A lane utilization adjustment factor of 1.0 was used for the model.

9. Adjustment for Left Turns, f_{LT}

Adjustment factor of 0.95 is used for left turn movements to estimate the capacities in this study.

10. Adjustment for Right Turns, f_{RT}

For right turn movements, the adjustment factor of 0.85 was used for the model.

11. Adjustment for Pedestrian-Bicycle Blockage on Left Turns, f_{Lpb}

Adjustment factor for pedestrian-bicycle blockage is set to 1.0 in HPMS procedure due to non-availability of extensive inputs.

12. Adjustment for Pedestrian-Bicycle Blockage on Right-Turns, f_{Rpb}

Similarly, the adjustment factor for pedestrian-bicycle blockage for right turns is also set to 1.

13. Peak Hour Factor (PHF)

The default values of 0.92 and 0.88 are set for urban and rural sections respectively.

14. Effective Green Ratios (g_i/C) for Lane Groups

A g_i/C value of 0.45 is used for principal and minor arterials while 0.40 is used for collectors. These values were default values suggested in HPMS. The values were evaluated based on signal timing data provided by the MPO and were found to be reasonable.

3.1.3. Step 3: Approach Capacity Calculation

After estimating the saturation flow rate for each lane group, the approach capacity for each link at the B end node of the link is calculated. This calculation is done by incorporating adjustment factors using the effective green ratio as shown in Equation 5.

Equation 5

$$C_{SI} = \sum_i S_i \times \frac{g_i}{C}$$

Where C_{SI} is signalized intersection approach capacity,

S_i represents saturation flow rate for lane group i and

$\frac{g_i}{C}$ represents effective green ratio for lane group i.

3.2. Capacities for Stop Control Intersections

The calculation for capacities for links that have stop controls at the B-node end also follow a series of steps as described next.

3.2.1. Step 1: Calculate the Potential Capacity for each Turning Movement

The potential capacity for each turning movement uses the conflicting flow rate, the critical gap, the number of lanes, follow up time for each movement, and percent heavy vehicles as input parameters. Equation 6 shows the equation used to calculate the potential capacity for stop controlled intersections for movements that are not shared.

Equation 6

$$C_{p,x} = CV_{c,x} \times \frac{e^{-V_{c,x} \times t_{c,x}/3600}}{1 - e^{-V_{c,x} \times t_{f,x}/3600}}$$

Where:

$C_{p,x}$	=	Potential Capacity of movement x (vph)
$CV_{c,x}$	=	Conflicting flow rate for each movement x (vph)
$t_{c,x}$	=	Critical gap (seconds) for each movement x $= t_{c,base} + (P_{HV} * t_{c,HV})$
$t_{c,base}$	=	Default values from Table 7
$t_{c,HV}$	=	1.0 for one or two-through lane roads 2.0 otherwise
P_{HV}	=	Percent of heavy vehicles in traffic stream, peak period, expressed as decimal
$t_{f,x}$	=	Follow-up time (seconds) for each movement x $= t_{f,base} + (P_{HV} * t_{f,HV})$
$t_{f,HV}$	=	0.9 for one or two through lane roads 1.0 otherwise

Table 7 and 8 show the default values that were used for calculating the potential capacities for stop-controlled intersections in the model.

Table 7 Default values for calculating potential capacities (Cp,x) of stop sign-controlled highways

Vehicle Movement (x)	Base Critical Gap, $t_{c,base}$	Follow-up Time, $t_{f,base}$
Right Turns	6.2	3.3
Through	6.5	4.0
Left Turns	7.1	3.5

Table 8 Default Values for Conflicting Flow Rates

Functional Class	Conflicting Flow Rate, $CV_{c,x}$
Rural Principal Arterials	100
Rural Minor Arterials	150
Other Rural	200
Urban Principal Arterials	250
Urban Minor Arterials	500
Other Urban	750

3.2.2. Step 2: Determine Potential Approach Capacity for Shared Lanes

For stop controlled intersections with shared turning lanes, Equation 7 was used to determine each approach's capacity. If turn lanes are not shared, step 2 is skipped.

Equation 7

$$C_{p,SH} = \frac{\sum_x V_x}{\sum_x \left(\frac{V_x}{C_{p,x}}\right)}$$

Where,

$C_{p,SH}$ = Potential capacity of the shared lane (vph)
V_x = Flow rate of the x movement in the shared lane (vph)
$C_{p,x}$ = Potential capacity of x movement in the shared lane (vph)

3.2.3. Step 3: Calculate Approach Capacity for each Lane Group Type

Table 9 shows the different equations that are used to calculate the approach capacity for each lane group as described previously for stop controlled intersections.

Table 9 Stop Sign Control Intersection Capacity Equations for Different Lane Groups

1	All Movements from Shared Lane	$C_A = N_T \times C_{p,SH}$
2	Shared LT + T lane; exclusive RT lane	$C_A = N_T \times C_{p,SH(LT+T)} + N_{RT} \times C_{p,RT}$
3	Shared RT + T lane; exclusive LT lane	$C_A = N_T \times C_{p,SH(RT+T)} + N_{LT} \times C_{p,LT}$
4	Exclusive lanes for all movements	$C_A = N_{LT} \times C_{p,LT} + N_T \times C_{p,T} + N_{RT} \times C_{p,RT}$
5	Consider only through volumes	$C_A = N_T \times C_{p,T}$

Where:

N_T	=	Number of peak through lanes; 1 for rural highways with two through lanes, 2 for rural highways with three through lanes
N_{LT}	=	Number of left turn lanes
N_{RT}	=	Number of right turn lanes
$C_{p,SH}$	=	Potential capacity of shared lane (vph)
$C_{p,T}$	=	Potential capacity for through movement (vph)
$C_{p,RT}$	=	Potential capacity for right turn movement (vph)
$C_{p,LT}$	=	Potential capacity for left turn movement (vph)

3.3. Freeway Capacity

For freeways, the following steps detailed the equations and procedures used to calculate their capacities.

3.3.1. Step 1: Calculate Free Flow Speed

Equation 8 shows the formula used to calculate free flow speeds. The equation utilizes the base free flow speed which is calculated using an algorithm that incorporates real time travel time data, lane width, right shoulder, number of lanes and interchange density adjustments.

Equation 8

$$FFS = BFFS - f_{LW} - f_{LC} - f_N - f_{ID}$$

Where:

BFFS	=	Base free flow speed
f_{LW}	=	Adjustment factor for lane width
f_{LC}	=	Adjustment factor for right shoulder lateral clearance
f_N	=	Adjustment factor for number of lanes
f_{ID}	=	Adjustment factor for interchange density

Table 10 shows the adjustment factors for lane width. This value is zero for 12ft wide lanes. However, if different widths exist, the values should be adjusted accordingly.

Table 10 Adjustment Factors Lane Width

Lane Width	Reduction in FFS (mph, f_{LW})
12 Ft	0.0
11 Ft	1.9
<= 10 ft	6.6

Table 11 shows the adjustment factors for right shoulder clearance. The model assumed a right shoulder clearance of greater than 6Ft. Adjustments should be made accordingly if these are different. For studies used to evaluate the construction/reconstruction impacts on freeways, this parameter will be critical in determining the reduced capacity if shoulders are closed or reduced.

Table 11 Right Shoulder Clearance Adjustment Factor

Right Shoulder Width (Ft)	Reduction in FFS (mph, f_{LC})			
	Lanes in one direction			
	2	3	4	>=5
>=6	0.0	0.0	0.0	0.0
5	0.6	0.4	0.2	0.1
4	1.2	0.8	0.4	0.2
3	1.8	1.2	0.6	0.3
2	2.4	1.6	0.8	0.4
1	3.0	2.0	1.0	0.5
0	3.6	2.4	1.2	0.6

Table 12 shows the adjustments used for interchange densities. The distance between two nodes connecting the interchanges is used to calculate the interchange density. The values for small urban areas are used in the model. For the model, all interchange densities were greater than 1 mile. This parameter becomes important when new interchanges that increase interchange densities are being considered as they will potentially reduce freeway capacities.

Table 12 Adjustments for Interchange Density

Functional Class	Area Size	Interchange Density	Interchange Adj. Factor, (f_{ID})
Urban Interstates	Small Urban	0.7	1
	Small Urbanized	0.76	1.3
	Large Urbanized	0.83	1.7
Other Urban Highways Qualifying as Freeways	Small Urban	0.83	1.7
	Small Urbanized	0.88	1.9
	Large Urbanized	0.91	2.1

Table 13 details the adjustment factors used for adjusting freeway capacities based on the number of lanes.

Table 13 Adjustments for Number of Lanes

No of Lanes (One direction; Urban only)	Reduction in FFS (mph, f_N)
>=5	0.0
4	1.5
3	3.0
2	4.5

3.3.2. Step 2: Calculate Base Freeway Capacity

The base freeway capacity is calculated using Equation 9 for freeways with speeds less than or equal to 70mph and freeways with speeds greater than 70mph.

Equation 9

$$BaseCap = 1{,}700 + 10FFS; for\ FFS \leq 70\ mph$$

$$BaseCap = 2{,}400 + 10FFS; for\ FFS > 70\ mph$$

3.4. Ramp Capacity Calculations

The following steps were used to calculate ramp capacities:

3.4.1. Step 1: Calculate Free Flow Speed

Using Equation 10, the free flow speed for ramps were calculated as follows

Equation 10: Ramp Free Flow Speed Equation

$S_{fo} = 25.6 + 0.47 * S_{pl}$

Where S_{fo} = base free-flow speed (BFFS); and

S_{pl}= posted speed limit

3.4.2. Step 2: Calculate Maximum Saturation Flow Capacity

The Chattanooga-Hamilton model was used to develop Equation 11 to calculate ramp capacities as follows:

Equation 11: Maximum Saturation Flow Capacity

$SF = C * N * (v/c)_I * PHF$

Where SF is maximum service flow rate;

C is ideal capacity based on S_{fo};

N represents lumber of lanes;

(v/c) is rate of service flow for levels of service D or E. v/c=0.88 at LOS D, 1 at LOS E; and

PHF represents peak hour factor.

Table 28 and Table 29 in Appendix 1 shows sample Capacity calculations that are used in the model for signalized intersections.

4. MODEL INPUT DATA

The main data used as input to the model are the network and socioeconomic data. The two datasets were developed through a collaborative effort between MPO staff and ATAC. These data are discussed next.

4.1. Transportation Network Data

The transportation network is an abstract representation of the transportation system that has essential data describing the available transportation supply. The network is maintained in GIS as a geodatabase that contains four feature classes. These feature classes included: links which represent the roadway, nodes which represent intersections, centroids which are the trip origin/destination points for transportation analysis zones (TAZ) and external centroids which are external loading trip points. The network was updated by ATAC and the MPO to represent 2015 base year conditions.

The main attributes of the network that are used in the model include the network geometries (number of lanes and turn lanes), posted and Free Flow Speeds, functional classification, length of links, link ADTs (passenger and truck counts), link location area type and the intersection controls.

4.1.1. Distribution of Modeled Network by Functional Classifications

Table 14 shows the percentage of centerline miles by functional class.

Table 14 Centerline Miles Distribution by Functional Classification

Roadway Type	Interstate	Major Arterials	Ramps	Minor Arterials	Collectors	Locals	Rural Paved	Rural Unpaved
% of Total Roadway	8%	11%	2%	18%	16%	8%	10%	25%
Miles	23	32	7	51	47	24	29	72

Figure 8 shows the distribution of centerline miles for the links within each functional classification used in the model. As expected, ramps made up the lowest percentage of centerline miles comprising only 2%, while Rural Unpaved roadways made up the highest percentage comprising 25% of the network. Rural Unpaved roadways typically occurred in the outskirts of the model network and carried very little volumes in the assigned network. Minor arterials and collectors made up 18 and 16% of the roadway network. Major arterials made up 11% and interstate roadways made up 8% of the modeled network.

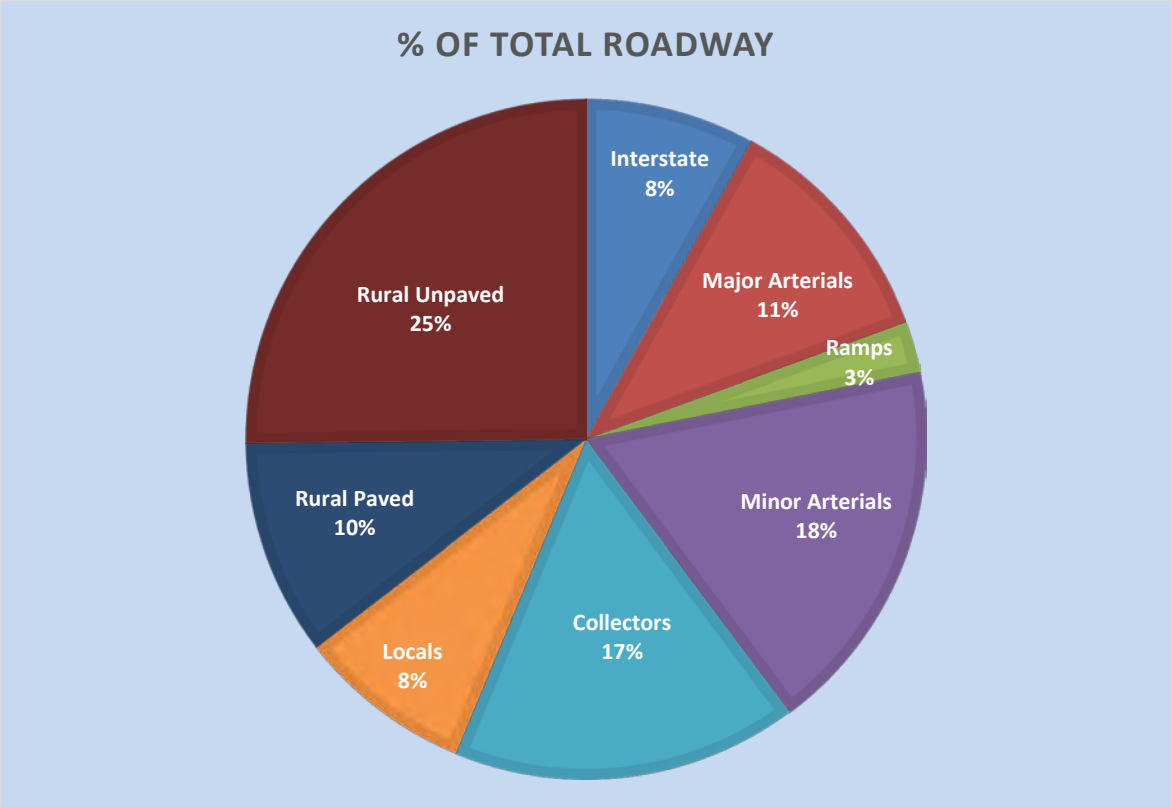


Figure 8 Centermile Distribution of Links in Network by Functional Class

Table 15 shows the percentage of lanemiles by functional class.

Table 15 LaneMiles Distribution by Functional Classification

Roadway Type	Interstate	Major Arterials	Ramps	Minor Arterials	Collectors	Locals	Rural Paved	Rural Unpaved
% Distribution	7%	19%	1%	17%	15%	8%	9%	23%
Lane Miles	46	118	7	107	94	47	58	143

Figure 9 show the lanemiles distribution by functional class. Lanemiles take into account the total number of through lanes and do not account for the turn lanes. Major arterials make up 19% of lanemiles in contrast to the 11% proportion for centermiles. The proportional distributions for the rest of the functional classes for lanemiles are within 2% points when compared to the centerline miles.

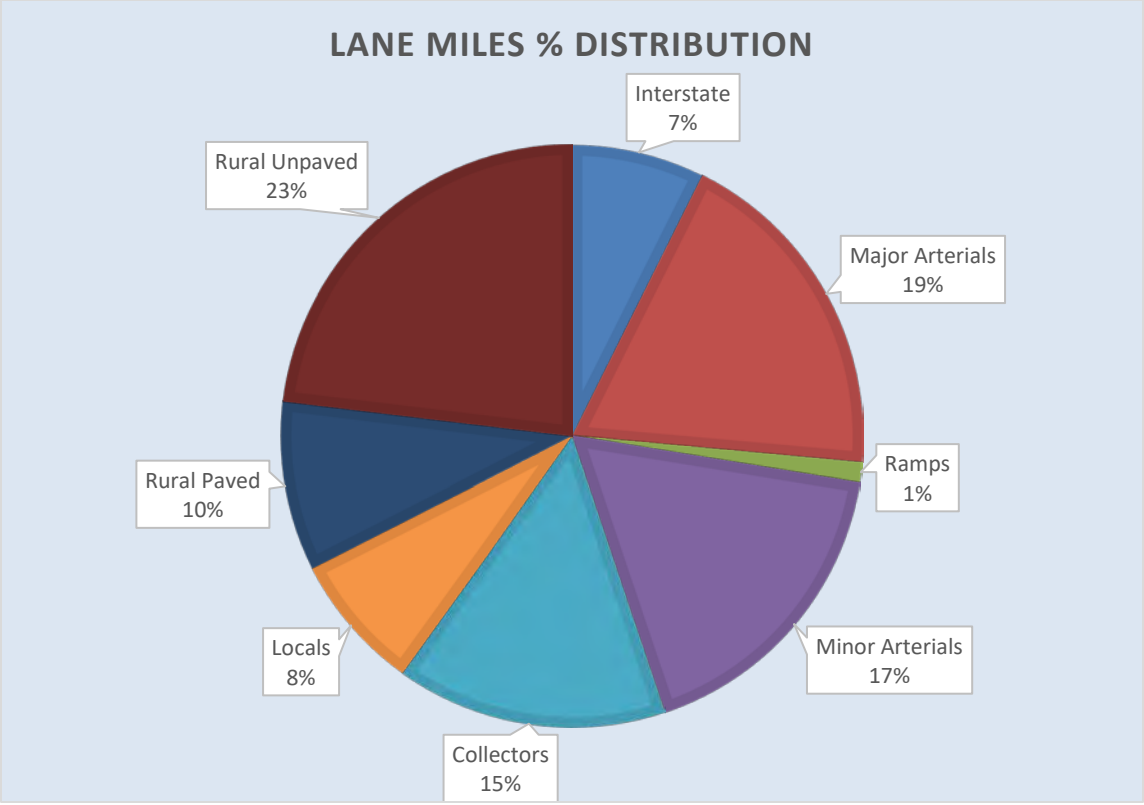


Figure 9 Lanemile Distribution of Links in Network by Functional Class

Figure 10 shows the modeled network distribution by functional class. The network does not show the centroid connectors.

Intersection controls were added to the model to incorporate delay experienced by road users. CUBE software uses a built in algorithm to calculate the delays that each intersection type contributes to the model. Two way stop controls; four way stop controls; Signals; Roundabouts and Yield controls were added as inputs to the model and are shown in Figure 11.

The intersection control signal timing data was provided by the GF-EGF MPO and represented actual signal timing data for signals for three time periods: AM Peak, PM Peak and Off peak periods. Using intersection data significantly enhanced the models replication of actual travel times. Without the intersection data, the model could only reasonable replicate 60% of ADT. Additionally, intersection delays would have to be added to the network travel times to represent delays, which may not be represent real world conditions.

