Sheyenne Street Corridor Study

Phase I: Sheyenne Street and 52nd Avenue

FINAL REPORT

West Fargo, North Dakota

2016

moore engineering, inc.

KLJ

Glossary of Commonly Used Terms

2012 Demographic Forecast Study: The 2012 Demographic Forecast Study was completed by Metro COG for use in the 2040 Long Range Transportation Plan. This study evaluates census population, housing and economic outputs to forecast 2020 and 2040 socioeconomic and demographic statistics.

Access Management: Access management is the process of balancing acceptable access to land uses while maintaining roadway safety and mobility by control access location, design, spacing and operation.

American Association of State Highway and Transportation Officials (AASHTO): The American Association of State Highway and Transportation Officials sets specifications, protocols and guidelines to be used in highway design and construction in the United States.

Americans with Disabilities Act of 1990 (ADA): This is a civil rights law which prohibits discrimination based on disability. It requires reasonable accommodations and imposes accessibility requirements on public accommodations. As it relates to transportation, reasonable accommodation would include curb ramps, detectable warning signs, wide sidewalks, minimal slopes, etc.

Average Daily Traffic (ADT): Average Daily Traffic is the number of cars using a given segment of roadway on an average day.

Crash Modification Factors: A crash modification factor is used to compute the expected number of crashes after implementing an improvement at specific site.

Categorical Exclusions (CE): A categorical exclusion is a category of actions which do not individually or cumulatively have a significant effect on the human environment and for which, therefore, neither an environmental assessment nor an environmental impact statement is required.

Environmental Justice: Environmental justice seeks to avoid, minimize or mitigate disproportionately high and adverse human health and environmental effects, including social and economic effects on minority and low-income populations.

Environmental Protection Agency (EPA): The federal regulatory agency responsible for administering and enforcing federal environmental laws.

Federal Highway Administration (FHWA): The Federal Highway Administration is a division of the United States Department of Transportation oversees federal funds for roadway construction and maintenance as well as performing and sponsoring research in the areas of roadway safety, congestion, highway materials and construction methods.

Highway Capacity Manual (HCM): The Highway Capacity Manual is produced by the Transportation Research Board of the National Academies of Science. It provides concepts, guidelines and computations to estimate the capacity and quality of service for various roadway facilities, now including transit, pedestrians and bicycle facilities.

Intelligent Transportation Systems (ITS): Intelligent Transportation Systems is the application of advanced technologies to improve the efficiency and safety of transportation systems.

Interstate Maintenance (IM): The Interstate Maintenance program provides funding for resurfacing, restoring, rehabilitating and reconstructing most routes on the Interstate System.

Institute of Transportation Engineers (ITE): The Institute of Transportation Engineers is an international education and scientific association of transportation professionals who are responsible for meeting mobility and safety needs.

Glossary of Commonly Used Terms

Level of Service (LOS): Level of Service is a qualitative measure used to relate the quality of service for a given transportation network. It often reflects the ease of traffic flow on a scale of "A" to "F", with free-flow being rated "A" and complete congestion "F".

Long Range Transportation Plan (LRTP): A long range transportation plan is the defining vision for the region's transportation systems and services. It indicates all of the transportation improvements scheduled for funding in the next 20 years.

Manual of Uniform Traffic Control Device (MUTCD): The Manual of Uniform Traffic Control Devices is a document issued by the Federal Highway Administration to specify the standards by which traffic signs, road surface markings and signals are designed, installed and used.

Metro COG: Metro COG is the regional policy body as required by the federal government for urbanized areas with populations over 50,000. It is responsible for carrying out the metropolitan transportation planning requirements of federal highway and transit legislation.

Moving Ahead for Progress in the 21st Century (MAP-21): The Moving Ahead for Progress in the 21st Century is a funding and authorization bill to govern United States federal surface transportation spending.

National Cooperative Highway Research Program (NCHRP): The National Cooperative Highway Research Program conducts research in areas affecting highway planning, design, construction, operation and maintenance in the United States. It is managed by the Transportation Research Board and supported by federal agencies, state departments of transportation and other nonprofit organizations.

National Environmental Policy Act (NEPA): Established a national environmental policy requiring that any project using federal funding or requiring federal approval examine the effects of proposed and alternative choices on the environment before a federal decision is made.

Pedestrian Refuge Island: A pedestrian refuge island is a small section of pavement or sidewalk where pedestrians can stop before finishing crossing a roadway.

Purpose and Need Statement (PNS): The Purpose and Need Statement briefly identifies and describes the proposed action and the transportation problem or other needs which it is intended to address.

Road Safety Audit (RSA): A road safety audit is a formal safety performance examination of an existing or future road or intersection by an independent, multidisciplinary team. It qualitatively estimates and reports on potential road safety issues and identifies opportunities for improvements in safety for all road users.

Recreational Trails Program (RTP): The Recreational Trails Program provides funds to the states to develop and maintain recreation trails and trail-related facilities for both non-motorized and motorized recreational trail uses.

Safe Routes to School Plan: Safe Routes to School Plans are specifically designed around schools to promote and encourage students to walk and bike to school to get the exercise they need.

State Transportation Improvement Plan (STIP): A State Transportation Improvement Program is a staged, multi-year, statewide, intermodal program of transportation projects, consistent with the statewide transportation plan and planning processes as well as metropolitan plans, Transportation Improvement Plans and processes.

Glossary of Commonly Used Terms

Surface Transportation Program (STP): Federal-aid highway funding program that funds a broad range of surface transportation capital needs, including many roads, transit, sea and airport access, vanpool, bicycle and pedestrian facilities.

Study Review Committee (SRC): The Study Review Committee is a group of stakeholders that performs technical review and advisory functions during the study development process.

Transportation Alternatives Program (TAP): The Transportation Alternatives Program was authorized under the Moving Ahead for Progress in the 21st Century bill which redefines the former Transportation Enhancement Activities and consolidates these programs with the former Safe Routes to School program.

Transportation Improvement Plan (TIP): A transportation improvement plan is a document prepared by a metropolitan planning organization that lists projects to be funded with federal funds for the next one- to three-year period.

Travel Demand Model (TDM): A travel demand model is a computer model that is used to estimate travel behavior and demand for a specific future time frame, based on a number of assumptions, like jobs or housing in a certain location.

Trip Generation: Trip generation predicts the number of trips originating or ending at a specific location.

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Executive Summary

Sheyenne Street is a vibrant corridor that follows the scenic Sheyenne River. Until 2009, Sheyenne Street was the only north-south arterial in West Fargo with access across I-94. The corridor has many diverse personalities, including acting as the city's central business district north of 7th Avenue, transitioning to a residential corridor with densely spaced driveways between 7th Avenue and I-94, an interstate interchange and finally a rural highway south of I-94. This varying roadway context results in a diverse range of needs including mobility, access and aesthetics. This study includes Sheyenne Street between 13th Avenue and 52nd Avenue and 52nd Avenue from the Sheyenne River Diversion to 4th Street. The study area is segregated into the following sections due to the varying context:

- North Sheyenne Street: Sheyenne Street from 13th Avenue to Beaton Drive
- I-94 Interchange: Sheyenne Street from Beaton Drive to 21st Avenue/Christianson Drive
- South Sheyenne Street: Sheyenne Street from 21st Avenue/Christianson Drive to 52nd Avenue
- 52nd Avenue: 52nd Avenue from the Sheyenne River Diversion to 4th Street

Summary of Existing and Future Conditions

Land Use and Traffic

The existing land use abutting Sheyenne Street is predominately residential. The unbalanced land use within the study area creates significant transportation challenges. With few places to work, shop or dine within reasonable walking or biking distance, vehicular traffic dominates the mode split in the area. This also contributes to the traffic congestion as motorists funnel out of the area in the morning and back in the evening.

Capacity

Under existing conditions, the corridor has some congested areas, but primarily operates efficiently in terms of delay per vehicle. Congestion on the corridor is primarily induced by bottlenecks at major intersections such as 32nd Avenue and the I-94 interchange, the only two locations where deficient levels of service (LOS) are currently experienced. The majority of the capacity issues are created by queued vehicles blocking adjacent lanes, limiting the overall capacity potential of the intersection. The corridor quickly becomes oversaturated in future models; operations at eleven intersections along the corridor fail. With full build-out anticipated to occur around 2020, this illustrates the need to add capacity to the corridor before gridlock ensues.

Crash Susceptibility

According to historic data, the study area experienced 38 crashes per year, including nine crashes per year resulting in an injury. There has been one fatality over the past three years. Crash rate analysis indicates that the intersection of Sheyenne Street and 32nd Avenue has a statistically significant crash rate. Detailed trend analysis indicates a direct correlation between corridor capacity and safety. Specifically, the majority of crashes along the corridor could be mitigated with capacity enhancements such as turn lanes, improved signal progression and intersection operations.

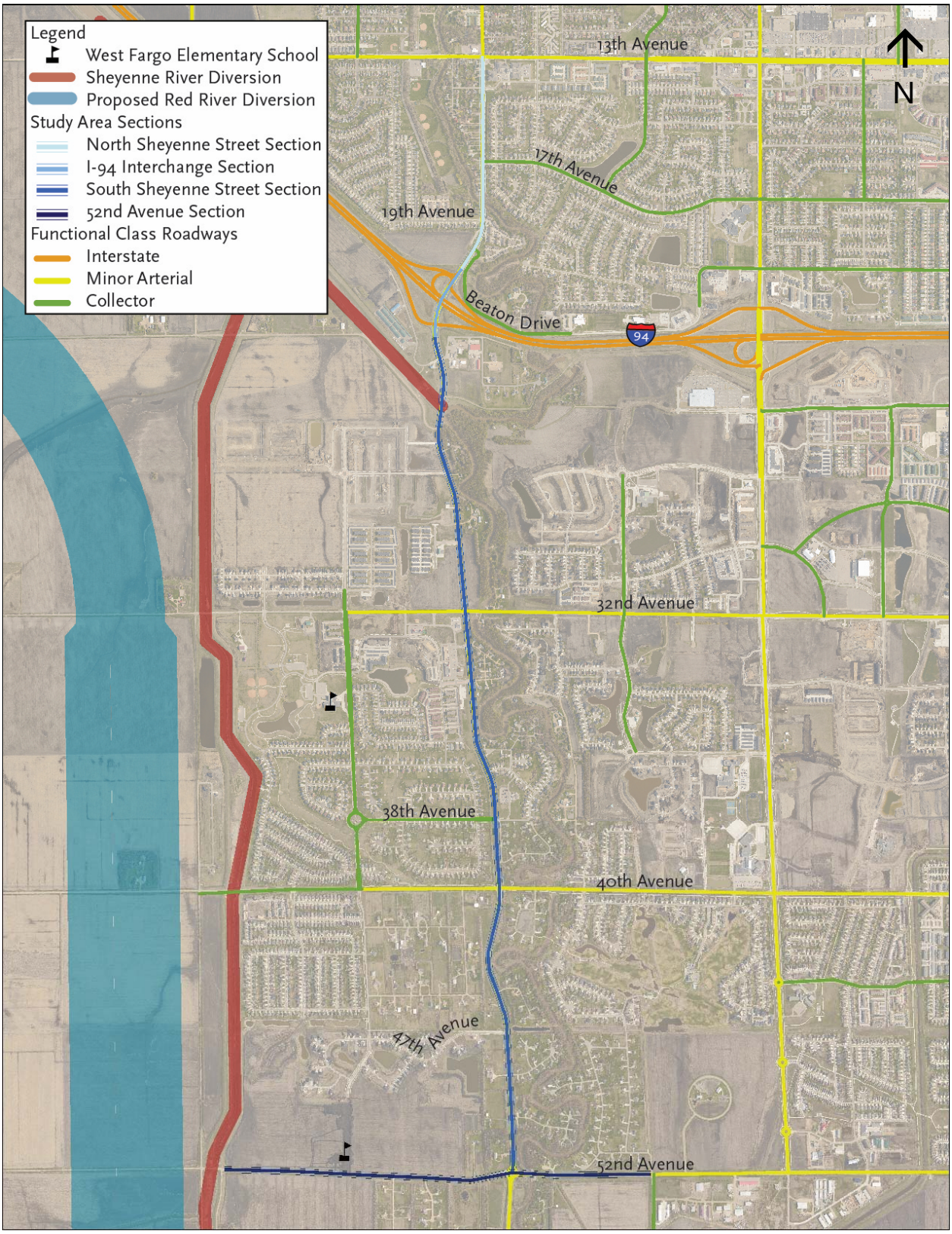
Pedestrian Accommodations

Studies have found that sidewalks reduce pedestrian crashes by an average of 88 percent, yet only ten percent of the study area has sidewalks on both sides of the street (FHWA, 2002). Furthermore, several locations with sidewalks have curb ramps that are not ADA compliant.

Bicycle Accommodations

The lack of off-street bicycle facilities south of I-94 is unappealing to novice cyclists as well as a safety concern for young cyclists traveling to-and-from the elementary schools in the study area.

FIGURE 1: STUDY AREA



Legacy Elementary School

Legacy Elementary School is located along 52nd Avenue in a platted yet undeveloped area of the study area. West Fargo city ordinances sidewalk requirements for new developments and planned improvements along 52nd Avenue south will provide a fully connected pedestrian and bicycle network leading up to the school. Many routes used by children walking or biking to and from school are hindered with connectivity gaps and high-speed, high-volume crossings.

Transit

A review of neighborhood generators, housing densities and trip origins and destinations in the study area suggest the Sheyenne Street corridor does not make an ideal candidate for hourly transit service. This analysis is supported by previous studies completed by Metro COG.

Access Density

Access management strategies have the potential to improve safety and traffic flow. A review of access spacing indicated the North Sheyenne Street study section exceeds the maximum allowable access points based on City of West Fargo ordinances; however, the majority of violations are between low-volume, low-risk access points. The desire to improve safety and traffic flow must be balanced with the need to provide reasonable access to all destinations along the corridor.

Roadway Alignment

Horizontal and vertical alignment deficiencies will require special attention during later phases of this project. However, preliminary horizontal alignments and key issues associated with vertical alignments were established as part of this study:

- Several locations where the roadway and river are in close proximity have experienced sliding in the past. The City of West Fargo has adopted ordinances requiring a minimum setback of 100 feet for any structure and river buffering standards that will be incorporated into final designs.
- Acquisitions of ROW will be required to meet current city standards, promote efficient maintenance and improve consistency with other similar corridors.
- Roadway improvements to 52nd Avenue west of Sheyenne Street, including realignment, will improve safety and pedestrian access to Legacy Elementary School.
- The Sheyenne Street and 24th Avenue intersection experiences sight distance limitations due to horizontal and vertical roadway alignment conflicts.
- During high water conditions, the Sheyenne Street corridor is an integral part of the city's river containment plan. Several areas along the corridor require a grade raise to provide protection during major flooding events.

Utilities

Coordinating potable and wastewater distribution and collection lines with roadway construction will help avoid later impacts to Sheyenne Street. This will include addressing two considerations during later stages of project development:

- Providing connections to residential areas serviced by rural water, wells and septic systems.
- Storm sewer improvements will be needed to accommodate drainage. If flood mitigation is incorporated into the designs, this corridor will require isolated storm drain lines discharging to the east and west.

Lighting

Currently, lighting is provided on Sheyenne Street. However, it will need to be improved to meet NDDOT lighting standards as part of any roadway improvement project. There is not currently lighting on 52nd Avenue. The section of 52nd Avenue east of Sheyenne Street met previous NDDOT lighting warrants that pertain to nighttime

crash patterns, but would not meet updated warrants until fully developed, improved to an urban section or if the City of West Fargo is willing to participate in cost sharing. The section of 52nd Avenue west of Sheyenne Street would meet warrants once fully developed, improved to urban section or if the City of West Fargo is willing to participate in cost sharing.

Infrastructure Conditions

Currently, roadways and bridges along the corridor are in fair condition or better with the exception of Sheyenne Street from the Sheyenne River Diversion bridge, south of I-94, to 32nd Avenue which is in poor condition. Although the remainder of the corridor is not in imminent need of rehabilitation, each roadway section will need periodic repair through 2040. No significant bridge work would likely be required during the study horizon.

Environmental Analysis

Preliminary environmental analysis showed no expected impacts to cultural resources, Section 4(f) properties or environmental justice areas. Preliminary noise analysis indicated noise abatement may be necessary. Three of the 14 identified wetlands along the corridor were jurisdictional and will need to be mitigated if disturbed.

Defining the Purpose and Need

The need for the proposed project along Sheyenne Street from 13th Avenue to 52nd Avenue and along 52nd Avenue from the Sheyenne River Diversion to 4th Street is driven by increasing motorist delay; congestion from development along the two corridors; safety concerns due to crash susceptibility and lack of multimodal opportunities. Current and projected needs within this corridor include capacity, social demands, economic development and safety.

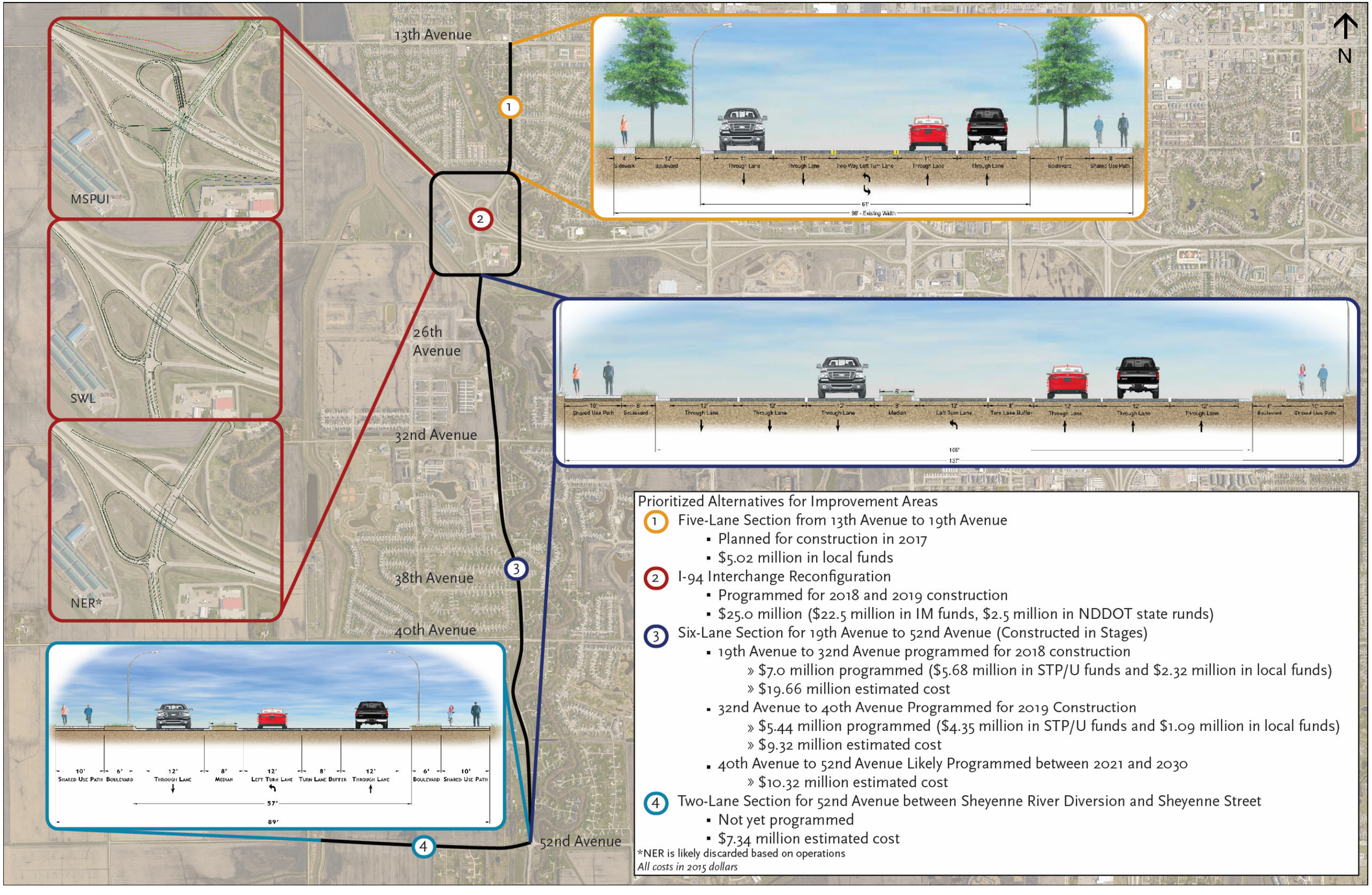
The purpose of the proposed project is to address capacity needs, safety issues and social and economic development along Sheyenne Street between 13th Avenue and 52nd Avenue, and along 52nd Avenue from the Sheyenne River Diversion to 4th Street.