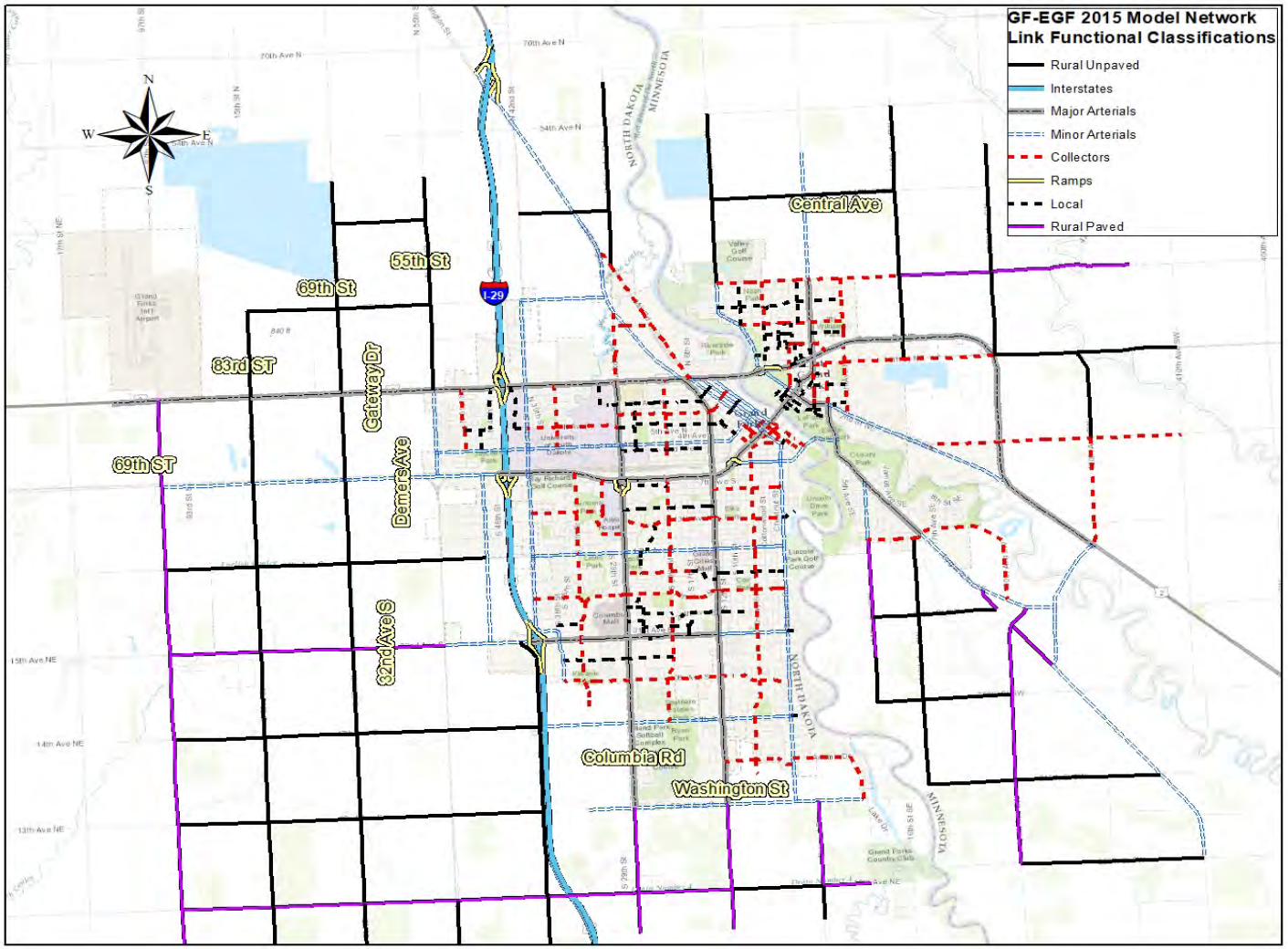


Figure 10 GF-EGF 2015 Model Network

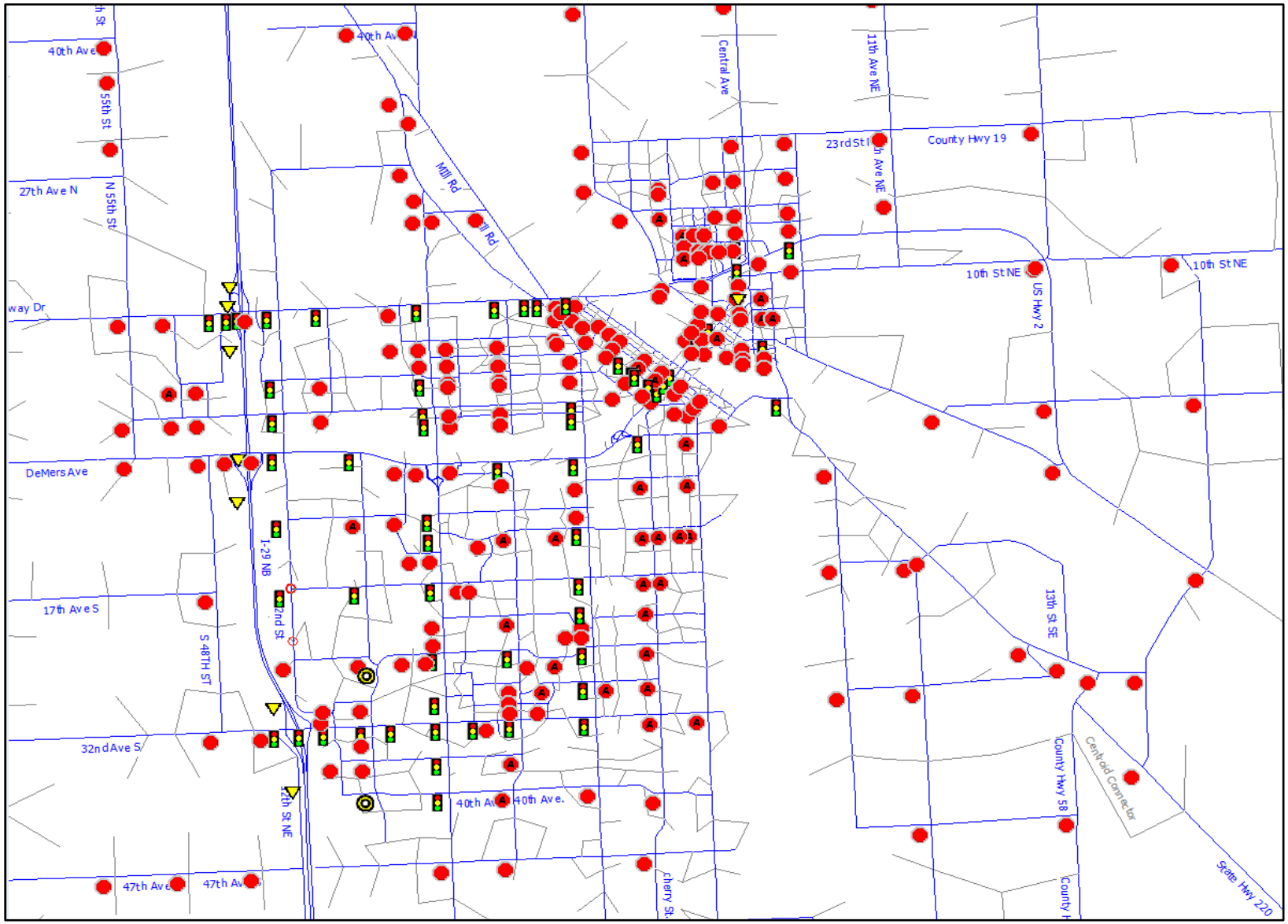


Figure 11 Intersection Data for Core Urban Area

4.2. Socioeconomic Data

Socioeconomic data are used to generate the total number of trips produced and attracted by each TAZ in the TDM. The TAZ geographies and the socioeconomic data included within each TAZ were developed by a collaborative effort between MPO staff and the ATAC. The socioeconomic data that was used in the model is described next.

4.2.1. TAZ Geography files:

584 internal total TAZs were used for the 2015 model. Several TAZs were modified (split or merged) based on input from both the MPO and ATAC.

4.2.2. Socioeconomic Data TAZ Attributes

The socioeconomic data within the TAZ contained the following fields

4.2.2.1. Number of Persons per household in each TAZ according to the following categories (attributes)

1. # of one person households
2. # of two person households
3. # of three person households
4. # of four person households
5. # of five person households
6. > # five person households
7. Total number of households

4.2.2.2. Vehicles per household in each TAZ[1]

1. # of zero vehicle households
2. # of one vehicle households
3. # of two vehicle households
4. # of three vehicle households
5. # of four vehicle households
6. > 4 vehicle households

4.2.2.3. School age children per household in each TAZ in four categories[2]

1. # of Grade school age children
2. # of Middle age school children
3. # of High school age children
4. # of College age (18-24)

[1] Data was not in the 2010 model
[2] Data was not in the 2010 model

4.2.2.4. Employment data (# for each TAZ)[3]

1. Manufacturing (NAICS 31-33)
2. Construction and resources (NAICS 21, 23)
3. Retail (NAICS 44-45)
4. Service (NAICS 52,53,55,56,56,51,62,71,81,99)
5. Agriculture (NAICS 11)
6. Wholesale Trade, Trans Utilities (NAICS:22,48-49,42)
7. Education (NAICS 61) with the following additional fields
    a. Elementary school enrollment for each TAZ
    b. Middle school enrollment for each TAZ
    c. High school enrollment for each TAZ
    d. College enrollment data
    e. Number of on campus students for each college
    f. Number of off campus students for each college
    g. Number of parking spots reserved for college students
    h. Number of parking spots reserved for staff

4.2.2.5. Enplanements

8. Yearly enplanements for the Grand Forks Airport for 2015 (145,272)

4.2.2.6. Special generators

9. Special generator TAZS (wholesale distributors (Walmart and Super Target, large retail stores, and the Columbia Mall).

4.2.2.7. ADT at external locations

Used as estimates of trips that have at least one trip end outside of the MPO area.

[3] Data has been disaggregated (Previously, it included retail, other and service jobs)

5. TRIP GENERATION

Trip generation is the first modeling step of TDM. The number of trips produced and attracted to each TAZ are developed in this step. Regression models were applied to the socioeconomic data to generate the number of trips produced and attracted to each TAZ. Trips Produced are typically a function of the household characteristics for each TAZ and represent the origins of trips. Trips attracted are a function of the employment magnitude and type for each TAZ and represent where trips generated are being attracted to. The inclusion of long-haul freight movements was an addition to the current model in contrast to previous version of the GF-EGF TDM. The next subsections describe in detail, the different trip generation methods that were used and the output from the trip generation step.

5.1. Internal-Internal Passenger Vehicle Trip Productions and Attractions

The Internal-Internal Passenger Vehicle Trip Generations (II Trips) represent the passenger vehicle trips that originate and terminate within the MPO area. These trips are classified into five main trip purposes including (Home Based Work) HBW, Home-Based Shop (HB-Shop), Home Based Other (HBO), Home Based School K-12 (HBSchool K-12), Home Based University (HBU) and Non Home Based (NHB) trips.

5.1.1. Trip Productions

Table 16 shows the trip generation equations that were used to develop the II trip production tables. The numbers in bold show the actual regression parameters used while the number underneath each one shows the p-value for each of the regression equations. The model parameters were developed from a household travel survey that was done in the Fargo-Moorhead area. These parameters are the starting equations that were used, the final equations were adjusted during the calibration process to reflect different area types and to match the observed traffic counts in the trip assignment step.

Table 16 Internal-Internal Passenger Trip Generation Equations

Persons per Household					
Purpose	**1**	**2**	**3**	**4+**	**Overall**
HBW	**1**	**1.72**	**2.56**	**2.42**	**1.75**
	14.9	*19.82*	*13.61*	*17.15*	*30.45*
HBO	**1.09**	**2.4**	**2.51**	**4.8**	**2.46**
	11.9	*21.04*	*9.64*	*9.74*	*20.81*
NHB	**1.57**	**2.4**	**2.89**	**3.57**	**2.43**
	11.44	*17.78*	*7.39*	*10.1*	*22.49*
HB-HiSch	**0**	**0**	**0.47**	**0.46**	**0.16**
	.	.	*4.65*	*4.66*	*6.64*
HB-GrSch	**0**	**0.13**	**0.8**	**2.4**	**0.62**
	0.88	*5.09*	*6*	*12.52*	*11.94*
HB-Sch	**0**	**0.13**	**1.27**	**2.86**	**0.77**
	0.88	*5.09*	*8.38*	*14.21*	*13.29*
IE	**0.05**	**0.3**	**0.18**	**0.31**	**0.21**
	2.25	*6.71*	*2.8*	*3.52*	*7.71*
Total	**3.72**	**7**	**9.52**	**14.04**	**7.66**
	27.77	*35.97*	*18.52*	*19.59*	*35.69*

Table 17 shows the total number of households for each household type (PHH1 = 1 person Households) that were used for the 2015 GF-EGF TDM. A total of 27,326 households were modeled for the 2015 base year TDM. One person households represented 34% of total households while only 2% of the households had 6 or more persons.

Table 17 Total Households per Household Type for the 2015 GF-EGF TDM

Household Category	PHH1	PHH2	PHH3	PHH4	PHH5	PHH6	Total
Total # of Households	9,357	8,956	4,332	2,939	1,133	609	27,326
Percent of total	34%	33%	16%	11%	4%	2%	100%

Applying the equations from Table 16 to the household data from each TAZ, the trip productions estimated in 2015 TDM are shown in Table 18. HB-Shopping and HBO were added together and are shown in the HBO column. NHB trips represented the highest number of trips followed by HBO and HBW trips. The Elementary school's trips were more than twice the Middle school trips.

Table 18 Total Trips Produced by Purpose for the 2010 TDM

Purpose	HBW	NHB	HBO	Elem	Mid	High
Total	41,573	117,472	47,010	8,630	3,793	5,308

5.1.2. Trip Attractions

Trip attractions represent the number of trips attracted to each zone based on employment or the size of the school for school trips. Table 19 shows the trip attraction rates (from NCHRP 718) that applied to the socioeconomic data to develop trip attraction tables. Although the socioeconomic data showed several different job types, these were aggregated to represent the categories shown in Table 19. The trip attractions by purpose were balanced and are identical to the trip productions shown in Table 18.

Table 19 Trip Attraction Rates

Purpose	Retail	Service	Other
HBW	1.2	1.2	1.2
HBO	8.1	1.5	.2
NHB	4.7	1.4	.5

Table 20 shows the school trip attraction rates that were used for the model. These trip rates were obtained from the ITE Trip Generation Manual. School trip attractions were balanced to the productions and were identical to the trip productions shown in Table 18.

Table 20 School Trip Attraction Rates

School	Rate
Elementary	1.88
Middle	1.88
High	1.88

5.1.3. UND Trip Generations

Since Universities do not fall under normal trip patterns used by the model, a special trip generation trip model was developed for UND students. Trip productions and attractions for UND students were divided into two main components, trip productions for students who live on campus and trip productions for students who live off campus.

For on campus trip generation, trip production rates were obtained from a study that was conducted at the University of Lincoln Nebraska (5). A trip rate of 0.22 was applied to the number of on campus students residing in each UND TAZ (dorms, student apartments, fraternities). The number of on campus students residing in each UND TAZ was obtained from several different sources including data from the GF-EGF MPO, and UND demographic data. UND campuses occupied nine of the 584 TAZs.

TAZs that are within two blocks of campus will be assumed to be 100% walk, shuttle or bike i.e. non-vehicle trips, between 2 and four blocks, 80%, etc. It was assumed that there were eight blocks per mile.

Several TAZs that were within the non-vehicle trip distances (< 12 blocks from UND campus), however had physical barriers to these modes. For these TAZs, all trips were considered to be 100% vehicle trips. These TAZs that were within non-vehicle trip mode choices include all TAZs West of I-29, TAZS South of Demers, TAZs North of 10th Ave N and TAZs East of 20th St N.

For students residing off campus, a trip generation rate of 3.8 was applied to the percentage of 18-24 year olds for each TAZ who were assumed to be UND students. The number of UND students for each TAZ was calculated as a proportion of the total UND off campus students to the total of 18-24 year olds for each TAZ. UND student trip production rates were added to HBO for on campus students and HBO for off campus trips.

5.2. Freight Trip Productions and Attractions

The decisions that involve the movement of freight differ from those involving passenger trips. For this reason a separate freight trip model was developed. A commodity-based model will using the Commodity Flow Survey Data from the U.S. Census Bureau was used . This data is publicly available for the 2015 base year and forecasts are also available for the next 30 years. Commodity Flow Survey Data exists only for the largest metropolitan areas and for the rest of the states. The implication is that for the GF-EGF MPO, the commodity flow survey data had to be disaggregated from statewide totals to local data. Data on the employment for the two states-ND and MN was used to disaggregate freight data to each MPO and for the rest of the state.

Ordinary Least Square Models were used to develop model parameters that were applied to the number of jobs for each freight generation industry for productions and attractions. The model used data for the metropolitan areas that had disaggregate commodity flow survey data to develop the parameter estimates. This parameter estimates were then applied to the commodity flow survey data for both North Dakota and Minnesota to obtain the total tonnage of freight produced and attracted to the MPO. The total tonnage was assigned to the TAZ level based on the number of jobs for each commodity group in the TAZ. Table 21 shows the results of the freight model by industry type.

Table 21 Freight Trip Productions and Attractions

Productions			
NAICS Category	**Grand Forks**	**East Grand Forks**	**Total**
Manufacturing and Agriculture	108	122	229
Manufacturing	459	530	990
Industrial	1,084	138	1,222
Total	**1,651**	**790**	**2,441**
Attractions			
NAICS Category	Grand Forks	East Grand Forks	Total
Wholesale	2,367	753	3,121
Industrial	1,902	200	2,103
Manufacturing,	102	66	168
Retail	520	46	566
Retail, Wholesale	590	52	642
Total	**5,482**	**1,118**	**6,600**

6. TRIP DISTRIBUTION

The trip distribution step takes the trip productions and attractions developed in the trip generation step and assigns them between Origin-Destination pairs. The gravity model assigns trips based on the number of productions, attractions, a friction factor (F), and a scaling factor (K). The friction factor is a value that is inversely proportional to distance, time, or cost which is a measure of the travel impedance between any two zonal pairs. The k factor is a scaling factor that is used during calibration and it limits or increases the volume of traffic that crosses sections of the network. Equation 12 shows the gravity model formulation that was used.

Equation 12 Gravity Model Used for Trip Distribution

$$T_{ij} = P_i \frac{K_{ij} A_j F_{ij}}{\sum K_j A_j F_j}$$

Where,

T_{ij}= Number of trips assigned between Zones i and j; P_i = Number of Productions in Zone i;

A_j= Number of Attractions in Zone j;

F_{ij}= Friction Factor; and

K_{ij}= Scaling factor used in calibration to influence specific ij pairs

The typical output of the trip distribution step in TDMs is a matrix showing the origins and destination of each trip. The gravity model uses the trip generation outputs (production and attractions by trip purpose for each zone), a measure of travel impedance between each zonal pair (travel time), and socioeconomic/area characteristic variables ("K-factor") variables as input. The K-factor is used to account for the effects of variables other than travel impedance in the model. The OD data were used to develop K-factor matrices imputed in the trip gravity model that were used for distributing IE/EI trips.

For the TDM, trips were distributed separately for the different periods.To develop K-factors, it was necessary to aggregate the external portions of these trips into four main external super zones. For example, all the trips that originated from zones to the North of the MPO area were aggregated to one "super TAZ". The proportions of trips from every internal GF/EGF OD TAZ to the "super TAZ" was calculated and used as the K-Factor for the trip distribution of trips. The K-factors used in this way enabled the model to distribute trips more efficiently.

For EE trips, the OD data were used to develop K factors in a similar manner to those described for EI/IE trips. This were then used in the EE trip distribution step for the TDM.

For K-12 school trip distribution, school zones were used to assign trips for Grand Forks Public Schools. For East Grand Forks Schools and for Private schools, the gravity model was used to distribute K-12 school trips. The K-factor matrix used ensured that no Public school trips between the cities

7. TRIP ASSIGNMENT

Trip assignment is computationally the last step in travel demand modeling. The trip assignment step develops routes and paths that each trip will be choosing on the network when going from its origin to its destination. Trip assignments were carried out for three origin destination matrixes; AM peak, PM peak and off peak periods.

A hybrid model that combined the user equilibrium traffic assignment method to estimate the link travel cost and the intersection control data for intersection delays was used to estimate the travel cost between any two points on the network. A volume delay function was used to calculate the overall cost of travel for each link. The volume delay function uses the BPR formulation that adds cost to a link as additional trips get assigned to that link. It is meant to mimic the fact that as more and more vehicles use a particular link, congestion will occur and will slow down traffic.

The formulation used to calculate the travel cost for the equilibrium assignment method is shown in equation Equation 13. It takes into account the link travel time, the value of travel time and the link distance.

Equation 13 Trip Assignment Cost Equation

$$TC = (VTT * L_t) + 0.76 * L_d$$

Where:

TC = Link Travel Cost

VTT= Value of Travel Time ($12.85 for the metro area)

L_t = Link Travel Time, and

L_d = Link Length.

Junction-based assignment uses an intersection constrained assignment method and uses the intersection controls to assign node delays to the network. Junction-based modeling attempts to simulate congestion on a roadway network by modeling what happens at the intersections using the intersection control data like signal timing data.

8. CALIBRATION AND VALIDATION

Model calibration refers to the adjustment of model input parameters in order to replicate observed real world data for a base year to otherwise produce reasonable results. It involves adjusting model input parameters such as trip generation rates, node delays, free flow speeds, K factors and friction factors. Figure 12 shows the calibration and validation flow chart that was used for the model. It was an iterative process that involved adjusting the model parameters until a certain level of confidence of the model's replication of real world data was achieved.

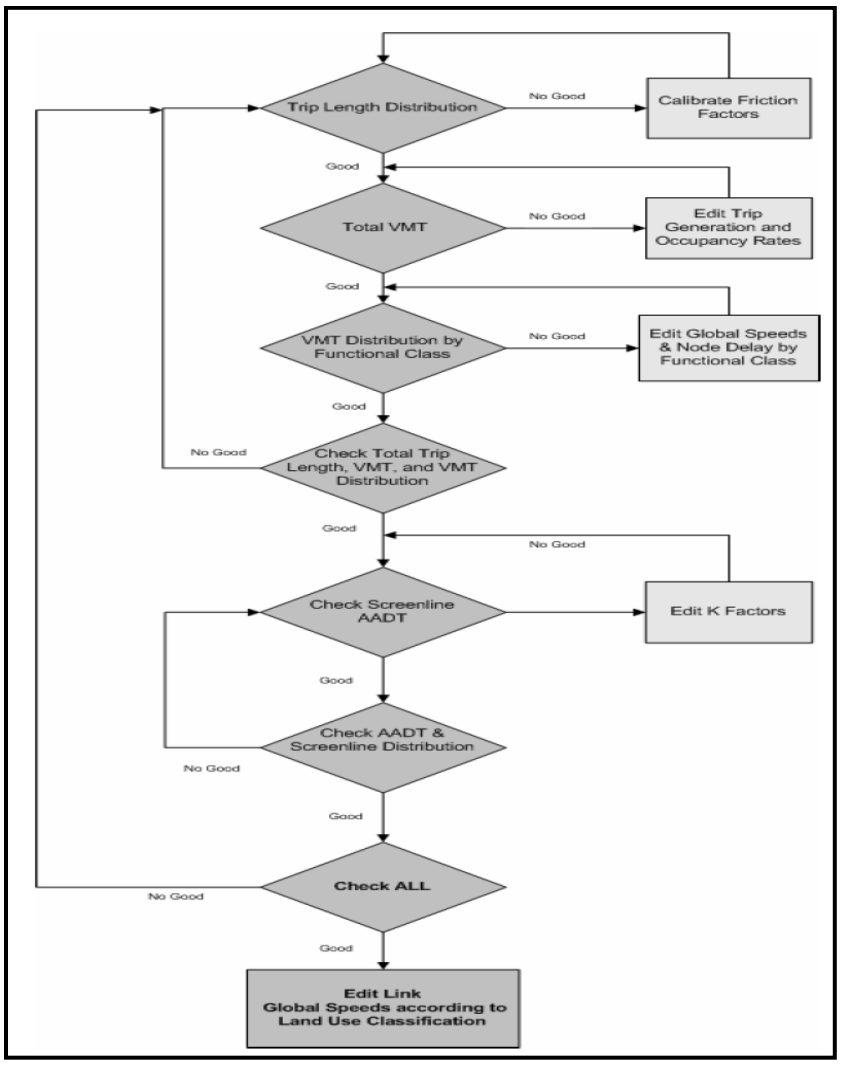


Figure 12 Calibration Flow Chart

Model validation compares base year calibrated models output to observed data. Ideally, model calibration data should not be used for validation purposes but this is not always feasible. Model validation is the ultimate step of the travel demand models and gives and indication of how well the model performs in replicating real world data.

The two processes, calibration and validation typically go hand in hand in an iterative process as was done for this model update. The next subsections describe the different methods, models and parameters that were used for model calibration and validation.

8.1. Trip Length Frequency Calibration and Validation

Trip length frequency distributions describe the travelers sensitivity to travel time by trip purpose. Steeper curves mean more sensitive travel times. Friction factors are calibrated until a desired trip length frequency is validated against observed data. The friction factors are the main dependent variable in the gravity model. The gamma function was used to develop the friction factor for this model and are shown in Figure 13.

Equation 14 Friction Factor Equation

$$F_{ij}^{p} = a * t_{ij}^{b} * exp(c * t_{ij}^{b})$$

Where,

F_{ij}^{p} = Friction factor for purpose p (HBW,HBO, NHB)

t_{ij}^{b} = travel impedance between zone i and j,

a, b and c are gamma function scaling factors.

The friction factors were calibrated by adjusting the a, b and c parameters until the desirable trip length frequency distribution for Home Based Work Travel times were reached. Observed trip length frequency data for the home-based work trips were obtained from the census journey to work database for the metropolitan area. Only trips lower than 35 minutes were considered with the assumption that 35 minutes was the highest possible travel time between any two points within the metro area.

The average trip length for the observed data was calculated as 11.85 compared to the average trip length of 11.76 produced by the model for HBW trips. The desired average trip lengths for HBO and NHB trips were 88% and 82% of the average trip length for HBO and NHB trips. The average trip length for the models HBO and NHB trips were 10.4 and 9.77 minutes respectively.