Summary of Prioritized Improvements

A variety of solutions were prioritized throughout the study area for each of the study sections. These alternatives, along with other technically feasible alternatives, including a No-Build alternative, will be carried forward into the NEPA process.

- A five-lane section, including two through lanes in each direction and a two-way left-turn lane, from 13th Avenue to 19th Avenue on Sheyenne Street is to be constructed in 2017. A shared-use path and sidewalk combination, as it exists today, will continue to be used throughout this section.
- I-94 interchange reconfiguration with three through lanes in each direction plus turn lanes and merge lanes. This is programmed for 2018 and 2019 construction.
- A six-lane section, including three through lanes in each direction with turn lanes, medians where necessary and shared-use paths on both sides, from 19th Avenue to 32nd Avenue on Sheyenne Street programmed for construction in 2018. Sheyenne Street from 32nd Avenue to 40th Avenue will be constructed in 2019 and will likely occur in stages, with a four-lane section with turn lanes and medians constructed initially, with designs for six-lanes to be implemented once traffic demands warrant extra capacity. The section of South Sheyenne Street from 40th Avenue to 52nd Avenue will not be reconstructed in the next five years but is planned with a similar cross-section.
- A two-lane section, with one through lane in each direction with turn lanes, medians where necessary, a shared-use path on both sides and traffic control for crossings to Legacy Elementary, on 52nd Avenue from the Sheyenne River Diversion to Sheyenne Street. 52nd Avenue east of Sheyenne Street needs to be studied as part of a larger 52nd Avenue corridor study that extends to a logical termini, like 45th Street, where the current cross-section begins.

FIGURE 2: SUMMARY OF PRIORITIZED ALTERNATIVES



Prioritized Alternatives for Improvement Areas

1. Five-Lane Section from 13th Avenue to 19th Avenue
   - Planned for construction in 2017
   - $5.02 million in local funds
2. I-94 Interchange Reconfiguration
   - Programmed for 2018 and 2019 construction
   - $25.0 million ($22.5 million in IM funds, $2.5 million in NDDOT state runds)
3. Six-Lane Section for 19th Avenue to 52nd Avenue (Constructed in Stages)
   - 19th Avenue to 32nd Avenue programmed for 2018 construction
     - » $7.0 million programmed ($5.68 million in STP/U funds and $2.32 million in local funds)
     - » $19.66 million estimated cost
   - 32nd Avenue to 40th Avenue Programmed for 2019 Construction
     - » $5.44 million programmed ($4.35 million in STP/U funds and $1.09 million in local funds)
     - » $9.32 million estimated cost
   - 40th Avenue to 52nd Avenue Likely Programmed between 2021 and 2030
     - » $10.32 million estimated cost
4. Two-Lane Section for 52nd Avenue between Sheyenne River Diversion and Sheyenne Street
   - Not yet programmed
   - $7.34 million estimated cost

*NER is likely discarded based on operations

All costs in 2015 dollars

I) Project Background

Introduction

Sheyenne Street is a vibrant corridor that follows the scenic Sheyenne River. Until 2009, Sheyenne Street was the only north-south arterial in West Fargo with access across I-94. The corridor has many diverse personalities, including acting as the city's central business district north of 7th Avenue, transitioning to a residential corridor with densely spaced driveways between 7th Avenue and I-94, an interstate interchange and finally a rural highway south of I-94. This varying roadway context results in a diverse range of needs including mobility, access and aesthetics.

FIGURE I-1: VARYING ROADWAY CHARACTERISTICS

Increasing capacity, reducing crash susceptibility and improving multimodal opportunities along the Sheyenne Street corridor is paramount not only to those living along the corridor but also to the city's key decision makers. This urgency was highlighted by Mayor Rich Mattern's comments during the 2013 Fargo-Moorhead-West Fargo Chamber's State of the Cities event where he described the immediate need to improve the roadway.

Study Area

This study includes the sections of Sheyenne Street between 13th Avenue and 52nd Avenue and 52nd Avenue from the Sheyenne River Diversion to 4th Street. The study area is segregated into the following sections due to the varying context:

- North Sheyenne Street: Sheyenne Street from 13th Avenue to Beaton Drive
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- 52nd Avenue: 52nd Avenue from the Sheyenne River Diversion to 4th Street

FIGURE I-2: STUDY AREA

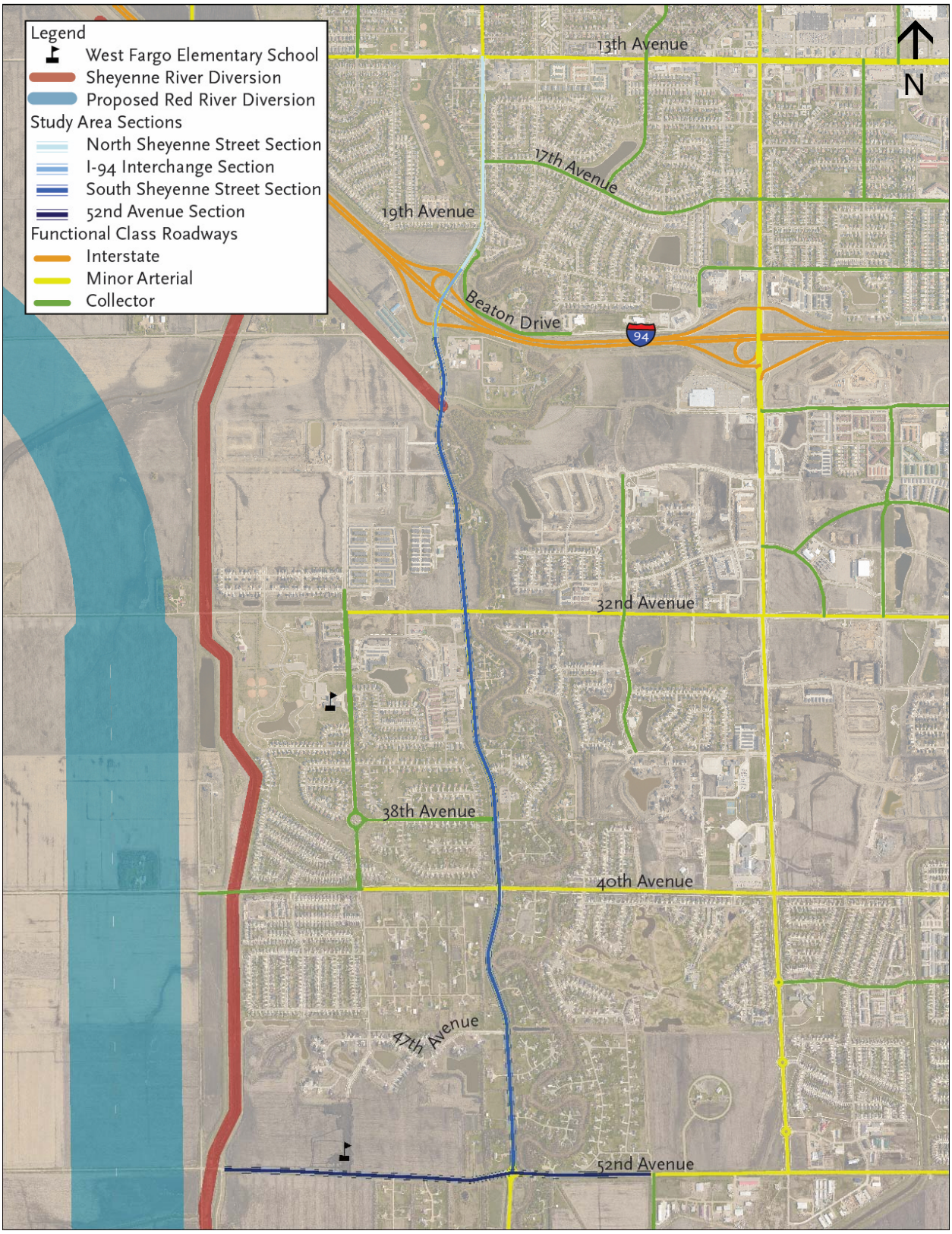


FIGURE I-3: NORTH SHEYENNE STREET STUDY SECTION

FIGURE I-4: I-94 INTERCHANGE FUNCTIONAL AREA STUDY SECTION

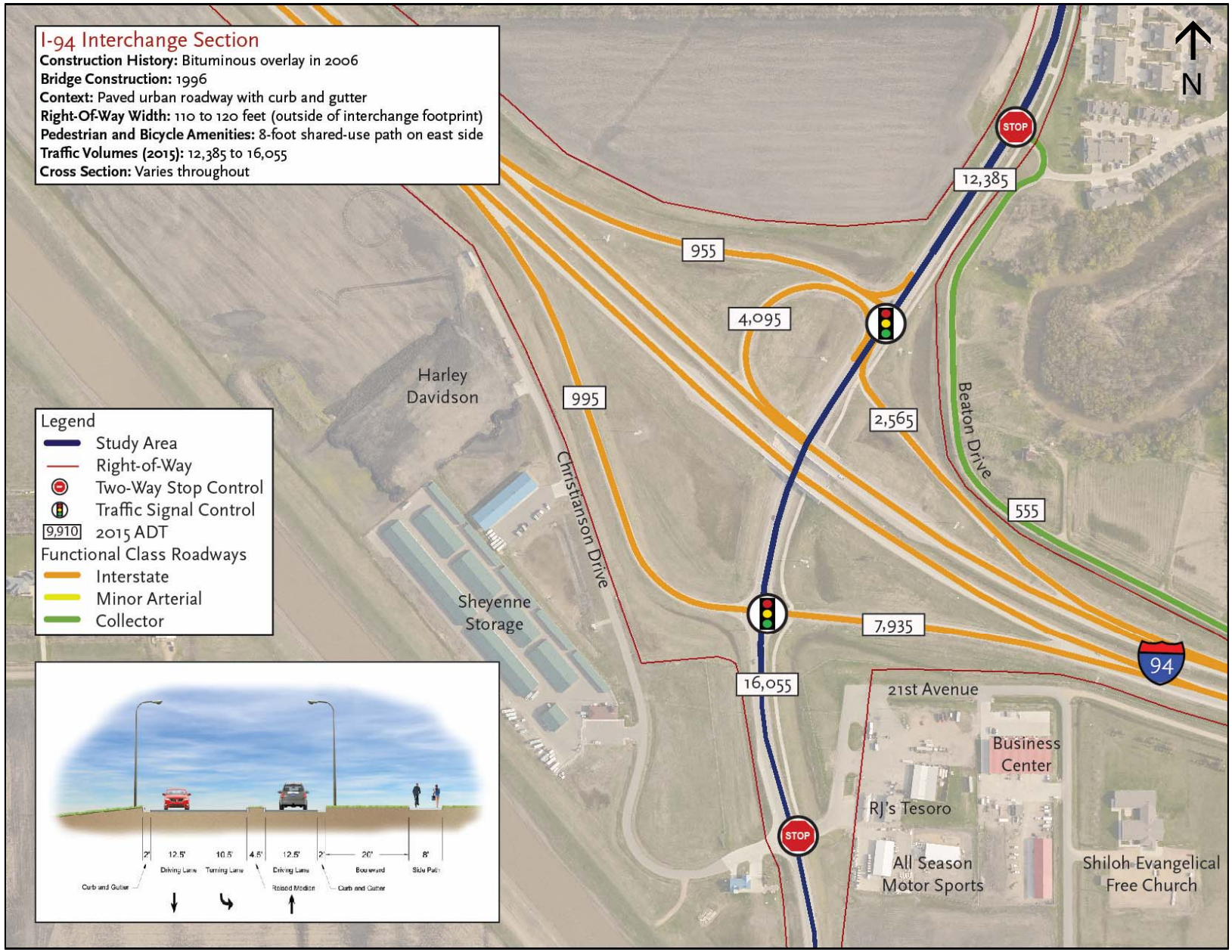


FIGURE I-5: SOUTH SHEYENNE STREET STUDY SECTION

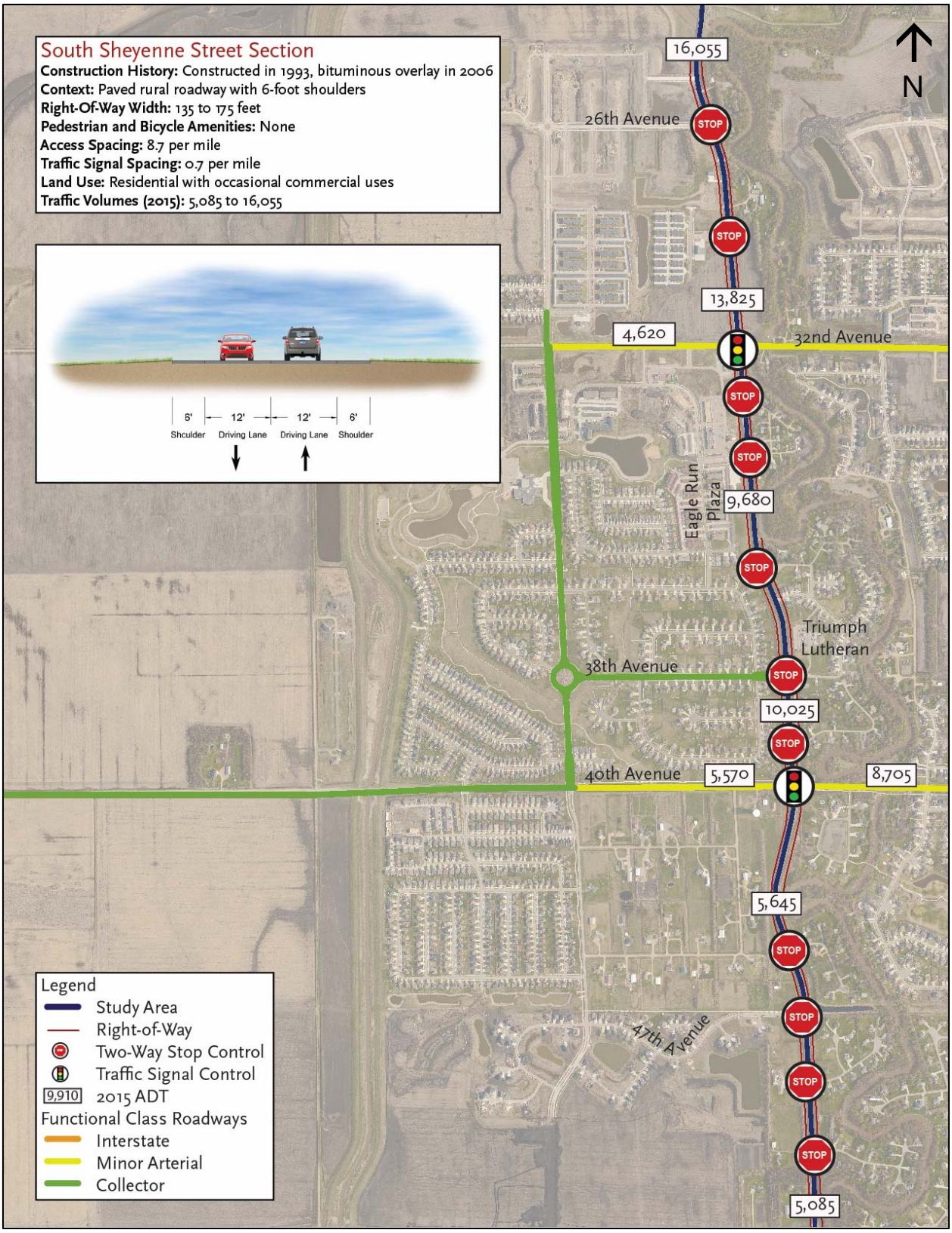
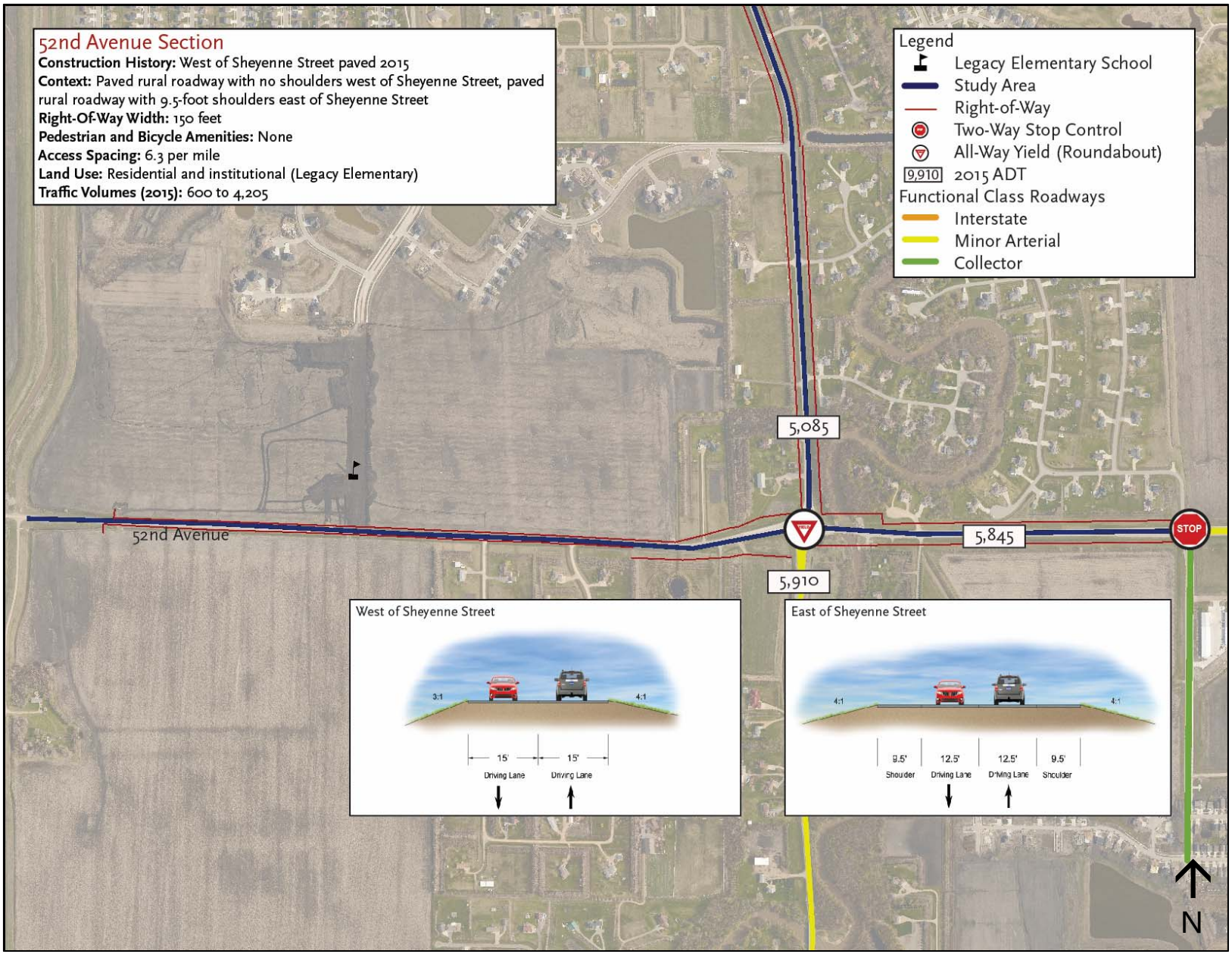


FIGURE I-6: 52ND AVENUE STUDY SECTION



Project Identification and Programming

The reconstruction and widening of the Sheyenne Street corridor from north of I-94 to 52nd Avenue was identified as one of the highest priorities of regional significance as part of Metro COG's 2040 *Long Range Transportation Plan* (LRTP).