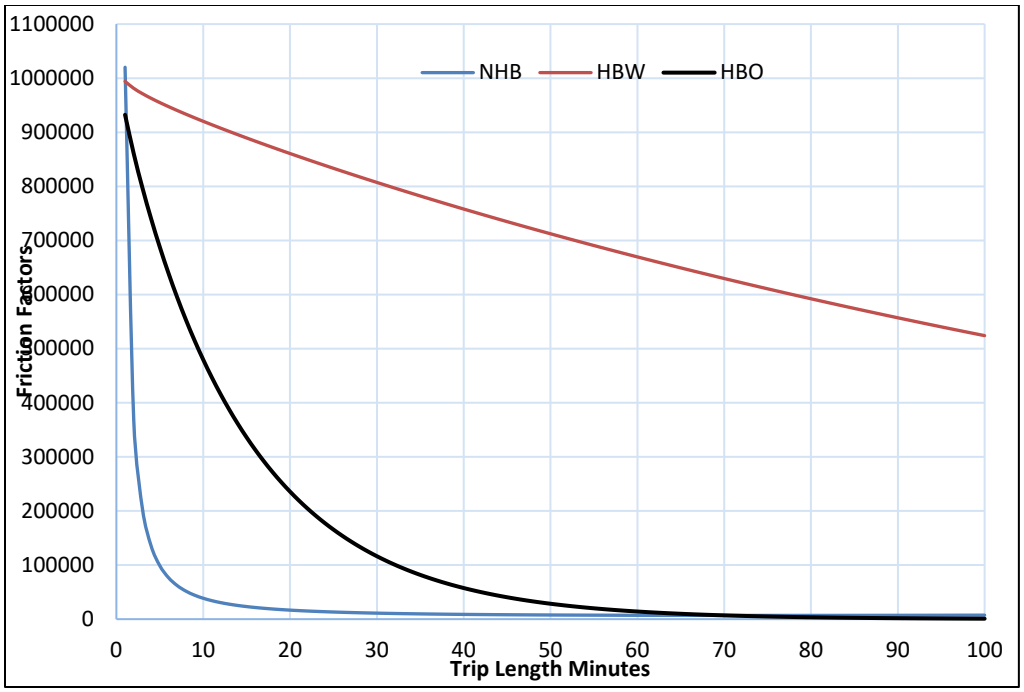


Figure 13 Friction Factors

Figure 14 shows the comparison between observed trip length frequencies and the modeled trip length frequencies for HBW trips. The comparison was done for only HBW trips since that's the only observed data available. The two graphs are very similar to each other.

Coincidence ratios were also calculated to verify the fit between the observed and modeled trip lengths. The coincidence ratio is the area under both curves divided by the area under at least one of the curves when both curves are plotted together. It measures how the percent of area between that coincides between two curves. Mathematically, the sum of the lower value of the two distributions for each time increment is divided by the sum of the higher value of the two distributions at each increment. Coincidence ratios lie between 0 and 1.0 with a ratio of 1.0 indicating identical distributions. The coincidence ratio calculated between the modeled and observed data was 0.89 showing a strong coincidence between modeled and observed trip lengths.

Given Figure 14 and the coincidence ratio calculations, the trip length frequency and average trip lengths were reasonably calibrated and validated. , it is reasonable to assume that trip length frequencies had been reasonably validated with observed data. Figure 15 shows the modeled trip length frequencies for all purposes.

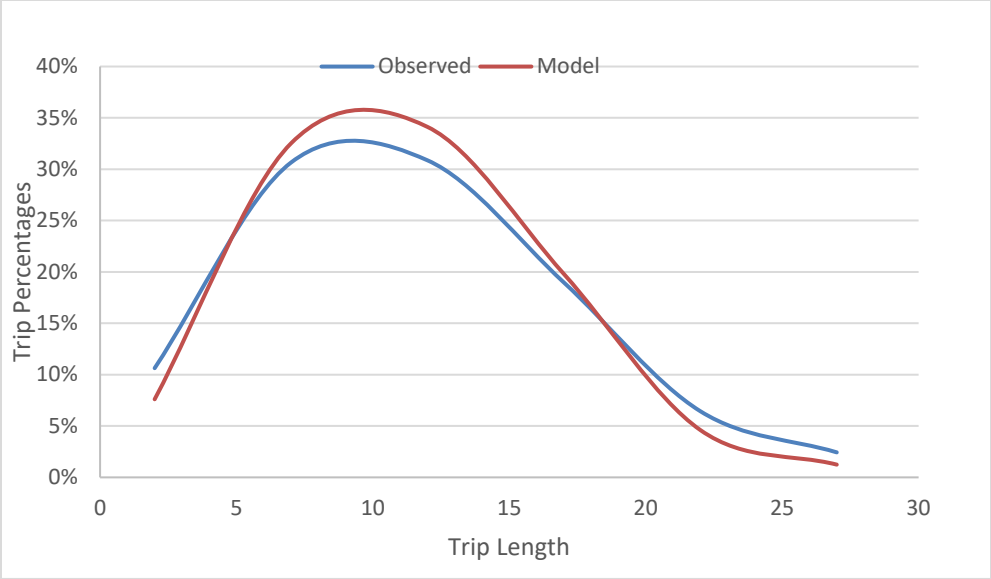


Figure 14 Comparison of Observed to Model Trip Length Frequency

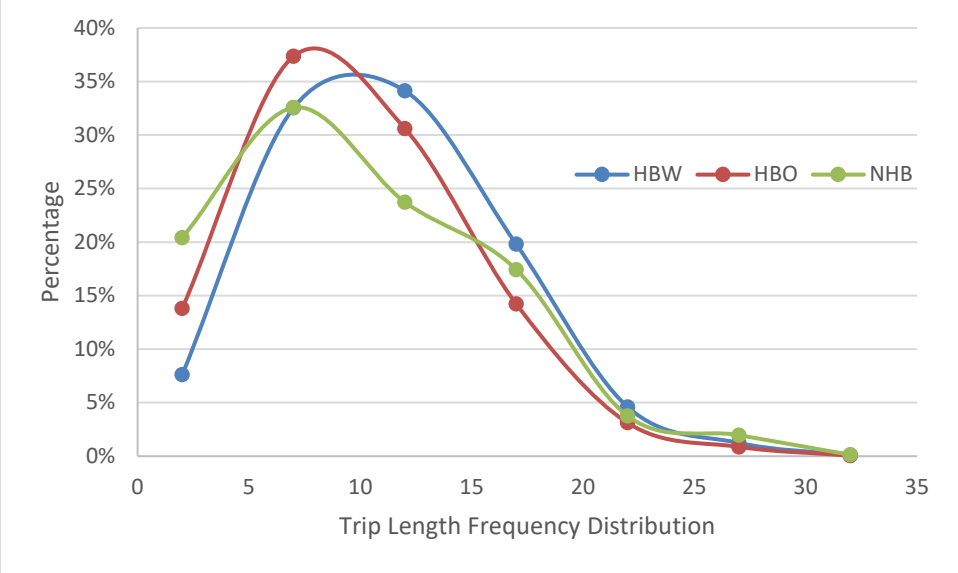


Figure 15 Modeled Trip Length Frequencies for All Trip Purposes

8.2. Vehicle Miles Traveled (VMT) Calibration and Validation

The modeled vehicle miles traveled are a function of trips generated by the model and the length of those trips in miles. VMTs summaries provide an indication of the overall reasonableness of the travel demand in the study area. To calibrate the VMT values, ATAC first calibrated the total VMT for the entire model area. If the modeled VMT values were different from the values calculated by multiplying the counted ADTs by length (observed VMTs), ATAC adjusted the trip generation and vehicle occupancy rates until the model and

reported VMT values were similar. Adjusting the trip generation and occupancy rates changes the total number of trips that are generated within the transportation model. This in turn increases or decreases the total number of vehicle miles traveled.

Once the total VMT was reasonable, ATAC checked the VMT distribution according to the functional class. VMT summaries by functional classification provide an indication of how well the models assignment procedures perform. They will indicate if the model handles free flow speeds, capacities or whether the trip assignment function has any issues. To calibrate the VMT by facility type, if functional class VMT distribution was off target, global speeds by facility type were adjusted.

Table 22 shows the VMT comparison between modeled and observed VMTs and their various distributions as a percentage of total VMT. The model performs very well in replicating the VMTs for Interstates and Major arterials with VMT differences of less than 2% and had similar distributions to the observed VMTs. The VMTs for Local and rural roads of 5% and -6% respectively which is an acceptable deviation. Collectors had a -12% VMT difference. Collectors had the most discrepancy between the modeled and observed VMTs. Overall, the model performs within reasonable and acceptable deviations in replicating VMTS by functional class.

Table 22 Modeled VMTs compared to Observed VMTs

	Observed VMT	Modeled VMT	Difference	% Difference	Observed Distribution	Modeled Distribution
Interstate	101,054	103,024	1,970	2%	21%	21%
Major Arterial	207,238	212,044	4,806	2%	43%	44%
Minor Arterial	95,705	95,741	36	0%	20%	20%
Collectors	61,287	54,706	(6,581)	-12%	13%	11%
Local	5,079	5,320	241	5%	1%	1%
Rural	11,340	10,726	(614)	-6%	2%	2%
Total	481,703	481,561	(142)	0%	100%	100%

8.3. Screenline Comparisons

Screenlines are barriers to travel between two areas in a travel demand model including natural barriers such as rivers, mountains, etc. and man-made barriers such are interstates and major arterials, railroads etc. Five screenlines were used for the model: BNSF Mainline railroad, the Red River, 32nd Ave S., Columbia Rd and I-29. Table 23 lists the Screenlines that were used in the GF EGF model.

The 32nd avenue south Screenline had the highest Screenline difference (-6.16%) between observed and Modeled screenlines. However, it still falls within a reasonable difference between modeled and observed volumes of ±10%. Based on Travel Model Validation and Reasonableness Checking Manual the values fall within stated reasonable deviation limits.

Table 23 Observed Screenlines Compared to Modeled Screenlines

	Observed	Modeled	Difference	% Difference
Red River	41,100	41,708	608	1.48%
BNSF Mainline Rail Road	79,195	80,172	977	1.23%
I-29	52,585	51,307	-1,278	-2.43%
32nd Ave S	63,423	59,513	-3,910	-6.16%

8.4. Modeled ADT Comparison to Observed ADT

Comparing the modeled ADTs to the Observed ADTs is the ultimate test of how well the model can replicate ground truths. The MP provided traffic counts for several links that were compared to the Model ADTs. Two comparisons are made, one for the different functionally classifications and one by volume ranges. Table 24 shows the comparison of the modeled and observed ADTs by functional classification. Overall, the model performs reasonably replicating over 87 of observed counts. Collector roads have the lowest replication of observed counts at 85%.

Table 24 Comparison of Modeled and Observed ADTS by Functional Classification

Functional Class	Above Criteria	Meets Criteria	Below Criteria	Within Criteria
Freeway	0	10	0	100%
Major Arterials	9	85	5	86%
Minor Arterials	5	126	14	87%
Rural Paved	0	20	0	100%
Collector	5	118	16	85%
Local Roads	2	23	1	88%
Total	21	382	36	87%

Table 25 shows the comparison of modeled and Observed ADTs by volume range. The FHWA criterion sets limits to the deviations between observed and modeled ADTs. Overall the model meets all deviation criterion for all the volume ranges.

Table 25 Comparison of Modeled and Observed ADT by Volume Range

Volume Range	Above Criteria	Meets Criteria	Below Criteria	Within Criteria	Criteria Deviation
AADT>25,000	0	9	0	100%	±15%
25,000 to 10,000	4	58	6	85%	±20%
10,000 to 5,000	6	62	22	69%	±25%
5,000 to 2,500	3	101	8	90%	±50%
2,500 to 1,000	3	93	0	97%	±100%
AADT<1000	5	59	0	92%	±100%
Total	**21**	**382**	**36**	87%	

8.5. Root Mean Square Error and Percent Root Mean Squared Error

The comparison between the modeled and observed ADTS give a good indication of a how well the model replicates real life. However, they do not provide statistical measures of goodness of fit test for the models replication of ground truths. Root Mean Squared Error (RMSE) and Percent Root Mean Squared Errors %RMSE were used to calculate the accuracy of the model. RMSE compares the error between the modeled and observed traffic volumes for the entire network, giving a statistical measure of the accuracy of the model. RMSE and % RMSE were found by squaring the error (difference between modeled and counted ADTs) for each link and then taking the square root of the averages as shown in Equation 15.

Equation 15 RMSE and % RMSE Calculations

$$RMSE = \sqrt{\frac{\sum_{i=1}^{N}[(Count_i - Model_i)^2]}{N}}$$,and

$$\%RMSE = \left[\frac{RMSE}{\sum_{i=1}^{N} Count_i/N}\right] * 100$$

Where:

$Count_i$ = Observed traffic count on link *i;*

Modeli = Modeled traffic volume for link *I;* and

N = The number of links in the group of links including link *i, (number of links with counts)*

Table 26 shows the %RMSE by volume range. The %RMSE is below the typical deviation limits for all the volume ranges shown indicating a good fit between the modeled and observed traffic volumess model is performing reasonably in replicating observed traffic.

Table 26 RMSE Comparison by Volume Range

Volume Range	RMSE (%)	Typical Limits (%)
AADT>25,000	6.72%	15-20 %
25,000 to 10,000	13.68%	25-30 %
10,000 to 5,000	24.71%	35-45 %
5,000 to 2,500	32.27%	45-100 %
2,500 to 1,000	51.42%	45-100 %

AADT<1000	98.71%	>100 %

8.6. Scatter Plots, R Squares of Model and Observed Traffic

Scatter plots of the modeled traffic volumes against the observed traffic volumes are a good indicator of the model's fit. Figure 16 shows the scatter plot of modeled traffic volumes versus observed counts. The scatter plot suggests that the amount of error in the modeled volumes is proportional to the observed traffic count which is an indication of a good fit between the model and the observed traffic counts.

The R-square (coefficient of determination) is the proportion of the variance in a dependent variable that is attributable to the variance of the independent variable. It measures the strength of the relationships between the assigned volumes and the traffic counts. It measures the amount of variation in traffic counts explained by the model. The modeled R-square of 0.93 shows a strong linear relationship between modeled and observed traffic counts.

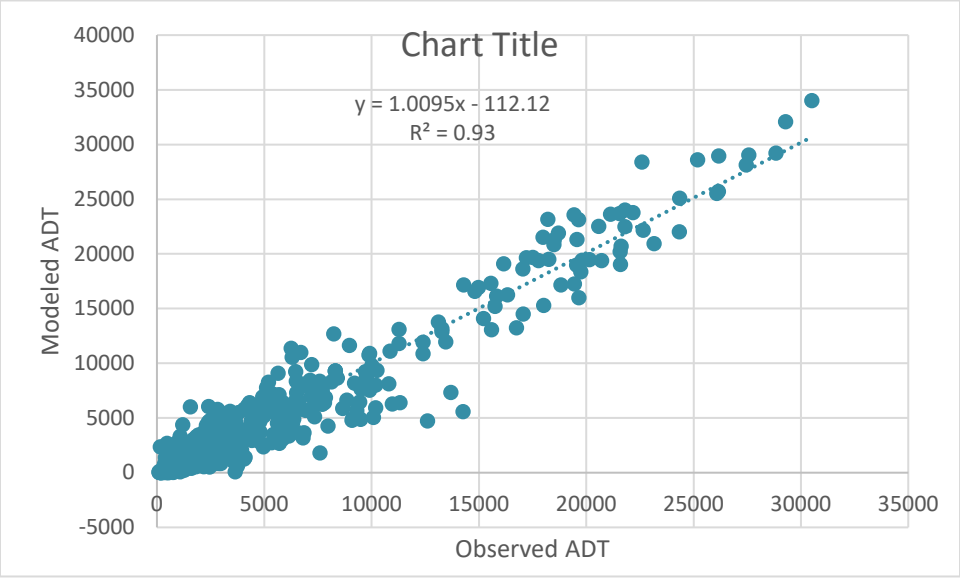


Figure 16 Scatter Plot of Modeled and Observed ADTS

8.7. Link Travel Time Validation

To evaluate how well the assignment algorithms and the intersection control data performed in the model assignment, sample travel times from the model were compared to average travel times that were obtained using online mapping tools. An online API was developed to collect the data for AM, PM and Off-peak travel times for the average weekdays. Table 27 shows the comparison of the modeled travel times and the average

travel times collected. The modeled travel times are within plus or minus one minute for the different peak periods for the group of selected roadways. This is an indication that the model's assignment algorithms are performing very well in terms of replicating real time travel time data.

Table 27 Travel Time Validation

Link Type/Location	Distance (Miles)	Observed Travel Time (Min)			Modeled Travel Time (Min)		
Principal Arterials		AM	PM	OFF	AM	PM	OFF
Gateway Drive - 16th St to N 55th St	2.8	3	3	3	3.52	3.69	3.39
Gateway Drive - N Columbia Rd to 5th Ave NE	2.9	6	7.5	6	6.53	7.37	5.48
Demers Ave - I-29 to Washington St	2.3	6	7	6	5.79	6.84	4.77
Washington St - Gateway Drive to 24th Ave S	2.6	9	10	8	8.11	9.35	6.43
32nd Ave S - I-29 Ramp W to Washington St	2.1	7	7.5	7	6.78	7.99	6.16
Minor Arterials							
32nd Ave S - Washington St to Belmont RD	0.7	3	3	3	1.89	2.22	1.85
N 42nd St - 27th Ave N to University Ave	1.7	5	5	5	3.76	3.92	3.57
17th Ave S - Columbia RD to Belmont Rd	1.7	6	7	6	5.29	5.97	4.65
Belmond Rd - 13th Ave S to 62nd Ave S	3.3	7	8	7	7.09	8.07	6.5
Collectors							
40th Ave S - to Washington St	1.3	4	4	4	3.77	3.86	3.71
40th Ave S - Washington to Belmont Rd	0.8	3	3	3	1.99	2.28	1.96
13th Ave S - S Columbia to Washington	1	4	5	4	2.98	3.65	2.61
20th St S - 20th Ave S to 36th Ave S	1	4	4	4	4.25	4.67	3.44

9. CONCLUSIONS

This document describes the development, calibration and validation of the GF-EGF MPO base 2015 TDM. Several improvements were made to previous modeling efforts including the addition of Freight movements and better representation of capacities. Overall the model replicates observed travel demand within typically accepted deviation limits.

10. APPENDIX

Table 28 Calculated Capacities for Signalized Intersections for Different Functional Classifications

Lane Grp	Number of Through Lanes (N)	Number of Left Turn Lanes	Number of Right Turn Lanes	Total Number of Through Lanes	Type of Arterial	Area Type	Area Type Adjustment Factor (f_a)	Base Saturation Flow Rate (S_o)	Heavy Vehicle Adjustment Factor (f_{HV})	Saturation Flow Rate for Through Lanes (S)	Total Saturation Flow Rate	Effective Green Ratio (g_i/C)	Intersection Approach Hourly Capacity (C_A)	Intersection Daily Approach Capacity
N0	1	0	0	1	**Principal**	**Urban**	**0.9**	**1900**	**0.90**	**1416**	**1416**	**0.55**	**779**	**7,787**
	1	0	0			**Rural**	**1**	**1900**	**0.90**	**1505**	**1505**	**0.55**	**828**	**8,276**
	1	0	0		Minor	Urban	0.9	1900	0.90	1416	1416	0.45	637	**6,371**
	1	0	0			Rural	1	1900	0.90	1505	1505	0.45	677	**6,772**
	1	0	0		**Collector**	**Urban**	**0.9**	**1900**	0.99	1308	1308	**0.4**	523	**5,233**
	1	0	0			**Rural**	**1**	**1900**	0.99	1390	1390	**0.4**	556	**5,562**
	2	0	0	2	Principal	Urban	0.9	1900	0.90	2832	2832	0.55	1557	**15,575**
	2	0	0			Rural	1	1900	0.90	3010	3010	0.55	1655	**16,553**
	2	0	0		Minor	Urban	0.9	1900	0.90	2832	2832	0.45	1274	**12,743**
	2	0	0			Rural	1	1900	0.90	3010	3010	0.45	1354	**13,543**
	2	0	0		**Collector**	**Urban**	**0.9**	**1900**	0.99	2866	2866	**0.4**	1146	**11,463**
	2	0	0			**Rural**	**1**	**1900**	0.99	3046	3046	**0.4**	1218	**12,183**
	3	0	0	3	Principal	Urban	0.9	1900	0.90	4248	4248	0.55	2336	**23,362**
	3	0	0			Rural	1	1900	0.90	4514	4514	0.55	2483	**24,829**
	3	0	0		Minor	Urban	0.9	1900	0.90	4248	4248	0.45	1911	**19,114**
	3	0	0			Rural	1	1900	0.90	4514	4514	0.45	2031	**20,315**
	3	0	0		**Collector**	**Urban**	**0.9**	**1900**	0.99	4439	4439	**0.4**	1776	**17,755**
	3	0	0			**Rural**	**1**	**1900**	0.99	4718	4718	**0.4**	1887	**18,870**

Lane Grp	Number of Through Lanes (N)	Number of Left Turn Lanes	Number of Right Turn Lanes	Total Number of Through Lanes	Type of Arterial	Area Type	Area Type Adjustment Factor (f_a)	Base Saturation Flow Rate (S_o)	Heavy Vehicle Adjustment Factor (f_{HV})	Saturation Flow Rate for Through Lanes (S)	Total Saturation Flow Rate	Effective Green Ratio (g_i/C)	Intersection Approach Hourly Capacity (C_A)	Intersection Daily Approach Capacity
N1	1	1	0	2	Principal	Urban	0.9	1900	0.90	1416	1841	0.55	1012	**10,124**
	1	1	0			Rural	1	1900	0.90	1505	1956	0.55	1076	**10,759**
	1	1	0		Minor	Urban	0.9	1900	0.90	1416	1841	0.45	828	**8,283**
	1	1	0			Rural	1	1900	0.90	1505	1956	0.45	880	**8,803**
	1	1	0		**Collector**	**Urban**	**0.9**	**1900**	0.99	1433	1863	**0.4**	745	**7,451**
	1	1	0			**Rural**	**1**	**1900**	0.99	1523	1980	**0.4**	792	**7,919**
	2	1	0	3	Principal	Urban	0.9	1900	0.90	2832	3257	0.55	1791	**17,911**
	2	1	0			Rural	1	1900	0.90	3010	3461	0.55	1904	**19,036**
	2	1	0		Minor	Urban	0.9	1900	0.90	2832	3257	0.45	1465	**14,654**
	2	1	0			Rural	1	1900	0.90	3010	3461	0.45	1557	**15,575**
	2	1	0		**Collector**	**Urban**	**0.9**	**1900**	0.99	2959	3403	**0.4**	1361	**13,612**
	2	1	0			**Rural**	**1**	**1900**	0.99	3145	3617	**0.4**	1447	**14,467**
	3	1	0	4	Principal	Urban	0.9	1900	0.90	4248	4672	0.55	2570	**25,698**
	3	1	0			Rural	1	1900	0.90	4514	4966	0.55	2731	**27,312**
	3	1	0		Minor	Urban	0.9	1900	0.90	4248	4672	0.45	2103	**21,026**
	3	1	0			Rural	1	1900	0.90	4514	4966	0.45	2235	**22,346**
	3	1	0		**Collector**	**Urban**	**0.9**	**1900**	0.99	4486	4934	**0.4**	1974	**19,736**
	3	1	0			**Rural**	**1**	**1900**	0.99	4767	5244	**0.4**	2098	**20,976**
N2	1	2	0	3	Principal	Urban	0.9	1900	0.90	1416	2265	0.55	1246	**12,460**
	1	2	0			Rural	1	1900	0.90	1505	2408	0.55	1324	**13,242**
	1	2	0		Minor	Urban	0.9	1900	0.90	1416	2265	0.45	1019	**10,194**

Lane Grp	Number of Through Lanes (N)	Number of Left Turn Lanes	Number of Right Turn Lanes	Total Number of Through Lanes	Type of Arterial	Area Type	Area Type Adjustment Factor (f_a)	Base Saturation Flow Rate (S_o)	Heavy Vehicle Adjustment Factor (f_{HV})	Saturation Flow Rate for Through Lanes (S)	Total Saturation Flow Rate	Effective Green Ratio (g_i/C)	Intersection Approach Hourly Capacity (C_A)	Intersection Daily Approach Capacity
	1	2	0			Rural	1	1900	0.90	1505	2408	0.45	1083	**10,835**
	1	2	0		**Collector**	**Urban**	**0.9**	**1900**	0.99	1480	2367	**0.4**	947	**9,469**
	1	2	0			**Rural**	**1**	**1900**	0.99	1573	2516	**0.4**	1006	**10,064**
	2	2	0	4	Principal	Urban	0.9	1900	0.90	2832	3681	0.55	2025	**20,247**
	2	2	0			Rural	1	1900	0.90	3010	3912	0.55	2152	**21,519**
	2	2	0		Minor	Urban	0.9	1900	0.90	2832	3681	0.45	1657	**16,566**
	2	2	0			Rural	1	1900	0.90	3010	3912	0.45	1761	**17,606**
	2	2	0		**Collector**	**Urban**	**0.9**	**1900**	0.99	2990	3887	**0.4**	1555	**15,550**
	2	2	0			**Rural**	**1**	**1900**	0.99	3178	4132	**0.4**	1653	**16,526**
	3	2	0	5	Principal	Urban	0.9	1900	0.90	4248	5097	0.55	2803	**28,034**
	3	2	0			Rural	1	1900	0.90	4514	5417	0.55	2980	**29,795**
	3	2	0		Minor	Urban	0.9	1900	0.90	4248	5097	0.45	2294	**22,937**
	3	2	0			Rural	1	1900	0.90	4514	5417	0.45	2438	**24,378**
	3	2	0		**Collector**	**Urban**	**0.9**	**1900**	0.99	4532	5439	**0.4**	2175	**21,755**
	3	2	0			**Rural**	**1**	**1900**	0.99	4817	5780	**0.4**	2312	**23,121**
N3	1	1	0	2	Principal	Urban	0.9	1900	0.90	1416	1841	0.55	1012	**10,124**
	1	1	0			Rural	1	1900	0.90	1505	1956	0.55	1076	**10,759**
	1	1	0		Minor	Urban	0.9	1900	0.90	1416	1841	0.45	828	**8,283**
	1	1	0			Rural	1	1900	0.90	1505	1956	0.45	880	**8,803**
	1	1	0		**Collector**	**Urban**	**0.9**	**1900**	0.99	1433	1863	**0.4**	745	**7,451**
	1	1	0			**Rural**	**1**	**1900**	0.99	1523	1980	**0.4**	792	**7,919**

Lane Grp	Number of Through Lanes (N)	Number of Left Turn Lanes	Number of Right Turn Lanes	Total Number of Through Lanes	Type of Arterial	Area Type	Area Type Adjustment Factor (f_a)	Base Saturation Flow Rate (S_o)	Heavy Vehicle Adjustment Factor (f_{HV})	Saturation Flow Rate for Through Lanes (S)	Total Saturation Flow Rate	Effective Green Ratio (g_i/C)	Intersection Approach Hourly Capacity (C_A)	Intersection Daily Approach Capacity
	2	1	0	3	Principal	Urban	0.9	1900	0.90	2832	3257	0.55	1791	**17,911**
	2	1	0			Rural	1	1900	0.90	3010	3461	0.55	1904	**19,036**
	2	1	0		Minor	Urban	0.9	1900	0.90	2832	3257	0.45	1465	**14,654**
	2	1	0			Rural	1	1900	0.90	3010	3461	0.45	1557	**15,575**
	2	1	0		**Collector**	**Urban**	**0.9**	**1900**	0.99	2959	3403	**0.4**	1361	**13,612**
	2	1	0			**Rural**	**1**	**1900**	0.99	3145	3617	**0.4**	1447	**14,467**
	3	1	0	4	Principal	Urban	0.9	1900	0.90	4248	4672	0.55	2570	**25,698**
	3	1	0			Rural	1	1900	0.90	4514	4966	0.55	2731	**27,312**
	3	1	0		Minor	Urban	0.9	1900	0.90	4248	4672	0.45	2103	**21,026**
	3	1	0			Rural	1	1900	0.90	4514	4966	0.45	2235	**22,346**
	3	1	0		**Collector**	**Urban**	**0.9**	**1900**	0.99	4486	4934	**0.4**	1974	**19,736**
	3	1	0			**Rural**	**1**	**1900**	0.99	4767	5244	**0.4**	2098	**20,976**
N4	1	0	1	2	Principal	Urban	0.9	1900	0.90	1416	1557	0.55	857	**8,566**
	1	0	1			Rural	1	1900	0.90	1505	1655	0.55	910	**9,104**
	1	0	1		Minor	Urban	0.9	1900	0.90	1416	1557	0.45	701	**7,009**
	1	0	1			Rural	1	1900	0.90	1505	1655	0.45	745	**7,449**
	1	0	1		**Collector**	**Urban**	**0.9**	**1900**	0.99	1433	1576	**0.4**	630	**6,305**
	1	0	1			**Rural**	**1**	**1900**	0.99	1523	1675	**0.4**	670	**6,701**
	2	0	1	3	Principal	Urban	0.9	1900	0.90	2832	2973	0.55	1635	**16,353**
	2	0	1			Rural	1	1900	0.90	3010	3160	0.55	1738	**17,380**
	2	0	1		Minor	Urban	0.9	1900	0.90	2832	2973	0.45	1338	**13,380**

Lane Grp	Number of Through Lanes (N)	Number of Left Turn Lanes	Number of Right Turn Lanes	Total Number of Through Lanes	Type of Arterial	Area Type	Area Type Adjustment Factor (f_a)	Base Saturation Flow Rate (S_o)	Heavy Vehicle Adjustment Factor (f_{HV})	Saturation Flow Rate for Through Lanes (S)	Total Saturation Flow Rate	Effective Green Ratio (g_i/C)	Intersection Approach Hourly Capacity (C_A)	Intersection Daily Approach Capacity
	2	0	1			Rural	1	1900	0.90	3010	3160	0.45	1422	**14,220**
	2	0	1		**Collector**	**Urban**	**0.9**	**1900**	0.99	2959	3107	**0.4**	1243	**12,429**
	2	0	1			**Rural**	**1**	**1900**	0.99	3145	3302	**0.4**	1321	**13,209**
	3	0	1	4	Principal	Urban	0.9	1900	0.90	4248	4389	0.55	2414	**24,141**
	3	0	1			Rural	1	1900	0.90	4514	4665	0.55	2566	**25,657**
	3	0	1		Minor	Urban	0.9	1900	0.90	4248	4389	0.45	1975	**19,752**
	3	0	1			Rural	1	1900	0.90	4514	4665	0.45	2099	**20,992**
	3	0	1		**Collector**	**Urban**	**0.9**	**1900**	0.99	4486	4635	**0.4**	1854	**18,540**
	3	0	1			**Rural**	**1**	**1900**	0.99	4767	4926	**0.4**	1970	**19,704**
N5	1	0	2	3	Principal	Urban	0.9	1900	0.90	1416	1699	0.55	934	**9,345**
	1	0	2			Rural	1	1900	0.90	1505	1806	0.55	993	**9,932**
	1	0	2		Minor	Urban	0.9	1900	0.90	1416	1699	0.45	765	**7,646**
	1	0	2			Rural	1	1900	0.90	1505	1806	0.45	813	**8,126**
	1	0	2		**Collector**	**Urban**	**0.9**	**1900**	0.99	1480	1776	**0.4**	710	**7,102**
	1	0	2			**Rural**	**1**	**1900**	0.99	1573	1887	**0.4**	755	**7,548**
	2	0	2	4	Principal	Urban	0.9	1900	0.90	2832	3115	0.55	1713	**17,132**
	2	0	2			Rural	1	1900	0.90	3010	3311	0.55	1821	**18,208**
	2	0	2		Minor	Urban	0.9	1900	0.90	2832	3115	0.45	1402	**14,017**
	2	0	2			Rural	1	1900	0.90	3010	3311	0.45	1490	**14,898**
	2	0	2		**Collector**	**Urban**	**0.9**	**1900**	0.99	2990	3289	**0.4**	1316	**13,157**
	2	0	2			**Rural**	**1**	**1900**	0.99	3178	3496	**0.4**	1398	**13,984**

Lane Grp	Number of Through Lanes (N)	Number of Left Turn Lanes	Number of Right Turn Lanes	Total Number of Through Lanes	Type of Arterial	Area Type	Area Type Adjustment Factor (f_a)	Base Saturation Flow Rate (S_o)	Heavy Vehicle Adjustment Factor (f_{HV})	Saturation Flow Rate for Through Lanes (S)	Total Saturation Flow Rate	Effective Green Ratio (g_i/C)	Intersection Approach Hourly Capacity (C_A)	Intersection Daily Approach Capacity
	3	0	2	5	Principal	Urban	0.9	1900	0.90	4248	4531	0.55	2492	**24,919**
	3	0	2			Rural	1	1900	0.90	4514	4815	0.55	2648	**26,484**
	3	0	2		Minor	Urban	0.9	1900	0.90	4248	4531	0.45	2039	**20,389**
	3	0	2			Rural	1	1900	0.90	4514	4815	0.45	2167	**21,669**
	3	0	2		**Collector**	**Urban**	**0.9**	**1900**	0.99	4532	4834	**0.4**	1934	**19,338**
	3	0	2			**Rural**	**1**	**1900**	0.99	4817	5138	**0.4**	2055	**20,552**
N6	1	0	1	2	Principal	Urban	0.9	1900	0.90	1416	1557	0.55	857	**8,566**
	1	0	1			Rural	1	1900	0.90	1505	1655	0.55	910	**9,104**
	1	0	1		Minor	Urban	0.9	1900	0.90	1416	1557	0.45	701	**7,009**
	1	0	1			Rural	1	1900	0.90	1505	1655	0.45	745	**7,449**
	1	0	1		**Collector**	**Urban**	**0.9**	**1900**	0.99	1433	1576	**0.4**	630	**6,305**
	1	0	1			**Rural**	**1**	**1900**	0.99	1523	1675	**0.4**	670	**6,701**
	2	0	1	3	Principal	Urban	0.9	1900	0.90	2832	2973	0.55	1635	**16,353**
	2	0	1			Rural	1	1900	0.90	3010	3160	0.55	1738	**17,380**
	2	0	1		Minor	Urban	0.9	1900	0.90	2832	2973	0.45	1338	**13,380**
	2	0	1			Rural	1	1900	0.90	3010	3160	0.45	1422	**14,220**
	2	0	1		**Collector**	**Urban**	**0.9**	**1900**	0.99	2959	3107	**0.4**	1243	**12,429**
	2	0	1			**Rural**	**1**	**1900**	0.99	3145	3302	**0.4**	1321	**13,209**
	3	0	1	4	Principal	Urban	0.9	1900	0.90	4248	4389	0.55	2414	**24,141**
	3	0	1			Rural	1	1900	0.90	4514	4665	0.55	2566	**25,657**
	3	0	1		Minor	Urban	0.9	1900	0.90	4248	4389	0.45	1975	**19,752**

Lane Grp	Number of Through Lanes (N)	Number of Left Turn Lanes	Number of Right Turn Lanes	Total Number of Through Lanes	Type of Arterial	Area Type	Area Type Adjustment Factor (f_a)	Base Saturation Flow Rate (S_o)	Heavy Vehicle Adjustment Factor (f_{HV})	Saturation Flow Rate for Through Lanes (S)	Total Saturation Flow Rate	Effective Green Ratio (g_i/C)	Intersection Approach Hourly Capacity (C_A)	Intersection Daily Approach Capacity
	3	0	1			Rural	1	1900	0.90	4514	4665	0.45	2099	**20,992**
	3	0	1		**Collector**	**Urban**	**0.9**	**1900**	0.99	4486	4635	**0.4**	1854	**18,540**
	3	0	1			**Rural**	**1**	**1900**	0.99	4767	4926	**0.4**	1970	**19,704**
N7	1	1	1	3	Principal	Urban	0.9	1900	0.90	1416	1982	0.55	1090	**10,902**
	1	1	1			Rural	1	1900	0.90	1505	2107	0.55	1159	**11,587**
	1	1	1		Minor	Urban	0.9	1900	0.90	1416	1982	0.45	892	**8,920**
	1	1	1			Rural	1	1900	0.90	1505	2107	0.45	948	**9,480**
	1	1	1		**Collector**	**Urban**	**0.9**	**1900**	0.99	1480	2071	**0.4**	829	**8,286**
	1	1	1			**Rural**	**1**	**1900**	0.99	1573	2202	**0.4**	881	**8,806**
	2	1	1	4	Principal	Urban	0.9	1900	0.90	2832	3398	0.55	1869	**18,690**
	2	1	1			Rural	1	1900	0.90	3010	3612	0.55	1986	**19,863**
	2	1	1		Minor	Urban	0.9	1900	0.90	2832	3398	0.45	1529	**15,292**
	2	1	1			Rural	1	1900	0.90	3010	3612	0.45	1625	**16,252**
	2	1	1		**Collector**	**Urban**	**0.9**	**1900**	0.99	2990	3588	**0.4**	1435	**14,354**
	2	1	1			**Rural**	**1**	**1900**	0.99	3178	3814	**0.4**	1526	**15,255**
	3	1	1	5	Principal	Urban	0.9	1900	0.90	4248	4814	0.55	2648	**26,477**
	3	1	1			Rural	1	1900	0.90	4514	5116	0.55	2814	**28,140**
	3	1	1		Minor	Urban	0.9	1900	0.90	4248	4814	0.45	2166	**21,663**
	3	1	1			Rural	1	1900	0.90	4514	5116	0.45	2302	**23,023**
	3	1	1		**Collector**	**Urban**	**0.9**	**1900**	0.99	4532	5137	**0.4**	2055	**20,546**
	3	1	1			**Rural**	**1**	**1900**	0.99	4817	5459	**0.4**	2184	**21,836**

Lane Grp	Number of Through Lanes (N)	Number of Left Turn Lanes	Number of Right Turn Lanes	Total Number of Through Lanes	Type of Arterial	Area Type	Area Type Adjustment Factor (f_a)	Base Saturation Flow Rate (S_o)	Heavy Vehicle Adjustment Factor (f_{HV})	Saturation Flow Rate for Through Lanes (S)	Total Saturation Flow Rate	Effective Green Ratio (g_i/C)	Intersection Approach Hourly Capacity (C_A)	Intersection Daily Approach Capacity
N8	1	2	1	4	Principal	Urban	0.9	1900	0.90	1416	2407	0.55	1324	**13,238**
	1	2	1			Rural	1	1900	0.90	1505	2558	0.55	1407	**14,070**
	1	2	1		Minor	Urban	0.9	1900	0.90	1416	2407	0.45	1083	**10,831**
	1	2	1			Rural	1	1900	0.90	1505	2558	0.45	1151	**11,512**
	1	2	1		**Collector**	**Urban**	**0.9**	**1900**	0.99	1495	2542	**0.4**	1017	**10,167**
	1	2	1			**Rural**	**1**	**1900**	0.99	1589	2701	**0.4**	1081	**10,806**
	2	2	1	5	Principal	Urban	0.9	1900	0.90	2832	3823	0.55	2103	**21,026**
	2	2	1			Rural	1	1900	0.90	3010	4063	0.55	2235	**22,346**
	2	2	1		Minor	Urban	0.9	1900	0.90	2832	3823	0.45	1720	**17,203**
	2	2	1			Rural	1	1900	0.90	3010	4063	0.45	1828	**18,283**
	2	2	1		**Collector**	**Urban**	**0.9**	**1900**	0.99	3021	4079	**0.4**	1632	**16,316**
	2	2	1			**Rural**	**1**	**1900**	0.99	3211	4335	**0.4**	1734	**17,341**
	3	2	1	6	Principal	Urban	0.9	1900	0.90	4248	5239	0.55	2881	**28,813**
	3	2	1			Rural	1	1900	0.90	4514	5568	0.55	3062	**30,623**
	3	2	1		Minor	Urban	0.9	1900	0.90	4248	5239	0.45	2357	**23,574**
	3	2	1			Rural	1	1900	0.90	4514	5568	0.45	2505	**25,055**
	3	2	1		**Collector**	**Urban**	**0.9**	**1900**	0.99	4532	5590	**0.4**	2236	**22,359**
	3	2	1			**Rural**	**1**	**1900**	0.99	4817	5941	**0.4**	2376	**23,763**
N9	1	1	2	4	Principal	Urban	0.9	1900	0.90	1416	2124	0.55	1168	**11,681**
	1	1	2			Rural	1	1900	0.90	1505	2257	0.55	1241	**12,415**
	1	1	2		Minor	Urban	0.9	1900	0.90	1416	2124	0.45	956	**9,557**

Lane Grp	Number of Through Lanes (N)	Number of Left Turn Lanes	Number of Right Turn Lanes	Total Number of Through Lanes	Type of Arterial	Area Type	Area Type Adjustment Factor (f_a)	Base Saturation Flow Rate (S_o)	Heavy Vehicle Adjustment Factor (f_{HV})	Saturation Flow Rate for Through Lanes (S)	Total Saturation Flow Rate	Effective Green Ratio (g_i/C)	Intersection Approach Hourly Capacity (C_A)	Intersection Daily Approach Capacity
	1	1	2			Rural	1	1900	0.90	1505	2257	0.45	1016	**10,157**
	1	1	2		**Collector**	**Urban**	**0.9**	**1900**	0.99	1495	2243	**0.4**	897	**8,971**
	1	1	2			**Rural**	**1**	**1900**	0.99	1589	2384	**0.4**	953	**9,534**
	2	1	2	5	Principal	Urban	0.9	1900	0.90	2832	3540	0.55	1947	**19,468**
	2	1	2			Rural	1	1900	0.90	3010	3762	0.55	2069	**20,691**
	2	1	2		Minor	Urban	0.9	1900	0.90	2832	3540	0.45	1593	**15,929**
	2	1	2			Rural	1	1900	0.90	3010	3762	0.45	1693	**16,929**
	2	1	2		**Collector**	**Urban**	**0.9**	**1900**	0.99	3021	3777	**0.4**	1511	**15,107**
	2	1	2			**Rural**	**1**	**1900**	0.99	3211	4014	**0.4**	1606	**16,056**
	3	1	2	6	Principal	Urban	0.9	1900	0.90	4248	4956	0.55	2726	**27,256**
	3	1	2			Rural	1	1900	0.90	4514	5267	0.55	2897	**28,967**
	3	1	2		Minor	Urban	0.9	1900	0.90	4248	4956	0.45	2230	**22,300**
	3	1	2			Rural	1	1900	0.90	4514	5267	0.45	2370	**23,701**
	3	1	2		**Collector**	**Urban**	**0.9**	**1900**	0.99	4532	5288	**0.4**	2115	**21,150**
	3	1	2			**Rural**	**1**	**1900**	0.99	4817	5620	**0.4**	2248	**22,479**

Table 29 Calculated Capacities for Ramps

	Speed	Ideal Capacity (Ex 13-10)	Speed Adjustment	V/C	PHF	Capacity	Daily Capacity
Urban	>50	2,100	1.00	0.9	0.800	1,512	15,120
	>40-50	2,100	0.95	0.9	0.800	1,443	14,433
	>30-40	2,100	0.91	0.9	0.800	1,375	13,745
	>=20-30	2,100	0.86	0.9	0.800	1,306	13,058
	<20	2,100	0.82	0.9	0.800	1,237	12,371
Rural	>50	2,200	1.00	0.9	0.868	1,719	17,186
	>40-50	2,200	0.95	0.9	0.868	1,641	16,405
	>30-40	2,200	0.91	0.9	0.868	1,562	15,622
	>=20-30	2,200	0.86	0.9	0.868	1,484	14,843
	<20	2,200	0.82	0.9	0.868	1,406	14,062