The Metro COG *2016 to 2019 Transportation Improvement Pla*n (TIP) identified and programmed the following improvements for Sheyenne Street:

- Reconstruction from 19th Avenue to 32nd Avenue including new traffic control signals at 26th Avenue and 32nd Avenue. This project includes shared-use paths on both sides of the roadway. Programmed cost of $8.00 million with $5.68 million in federal funds from NDDOT STP/U funds and $2.32 million in local funds. Any costs that surpass the estimated programmed cost will be the City of West Fargo's responsibility. This project is programmed for 2018 construction.
- Reconstruction from 32nd Avenue to 40th Avenue including a new traffic control signal at 40th Avenue and shared-use path on both sides of the roadway. Programmed cost of $5.44 million with $4.35 in federal funds from NDDOT STP/U funds and $1.09 million in local funds. Any costs that surpass the estimated programmed cost will be the City of West Fargo's responsibility. This project is programmed for 2019 construction.

As part of developing the *2016 to 2019 State Transportation Improvement Program* (STIP), NDDOT programmed the reconstruction of the I-94 Interchange at Sheyenne Street as to correspond with the reconstruction of Sheyenne Street. The 2016 to 2019 STIP includes $25.00 million for the reconstruction of the I-94 Interchange, which includes incidental costs for median crossovers, structure replacements and ramp revisions. The 90 percent federal share is NDDOT Interstate Maintenance (IM) funds. The need to address geometric deficiencies at this location has been documented since at least 2008, when NDDOT completed the *Horace Road Interchange Traffic Operations Study*.

All costs are in 2015 dollars.

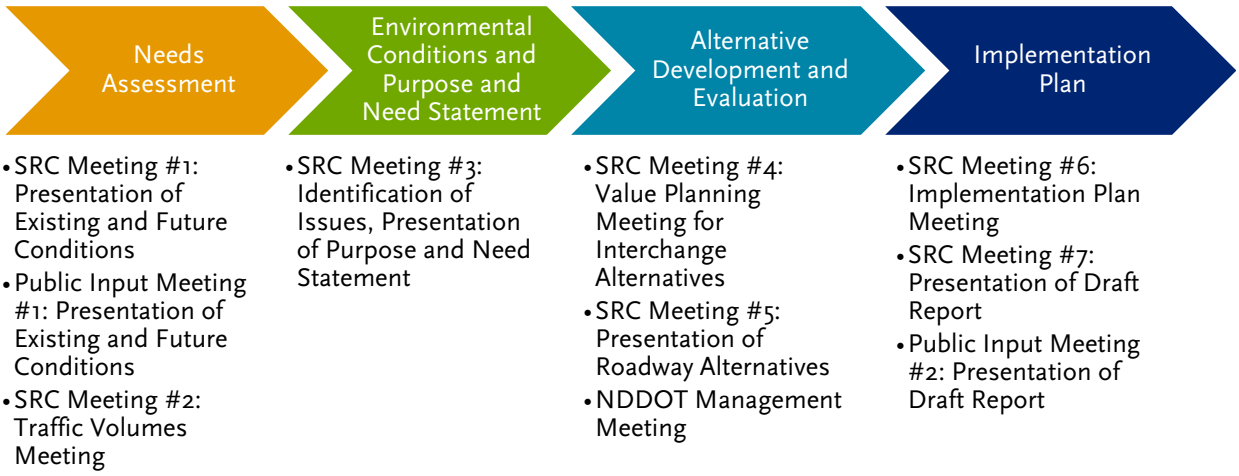
Project Phasing

The varying nature of issues and needs for Sheyenne Street necessitates two phases of study. The first phase evaluates Sheyenne Street from 13th Avenue south to 52nd Avenue, including a small section of 52nd Avenue. The second phase evaluates Sheyenne Street from Main Avenue to 13th Avenue. Both of these study phases were initiated independently with differing schedules. Phase I is slated for a December 2015 completion while Phase II will be completed in May 2016. This report will be officially finalized upon completion of Phase II.

II) Summary of Public Input

The study approach was a four-part process. Each step is detailed within its respective chapter or associated appendix. Figure II-1 below highlights the process.

FIGURE II-1: STUDY APPROACH



The public involvement process throughout the study included multiple Study Review Committee (SRC) meetings and two public input meetings. Summaries are provided below with all meeting documents, including minutes, in Appendix E.

Meeting Summaries

Study Review Committee Meeting #1: Presentation of Existing and Future Conditions

The first SRC meeting summarized the needs assessment, highlighting the staggering population and traffic growth the corridor is experiencing and the impacts it is having on the roadway. This faster-than-expected growth has resulted in traffic volumes ahead of the *Long Range Transportation Plan* (LRTP) travel demand model (TDM) 2020 outputs. At this meeting, additional analysis on full build-out was recommended.

The purpose of this meeting was to identify all deficiencies along the corridor. Topics covered during this meeting included access management, roadway alignment, utilities, ITS, lighting, infrastructure, transit, safety and pedestrian and bicycle amenities.

Public Input Meeting #1: Presentation of Existing and Future Conditions

The first public input meeting provided multiple opportunities for the public to identify any issues for the topic areas discussed in the Existing Conditions Technical Memorandum and any other the study team and SRC may have missed. Attendees were given four methods to leave comments including a written comment form, large aerial maps, topic boards with sticky notes and the street section board. In total, more than 59 people attended the meeting with more than 100 comments received. Nine e-mails were received after the meeting.

FIGURE II-2: PUBLIC INPUT MEETING #1

Study Review Committee Meeting #2: Traffic Volumes Meeting

After discussion at SRC Meeting #1, additional analysis was completed by both the study team and Metro COG. Analysis for this study found full build-out of Sheyenne Street to occur around 2020, not 2040. This analysis was verified with Metro COG's analysis, finding that not only will build-out on Sheyenne Street occur around 2020, but that the southwest metro area will see an increase of 27,512 residents beyond what was approved in the demographic projections. Using this information, the TDM was updated to provide new outputs. A summary of refinements can be found in Chapter III) Traffic Forecasting, with the full methodology found in Appendix B.

Study Review Committee Meeting #3: Identification of Issues, Presentation of Purpose and Need Statement

SRC Meeting #3 recapped Public Input Meeting #1: Presentation of Existing and Future Conditions and Study Review Committee Meeting #2: Traffic Volumes Meeting. The SRC agreed that enough work has been done to substantiate claims the corridor will be fully developed around 2020, not 2040. The consultant working on the *Southwest Metro Transportation Plan* for Fargo and Horace updated the TDM to reflect the changes.

Based on the SRC Meeting #1 and #2 and Public Input Meeting #1, the Purpose and Needs Statement was presented, identifying the primary needs for the corridor: capacity, safety and social and economic development. All alternatives will be evaluated based on meeting these three needs. Part of the environmental analysis was presented, including the wetland delineation report and preliminary noise analysis.

Study Review Committee Meeting #4: Value Planning Meeting for Interchange Alternatives

FIGURE II-3: SRC MEETING #3

SRC Meeting #4 was a value planning workshop for interchange alternatives. It included representatives from the City of West Fargo, Cass County, Metro COG and NDDOT, including representatives from NDDOT-Fargo District, Planning and Asset Management, Programming, Bridge, Design, Local Government and Safety.

The meeting began with a summary of the major issues at the interchange, including lack of capacity at the ramp intersections, travel patterns, crash history and bicycle and pedestrian connectivity. The study team presented the assessment methodology and completed a field review with meeting attendees. Four alternatives that increased capacity, safety and encouraged social and economic development were presented: Southwest Loop alternative, Northeast Ramp alternative, Diverging Diamond alternative and the Modified Single Point Urban Interchange alternative (MSPUI). The attendees first prioritized the value planning criteria. These weighted scores were applied to the technical rankings. Attendees were then asked to rank the alternatives based on preference. Both the weighted technical ranking and preference ranking resulted in the MSPUI being ranked first, followed by the Southwest Loop.

Related issues like pedestrian and bicycle amenities, drainage, surrounding development and project phasing were also discussed.

Study Review Committee Meeting #5: Presentation of Roadway Alternatives

SRC Meeting #5 discussed potential roadway alternatives. Members present represented the City of West Fargo, Cass County and Metro COG. At this meeting, alternatives were presented for three study sections: North Sheyenne Street Section, South Sheyenne Street Section and 52nd Avenue Section. Using keypad polling devices, the SRC prioritized the alternatives based on the technical scoring of each alternative.

Study Review Committee Meeting #6: Implementation Plan Meeting

SRC Meeting #6 explored implementation and funding strategies for the prioritized technically feasible alternatives. The SRC developed general construction timelines and funding sources.

NDDOT Management Meeting

At the NDDOT Management Meeting, existing and future conditions as well as all technically feasible alternatives for all study area sections were presented to NDDOT for comment.

Study Review Committee Meeting #7: Presentation of Draft Report

The purpose of this meeting was to present the draft report with specific focus on the aesthetics plan. This meeting also covered materials to present and discuss with the public at Public Input Meeting #2.

FIGURE II-4: ATTENDEE QUESTIONS DURING THE FORMAL PRESENTATION

Public Input Meeting #2: Presentation of Draft Report

The second, and final, public input meeting worked with the public to refine the proposed improvement plan and discuss the timing and financial requirements of the corridor study. Attendees were given three methods to leave comments including a written comment form, large aerial maps and prioritized improvement boards with sticky notes. In total, more than 67 people attended the meeting with eight comments received at the meeting and 18 e-mails received after the meeting.

III) Traffic Forecasting Methodology

Traffic forecasts for future conditions are developed every five years by Metro COG for the purposes of developing the LRTP. This process begins with a demographic forecast study. Using the results of the demographic study, the TDM is updated, calibrated and validated to be used in the LRTP. The most recent update to the TDM developed forecasts for 2020 and 2040.