Appendix E

Revenue Forecast

FY	Capital																				
	NORTH DAKOTA											MINNESOTA								Total
	ND HSIP[1]	ND Interstate Program[1,2]	ND Urban Regional[1]	ND Urban Local[1]	ND Main Street Initiative[3]	ND State Match[5,6]	ND Other (GF County Federal)[7]	ND County[2,7]	GF New Sales Tax[3,5]	GF City Existing Available Capital Revenues[3,4]	MN HSIP[1]	MN Statewide Perf Program (SPP)[1]	MN District Risk Management Program[1]	MN City Sub-Target (STBGP)[1]	MN Match[3,8]	MN Municipal State Aid[1]	MN Polk County State Aid[2]	
2013																				
2014																				
2015																				
2016	$ 510,000										$ 25,000									
2017	$ 520,200										$ 25,550									
2018	$ 530,604	$ 320,000	$ 2,800,000	$ 2,458,000	$ 600,000	$ 390,000	$ 80,000	$ 25,000	$ 2,350,000	$ 2,550,000	$ 25,550	$ -	$ -	$ 860,000	$ -	$ 314,469	$ 100,000	$ 13,403,623
2019	$ 541,216	$ 326,400	$ 2,856,000	$ 2,540,000	$ 612,000	$ 397,800	$ 81,600	$ 25,500	$ 2,397,000	$ 2,601,000	$ 25,550	$ -	$ -	$ -	$ -	$ 320,444	$ 101,900	$ 12,826,410
2020	$ 552,040	$ 332,928	$ 2,913,120	$ 2,628,000	$ 624,240	$ 405,756	$ 83,232	$ 26,010	$ 2,444,940	$ 2,653,020	$ 25,550	$ -	$ -	$ -	$ -	$ 326,532	$ 103,836	$ 13,119,205
2021	$ 563,081	$ 339,587	$ 2,971,382	$ 2,687,000	$ 636,725	$ 413,871	$ 84,897	$ 26,530	$ 2,493,839	$ 2,706,080	$ 25,550	$ 10,800,000	$ -	$ -	$ -	$ 332,736	$ 105,809	$ 24,187,088
2022	$ 574,343	$ 346,378	$ 3,030,810	$ 2,740,740	$ 649,459	$ 422,149	$ 86,595	$ 27,061	$ 2,543,716	$ 2,760,202	$ 25,550	$ -	$ -	$ 918,018	$ -	$ 339,058	$ 107,819	$ 14,571,898
2023	$ 585,830	$ 353,306	$ 3,091,426	$ 2,795,555	$ 662,448	$ 430,592	$ 88,326	$ 27,602	$ 2,594,590	$ 2,815,406	$ 26,112	$ -	$ 600,000	$ -	$ 180,000	$ 345,501	$ 109,868	$ 14,706,562
2024	$ 597,546	$ 360,372	$ 3,153,255	$ 2,851,466	$ 675,697	$ 439,203	$ 90,093	$ 28,154	$ 2,646,482	$ 2,871,714	$ 26,687	$ -	$ -	$ -	$ -	$ 352,065	$ 111,955	$ 14,204,690
2025	$ 609,497	$ 367,579	$ 3,216,320	$ 2,908,495	$ 689,211	$ 447,987	$ 91,895	$ 28,717	$ 2,699,411	$ 2,929,148	$ 27,274	$ -	$ -	$ -	$ -	$ 358,754	$ 114,083	$ 14,488,373
2026	$ 621,687	$ 374,931	$ 3,280,646	$ 2,966,665	$ 702,996	$ 456,947	$ 93,733	$ 29,291	$ 2,753,400	$ 2,987,731	$ 27,874	$ 5,600,000	$ -	$ 1,023,542	$ 1,000,000	$ 365,571	$ 116,250	$ 22,401,264
2027	$ 634,121	$ 382,430	$ 3,346,259	$ 3,025,998	$ 717,056	$ 466,086	$ 95,607	$ 29,877	$ 2,808,468	$ 3,047,486	$ 28,487	$ 4,100,000	$ -	$ -	$ 800,000	$ 372,516	$ 118,459	$ 19,972,850
2028	$ 646,803	$ 390,078	$ 3,413,184	$ 3,086,518	$ 731,397	$ 475,408	$ 97,520	$ 30,475	$ 2,864,637	$ 3,108,436	$ 29,114	$ -	$ -	$ -	$ -	$ 379,594	$ 120,710	$ 15,373,873
2029	$ 659,739	$ 397,880	$ 3,481,448	$ 3,148,249	$ 746,025	$ 484,916	$ 99,470	$ 31,084	$ 2,921,930	$ 3,170,604	$ 29,754	$ -	$ 2,000,000	$ -	$ 400,000	$ 386,807	$ 123,003	$ 18,080,909
2030	$ 672,934	$ 405,837	$ 3,551,077	$ 3,211,214	$ 760,945	$ 494,614	$ 101,459	$ 31,706	$ 2,980,368	$ 3,234,017	$ 30,409	$ -	$ -	$ 1,116,630	$ -	$ 394,156	$ 125,340	$ 17,110,706
2031	$ 686,393	$ 413,954	$ 3,622,099	$ 3,275,438	$ 776,164	$ 504,507	$ 103,489	$ 32,340	$ 3,039,976	$ 3,298,697	$ 31,078	$ -	$ -	$ -	$ -	$ 401,645	$ 127,722	$ 16,313,499
2032	$ 700,121	$ 422,233	$ 3,694,541	$ 3,340,947	$ 791,687	$ 514,597	$ 105,558	$ 32,987	$ 3,100,775	$ 3,364,671	$ 31,761	$ -	$ -	$ -	$ -	$ 409,276	$ 130,148	$ 16,639,302
2033	$ 714,123	$ 430,678	$ 3,768,431	$ 3,407,766	$ 807,521	$ 524,889	$ 107,669	$ 33,647	$ 3,162,791	$ 3,431,964	$ 32,460	$ -	$ 4,000,000	$ -	$ 800,000	$ 417,052	$ 132,621	$ 21,771,612
2034	$ 728,406	$ 439,291	$ 3,843,800	$ 3,475,921	$ 823,671	$ 535,386	$ 109,823	$ 34,320	$ 3,226,046	$ 3,500,604	$ 33,174	$ -	$ -	$ 1,218,184	$ -	$ 424,976	$ 135,141	$ 18,528,744
2035	$ 742,974	$ 448,077	$ 3,920,676	$ 3,545,439	$ 840,145	$ 546,094	$ 112,019	$ 35,006	$ 3,290,567	$ 3,570,616	$ 33,904	$ -	$ 3,000,000	$ -	$ 600,000	$ 433,051	$ 137,709	$ 21,256,277
2036	$ 757,833	$ 457,039	$ 3,999,089	$ 3,616,348	$ 856,948	$ 557,016	$ 114,260	$ 35,706	$ 3,356,379	$ 3,642,028	$ 34,650	$ -	$ -	$ -	$ -	$ 441,279	$ 140,325	$ 18,008,900
2037	$ 772,990	$ 466,180	$ 4,079,071	$ 3,688,675	$ 874,087	$ 568,156	$ 116,545	$ 36,420	$ 3,423,506	$ 3,714,868	$ 35,412	$ -	$ -	$ -	$ -	$ 449,663	$ 142,991	$ 18,368,566
2038	$ 788,450	$ 475,503	$ 4,160,653	$ 3,762,449	$ 891,568	$ 579,519	$ 118,876	$ 37,149	$ -	$ 3,789,166	$ 36,191	$ -	$ -	$ 1,328,974	$ -	$ 458,207	$ 145,708	$ 16,572,412
2039	$ 804,219	$ 485,013	$ 4,243,866	$ 3,837,698	$ 909,400	$ 591,110	$ 121,253	$ 37,892	$ -	$ 3,864,949	$ 36,988	$ -	$ -	$ -	$ -	$ 466,913	$ 148,477	$ 15,547,776
2040	$ 820,303	$ 494,713	$ 4,328,743	$ 3,914,452	$ 927,588	$ 602,932	$ 123,678	$ 38,649	$ -	$ 3,942,248	$ 37,801	$ -	$ -	$ -	$ -	$ 475,784	$ 151,298	$ 15,858,190
2041	$ 836,709	$ 504,608	$ 4,415,318	$ 3,992,741	$ 946,140	$ 614,991	$ 126,152	$ 39,422	$ -	$ 4,021,093	$ 38,633	$ 15,000,000	$ -	$ -	$ 3,000,000	$ 484,824	$ 154,172	$ 34,174,802
2042	$ 853,443	$ 514,700	$ 4,503,624	$ 4,072,595	$ 965,062	$ 627,291	$ 128,675	$ 40,211	$ -	$ 4,101,515	$ 39,483	$ -	$ -	$ 1,449,840	$ -	$ 494,036	$ 157,102	$ 17,947,576
2043	$ 870,512	$ 524,994	$ 4,593,697	$ 4,154,047	$ 984,364	$ 639,836	$ 131,248	$ 41,015	$ -	$ 4,183,545	$ 40,352	$ 5,500,000	$ -	$ -	$ 1,100,000	$ 503,422	$ 160,086	$ 23,427,119
2044	$ 887,922	$ 535,494	$ 4,685,571	$ 4,237,128	$ 1,004,051	$ 652,633	$ 133,873	$ 41,835	$ -	$ 4,267,216	$ 41,239	$ -	$ -	$ -	$ -	$ 512,987	$ 163,128	$ 17,163,079
2045	$ 905,681	$ 546,204	$ 4,779,282	$ 4,321,871	$ 1,024,132	$ 665,686	$ 136,551	$ 42,672	$ -	$ 4,352,561	$ 42,146	$ -	$ -	$ -	$ -	$ 522,734	$ 166,228	$ 17,505,747
Total 2023-2045	**$ 16,898,236**	**$ 10,191,094**	**$ 89,172,076**	**$ 80,637,675**	**$ 19,108,302**	**$ 12,420,396**	**$ 2,547,774**	**$ 796,179**	**$ 44,869,325**	**$ 81,210,284**	**$ 770,983**	**$ 30,200,000**	**$ 9,600,000**	**$ 6,137,169**	**$ 7,880,000**	**$ 9,850,813**	**$ 3,132,523**	**$ 425,422,830**
	Safety	Interstate	other federal	other federal	ND Main Street	State	other federal	Local	Local	Local	Safety	Other federal	Other federal	Other federal	State	Local	Local	

Notes
1. Data provided by agency

2. Data assembled from analyzing TIPs (2012-2021)
3. Data calculated by MPO in coordination with agency; see separate calculations
4. NOT USED
5. Sources: 67% of "Maintenance" appropritionment of new sales tax; 100% Capital approprotionment of New Sales tax
6. Assumed 10% match to Interstate and Urban Regional programs (reflecting that most projects are completed on the Urban Regional Secondary network, not Urban Regional Primary)
7. Estimate based on 20% match to federal and share of County road network within MPO study area
8. Assumed match increase every fourth year consistent with NWATP allocation

Note: 2037 Sales Tax Sunset

Note: Project costs provided by MnDOT, assume 80/20

Note: MnDOT allocated funding anticipated every four years

Note: Project costs provided by MnDOT, assume 80/20

Appendix F

Current Revenue Scenario Projects

2045 Street/Highway Plan: 2019-2022 TIP

Roadway	Location	Project Description	Lead Agency	Time Frame	Current Cost	Inflation Adjusted Cost Based on Time Frame	FY	Cost Source	Jurisdiction	State	Project Type	Funding Source	NHS/ Non-NHS
DeMers Avenue	Sorlie Bridge to North 5th Street	Reconstruct	NDDOT	Programmed	**$5,406,000**	n/a	2019	**MPO TIP**	NDDOT	North Dakota	State of Good Repair	NDDOT Regional	NHS
DeMers Avenue	Norht 5th Street to North 6th Street	Reconstruct	NDDOT	Programmed	**$1,744,000**	n/a	2019	**MPO TIP**	NDDOT	North Dakota	State of Good Repair	NDDOT Regional	NHS
Gateway Drive	Various	Install red light running confirmation lights, backplates, and leading pedestrian phasing at signals	City of Grand Forks	Programmed	**$399,000**	n/a	2019	**MPO TIP**	NDDOT	North Dakota	Safety	HSIP	NHS
DeMers Avenue	Columbia Road west ramp intersection	Traffic signals and turn lanes	NDDOT	Programmed	**$600,000**	n/a	2019	**MPO TIP**	NDDOT	North Dakota	State of Good Repair	NDDOT Regional	NHS
32nd Avenue South	Various intersections between I-29 and South Washington Street	Safety improvements	City of Grand Forks	Programmed	**$7,373,000**	n/a	2019	**MPO TIP**	NDDOT	North Dakota	Safety	HSIP	NHS
Washington Street	Hammerling to DeMers	Address ADA curb ramps	NDDOT	Programmed	**$476,000**	n/a	2019	**MPO TIP**	NDDOT	North Dakota	ADA Transition	NDDOT Regional	NHS
US 2	North 69th Street West to Grand Forks Air Force Base	Mill and Overlay	NDDOT	Programmed	**$9,069,000**	n/a	2019	**MPO TIP**	NDDOT	North Dakota	State of Good Repair	NDDOT Regional	NHS
North Washington Street	Over flood diversion bridge	concrete panel replacement and pavement grinding	NDDOT	Programmed	**$96,000**	n/a	2019	**MPO TIP**	NDDOT	North Dakota	State of Good Repair	NDDOT	Non-NHS
Gateway Drive	at 55th Street	Signal and Turn Lanes	NDDOT	Programmed	**$600,000**	n/a	2019	**MPO TIP**	NDDOT	North Dakota	Safety/Operations	NDDOT Regional	NHS
North Washington Street	8th Avenue North to US 2	concrete panel replacement and pavement grinding	NDDOT	Programmed	**$1,420,000**	n/a	2019	**MPO TIP**	NDDOT	North Dakota	State of Good Repair	NDDOT	Non-NHS
University Avenue	State Road to North 3rd Street	Mill and Overlay	City of Grand Forks	Programmed	**$3,461,000**	n/a	2019	**MPO TIP**	City of Grand Forks	North Dakota	State of Good Repair	NDDOT Urban	Non-NHS
North 5th Street	Gateway Drive to DeMers Avenue	Minor Rehabilitation	NDDOT	Programmed	**$1,045,000**	n/a	2020	**MPO TIP**	NDDOT	North Dakota	State of Good Repair	NDDOT Regional	Non-NHS
US 2	North 69th Street West to Grand Forks Air Force Base	Mill and Overlay	NDDOT	Programmed	**$7,107,000**	n/a	2021	**MPO TIP**	NDDOT	North Dakota	State of Good Repair	NDDOT Regional	NHS
North Columbia Road	North end of Columbia Road overpass to north of University Avenue	Reconstruct	City of Grand Forks	Programmed	**$6,244,000**	n/a	2021	**MPO TIP**	NDDOT	North Dakota	State of Good Repair	NDDOT Urban	NHS
I-29	Bridge over I-29 north of US 2 Interchange	Repaint	NDDOT	Programmed	**$432,000**	n/a	2021	**MPO TIP**	NDDOT	North Dakota	State of Good Repair	NDDOT	NHS
Varies	Varies	Replace school flashing beacons in Grand Forks	City of Grand Forks	Programmed	**$700,000**	n/a	2021	**MPO TIP**	Varies	North Dakota	State of Good Repair	HSIP	Non-NHS
US2	5th Ave NE in EGF to Fisher (MPO Portion)	Pavement Preservation WBL and intersection Improvement at US Bus2	MnDOT	Programmed	**$10,800,000**	n/a	2021	**MPO TIP**	MnDOT	Minnesota	State of Good Repair	HSIP	NHS
North Washington Street	5th Avenue South to 1st Avenue North	Reconstruction and Underpass	NDDOT	Programmed	**$17,600,000**	n/a	2022	**MPO TIP**	NDDOT	North Dakota	State of Good Repair	NDDOT Urban/Rural	NHS
Bygland Road	at Rhinehart Drive	Roundabout	City of East Grand Forks	Programmed	**$1,670,000**	n/a	2022	**MPO TIP**	City of East Grand Forks	Minnesota	Safety/Operations	NWDTP City	Non-NHS
				MPO TIP	**$76,242,000**								

2045 Street/Highway Plan Existing Plus Committed (E + C) Network

Roadway	Location	Project Description	Lead Agency	Time Frame	Current Cost	Inflation Adjusted Cost Based on Time Frame	FY	Source	Jurisdiction	State	Project Type	Funding Source	NHS/Non-NHS
47th Avenue South	South 20th Street to Columbia Road	2 Lane to 3 Lane Rural to Urban Expansion	City of Grand Forks	E + C Network	**$1,973,000**	n/a	n/a	**2018 City Budget**	City of Grand Forks	North Dakota	Capacity	Local	Non-NHS
South 42nd Street	34th Avenue South to 40th Avenue South	Gravel to Concrete Improvement	City of Grand Forks	Programmed	**$477,000**	n/a	n/a	**2018 City Budget**	City of Grand Forks	North Dakota	Capacity	Local	Non-NHS
South 34th Street	45th Avenue South to 47th Avenue South	New 2 Lane Roadway Extension	City of Grand Forks	E + C Network	**$557,000**	n/a	n/a	**2018 City Budget**	City of Grand Forks	North Dakota	Capacity	Local	Non-NHS
47th Avenue South	Columbia Road to South 34th Street CIP describes as temporary surface	Gravel to Concrete Upgrade	City of Grand Forks	E + C Network	**$1,645,000**	n/a	n/a	**2018 City Budget**	City of Grand Forks	North Dakota	Capacity	Local	Non-NHS
6th Avenue North	North 55th Street to North 58th Street	New 2 Lane Roadway Extension	City of Grand Forks	E + C Network	**$1,094,000**	n/a	n/a	**2018 City Budget**	City of Grand Forks	North Dakota	Capacity	Local	Non-NHS
South 38th Street	40th Avenue South to 43rd Avenue South	New 2 Lane Roadway Extension	City of Grand Forks	E + C Network	**$1,021,000**	n/a	n/a	**2018 City Budget**	City of Grand Forks	North Dakota	Capacity	Local	Non-NHS
South 38th Street	43th Avenue South to 47th Avenue South	New 2 Lane Roadway Extension	City of Grand Forks	E + C Network	**$1,021,000**	n/a	n/a	**2018 City Budget**	City of Grand Forks	North Dakota	Capacity	Local	Non-NHS
36th Avenue South	South Washington Street to South 20th Street	New 2 Lane Roadway Extension	City of Grand Forks	E + C Network	**$800,000**	n/a	n/a	**Similar TIP Project**	City of Grand Forks	North Dakota	Capacity	Local	Non-NHS
South 20th Street	at 47th Avenue South	Signalized Intersection	City of Grand Forks	E + C Network	**$600,000**	n/a	n/a	**Similar TIP Project**	City of Grand Forks	North Dakota	Safety/Operations	Local	Non-NHS
South 20th Street	at 40th Avenue South	Signalized Intersection	City of Grand Forks	E + C Network	**$600,000**	n/a	n/a	**Similar TIP Project**	City of Grand Forks	North Dakota	Safety/Operations	Local	Non-NHS
South 17th Street	at 32nd Avenue South	Signalized Intersection	City of Grand Forks	E + C Network	**$750,000**	n/a	n/a	**2018 City Budget**	City of Grand Forks	North Dakota	Safety/Operations	Local	Non-NHS
South 34th Street	47th Avenue South to 52nd Avenue South	New 2 Lane Roadway Extension	City of Grand Forks	E + C Network	**$1,034,000**	n/a	n/a	**2018 City Budget**	City of Grand Forks	North Dakota	Capacity	Local	Non-NHS
47th Avenue South	South 34th Street to South 38th Street CIP describes as temporary surface	Gravel to Concrete Upgrade	City of Grand Forks	E + C Network	**$1,125,000**	n/a	n/a	**2018 City Budget**	City of Grand Forks	North Dakota	State of Good Repair	Local	Non-NHS
North 62nd Street	Gateway Drive to 10th Avenue North	New 2 Lane Roadway Extension	City of Grand Forks	E + C Network	**$930,000**	n/a	n/a	**2018 City Budget**	City of Grand Forks	North Dakota	Capacity	Local	Non-NHS
University Avenue	58th Street North to 62nd Street North CIP describes as 55th to 58th	New 2 Lane Road Extension	City of Grand Forks	E + C Network	**$1,040,000**	n/a	n/a	**2018 City Budget**	City of Grand Forks	North Dakota	Capacity	Local	Non-NHS
Cherry Street	60th Avenue South to 62nd Avenue South	New 2 Lane Roadway Extension	City of Grand Forks	E + C Network	**$770,000**	n/a	n/a	**2018 City Budget**	City of Grand Forks	North Dakota	Capacity	Local	Non-NHS
North 36th Street	20th Avenue North to 24th Avenue North	New 2 Lane Roadway Extension	City of Grand Forks	E + C Network	**$911,000**	n/a	n/a	**2018 City Budget**	City of Grand Forks	North Dakota	Capacity	Local	Non-NHS

2045 Street/Highway Plan Existing Plus Committed (E + C) Network

Roadway	Location	Project Description	Lead Agency	Time Frame	Current Cost	Inflation Adjusted Cost Based on Time Frame	FY	Source	Jurisdiction	State	Project Type	Funding Source	NHS/Non-NHS
40th Avenue South	South 42nd Street to South 45th Street	New 2 Lane Road Extension	City of Grand Forks	E + C Network	**$1,034,000**	n/a	n/a	**2018 City Budget**	City of Grand Forks	North Dakota	Capacity	Local	Non-NHS
South 48th Street	32nd Avenue South to 40th Avenue South CIP states to 36th Ave S	New 2 Lane Road Extension	City of Grand Forks	E + C Network	**$1,452,000**	n/a	n/a	**2018 City Budget**	City of Grand Forks	North Dakota	Capacity	Local	Non-NHS
27th Avenue North	North 42nd Street to North 36th Street	New 2 Lane Roadway Extension	City of Grand Forks	E + C Network	**$2,500,000**	n/a	n/a	**Similar Project**	City of Grand Forks	North Dakota	Capacity	Local	Non-NHS
North 62nd Street	at Gateway Drive	Signalized Intersection	City of Grand Forks	E + C Network	**$600,000**	n/a	n/a	**Similar Project**	Grand Forks County	North Dakota	Safety/Operations	Local	Non-NHS
North 62nd Street	Gateway Drive to 17th Ave N	New 2 Lane Road Extension	City of Grand Forks	E + C Network	**$750,000**	n/a	n/a	**Similar Project**	Grand Forks County	North Dakota	Safety/Operations	Local	Non-NHS
5th Avenue Northwest	at Gateway Drive	Full Intersection	City of East Grand Forks	E + C Network	**$1,600,000**	n/a	n/a	**Similar Project**	Grand Forks County	North Dakota	Safety/Operations	Local	Non-NHS
30th Street Northwest	County Highway 64 to 8th Avenue Northwest	Full Intersection	City of East Grand Forks	E + C Network	**$1,600,000**	n/a	n/a	**Similar Project**	Grand Forks County	North Dakota	Safety/Operations	Local	Non-NHS
8th Avenue Northwest	30th Street Northwest to 23rd Street Northwest	Gravel to Concrete Upgrade	City of East Grand Forks	E + C Network	**$800,000**	n/a	n/a	**Similar Project**	City of Grand Forks	Minnesota	Safety/Operations	Local	Non-NHS
17th Street	at Central Avenue	Signalized Intersection	City of East Grand Forks	E + C Network	**$600,000**	n/a	n/a	**Similar Project**	City of East Grand Forks	Minnesota	Safety/Operations	Local	Non-NHS
17th Street Southeast	14th Avenue Southeast to Rhinehart Drive	New 2 Lane Roadway Extension	City of East Grand Forks	E + C Network	**$800,000**	n/a	n/a	**Similar Project**	City of East Grand Forks	Minnesota	Safety/Operations	Local	Non-NHS
South 38th Street	47th Avenue South to 55th Avenue South	New 2 Lane Roadway Extension	City of Grand Forks	E + C Network	**$2,000,000**	n/a	n/a	**Similar Project**	City of Grand Forks	North Dakota	Capacity	Local	Non-NHS
South 58th Street (W. of RR Tracks)	DeMers Avenue to 17th Avenue South	New 2 Lane Roadway Extension	City of Grand Forks	E + C Network	**$1,600,000**	n/a	n/a	**Similar Project**	City of Grand Forks	North Dakota	Capacity	Local	Non-NHS
South 52nd Street (E of RR Tracks)	17th Avenue South to 47th Avenue South	New 2 Lane Roadway Extension	City of Grand Forks	E + C Network	**$3,200,000**	n/a	n/a	**Similar Project**	City of Grand Forks	North Dakota	Capacity	Local	Non-NHS
40th Avenue South	South 48th Street to South 52nd Street	New 2 Lane Roadway Extension	City of Grand Forks	E + C Network	**$1,500,000**	n/a	n/a	**City of G.F. 10 Yr. Needs**	City of Grand Forks	North Dakota	Capacity	Local	Non-NHS
South 48th Street	40th Avenue South to 47th Avenue South	New 2 Lane Roadway Extension	City of Grand Forks	E + C Network	**$1,620,000**	n/a	n/a	**2017 City Budget**	City of Grand Forks	North Dakota	Capacity	Local	Non-NHS
24th Avenue South	South 48th Street to South 52nd Street	New 2 Lane Roadway Extension	City of Grand Forks	E + C Network	**$1,600,000**	n/a	n/a	**Similar Project**	City of Grand Forks	North Dakota	Capacity	Local	Non-NHS
South 34th Street	55th Avenue South to 62nd Avenue South	New 2 Lane Roadway Extension	City of Grand Forks	E + C Network	**$700,000**	n/a	n/a	**Similar Project**	City of Grand Forks	North Dakota	Capacity	Local	Non-NHS
55th Avenue South	Columbia Road to 38th Street South	New 2 Lane Roadway Extension	City of Grand Forks	E + C Network	**$2,600,000**	n/a	n/a	**City of G.F. 10 Yr. Needs**	City of Grand Forks	North Dakota	Capacity	Local	Non-NHS
South 48th Street	at 32nd Avenue South	Signalized Intersection	City of Grand Forks	E + C Network	**$600,000**	n/a	n/a	**Similar Project**	City of Grand Forks	North Dakota	Safety/Operations	Local	Non-NHS

2045 Street/Highway Plan Existing Plus Committed (E + C) Network

Roadway	Location	Project Description	Lead Agency	Time Frame	Current Cost	Inflation Adjusted Cost Based on Time Frame	FY	Source	Jurisdiction	State	Project Type	Funding Source	NHS/Non-NHS
24th Avenue South	at South 42nd Street	Signalized Intersection	City of Grand Forks	E + C Network	**$600,000**	n/a	n/a	**Similar Project**	City of Grand Forks	North Dakota	Safety/Operations	Local	Non-NHS
South 20th Street	62nd Avenue South to 69th Avenue South	New 2 Lane Roadway Extension	City of Grand Forks	E + C Network	**$700,000**	n/a	n/a	**Similar Project**	City of Grand Forks	North Dakota	Capacity	Local	Non-NHS
University Avenue	North 62nd Street to North 69th Street	New 2 Lane Roadway Extension	City of Grand Forks	E + C Network	**$700,000**	n/a	n/a	**Similar Project**	City of Grand Forks	North Dakota	Capacity	Local	Non-NHS
62nd Avenue South	34th Street South to Belmont Road	2 Lane to 3 Lane Rural to Urban Expansion	City of Grand Forks	E + C Network	**$10,300,000**	n/a	n/a	**2017 City Budget**	City of Grand Forks	North Dakota	Capacity	Local	Non-NHS
South Washington Street	at 55th Avenue South	Signalized Intersection	City of Grand Forks	E + C Network	**$600,000**	n/a	n/a	**Similar TIP Project**	City of Grand Forks	North Dakota	Safety/Operations	Local	NHS
Belmont Road	47th Avenue South to 62nd Avenue South	2 Lane to 3 Lane Rural to Urban Expansion	City of Grand Forks	E + C Network	**$4,500,000**	n/a	n/a	**2017 City Budget**	City of Grand Forks	North Dakota	Capacity	Local	Non-NHS
Columbia Road	47th Avenue South to 55th Avenue South	2 Lane to 3 Lane Rural to Urban Expansion	City of Grand Forks	E + C Network	**$6,100,000**	n/a	n/a	**Sales Tax**	City of Grand Forks	North Dakota	Capacity	Local	NHS
South Washington	48th Avenue South to 55th Avenue South	2 Lane to 3 Lane Rural to Urban Expansion	City of Grand Forks	E + C Network	**$2,600,000**	n/a	n/a	**2017 City Budget**	City of Grand Forks	North Dakota	Capacity	Local	NHS
17th Street Northeast	5th Avenue Northeast to 11th Avenue Northeast	New 2 Lane Roadway Extension	City of East Grand Forks	E + C Network	**$600,000**	n/a	n/a	**Similar Project**	City of Grand Forks	North Dakota	Capacity	Local	Non-NHS
13th Street Southeast	at Bygland Road Southeast	Signalized Intersection	City of East Grand Forks	E + C Network	**$600,000**	n/a	n/a	**Similar Project**	City of East Grand Forks	Minnesota	Safety/Operations	Local	Non-NHS
23rd Street	at Central Avenue	Signalized Intersection	City of East Grand Forks	E + C Network	**$600,000**	n/a	n/a	**Similar Project**	City of East Grand Forks	Minnesota	Safety/Operations	Local	Non-NHS
8th Avenue Northeast	17th Street Northeast to Gateway Drive	New 2 Lane Roadway Extension	City of East Grand Forks	E + C Network	**$500,000**	n/a	n/a	**Similar Project**	City of East Grand Forks	Minnesota	Capacity	Local	Non-NHS
30th Street Northwest	Central Avenue to 8th Avenue Northwest	New 2 Lane Roadway Extension	City of East Grand Forks	E + C Network	**$800,000**	n/a	n/a	**Similar Project**	City of East Grand Forks	Minnesota	Capacity	Local	Non-NHS
				2045 Plan Existing + Committed (E + C) Network Projects	**$72,704,000**								

NDDOT State of Good Repair Financially Constrained (2023 to 2045)

Table 3

Ref #	Roadway	Termini	Project Type	Agency	Time Frame	Federal/State Funds	City Match	YOE Total
REP-224	US 2 (Gateway Drive)	Grand Forks I-29 East to Columbia Road	CPR/DBR/Grind	NDDOT	Short-Range	$753,000	$0	$753,000
REP-225	US 2 (Gateway Drive)	Gateway Drive-Columbia Road to Red River	CPR/DBR/Grind	NDDOT	Short-Range	$811,000	$0	$811,000
REP-228A	US 2 Business	Grand Forks - Gateway Drive to DeMers	Chip Seal	NDDOT	Short-Range	$45,900	$5,100	$51,000
REP-237	US 2 (Gateway Drive)	Grand Forks I-29 East to Columbia Road	CPR & Grind	NDDOT	Short-Range	$753,000	$0	$753,000
REP-238	US 2 (Gateway Drive)	Gateway Drive - Columbia Road to Red River	CPR & Grind	NDDOT	Short-Range	$811,000	$0	$811,000
REP-266A	US 81 Business	Grand Forks - South Washington Street (Hammerling to 8th Avenue South)	Reconstruct	NDDOT	Short-Range	$5,329,800	$592,200	$5,922,000
REP-268A	US 81 Business	Grand Forks - South Washington Street (8th Avenue South to DeMers Avenue)	Reconstruct	NDDOT	Short-Range	$1,065,600	$118,400	$1,184,000
REP-296	US 2 (Gateway Drive)	8 MI East of Grand Forks AFB to 2 MI West of Columbia Rd	Chip Seal	NDDOT	Short-Range	$205,000	$0	$205,000
REP-305	Various	Various	Regional Traffic Signal Upgrade	NDDOT	Short-Range	$6,514,200	$723,800	$7,238,000
REP-239A	I-29	N of ND 15 to Near 32nd Avenue Grand Forks (NB)	CPR & Grind	NDDOT	Short-Range	$1,946,000	$0	$1,946,000
REP-239B	I-29	N of ND 15 to Near 32nd Avenue Grand Forks (SB)	CPR & Grind	NDDOT	Short-Range	$1,946,000	$0	$1,946,000
REP-223	US 2 (Gateway Drive)	Grand Forks 55th Street East to I-29 East Bound	CPR/DBR/Grind	NDDOT	Mid-Range	$570,600	$63,400	$634,000
REP-232	US 2 Business	DeMers to Red River (include 5th to 6th)	CPR/Grind	NDDOT	Mid-Range	$158,000	$0	$158,000
REP-236	US 2 (Gateway Drive)	Grand Forks 55th Street East to I-29 West Bound	CPR & Grind	NDDOT	Mid-Range	$634,000	$0	$634,000
REP-258A & REP 259A	US 81 Business	I-29 to South Washington Street	Reconstruct	NDDOT	Mid-Range	$27,718,200	$3,079,800	$30,798,000
REP-262A	US 81 Business	Grand Forks South Washington Street (32nd Avenue South to 26th Avenue South)	CPR & Grind	NDDOT	Mid-Range	$256,500	$28,500	$285,000
REP-263A	US 81 Business	Grand Forks - South Washington Street (26th Avenue to Hammerling)	CPR & Grind	NDDOT	Mid-Range	$621,900	$69,100	$691,000
REP-277	US 81 Business	Grand Forks North Washington Street (.05 MI S 8th to 8th Avenue)	CPR & Grind	NDDOT	Mid-Range	$9,000	$1,000	$10,000
REP-278	US 81 Business	Grand Forks North Washington Street (8th Avenue to 9th Avenue)	CPR & Grind	NDDOT	Mid-Range	$29,700	$3,300	$33,000
REP-279	US 81 Business	Grand Forks North Washington Street (9th Avenue NE to 13th Avenue)	CPR & Grind	NDDOT	Mid-Range	$262,800	$29,200	$292,000
REP-280	US 81 Business	Grand Forks North Washington Street (13th Avenue NE to US 2)	CPR & Grind	NDDOT	Mid-Range	$36,000	$4,000	$40,000
REP-281	US 81 Business	Grand Forks North Washington Street (JCT US 2 to STA 105)	CPR & Grind	NDDOT	Mid-Range	$285,300	$31,700	$317,000
REP-284	Hwy 297 (Demers Avenue)	Grand Forks DeMers Avenue (I-29 to Near 34th Street)	CPR & Grind	NDDOT	Mid-Range	$540,900	$60,100	$601,000
REP-285	Hwy 297 (Demers Avenue)	Grand Forks DeMers Avenue (34th Street to US 2)	CPR & Grind	NDDOT	Mid-Range	$1,641,600	$182,400	$1,824,000
REP-286	Hwy 297 (Demers Avenue)	Grand Forks DeMers Avenue (I-29 to US 2)	CPR & Grind	NDDOT	Mid-Range	$2,046,600	$227,400	$2,274,000
REP-292	US 81 Business	DeMers Avenue to Dyke Avenue	CPR/Grind	NDDOT	Mid-Range	$66,600	$7,400	$74,000
REP-294	US 81 Business	Dyke Avenue to .05 Mi South of 8th Avenue	Reconstruction	NDDOT	Mid-Range	$8,505,000	$945,000	$9,450,000
REP-297	US 2 (Gateway Drive)	8 MI East of Grand Forks AFB to 2 MI West of Columbia Rd	Mill & HBP 2"	NDDOT	Mid-Range	$1,365,000	$0	$1,365,000
REP-240A	I-29	Near 32nd Avenue South N of HWY 2 Interchange	CPR & Grind	NDDOT	Mid-Range	$1,635,000	$0	$1,635,000
REP-242A	I-29	N of ND 15 N to Near 32nd Avenue Grand Forks	CPR & Grind	NDDOT	Mid-Range	$504,000	$0	$504,000
REP-246A	I-29	US 2 North	CPR & Grind	NDDOT	Mid-Range	$1,134,000	$0	$1,134,000
REP-248A	I-29	South of North Grand Forks Interchange to North of North Grand Forks Interchange South Bound	CPR & Grind	NDDOT	Mid-Range	$86,000	$0	$86,000
REP-243B	I-29	Near 32nd Avenue North to 32nd Avenue	CPR & Grind	NDDOT	Mid-Range	$32,000	$0	$32,000
REP-245B	I-29	South US 2 to North US 2	CPR & Grind	NDDOT	Mid-Range	$1,044,000	$0	$1,044,000
REP-254	I-29	N of US 2 North to South of N Grand Forks Interchange	CPR & Grind	NDDOT	Mid-Range	$1,302,000	$0	$1,302,000
REP-228B	US 2 Business	Grand Forks - Gateway Drive to DeMers	Mill & HBP 3"	NDDOT	Long-Range	$2,537,100	$281,900	$2,819,000
REP-228C	US 2 Business	Grand Forks - Gateway Drive to DeMers	Chip Seal	NDDOT	Long-Range	$99,000	$11,000	$110,000
REP-258B	US 81 Business	32nd Avenue South Grand Forks (STA 14 to 95) 4 LN	CPR & Grind	NDDOT	Long-Range	$0	$0	$0
REP-259B	US 81 Business	32nd Avenue South Grand Forks (STA 95 to S. Washington) 5 LN	CPR & Grind	NDDOT	Long-Range	$0	$0	$0
REP-262B	US 81 Business	Grand Forks South Washington Street (32nd Avenue South to 26th Avenue South)	CPR & Grind	NDDOT	Long-Range	$365,400	$40,600	$406,000
REP-263B	US 81 Business	Grand Forks - South Washington Street (26th Avenue to Hammerling)	CPR & Grind	NDDOT	Long-Range	$885,600	$98,400	$984,000
REP-266B	US 81 Business	Grand Forks - South Washington Street (Hammerling to 8th Avenue South)	CPR & Grind	NDDOT	Long-Range	$502,200	$55,800	$558,000
REP-268B	US 81 Business	Grand Forks - South Washington Street (8th Avenue South to DeMers Avenue)	CPR & Grind	NDDOT	Long-Range	$144,900	$16,100	$161,000
REP-289	US 2 (Gateway Drive)	US 2 over the Red River, Bridge 9090 (Kennedy)	Repaint Bridge	NDDOT	Long-Range	$2,750,000	$0	$2,750,000
REP-291	US 2 Business	US 2B over the Red River, Bridge 4700 (Sorlie)	Repaint Bridge	NDDOT	Long-Range	$2,475,000	$275,000	$2,750,000
REP-293	US 81 Business	DeMers Avenue to Dyke Avenue	CPR/Grind	NDDOT	Long-Range	$94,500	$10,500	$105,000
REP-295	US 81 Business	Dyke Avenue to .05 Mi South of 8th Avenue	CPR/Grind	NDDOT	Long-Range	$296,100	$32,900	$329,000
REP-298	US 2 (Gateway Drive)	8 MI East of Grand Forks AFB to 2 MI West of Columbia Rd	Chip Seal	NDDOT	Long-Range	$399,000	$0	$399,000
REP-306	Various	Various	Regional Traffic Signal Upgrade	NDDOT	Long-Range	$14,301,900	$1,589,100	$15,891,000
REP-299	I-29	HWY 2 Interchange to North of Grand Forks (NB)	CPR & Grind	NDDOT	Long-Range	$3,511,000	$0	$3,511,000
REP-240B	I-29	Near 32nd Avenue South N of HWY 2 Interchange	CPR & Grind	NDDOT	Long-Range	$2,326,000	$0	$2,326,000
REP-243A	I-29	Near 32nd Avenue North to 32nd Avenue	CPR & Grind	NDDOT	Long-Range	$717,000	$0	$717,000
REP-244A	I-29	32nd Avenue North to South US 2	CPR & Grind	NDDOT	Long-Range	$3,790,000	$0	$3,790,000
REP-245A	I-29	South US 2 to North US 2	CPR & Grind	NDDOT	Long-Range	$3,790,000	$0	$3,790,000
REP-247	I-29	North of US 2 North to South of North Grand Forks Interchange	CPR & Grind	NDDOT	Long-Range	$0	$0	$0
REP-242B	I-29	N of ND 15 N to Near 32nd Avenue Grand Forks	CPR & Grind	NDDOT	Long-Range	$122,000	$0	$122,000
REP-244B	I-29	32nd Avenue North to South US 2	CPR & Grind	NDDOT	Long-Range	$46,000	$0	$46,000
REP-246B	I-29	US 2 North	CPR & Grind	NDDOT	Long-Range	$1,486,000	$0	$1,486,000
REP-248B	I-29	South of North Grand Forks Interchange to North of North Grand Forks Interchange South Bound	CPR & Grind	NDDOT	Long-Range	$0	$0	$0
REP-300	I-29	HWY 2 Interchange to North of Grand Forks (NB)	CPR & Grind	NDDOT	Long-Range	$3,511,000	$0	$3,511,000
					Totals	$114,814,900	$8,583,100	$123,398,000

City of Grand Forks Financially Constrained State of Good Repair (2023-2045)

Ref#	Roadway	Termini	Project Type	Agency	Time Frame	Federal Funds and Local Match	Additional City Funds	YOE Total
REP-043	Columbia Road	Columbia Road Railroad Overpass North of DeMers Ave.	Overpass	City of Grand Forks	Short-Range	**$5,625,000**	**$1,856,000**	**$7,481,000**
REP-045	Point Bridge	Bridge	Rehabilitation	City of Grand Forks	Short-Range	**$1,048,000**	**$0**	**$1,048,000**
REP-301	Various	Various	Traffic Signal Upgrade	City of Grand Forks	Short-Range	**$3,901,000**	**$250,000**	**$4,151,000**
REP-044	North Columbia Road	8th Avenue North to US 2 (Gateway Drive)	Reconstruct	City of Grand Forks	Short-Range	**$7,994,000**	**$2,638,000**	**$10,632,000**
REP-046	North Columbia Road	University Avenue to 8th Avenue North	Reconstruct	City of Grand Forks	Mid-Range	**$9,724,000**	**$3,209,000**	**$12,933,000**
REP-049	South Washington Street	32nd Avenue South to 47th Avenue South	Concrete Pavement Rehabilitation (CPR)	City of Grand Forks	Mid-Range	**$8,428,000**	**$2,781,000**	**$11,209,000**
REP-050	South Columbia Road	17th Avenue South to 32nd Avenue South	Concrete Pavement Rehabilitation (CPR)	City of Grand Forks	Mid-Range	**$8,590,000**	**$2,835,000**	**$11,425,000**
REP-051	South Columbia Road	DeMers Avenue to 17th Avenue South	Concrete Pavement Rehabilitation (CPR)	City of Grand Forks	Mid-Range	**$7,131,000**	**$2,353,000**	**$9,484,000**
REP-060	S 48th Street	DeMers Avenue to 10th Avenue South	Reconstruct	City of Grand Forks	Mid-Range	**$3,241,000**	**$1,070,000**	**$4,311,000**
REP-061	S 48th Street	10th Avenue South to 15th Avenue South	Reconstruct	City of Grand Forks	Mid-Range	**$3,241,000**	**$1,070,000**	**$4,311,000**
REP-041	32nd Avenue South	South 10th Street to Cherry Street	Reconstruct	City of Grand Forks	Mid-Range	**$1,783,000**	**$588,000**	**$2,371,000**
REP-052	Columbia Road**	47th - 62nd and Washington SED - 62nd	Maintenance and Operations	City of Grand Forks	Long-Range	**$6,847,000**	**$2,260,000**	**$9,107,000**
REP-053B	Columbia Road	32nd Avenue South to 47th Avenue South	Concrete Pavement Rehabilitation (CPR)	City of Grand Forks	Long-Range	**$11,763,000**	**$3,882,000**	**$15,645,000**
REP-302	Various	Various	New Traffic Signal or Roundabout	City of Grand Forks	Long-Range	**$2,883,000**	**$951,000**	**$3,834,000**
REP-303	Various	Various	New Traffic Signal or Roundabout	City of Grand Forks	Long-Range	**$2,883,000**	**$951,000**	**$3,834,000**
REP-304	Various	Various	New Traffic Signal or Roundabout	City of Grand Forks	Long-Range	**$2,883,000**	**$951,000**	**$3,834,000**
REP-307	Various	Various	Traffic Signal Upgrade	City of Grand Forks	Long-Range	**$8,937,000**	**$2,949,000**	**$11,886,000**
REP-042	32nd Avenue South	Cherry Street to Belmont Road	Reconstruct	City of Grand Forks	Long-Range	**$3,921,000**	**$1,294,000**	**$5,215,000**
					Totals	**$100,823,000**	**$31,888,000**	**$132,711,000**

** Columbia Road project includes two separate termini. These projects are being packaged together by the City of Grand Forks for a future NDDOT Urban Roads Program grant funding request.