Regional Traffic Growth

The metro-wide level of analysis conducted for the LRTP is not designed to incorporate the intricate details required for a corridor or subarea study. Thus, refinements to the model were considered as part of this project and the *Southwest Metro Transportation Plan*, a concurrent study that focused on improvements between 52nd Avenue and 100th Avenue to the north and south, and the Red River and Sheyenne Street to the east and west. These refinements were made to develop updated 2020 and 2040 Average Daily Traffic (ADT) traffic projections. A comparison of the LRTP and updated ADTs is shown in Figure III-1. Appendix B has the full traffic forecasting memorandum, which contains all refinements used to update the TDM. Below is a summary of refinements.

Land Consumption Analysis

In September 2014, the study team completed an analysis of land consumption rates surrounding the *Sheyenne Street Corridor Study* area from 13th Avenue to 52nd Avenue. This analysis incorporated recent development and approved plats since the 2010 Census, which was used for the LRTP TDM, to determine when the Sheyenne Street corridor would be fully built-out. The results of this analysis indicated that the Sheyenne Street corridor would be fully platted by 2020 and built-out soon after, not by 2040 as predicted by the *Demographic Forecast Study for the FM Metropolitan Area*. This approach was approved by the SRC.

Historic Building Permit Review

In June 2014, Metro COG reviewed historic household building permit data for Fargo and West Fargo to compare against the approved demographic projections and growth rates in the *Demographic Forecast Study for the FM Metropolitan Area*. This was done to determine the accuracy of growth projections and whether additional revised growth scenarios should be evaluated to assume more aggressive population and household growth in the southwest metro area. The result of this analysis concluded the southwest metro area will see an increase of 27,512 residents beyond the currently approved demographic projections for the metropolitan area. This approach was approved by the Metro COG Policy Board. Based on analyses completed by both *Southwest Metro Transportation Plan* and this study, it was determined that 20,444 of the population increase will reside in Fargo and 7,058 will reside in Horace. This approach was approved by the SRC.

Southwest Subarea Infrastructure Needs

The focus of the *Southwest Metro Transportation Plan* was to identify future infrastructure needs based on updated and refined TDM outputs. This study identified a wide range of roadway widening projects, overpasses, interchanges, new roads and roadway extensions that were not included in the LRTP. Revised recommendations from the *Southwest Metro Transportation Plan* were approved by *Southwest Metro Transportation Plan* Study Review Committee. The improvements with notable impacts to Sheyenne Street include:

- The 2040 transportation network will not include an extension of Veteran's Boulevard from 52nd Avenue to 76th Avenue leaving a two-mile gap between Sheyenne Street and the next closest north-south arterial (45th Street). This is expected to result in Sheyenne Street carrying additional north-south traffic.
- The 2040 transportation network was modelled for future analysis to include a new I-29 Interchange at 76th Avenue. This major improvement allows 76th Avenue access to the interstate for improved regional traffic circulation. This is expected to reduce the number of vehicles to-and-from Horace using Sheyenne Street to access the interstate system.

FIGURE III-1: COMPARISON OF LRTP AND UPDATED TDM OUTPUTS

Regional Traffic Forecasting Summary

Both the LRTP and updated TDM volumes have potential inaccuracies associated with them, which is unavoidable when trying to balance a variety of factors that impact traffic for more than 20 years. The updated volumes include new infrastructure, such as the 76th Avenue Interchange that could not fit within the fiscally constrained plan, but is believed by many to be implemented before 2040. The updated volumes also assume exponential growth in Horace, another topic debated by many.

The study team evaluated both the LRTP TDM and the updated TDM volumes, using the output with the higher volumes as the first analysis scenario to provide a more conservative analysis.

- At the interchange, LRTP TDM outputs were used
- Throughout the corridor, updated TDM outputs were used

For both the interchange and corridor analysis, the alternative outputs were also analyzed to ensure a wide variety of variables were considered.

Local Traffic Growth

The study team evaluated the development and traffic growth assumptions surrounding the interchange to better estimate realistic traffic patterns to be used in the development and analysis of alternatives. A high level of accuracy is required for the microsimulation models used at the interchange. Figure III-2 illustrates the planned and zoned development pattern surrounding the interchange. Although much of the open space surrounding the

FIGURE III-2: FUTURE DEVELOPMENT AND PROJECTED ADTS

interchange is undeveloped now, as the Veterans Boulevard Interchange begins to build-out, it is anticipated that this area will be the next logical place for similar development, maintaining the 2020 full build-out assumption. Below is a summary of the analyses and revisions. Refinements at this level were not undertaken for other areas of the corridor because of the certainty of uses; most all other areas of the corridor will be entirely residential.

Beaton Drive

Only the east approach of Beaton Drive exists today. As development interest along the corridor increases, the parcel of land on the west side of Sheyenne Street is likely to be developed, with access desired by the developer. This parcel is approximately 900 thousand square feet and zoned for commercial office park. Based on the size of the parcel, the zoning and a 25 percent floor area ratio, it is assumed that this parcel will generate 1,060 trips per day (based on ITE trip generation rates).

In the LRTP TDM, traffic from the west approach of 19th Avenue and the potential west approach of Beaton Drive was estimated by analyzing the number of daily trips generated by the adjacent traffic analysis zone. Through 2040, traffic in this zone grew by 1,170. Assuming that no additional growth can occur on 19th Avenue, because it is considered built out, the entirety of that growth was applied to the west approach of Beaton Drive. Access from Beaton Drive is discussed in Chapter IV) Existing and Future Needs Assessment.

21st Avenue/Christianson Drive

In the LRTP and updated TDM, development expectations for the area surrounding this intersection were very low; combined, both approaches were projected to carry less than 3,100 vehicles per day. A review of more recently planned development and land uses indicate that number is significantly lower than what normal trip generation rates for these land uses would be (based on ITE Trip Generation data).

Proposed and/or approved developments along Christianson Drive, the west approach, include a construction company, auto body shop, hotel, Harley Davidson and general commercial properties, for an additional total trip generation of 7,600 trips under full build-out. On 21st Avenue, the east approach, developers have proposed a series of commercial properties that will add 2,200 trips per day. Using the proposed and approved site plans, existing zoning and the ITE *Trip Generation Manual*, revised traffic projections were developed. Access to-and-from the sites is discussed later.

TABLE III-1: TRIP GENERATION RATES FOR NEW DEVELOPMENTS (ITE DATA)

Development Type	Approximate Size	Trip Generation	ITE Land Use	Assumptions
Auto Body Shop	40,000 ft²	330 Daily 30 in A.M. Peak 35 in P.M. Peak	Automobile Care Center	25% Floor Area Ratio assumed.
Construction Company	29,000 ft²	90 Daily 25 in A.M. Peak 30 in P.M. Peak	General Light Industrial	Based on proposed site plan presented at West Fargo City Commission Meeting.
Hotel	91,000 ft²	890 Daily 70 in A.M. Peak 80 in P.M. Peak	Hotel	Assumed 100 units based on recently constructed hotels in the area.
General Commercial	923,000 ft²	8,020 Daily 230 in A.M. Peak 860 in P.M. Peak	Shopping Center/ Factor Outlet	25% Floor Area Ratio assumed. 1,820 of these trips will originate from the east side of Sheyenne Street, 6,200 from the west side.
Harley Davidson	25,000 ft²	65 Daily 50 in A.M. Peak 65 in P.M. Peak	Recreational Vehicle Sales	Size based on approved site plan.

Once trip generation rates were established, trip distribution and trip assignment assumptions were developed. This process involves identifying which directions and roadway vehicles will use to access and exit the site. This was estimated using the location of regional traffic generators and patterns, including existing volumes and directional distributions. This analysis also used the ITE *Trip Generation Manual* to estimate pass-by or diverted link trips to identify how much of the traffic was new or already on Sheyenne Street. Finally, *NCHRP Report 684: Enhancing Internal Trip Capture Estimation for Mixed-Use Developments* was used to determine how much of the trip generation would be within the developments and not access Sheyenne Street.

Future Turning Movements

Turning movement counts were collected at each of the thirteen study intersections:

- 13th Avenue
- 17th Avenue
- 19th Avenue
- Beaton Drive
- I-94 North Ramp
- I-94 South Ramp
- 21st Avenue/ Christianson Drive
- 26th Avenue
- 32nd Avenue
- 38th Avenue
- 40th Avenue
- 47th Avenue
- 52nd Avenue

Using these turning movement counts and the projected ADTs from the LRTP and updated TDM, 2020 and 2040 turning movement counts were estimated. The study team then used an approach that follows *NCHRP 765: Analytical Travel Forecasting Approaches for Project Level Planning and Design* methodology. This involves using directional factors (D-Factors), peak hour factors (K-Factors) and iteratively adjusting volumes until balanced. This was manually adjusted where appropriate, based on engineering judgment. Existing, 2020 and 2040 ADT volumes and estimated peak hour turning volumes can be seen in Figure III-3 and Figure III-4.

FIGURE III-3: EXISTING, 2020 AND 2040 A.M. PEAK HOUR TURNING MOVEMENTS

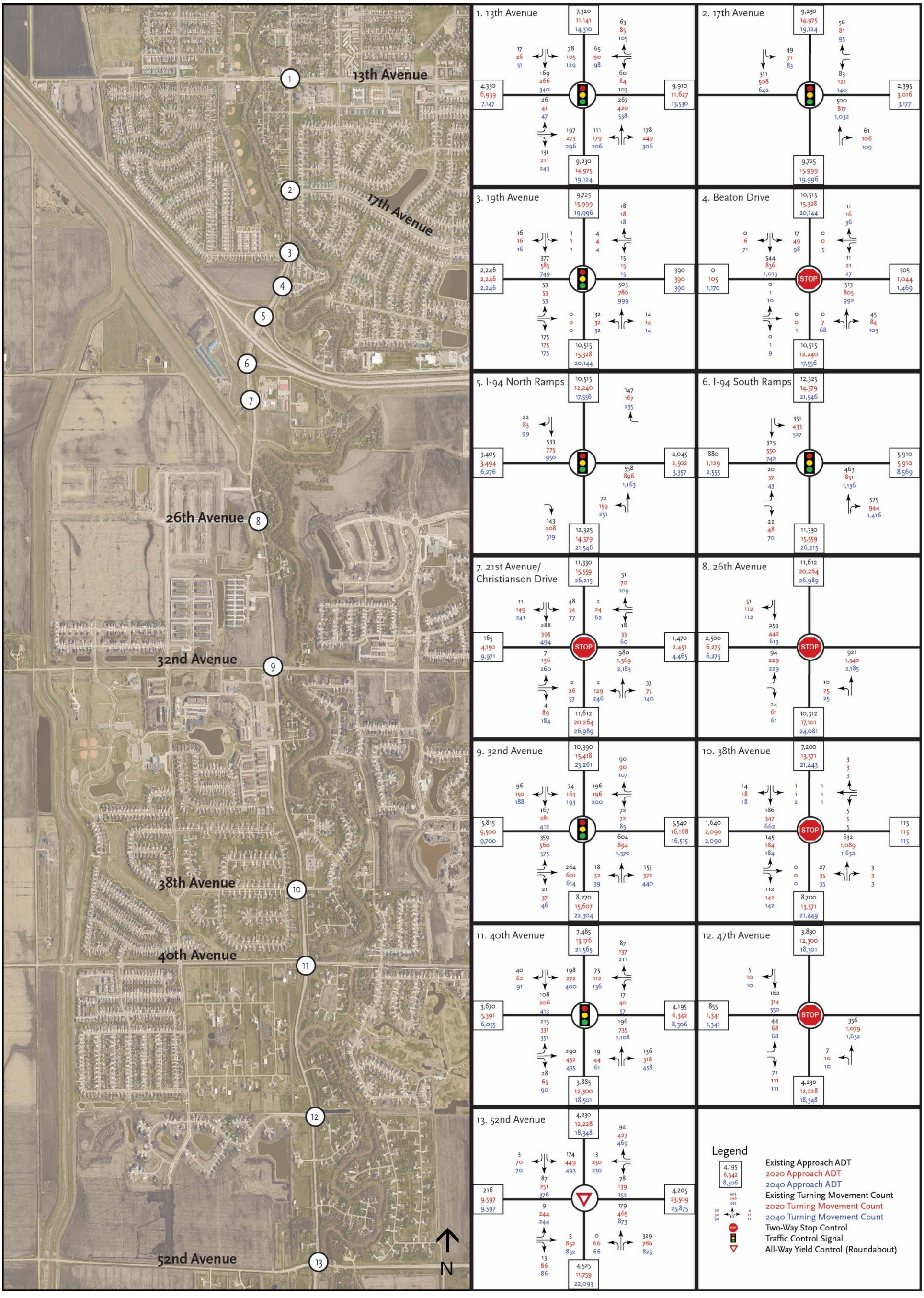
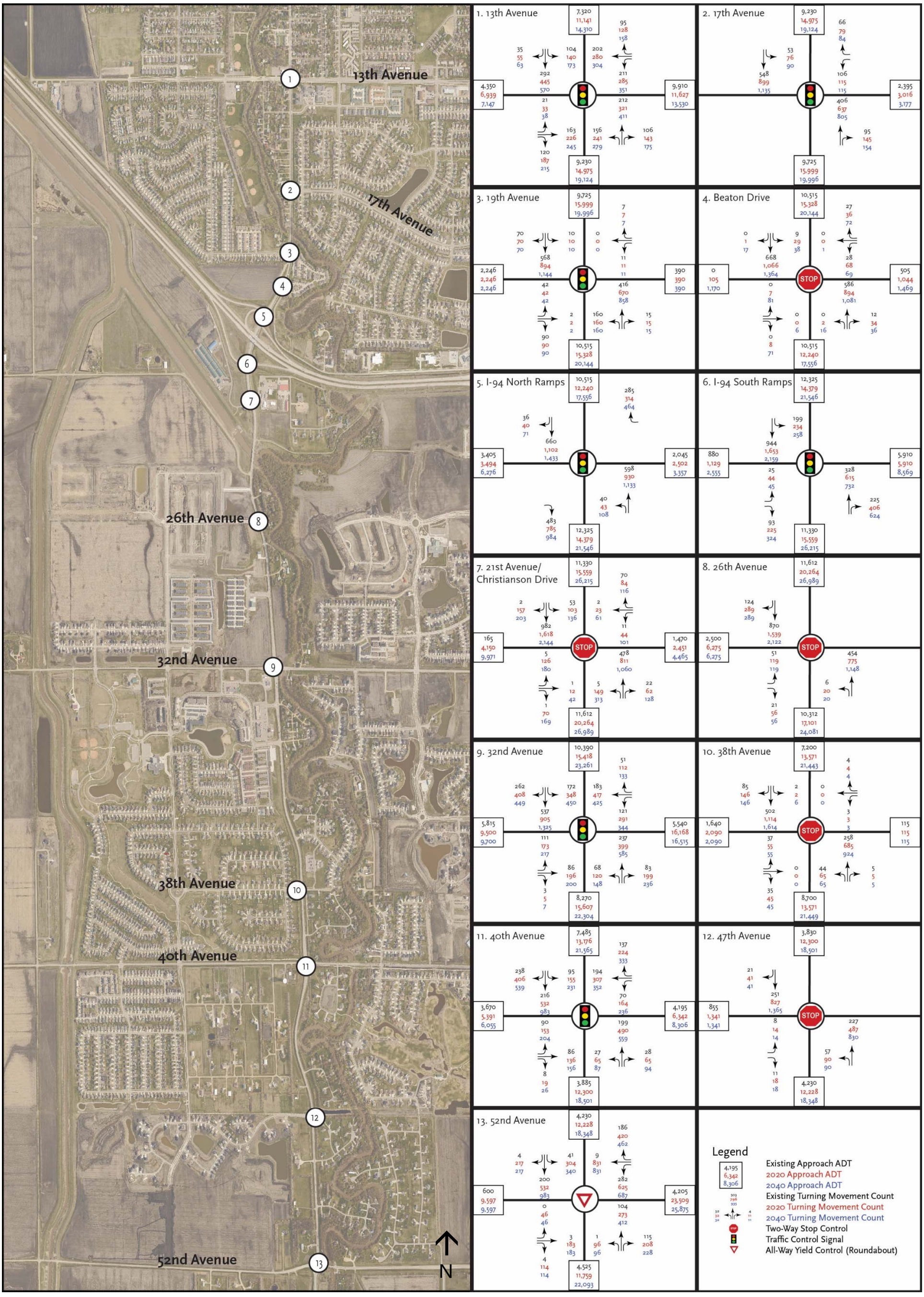


FIGURE III-4: EXISTING, 2020 AND 2040 P.M. PEAK HOUR TURNING MOVEMENTS



IV) Existing and Future Needs Assessment

Land Use and Development

The existing land uses abutting Sheyenne Street are 73 percent residential, excluding vacant property. Essentially, the corridor acts as a bedroom community for the surrounding metro area. According to 2010 Census data, approximately 36 percent of the total West Fargo population lives in the neighborhoods surrounding Sheyenne Street. By 2040, 53 percent of the total West Fargo population is expected to live in the surrounding neighborhoods, based on growth projections made in Metro COG's 2040 LRTP.

Development surrounding the Sheyenne Street corridor has significantly increased in recent decades. The area surrounding the corridor is anticipated to experience continued accelerated growth that will likely result in full build-out as soon as 2020. This estimate is based on information from city staff who are continually working with developers in the area and supported by additional analyses completed by the study team and Metro COG. Once the commercial areas along Veterans Boulevard are built-out, the few remaining commercial areas along Sheyenne Street are expected to follow. Employment opportunities in neighborhoods surrounding Sheyenne Street are expected to increase from 794 in 2010 to 1,656 in 2040 according to the LRTP.