City of Grand Forks Main Street Financially Constrained (2023-2045)

Ref#	Roadway	Termini	Project Type	Agency	Time Frame	YOE Total Federal/City Match
MUL-006	Eastern Downtown Area	Eastern Downtown Area	Revitalization	City of Grand Forks	Short-Range	**$1,000,000**
MUL-018	N 3rd Street	DeMers Avenue to 1st Avenue North	Reconstruct	City of Grand Forks	Short-Range	**$1,776,385**
MUL-019	N 3rd Street	1st Avenue North to 2nd Avenue North	Reconstruct	City of Grand Forks	Short-Range	**$1,776,385**
MUL-020	N 3rd Street	2nd Avenue North to University Avenue	Reconstruct	City of Grand Forks	Short-Range	**$1,776,385**
MUL-005	Northern Downtown Area	Northern Downtown Area	Revitalization	City of Grand Forks	Mid-Range	**$1,000,000**
MUL-023	N 4th Street	DeMers Avenue to 1st Avenue North	Reconstruct	City of Grand Forks	Mid-Range	**$2,431,056**
MUL-024	N 4th Street	1st Avenue North to 2nd Avenue North	Reconstruct	City of Grand Forks	Mid-Range	**$2,431,056**
MUL-025	N 4th Street	2nd Avenue North to University Avenue	Reconstruct	City of Grand Forks	Mid-Range	**$2,431,056**
MUL-007	Southern Downtown Area	Southern Downtown Area	Revitalization	City of Grand Forks	Long-Range	**$1,000,000**
MUL-004	Western Downtown Area	Western Downtown Area	Revitalization	City of Grand Forks	Long-Range	**$1,000,000**
MUL-021	S 3rd Street	DeMers Avenue to Kittson Avenue	Reconstruct	City of Grand Forks	Long-Range	**$4,324,540**
MUL-022	S 3rd Street	Kittson Avenue to Division Avenue	Reconstruct	City of Grand Forks	Long-Range	**$6,919,263**
MUL-026	S 4th Street	DeMers Avenue to Kittson Avenue	Reconstruct	City of Grand Forks	Long-Range	**$4,324,539**
MUL-027	S 4th Street	Kittson Avenue to Division Avenue	Reconstruct	City of Grand Forks	Long-Range	**$6,919,263**
					Total	**$39,109,928**

Grand Forks County State of Good Repair Financially Constrained Project List (2023-2045)

Ref#	Roadway	Termini	Project Type	Agency	Time Frame	YOE Federal/County Match	YOE County Funds Only
Various	Various	Various	Chip Seal	Grand Forks County	Short-Range		**$618,000**
REP-023A	CR 6 (12th Avenue NE)	County Road 8 (9th Street NE) to 8th Street NE	Mill & Overlay	Grand Forks County	Short-Range	**$329,000**	
REP-026A	32nd Avenue South	CR 5 (16th Street NE) to Railroad Tracks	Mill & Overlay	Grand Forks County	Short-Range	**$987,000**	
Various	Various	Various	Chip Seal	Grand Forks County	Mid-Range		**$1,162,000**
REP-009B	CR 5 (16th Street NE)	County Road 6 (12th Avenue NE) to US 2 (Gateway Drive)	Mill & Overlay	Grand Forks County	Mid-Range	**$2,702,000**	
Various	Various	Various	Chip Seal	Grand Forks County	Long-Range		**$1,459,000**
REP-030C	County Road 17 (South Columbia Rd)	County Road 81 to 62nd Avenue South	Mill & Overlay	Grand Forks County	Long-Range	**$3,845,000**	
					Totals	**$7,863,000**	**$3,239,000**

Safety/Operations Financially Constrained Project List - North Dakota Portion of MPO (2023-2045)

Ref#	Roadway	Termini	Project Type	Agency	Time Frame	YOE Total Federal/State/Local
PS0-004	Various	Various	Install Red Light Confirmation Indicators for the Through Lane Traffic	City of Grand Forks	Short-Range	**$101,000**
PS0-006	Various	Various	Advanced Walk Timer Bicycle/Pedestrian Upgrade	City of Grand Forks	Short-Range	**$357,000**
PS0-003	Various	Various	Rural Intersection and Segment Safety Upgrades	Grand Forks County	Short-Range	**$466,000**
PS0-005	Various	Various	Install Red Light Confirmation Indicators for the Through Lane Traffic	NDDOT/City	Short-Range	**$13,000**
PS0-007	Various	Various	Advanced Walk Timer Bicycle/Pedestrian Upgrade	NDDOT/City	Short-Range	**$171,000**
PS0-012	DeMers Avenue	at 16th Street Northeast	Rural Intersection Safety Upgrades	Grand Forks County	Short-Range	**$105,000**
PS0-013	Gateway Drive	at Airport Drive	Intersection Reconfiguration and ITS Improvements	NDDOT/City/County	Short-Range	**$2,266,000**
PS0-011	Gateway Drive/US 2	at Stanford Road	Realign Stanford Road to North 36th Street	City of Grand Forks	Mid-Range	**$1,316,000**
DIS-045	Interstate 29	at Gateway Drive	Upgrade to Existing Interchange (NE Loop and Other Upgrades)	NDDOT	Mid-Range	**$0**
DIS-003	Gateway Dr	Cambridge St (RE Arena Entrance)to Columbia Rd	Reconstruct intersection at Columbia Rd, signalize intersection, remove north frontage road access (see study)	NDDOT	Mid-Range	**$0**
					Total	**$4,795,000**

Safety/Operations Example Project List - Minnesota Portion of MPO

Ref#	Roadway	Termini	Project Type	Agency	Time Frame	YOE Total Federal/State/Local
PS0-009	Various	Various	Access Management and Safety Upgrades	MnDOT	Short-Range	**$852,000**
PS0-010	Various	Various	Signal and Turn Lane Upgrades	MnDOT	Short-Range	**$881,000**
PS0-014	US 2	W JCT TH 220 MSAS 120 RT/EGF	Signal and Turn Lane Upgrades	MnDOT	Short-Range	**$4,417,000**
PS0-015	US 2	5th Avenue NEM 98/EGF	Signal and Turn Lane Upgrades	MnDOT	Short-Range	**$1,355,000**
PS0-008	Various	Various	Rumble Strip and Edgeline Safety Upgrades	Polk County	Short-Range	**$27,000**
DIS-008	Bygland Road	at 13th Avenue	Roundabout	City of East Grand Forks	Long-Range	**$5,271,000**
DIS-007	Bygland Road	at 5th Avenue	Roundabout	City of East Grand Forks	Long-Range	**$5,271,000**
					Total	**$18,074,000**

MnDOT Financially Constrained State of Good Repair Projects (2023-2045)

Table 12

Ref #	Roadway	Termini	Project Type	Agency	Time Frame	Federal/State Funds	City Match	YOE Total
REP-213	US 2	Over River Road NW	Replace Bridge	MnDOT	Short-Range	**$5,600,000**	**$0**	**$5,600,000**
REP-215	US 2 Business	US 2B from 2nd Street to 4th Street	Replace 3 Signal Systems	MnDOT	Short-Range	**$600,000**	**$0**	**$600,000**
REP-220	US 2	EB from 0.2 Miles East of US 2 Business to 0.3 Miles East of CSAH 15	Bituminous Mill and Overlay	MnDOT	Short-Range	**$4,100,000**	**$0**	**$4,100,000**
REP-217	US 2 Business	US 2B from DeMers Ave to US 2	Resurfacing with potential turnback	MnDOT	Mid-Range	**$2,000,000**	**$0**	**$2,000,000**
REP-218	US 2/MN 220	US 2 from North Dakota border to US 2B/ MN 220 from US 2 to CSAH 29	Concrete Rehabilitation	MnDOT	Mid-Range	**$4,000,000**	**$0**	**$4,000,000**
REP-287	US 2 Business	US 2B from North Dakota Border to 4th Street	Concrete Pavement Replacement/Rehabilitation, Rehabilitate Sorlie Bridge	MnDOT	Mid-Range	**$3,000,000**	**$0**	**$3,000,000**
REP-219	US 2	US 2 WB from 0.5 miles W of the W JCT of MN 220 (East Grand Forks) to 0.3 miles E of Polk CSAH 15 (Fisher)	Resurfacing	MnDOT	Long-Range	**$15,000,000**	**$0**	**$15,000,000**
REP-288	US 2	US 2 over the Red River, Bridge 9090 (Kennedy)	Repaint Bridge	MnDOT	Long-Range	**$2,750,000**	**$0**	**$2,750,000**
REP-290	US 2 Business	US 2B over the Red River, Bridge 4700 (Sorlie)	Repaint Bridge	MnDOT	Long-Range	**$2,750,000**	**$0**	**$2,750,000**
					Totals	**$39,800,000**	**$0**	**$39,800,000**

City of East Grand Forks State of Good Repair Financially Constrained (2023 to 2045)

Ref#	Roadway	Termini	Project Type	Agency	Time Frame	YOE Total
REP-194	Point Bridge	Across Red River	Rehabilitation	City of East Grand Forks	Short-Range	**$1,048,000**
REP-209	Bygland Road	6th St SE - 8th St SE	Reconstruction	City of East Grand Forks	Short-Range	**$980,000**
REP-210	Bygland Road	Heartsville Coulee Crossing	Reconstruction	City of East Grand Forks	Short-Range	**$710,000**
REP-202	10th Street NE	5th Ave NE - Central Ave	Reconstruction	City of East Grand Forks	Mid-Range	**$2,576,000**
REP-207B	Rhinehart Drive	13th St SE - 6th St SE	Reconstruction	City of East Grand Forks	Mid-Range	**$3,816,000**
REP-197	8th Ave NW	20th St NW - 23rd St NW	Reconstruction	City of East Grand Forks	Long-Range	**$2,502,000**
REP-211	Bygland Road	13th St SE - 8th St SE	Reconstruction	City of East Grand Forks	Long-Range	**$4,300,830**
					Total	**$15,932,830**

Polk County State of Good Repair Financially Constrained Project List (2023-2045)

Ref#	Roadway	Termini	Project Type	Agency	Time Frame	YOE Federal/County Match	YOE County Funds Only
REP 001	CSAH 72	TH 220 to South EGF City Boundary	Mill & Overlay	Polk County	Short-Range	**$202,800**	**$0**
REP 002	CSAH 73	US 2 to CSAH 29	Mill & Overlay	Polk County	Mid-Range	**$286,000**	**$0**
REP 003	CSAH 76	US 2 to CR 17	Mill & Overlay	Polk County	Mid-Range	**$352,000**	**$0**
					Totals	**$840,800**	**$0**

Appendix G

Illustrative Projects

2045 Plan: Illustrative Projects

Project Number	Roadway	Location	Project Type	Project Description	Lead Agency	Prioritization Score	Current Cost
REP-204	DeMers Avenue	4th St NW - Hwy 2	State of Good Repair	Reconstruction	City of East Grand Forks	47.5	**$2,125,000**
DIS-041	2nd Ave NE	4th St NE to Gateway Dr	Discretionary	Grade-separation from railroad, creating continuous N/S corridor	City of East Grand Forks	42.5	**$14,930,764**
DIS-042	32nd Ave	44th Ave SW to Bygland Rd	Discretionary	Connect 32nd Ave Bridge to Bygland Rd	City of East Grand Forks	40	**$5,061,276**
DIS-040	New roadway	American Crystal Sugar	Discretionary	New road access to Crystal Sugar	City of East Grand Forks	40	**$1,644,915**
REP-211B	Bygland Road	5th - 6th	State of Good Repair	Reconstruction	City of East Grand Forks	35	**$645,000**
REP-212	Bygland Road	2nd Ave NE - Bus Highway 2 - Louis Murray Bridge	State of Good Repair	Reconstruction	City of East Grand Forks	35	**$950,000**
REP-192	5th Avenue NE	15th Street NE to 23rd Street NE	State of Good Repair	Reconstruction	City of East Grand Forks	30	**$2,523,000**
REP-198	17th St NW	12th Ave NW - Highway 220	State of Good Repair	Reconstruction	City of East Grand Forks	30	**$3,100,000**
REP-201	5th Avenue NE	Hwy 2 - Business Hwy 2	State of Good Repair	Reconstruction	City of East Grand Forks	30	**$3,000,000**
REP-205	2nd Ave NE	Business Hwy 2 - 10th St NE	State of Good Repair	Reconstruction	City of East Grand Forks	30	**$1,850,000**
REP-206	1st St SE	Point Bridge to Bygland Rd	State of Good Repair	Reconstruction	City of East Grand Forks	30	**$565,000**
REP-207A	Rhinehart Drive	13th St SE - City Limits	State of Good Repair	Reconstruction	City of East Grand Forks	30	**$600,000**
REP-190	Point Bridge	East Approach	State of Good Repair	Improvement/Rehabilitation/Slide Repair Project	City of East Grand Forks	20	**$4,000,000**

2045 Plan: Illustrative Projects

Project Number	Roadway	Location	Project Type	Project Description	Lead Agency	Prioritization Score	Current Cost
DIS-039	2nd Ave NE	10th Street NE to US 2	Discretionary	New 2 lane Road Extension	City of East Grand Forks	20	**$560,000**
REP-191	River Road	US 2 to 23rd Street NW	State of Good Repair	Mill and Overlay	City of East Grand Forks	15	**$390,000**
REP-196	8th Ave NW	17th St NW - 20th St NW	State of Good Repair	Mill and Overlay	City of East Grand Forks	15	**$90,000**
REP-199	14th St NW	6th Ave NW - Highway 220	State of Good Repair	Mill and Overlay	City of East Grand Forks	15	**$125,000**
REP-200	5th Ave NW	14th St NW - 10th St NW	State of Good Repair	Mill and Overlay	City of East Grand Forks	15	**$95,000**
REP-203	Central Ave	Demers Ave - Business Hwy 2	State of Good Repair	Mill and Overlay	City of East Grand Forks	15	**$125,000**
DIS-010	CR 58	at Bygland Rd	Discretionary	Add Westbound left-turn lane, with connection to new bridge	City of East Grand Forks	15	**$126,532**

2045 Plan: Illustrative Projects

Project Number	Roadway	Location	Project Type	Project Description	Lead Agency	Prioritization Score	Current Cost
DIS-035	Columbia Rd	14th Ave S to 24th Ave S	Discretionary	Reconstruct to variable 5-lane to 6-lane roadway with 11 ft lanes, replacement of signing, signals, lights, construction of shared use path and replacement of sidewalks	City of Grand Forks	62.5	**$12,750,000**
DIS-047	42nd Street	North of DeMers Avenue	Discretionary	Railroad Grade Separation	City of Grand Forks	50	**$40,000,000**
REP-040	32nd Avenue South	South Washington Street to South 10th Street	State of Good Repair	Reconstruct	City of Grand Forks	47.5	**$989,880**
DIS-011	42nd Street/32nd Avenue South	East of I - 29	Discretionary	Ramp Realignment	City of Grand Forks	47.5	**$16,000,000**
DIS-031	South Columbia Road/South Washington Street	47th Avenue South to 62nd Avenue South/SED to 62nd Avenue South	Discretionary	Reconstruct	City of Grand Forks	47.5	**$12,000,000**
DIS-032	32nd Ave	48th St to 52nd St	Discretionary	Urban to Rural transition improvement: Expand to 4 lanes	City of Grand Forks	47.5	**$1,391,851**
REP-158	Minnesota Avenue	4th Avenue South to Bridge	State of Good Repair	Reconstruct	City of Grand Forks	45	**$1,079,869**
REP-074	N 36th Street	18th Avenue North to RR Tracks	State of Good Repair	Reconstruct	City of Grand Forks	40	**$480,000**
REP-075	N 36th Street	Gateway Drive (US 2) to RR Tracks	State of Good Repair	Reconstruct	City of Grand Forks	40	**$960,000**
DIS-037	47th Avenue South & I - 29 Interchange	West of Columbia Road	Discretionary	New 2 Lane Road Extension and New Interchange with I - 29	City of Grand Forks	40	**$46,000,000**
DIS-016	Mill Spur Railway	Gateway Dr to University Ave	Discretionary	Implement warning devices, gates and flashers, crossing Closures and median improvements and landscape and trail improvements	City of Grand Forks	35	**$3,229,000**
REP-039	32nd Avenue South	South 48th Street to I-29	State of Good Repair	Concrete Pavement Rehabilitation (CPR) and Grind	City of Grand Forks	32.5	**$1,799,782**

2045 Plan: Illustrative Projects

Project Number	Roadway	Location	Project Type	Project Description	Lead Agency	Prioritization Score	Current Cost
REP-047	DeMers Avenue	West RR Wye to North 55th Street	State of Good Repair	Concrete Pavement Rehabilitation (CPR) and Grind	City of Grand Forks	32.5	**$600,000**
REP-048	DeMers Avenue	North 55th Street to I-29 SB Ramps	State of Good Repair	Concrete Pavement Rehabilitation (CPR) and Grind	City of Grand Forks	32.5	**$3,059,630**
REP-067	S 42nd Street	29th Avenue South to South 38th Street	State of Good Repair	Reconstruct	City of Grand Forks	32.5	**$1,360,000**
REP-152	University Avenue	State Street to Stanford Road	State of Good Repair	Reconstruct	City of Grand Forks	32.5	**$400,000**
REP-153	University Avenue	Stanford Road to North Columbia Road	State of Good Repair	Reconstruct	City of Grand Forks	32.5	**$2,880,000**
REP-154	University Avenue	North Columbia Road to North 20th Street	State of Good Repair	Reconstruct	City of Grand Forks	32.5	**$2,160,000**
REP-155	University Avenue	North 20th Street to North Washington Street	State of Good Repair	Reconstruct	City of Grand Forks	32.5	**$2,000,000**
REP-156	University Avenue	North Washington Street to North 3rd Street	State of Good Repair	Reconstruct	City of Grand Forks	32.5	**$3,149,619**
DIS-034	42nd St	17th Ave to 29th Ave	Discretionary	Expand to 4 lanes	City of Grand Forks	32.5	**$5,946,999**
DIS-038	Columbia Road	55th Avenue to 62nd Avenue	Discretionary	Roadway Upgrades	City of Grand Forks	32.5	**$7,400,000**
REP-056	N 51st Street	Gateway Drive (US 2) to 10th Avenue North	State of Good Repair	Reconstruct	City of Grand Forks	30	**$1,040,000**
REP-057	N 51st Street	10th Avenue North to 6th Avenue North	State of Good Repair	Reconstruct	City of Grand Forks	30	**$1,120,000**
REP-058	N 51st Street	6th Avenue North to University Avenue	State of Good Repair	Reconstruct	City of Grand Forks	30	**$1,040,000**

2045 Plan: Illustrative Projects

Project Number	Roadway	Location	Project Type	Project Description	Lead Agency	Prioritization Score	Current Cost
REP-068	S 38th Street	South 42nd Street to 32nd Avenue South	State of Good Repair	Reconstruct	City of Grand Forks	30	**$400,000**
REP-071	Stanford Road	Gateway Drive (US 2) to 11th Avenue North	State of Good Repair	Reconstruct	City of Grand Forks	30	**$880,000**
REP-076	S 34th Street	DeMers Avenue to Duke Drive	State of Good Repair	Reconstruct	City of Grand Forks	30	**$960,000**
REP-077	S 34th Street	Duke Drive to 17th Avenue South	State of Good Repair	Reconstruct	City of Grand Forks	30	**$3,040,000**
REP-078	S 34th Street	17th Avenue South to 24th Avenue South	State of Good Repair	Reconstruct	City of Grand Forks	30	**$2,160,000**
REP-079	S 34th Street	24th Avenue South to 30th Avenue South	State of Good Repair	Reconstruct	City of Grand Forks	30	**$1,120,000**
REP-080	S 34th Street	30th Avenue South to 32nd Avenue South	State of Good Repair	Reconstruct	City of Grand Forks	30	**$720,000**
REP-084	S 20th Street	DeMers Avenue to 7th Avenue South	State of Good Repair	Reconstruct	City of Grand Forks	30	**$240,000**
REP-085	S 20th Street	7th Avenue South to Westward Drive	State of Good Repair	Reconstruct	City of Grand Forks	30	**$640,000**
REP-086	S 20th Street	Westward Drive to 17th Avenue South	State of Good Repair	Reconstruct	City of Grand Forks	30	**$2,720,000**
REP-087	S 20th Street	17th Avenue South to 24th Avenue South	State of Good Repair	Reconstruct	City of Grand Forks	30	**$2,112,000**
REP-090	Cherry Street	South 5th Street to 4th Avenue South	State of Good Repair	Reconstruct	City of Grand Forks	30	**$2,080,000**
REP-093	Cherry Street	32nd Avenue South to 40th Avenue South	State of Good Repair	Reconstruct	City of Grand Forks	30	**$2,400,000**

2045 Plan: Illustrative Projects

Project Number	Roadway	Location	Project Type	Project Description	Lead Agency	Prioritization Score	Current Cost
REP-101	N 3rd Street	8th Avenue North to University Avenue	State of Good Repair	Reconstruct	City of Grand Forks	30	**$1,600,000**
REP-103	N 6th Street	DeMers Avenue to University Avenue	State of Good Repair	Reconstruct	City of Grand Forks	30	**$880,000**
REP-104	Kittison Avenue	DeMers Avenue to South 3rd Street	State of Good Repair	Reconstruct	City of Grand Forks	30	**$1,040,000**
REP-108	University Avenue	North 55th Street to I-29 Overpass	State of Good Repair	Reconstruct	City of Grand Forks	30	**$3,040,000**
REP-111	4th Avenue South	DeMers Avenue to Cherry Street	State of Good Repair	Reconstruct	City of Grand Forks	30	**$629,924**
REP-113	8th Avenue South	South 10th Street to Walnut Street	State of Good Repair	Reconstruct	City of Grand Forks	30	**$1,680,000**
REP-115	13th Avenue South	South Columbia Road to South 19th Street	State of Good Repair	Reconstruct	City of Grand Forks	30	**$2,560,000**
REP-116	13th Avenue South	South 16th Street to South Washington Street	State of Good Repair	Reconstruct	City of Grand Forks	30	**$880,000**
REP-117	13th Avenue South	South Washington Street to South 10th Street	State of Good Repair	Reconstruct	City of Grand Forks	30	**$1,040,000**
REP-118	13th Avenue South	S 10th Street to Cherry Street	State of Good Repair	Reconstruct	City of Grand Forks	30	**$800,000**
REP-120	17th Avenue South	South 35th Street to South Columbia Road	State of Good Repair	Reconstruct	City of Grand Forks	30	**$2,699,674**
REP-121	17th Avenue South	South Columbia Road to Rider Road	State of Good Repair	Reconstruct	City of Grand Forks	30	**$1,169,859**
REP-122	17th Avenue South	Rider Road to South 20th Street	State of Good Repair	Reconstruct	City of Grand Forks	30	**$1,169,859**

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Project Number	Roadway	Location	Project Type	Project Description	Lead Agency	Prioritization Score	Current Cost
REP-124	24th Avenue South	South 42nd Street to South 34th Street	State of Good Repair	Reconstruct	City of Grand Forks	30	**$2,080,000**
REP-125	24th Avenue South	South 34th Street to South Columbia Road	State of Good Repair	Reconstruct	City of Grand Forks	30	**$1,760,000**
REP-126	24th Avenue South	South Columbia Road to South 20th Street	State of Good Repair	Reconstruct	City of Grand Forks	30	**$2,080,000**
REP-127	24th Avenue South	South 20th Street to South Washington Street	State of Good Repair	Reconstruct	City of Grand Forks	30	**$2,240,000**
REP-132	40th Avenue South	Clearview Drive to Belmont Road	State of Good Repair	Reconstruct	City of Grand Forks	30	**$2,160,000**
REP-138	Stanford Road	6th Avenue North to 11th Avenue North	State of Good Repair	Reconstruct	City of Grand Forks	30	**$1,120,000**
REP-139	North Columbia Road	Gateway Drive (US 2) to North Washington Street	State of Good Repair	Reconstruct	City of Grand Forks	30	**$12,900,000**
REP-140	N 20th Street	Gateway Drive (US 2) to University Avenue	State of Good Repair	Reconstruct	City of Grand Forks	30	**$3,120,000**
REP-141	S 20th Street	24th Avenue South to 32nd Avenue South	State of Good Repair	Reconstruct	City of Grand Forks	30	**$2,112,000**
REP-142	N 8th Street	University Avenue to DeMers Avenue	State of Good Repair	Reconstruct	City of Grand Forks	30	**$800,000**
REP-143	Cherry Street	4th Avenue South to 17th Avenue South	State of Good Repair	Reconstruct	City of Grand Forks	30	**$4,240,000**
REP-144	Cherry Street	28th Avenue South to 32nd Avenue South	State of Good Repair	Reconstruct	City of Grand Forks	30	**$1,040,000**
REP-145	Belmont Road	South 5th Street to 17th Avenue South	State of Good Repair	Reconstruct	City of Grand Forks	30	**$5,624,320**

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Project Number	Roadway	Location	Project Type	Project Description	Lead Agency	Prioritization Score	Current Cost
REP-146	Belmont Road	Park Drive to 32nd Avenue South	State of Good Repair	Reconstruct	City of Grand Forks	30	**$3,329,597**
REP-147	Belmont Road	47th Avenue South to 62nd Avenue South	State of Good Repair	Reconstruct	City of Grand Forks	30	**$4,240,000**
REP-148	N 3rd Street	Gateway Drive (US 2) to 8th Avenue North	State of Good Repair	Reconstruct	City of Grand Forks	30	**$1,280,000**
REP-149	Adams Drive	Adams Drive to 62nd Avenue South	State of Good Repair	Reconstruct	City of Grand Forks	30	**$2,400,000**
REP-150	8th Avenue North	N Columbia Road to North 25th Street	State of Good Repair	Reconstruct	City of Grand Forks	30	**$720,000**
REP-151	8th Avenue North	N Washington Street to North 3rd Street	State of Good Repair	Reconstruct	City of Grand Forks	30	**$1,360,000**
REP-157	4th Avenue South	Chery Street to Minnesota Avenue	State of Good Repair	Reconstruct	City of Grand Forks	30	**$989,880**
REP-159	8th Avenue South	Walnut Street to Belmont Road	State of Good Repair	Reconstruct	City of Grand Forks	30	**$560,000**
REP-160	13th Avenue South	South 16th Street to South 14th Street	State of Good Repair	Reconstruct	City of Grand Forks	30	**$1,520,000**
REP-161	13th Avenue South	Cherry Street to Belmont Road	State of Good Repair	Reconstruct	City of Grand Forks	30	**$1,360,000**
REP-162	17th Avenue South	South 20th Street to South Washington Street	State of Good Repair	Reconstruct	City of Grand Forks	30	**$2,339,717**
REP-163	17th Avenue South	South 12th Street to Cherry Street	State of Good Repair	Reconstruct	City of Grand Forks	30	**$1,709,793**
REP-164	17th Avenue South	Cherry Street to Belmont Road	State of Good Repair	Reconstruct	City of Grand Forks	30	**$1,529,815**

2045 Plan: Illustrative Projects

Project Number	Roadway	Location	Project Type	Project Description	Lead Agency	Prioritization Score	Current Cost
REP-165	24th Avenue South	South Washington Street to Belmont Road	State of Good Repair	Reconstruct	City of Grand Forks	30	**$3,040,000**
REP-073	N 36th Street	20th Avenue North to 18th Avenue North	State of Good Repair	Concrete Pavement Rehabilitation (CPR) and Grind	City of Grand Forks	25	**$75,000**
REP-178	Gateway Dr N Frontage Road	North Columbia Road to North 36th Street	State of Good Repair	Concrete Pavement Rehabilitation (CPR) and Grind	City of Grand Forks	25	**$381,250**
REP-180	Gateway Dr N Frontage Road	North 36th Street to North 42nd Street	State of Good Repair	Concrete Pavement Rehabilitation (CPR) and Grind	City of Grand Forks	25	**$212,500**
REP-182	Gateway Dr N Frontage Road	North 42nd Street to I-29	State of Good Repair	Concrete Pavement Rehabilitation (CPR) and Grind	City of Grand Forks	25	**$106,250**
REP-183	Gateway Dr N Frontage Road	I-29 to North 48th Street	State of Good Repair	Concrete Pavement Rehabilitation (CPR) and Grind	City of Grand Forks	25	**$100,000**
REP-184	Gateway Dr N Frontage Road	North 48th Street to North 51st Street	State of Good Repair	Concrete Pavement Rehabilitation (CPR) and Grind	City of Grand Forks	25	**$125,000**
REP-185	Gateway Dr N Frontage Road	North 51st Street to North 55th Street	State of Good Repair	Concrete Pavement Rehabilitation (CPR) and Grind	City of Grand Forks	25	**$200,000**
REP-186	Gateway Dr S Frontage Road	North 51st Street to North 55th Street	State of Good Repair	Concrete Pavement Rehabilitation (CPR) and Grind	City of Grand Forks	25	**$193,750**
REP-188	Mill Road	Seward Ave to Bacon Rd	State of Good Repair	Mill and Overlay	City of Grand Forks	25	**$500,000**
DIS-029	University Avenue	North 55th Street to North 58th Street	Discretionary	New 2 Lane Roadway Extension	City of Grand Forks	25	**$1,174,000**
DIS-036	Cherry Street	62nd Avenue South to 66th Avenue South	Discretionary	New 2 Lane Road Extension	City of Grand Forks	25	**$1,034,000**
REP-065	42nd Street	University Avenue to 17th Avenue South	State of Good Repair	Concrete Pavement Rehabilitation (CPR) and Grind	City of Grand Forks	17.5	**$942,074**

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Project Number	Roadway	Location	Project Type	Project Description	Lead Agency	Prioritization Score	Current Cost
REP-066	S 42nd Street	17th Avenue South to 29th Avenue South	State of Good Repair	Concrete Pavement Rehabilitation (CPR) and Grind	City of Grand Forks	17.5	**$500,000**
REP-054	N 55th Street	Gateway Drive (US 2) to University Avenue	State of Good Repair	Concrete Pavement Rehabilitation (CPR) and Grind	City of Grand Forks	15	**$475,000**
REP-055	N 55th Street	University Avenue to DeMers Avenue	State of Good Repair	Concrete Pavement Rehabilitation (CPR) and Grind	City of Grand Forks	15	**$187,500**
REP-059	N 48th Street	17th Avenue North to Gateway Drive (US 2)	State of Good Repair	Concrete Pavement Rehabilitation (CPR) and Grind	City of Grand Forks	15	**$175,000**
REP-062	S 48th Street	15th Avenue South to 32nd Avenue South	State of Good Repair	Concrete Pavement Rehabilitation (CPR) and Grind	City of Grand Forks	15	**$812,500**
REP-063	N 42nd Street	27th Avenue North to Gateway Drive (US 2)	State of Good Repair	Concrete Pavement Rehabilitation (CPR) and Grind	City of Grand Forks	15	**$662,500**
REP-064	N 42nd Street	Gateway Drive (US 2) to University Avenue	State of Good Repair	Concrete Pavement Rehabilitation (CPR) and Grind	City of Grand Forks	15	**$942,074**
REP-069	S 38th Street	32nd Avenue South to 36th Avenue South	State of Good Repair	Concrete Pavement Rehabilitation (CPR) and Grind	City of Grand Forks	15	**$175,000**
REP-070	S 38th Street	36th Avenue South to 40th Avenue South	State of Good Repair	Concrete Pavement Rehabilitation (CPR) and Grind	City of Grand Forks	15	**$150,000**
REP-072	Stanford Road	6th Avenue North to University Avenue	State of Good Repair	Concrete Pavement Rehabilitation (CPR) and Grind	City of Grand Forks	15	**$150,000**
REP-081	S 34th Street	32nd Avenue South to 36th Avenue South	State of Good Repair	Concrete Pavement Rehabilitation (CPR) and Grind	City of Grand Forks	15	**$162,500**
REP-082	S 34th Street	36th Avenue South to Rummelle Rd	State of Good Repair	Concrete Pavement Rehabilitation (CPR) and Grind	City of Grand Forks	15	**$75,000**
REP-083	S 34th Street	Rummelle Rd to 45th Avenue South	State of Good Repair	Concrete Pavement Rehabilitation (CPR) and Grind	City of Grand Forks	15	**$325,000**

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Project Number	Roadway	Location	Project Type	Project Description	Lead Agency	Prioritization Score	Current Cost
REP-088	S 20th Street	32nd Avenue South to 40th Avenue South	State of Good Repair	Concrete Pavement Rehabilitation (CPR) and Grind	City of Grand Forks	15	**$330,000**
REP-089	S 20th Street	40th Avenue South to 47th Avenue South	State of Good Repair	Concrete Pavement Rehabilitation (CPR) and Grind	City of Grand Forks	15	**$330,000**
REP-091	Cherry Street	17th Avenue South to 25th Avenue South	State of Good Repair	Concrete Pavement Rehabilitation (CPR) and Grind	City of Grand Forks	15	**$375,000**
REP-092	Cherry Street	25th Avenue South to 28th Avenue South	State of Good Repair	Concrete Pavement Rehabilitation (CPR) and Grind	City of Grand Forks	15	**$162,500**
REP-094	Cherry Street	40th Avenue South to 47th Avenue South	State of Good Repair	Concrete Pavement Rehabilitation (CPR) and Grind	City of Grand Forks	15	**$287,500**
REP-095	Cherry Street	47th Avenue South to SED	State of Good Repair	Concrete Pavement Rehabilitation (CPR) and Grind	City of Grand Forks	15	**$187,500**
REP-096	Cherry Street	SED to 55th Avenue South	State of Good Repair	Concrete Pavement Rehabilitation (CPR) and Grind	City of Grand Forks	15	**$150,000**
REP-097	Cherry Street	55th Avenue South to 58th Avenue South	State of Good Repair	Concrete Pavement Rehabilitation (CPR) and Grind	City of Grand Forks	15	**$112,500**
REP-098	Belmont Road	17th Avenue South to Park Drive	State of Good Repair	Concrete Pavement Rehabilitation (CPR) and Grind	City of Grand Forks	15	**$200,000**
REP-099	Belmont Road	32nd Avenue South to 47th Avenue South	State of Good Repair	Concrete Pavement Rehabilitation (CPR) and Grind	City of Grand Forks	15	**$650,000**
REP-100	N 4th Street	Gateway Drive (US 2) to University Avenue	State of Good Repair	Concrete Pavement Rehabilitation (CPR) and Grind	City of Grand Forks	15	**$450,000**
REP-102	S 3rd Street	Division Avenue to Minnesota Avenue	State of Good Repair	Concrete Pavement Rehabilitation (CPR) and Grind	City of Grand Forks	15	**$137,500**
REP-105	8th Avenue North	North 25th Street to North Washington Street	State of Good Repair	Concrete Pavement Rehabilitation (CPR) and Grind	City of Grand Forks	15	**$537,500**

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Project Number	Roadway	Location	Project Type	Project Description	Lead Agency	Prioritization Score	Current Cost
REP-106	6th Avenue North	42nd Street to State Street	State of Good Repair	Concrete Pavement Rehabilitation (CPR) and Grind	City of Grand Forks	15	**$175,000**
REP-107	6th Avenue North	State Street to North Columbia Road	State of Good Repair	Concrete Pavement Rehabilitation (CPR) and Grind	City of Grand Forks	15	**$487,500**
REP-109	University Avenue	I-29 Overpass to North 42nd Street	State of Good Repair	Concrete Pavement Rehabilitation (CPR) and Grind	City of Grand Forks	15	**$137,500**
REP-110	University Avenue	North 42nd Street to State Street	State of Good Repair	Concrete Pavement Rehabilitation (CPR) and Grind	City of Grand Forks	15	**$182,790**
REP-112	8th Avenue South	South Washington Street to South 10th Street	State of Good Repair	Concrete Pavement Rehabilitation (CPR) and Grind	City of Grand Forks	15	**$137,500**
REP-114	11th Avenue South	South 42nd Street to South 30th Street	State of Good Repair	Concrete Pavement Rehabilitation (CPR) and Grind	City of Grand Forks	15	**$437,500**
REP-119	17th Avenue South	South 42nd Street to South 35th Street	State of Good Repair	Concrete Pavement Rehabilitation (CPR) and Grind	City of Grand Forks	15	**$287,500**
REP-123	20th Avenue South	South Columbia Road to South 20th Street	State of Good Repair	Concrete Pavement Rehabilitation (CPR) and Grind	City of Grand Forks	15	**$325,000**
REP-128	40th Avenue South	South 38th Street to Rummelle Road	State of Good Repair	Concrete Pavement Rehabilitation (CPR) and Grind	City of Grand Forks	15	**$237,500**
REP-129	40th Avenue South	Rummelle Road to South 20th Street	State of Good Repair	Concrete Pavement Rehabilitation (CPR) and Grind	City of Grand Forks	15	**$525,000**
REP-130	40th Avenue South	South 20th Street to South Washington Street	State of Good Repair	Concrete Pavement Rehabilitation (CPR) and Grind	City of Grand Forks	15	**$375,000**
REP-131	40th Avenue South	South Washington Street to Clearview Drive	State of Good Repair	Concrete Pavement Rehabilitation (CPR) and Grind	City of Grand Forks	15	**$175,000**
REP-133	47th Avenue South	South Columbia Road to South Washington Street	State of Good Repair	Concrete Pavement Rehabilitation (CPR) and Grind	City of Grand Forks	15	**$662,500**

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Project Number	Roadway	Location	Project Type	Project Description	Lead Agency	Prioritization Score	Current Cost
REP-134	47th Avenue South	South Washington Street to Belmont Road	State of Good Repair	Concrete Pavement Rehabilitation (CPR) and Grind	City of Grand Forks	15	**$662,500**
REP-135	55th Avenue South	South Washington Street to Cherry Street	State of Good Repair	Concrete Pavement Rehabilitation (CPR) and Grind	City of Grand Forks	15	**$237,500**
REP-136	55th Avenue South	Cherry Street to Belmont Road	State of Good Repair	Concrete Pavement Rehabilitation (CPR) and Grind	City of Grand Forks	15	**$275,000**
REP-137	Adams Drive	Belmont Road to Shady Ridge Court	State of Good Repair	Concrete Pavement Rehabilitation (CPR) and Grind	City of Grand Forks	15	**$412,500**
REP-166	S Washington Street E Frontage Rd	Hammerling Avenue to 17th Avenue South	State of Good Repair	Concrete Pavement Rehabilitation (CPR) and Grind	City of Grand Forks	15	**$93,750**
REP-167	S Washington Street W Frontage Rd	Hammerling Avenue to 17th Avenue South	State of Good Repair	Concrete Pavement Rehabilitation (CPR) and Grind	City of Grand Forks	15	**$143,750**
REP-168	S Washington Street E Frontage Rd	17th Avenue South to 24th Avenue South	State of Good Repair	Concrete Pavement Rehabilitation (CPR) and Grind	City of Grand Forks	15	**$256,250**
REP-169	S Washington Street W Frontage Rd	17th Avenue South to 24th Avenue South	State of Good Repair	Concrete Pavement Rehabilitation (CPR) and Grind	City of Grand Forks	15	**$281,250**
REP-170	S Washington Street E Frontage Rd	24th Avenue South to 32nd Avenue South	State of Good Repair	Concrete Pavement Rehabilitation (CPR) and Grind	City of Grand Forks	15	**$318,750**
REP-171	S Washington Street W Frontage Rd	24th Avenue South to 32nd Avenue South	State of Good Repair	Concrete Pavement Rehabilitation (CPR) and Grind	City of Grand Forks	15	**$243,750**
REP-172	S Washington Street E Frontage Rd	32nd Avenue South to 36th Avenue South	State of Good Repair	Concrete Pavement Rehabilitation (CPR) and Grind	City of Grand Forks	15	**$137,500**

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Project Number	Roadway	Location	Project Type	Project Description	Lead Agency	Prioritization Score	Current Cost
REP-173	S Washington Street W Frontage Rd	32nd Avenue South to 36th Avenue South	State of Good Repair	Concrete Pavement Rehabilitation (CPR) and Grind	City of Grand Forks	15	**$62,500**
REP-174	DeMers Avenue S Frontage Road	South Washington Street to South 20th Street	State of Good Repair	Concrete Pavement Rehabilitation (CPR) and Grind	City of Grand Forks	15	**$293,750**
REP-175	DeMers Avenue S Frontage Road	South 20th Street to Columbia Road Overpass	State of Good Repair	Concrete Pavement Rehabilitation (CPR) and Grind	City of Grand Forks	15	**$250,000**
REP-177	DeMers Avenue S Frontage Road	South 30th Street to South 34th Street	State of Good Repair	Concrete Pavement Rehabilitation (CPR) and Grind	City of Grand Forks	15	**$206,250**
REP-179	Gateway Dr S Frontage Road	North Columbia Road to Stanford Road	State of Good Repair	Concrete Pavement Rehabilitation (CPR) and Grind	City of Grand Forks	15	**$68,750**
REP-181	Gateway Dr S Frontage Road	Stanford Road to North 42nd Street	State of Good Repair	Concrete Pavement Rehabilitation (CPR) and Grind	City of Grand Forks	15	**$193,750**
REP-189	Stanford Road	14th Avenue North to 11th Avenue North	State of Good Repair	Major Rehabilitation	City of Grand Forks	15	**$50,000**
DIS-002	DeMers Avenue	at County Road 5	Discretionary	New Signal and Turn Lanes	Grand Forks County	47.5	**$1,350,000**

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Project Number	Roadway	Location	Project Type	Project Description	Lead Agency	Prioritization Score	Current Cost
DIS-030	47th Avenue South	County Road 5 (16th Street NE) to I-29	Discretionary	Construct New Roadway	Grand Forks County	35	**$5,000,000**
REP-005B	CR 4 (Demers Ave)	County Road 5 (16th Street NE) to N 58th Street	State of Good Repair	Mill & Overlay	Grand Forks County	32.5	**$700,000**
REP-034A	County Road 81 (S Washington Street)	CR 6 (12th Avenue NE) to 62nd Avenue South	State of Good Repair	Mill & Overlay	Grand Forks County	30	**$250,000**
DIS-009	32nd Avenue	at County Road 5	Discretionary	New Signal and Turn Lanes	Grand Forks County	30	**$1,350,000**
DIS-043	North Bypass Truck Route	North of Gateway Dr	Discretionary	Evaluate long-term need for bypass	Grand Forks County	25	**TBD**
REP-014A	CR 6 (12th Avenue NE)	County Road 5 (16th Street NE) to I-29	State of Good Repair	Mill & Overlay	Grand Forks County	15	**$1,500,000**
REP-017A	CR 6 (12th Avenue NE)	I-29 to County Road 81 (S Washington Street)	State of Good Repair	Mill & Overlay	Grand Forks County	15	**$375,000**
REP-021A	CR 6 (12th Avenue NE)	CR 81 (S Washington Street) to CR 8 (9th Street NE)	State of Good Repair	Mill & Overlay	Grand Forks County	15	**$250,000**

2045 Plan: Illustrative Projects

Project Number	Roadway	Location	Project Type	Project Description	Lead Agency	Prioritization Score	Current Cost
DIS-015	Central Ave	17th St to 23rd St	Discretionary	Construct multi-purpose paths/crosswalks, install traffic signal at 23rd St and 4-lane to 2-lane transition	MnDOT	60	**$2,575,000**
DIS-012	TH 220	East Intersection with US 2	Discretionary	Signalize intersection with connection to new bridge connection	MnDOT	47.5	**$379,596**
DIS-001	Gateway Dr	at Central Ave	Discretionary	Improve intersection with right turn lane and acceleration/merge lane modifications and signal timing	MnDOT	47.5	**$1,000,000**
DIS-026	TH 220	S of TH 2 to Southern MPO Limits	Discretionary	Reconstruct	MnDOT	45	**$10,600,000**

2045 Plan: Illustrative Projects

Project Number	Roadway	Location	Project Type	Project Description	Lead Agency	Prioritization Score	Current Cost
DIS-052	32nd Avenue	Red River Crossing (River Crossing Amendment Study)	Discretionary	Construct new bridge	Multiple	40	**$33,000,000**
DIS-054	Merrifield Road	Red River Crossing (River Crossing Amendment Study)	Discretionary	Construct new bridge	Multiple	25	**$35,000,000**

2045 Plan: Illustrative Projects

Project Number	Roadway	Location	Project Type	Project Description	Lead Agency	Prioritization Score	Current Cost
DIS-004	Washington St	5th Ave S to 7th Ave S	Discretionary	Full pavement reconstruction with continuous flow intersection (CFI) at DeMers Ave	NDDOT	62.5	**$11,716,269**
DIS-013	Gateway Drive	Washington Street to Mill Road	Discretionary	Reconstruction, Turn Lanes, Remove Skews and Replace Traffic Signals	NDDOT	62.5	**$25,000,000**
DIS-003	Gateway Dr	Cambridge St (RE Arena Entrance)to Columbia Rd	Discretionary	Reconstruct intersection at Columbia Rd, signalize intersection at entrance to arena and remove north frontage road access at arena entrance (see traffic study)	NDDOT	62.5	**$4,264,000**
DIS-046	Gateway Drive	East of Interstate 29	Discretionary	Railroad Grade Separation	NDDOT	60	**$28,300,000**
DIS-044	Interstate 29	at North Washington Street	Discretionary	Upgrade to Existing Interchange	NDDOT	50	**$5,980,000**
DIS-045	Interstate 29	at Gateway Drive	Discretionary	Upgrade to Existing Interchange (NE Loop and Other Upgrades)	NDDOT	50	**$6,342,000**
DIS-048	Interstate 29	at DeMers Avenue	Discretionary	Upgrade to Existing Interchange	NDDOT	50	**$7,400,000**
DIS-049	Interstate 29	at 32nd Avenue	Discretionary	Upgrade to Existing Interchange	NDDOT	50	**$915,000**
DIS-017	US 2/Gateway Drive	55th Street to 69th Street	Discretionary	Rural to Urban Section Upgrade	NDDOT	47.5	**$10,000,000**
DIS-018	US Highway 2	GF I-29 to Columbia Road	Discretionary	Reconstruct Both Directions	NDDOT	47.5	**$6,640,900**

2045 Plan: Illustrative Projects

Project Number	Roadway	Location	Project Type	Project Description	Lead Agency	Prioritization Score	Current Cost
DIS-019	US Highway 2	Gateway Drive/Columbia Road to Red River	Discretionary	Reconstruct Both Directions	NDDOT	47.5	**$7,197,400**
DIS-024	NDDOT 297	GF DeMers Avenue (Bus US 81 to Bus US 2)	Discretionary	Reconstruct Both Directions	NDDOT	47.5	**$7,950,000**
REP-222	US 2 (Gateway Drive)	8 MI East of Grand Forks AFB to 2 MI West of Columbia Rd	State of Good Repair	Mill & HBP 3"	NDDOT	32.5	
DIS-025	Interstate 29	N of ND 15 to Near 32nd Avenue GF	Discretionary	CPR & Grind Southbound	NDDOT	32.5	**$2,688,960**
DIS-005	Gateway Dr	42nd St to 43rd St	Discretionary	Extend full-width EB and WB turn lanes	NDDOT	32.5	**$1,000,000**
DIS-014	Gateway Drive	at 69th Street (Northern Plains Nitrogen Development)	Discretionary	Roadway Upgrades	NDDOT	32.5	**$2,670,000**
REP-258B	US 81 Business	32nd Avenue South Grand Forks (STA 14 to 95) 4 LN	State of Good Repair	CPR & Grind	NDDOT	30	**$680,240**
REP-259B	US 81 Business	32nd Avenue South Grand Forks (STA 95 to S. Washington) 5 LN	State of Good Repair	CPR & Grind	NDDOT	30	**$195,360**