FIGURE IV-1: AERIALS DEPICTING RAPID GROWTH IN STUDY AREA

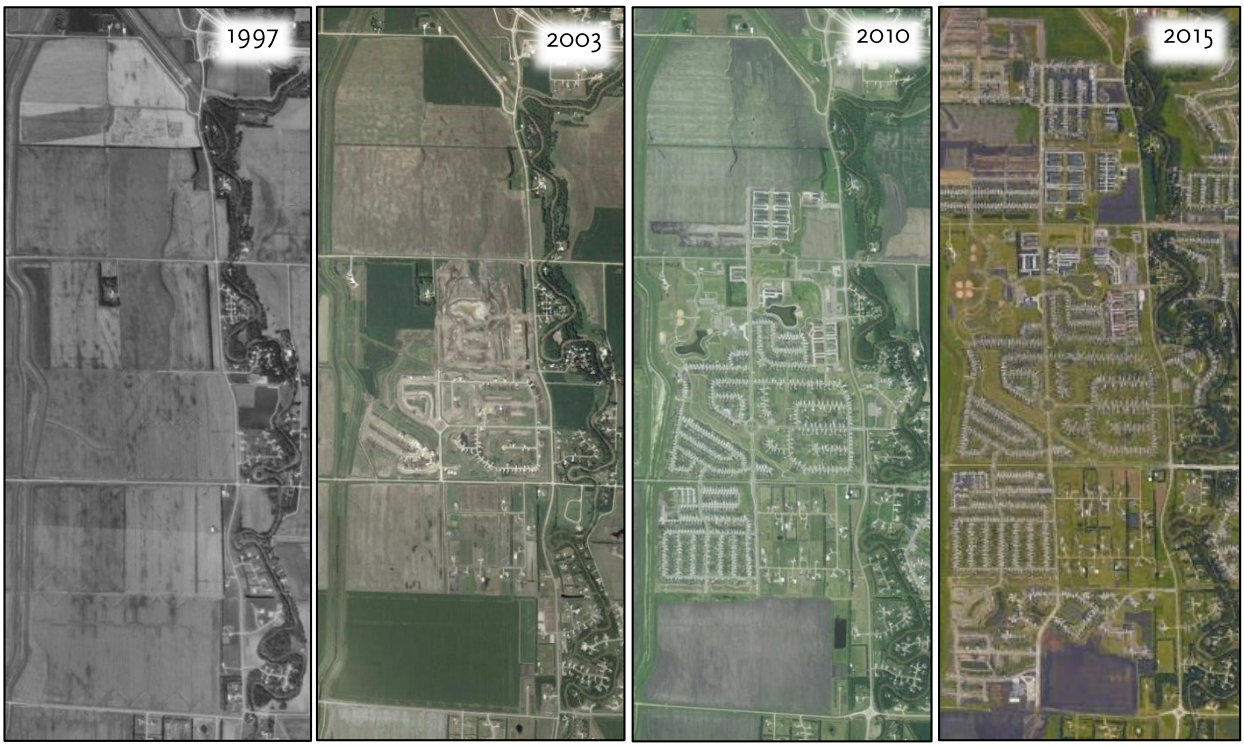
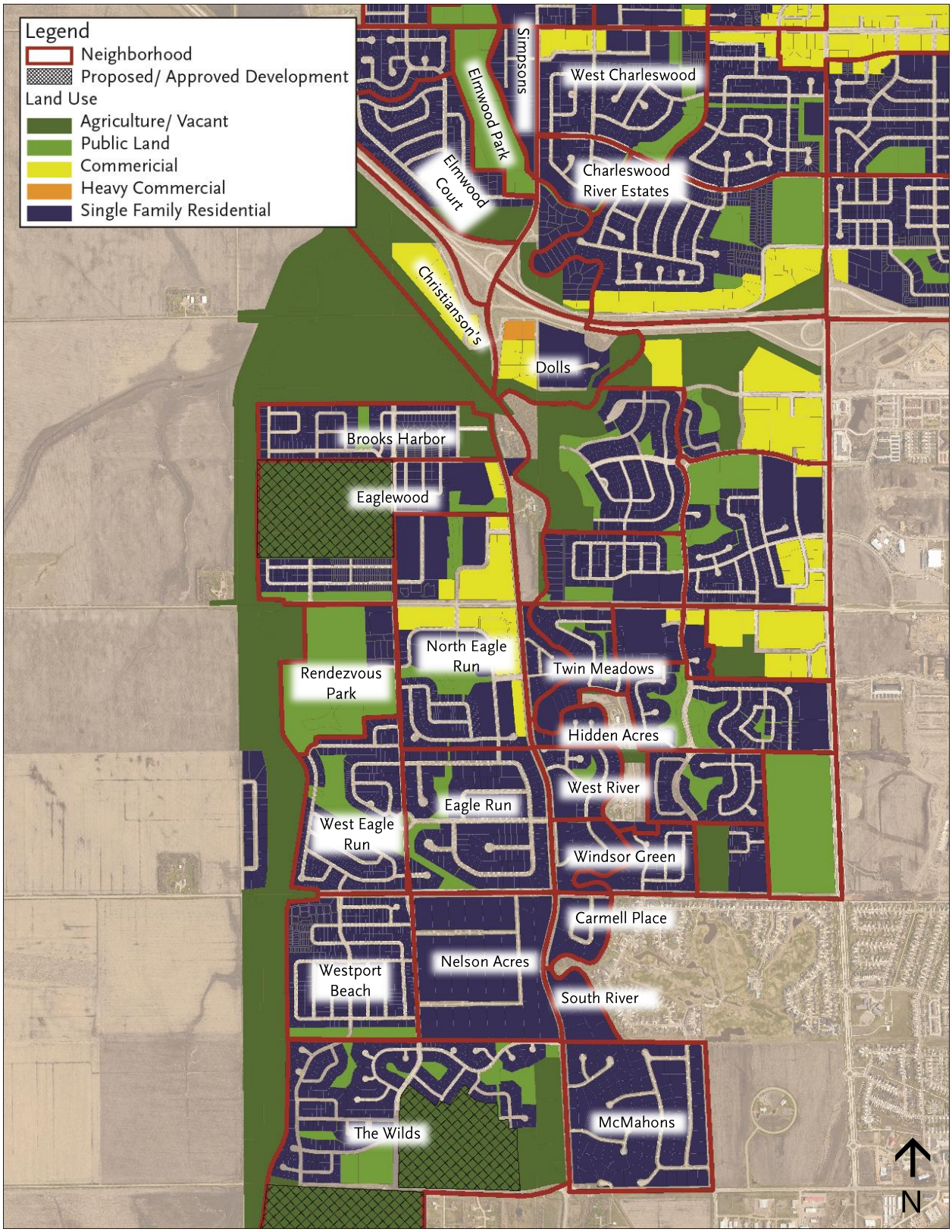


Figure IV-2 illustrates the land uses within the study area; predominantly residential, with few places to work, shop or dine within reasonable walking or biking distance means vehicular traffic dominates the mode split in the area. This conflicts with pedestrian and bicycle activity along the corridor.

FIGURE IV-2: LAND USE WITH SHEYENNE STREET NEIGHBORHOODS



Traffic Volumes

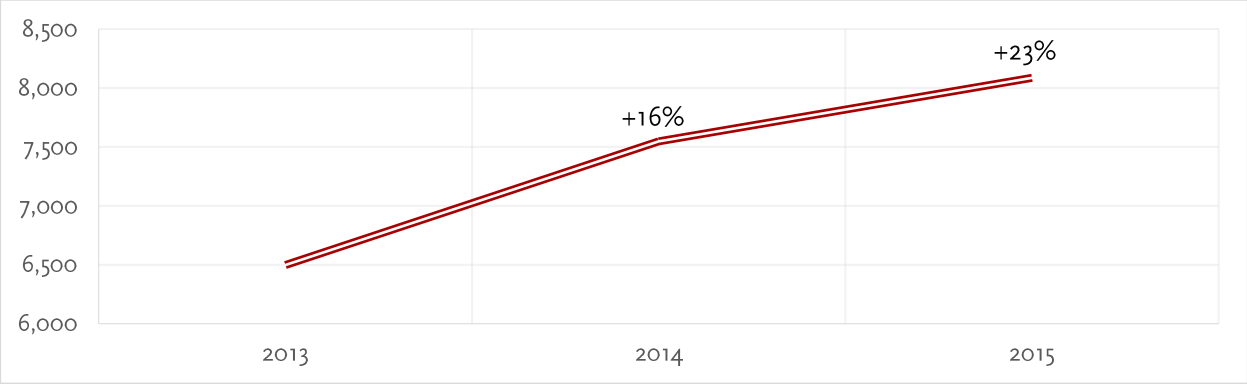
Turning movement counts were collected at the thirteen Sheyenne Street study intersections during April and May 2014:

- 13th Avenue
- 17th Avenue
- 19th Avenue
- Beaton Drive
- I-94 North Ramps
- I-94 South Ramps
- 21st Avenue/ Christianson Drive
- 26th Avenue (collected later)
- 32nd Avenue
- 38th Avenue
- 40th Avenue
- 47th Avenue
- 52nd Avenue

Intersections were selected based on existing and projected traffic volumes. The results of the turning movements collected for this study are presented in Appendix A.

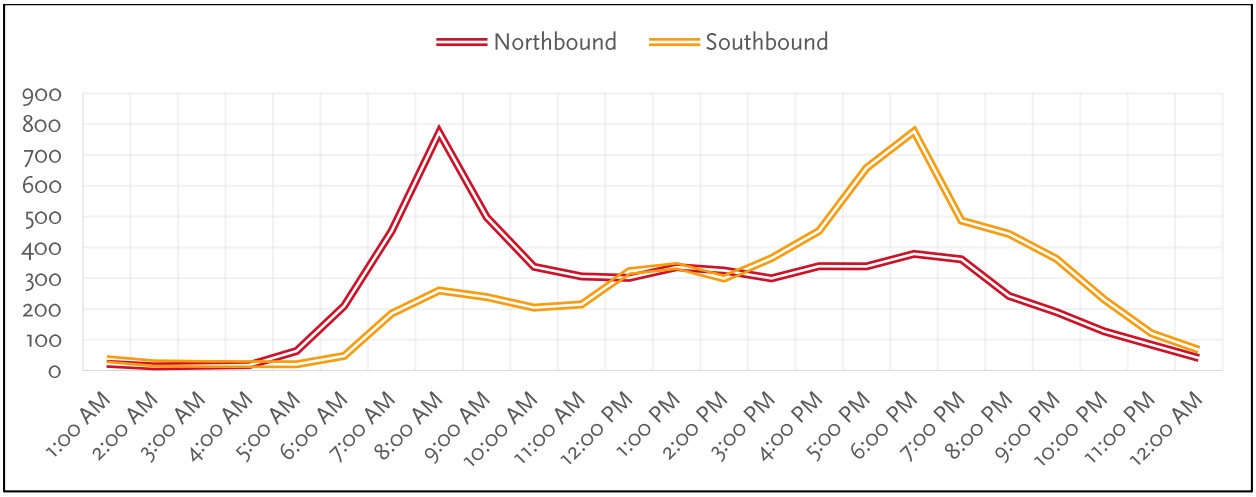
Based on 2013 counts, Sheyenne Street carries between 3,800 vehicles on the south end to 11,300 vehicles near the interchange. More recently collected data shows an increase of 16 percent between 2013 and 2014 and another seven percent growth between 2014 and 2015.

FIGURE IV-3: RECENT TRAFFIC GROWTH ON SHEYENNE STREET AT I-94 RAMPS



The residential land uses surrounding the corridor produce dramatic peak traffic periods as the traffic funnels out of the area in the morning and back into the area in the evening. Figure IV-4 shows daily traffic patterns along the corridor. As much as 30 percent of the daily traffic occurs during the A.M. and P.M. peak periods combined. This is twice the statewide average for urban minor arterials.

FIGURE IV-4: DAILY TRAFFIC DISTRIBUTIONS ON SHEYENNE STREET BETWEEN I-94 AND 32ND AVENUE



Traffic primarily funnels out of residential land uses in the A.M. peak and returns during the P.M. peak. This results in a typical directional distribution around 75 percent in the peak direction with slight variation dependent on peak hour and location, leading to very high demand for limited capacity over short periods of the day. These characteristics result in an approximate 40 percent reduction in corridor capacity when compared to a roadway with an even directional distribution and typical peaking factor of nine percent.

FIGURE IV-5: DIRECTIONAL CONGESTION ON SHEYENNE STREET

Traffic Operations

Corridor capacity was gauged via bottleneck analysis at the thirteen study intersections. Under existing conditions, the majority of congestion on Sheyenne Street is caused by traffic control measures designed to allow the efficient exchange of traffic between intersecting arterials. Intersection capacity analysis was evaluated in terms of delay and level of service (LOS), a term used to describe operational performance of transportation infrastructure elements. Essentially, LOS is a letter grade that corresponds to specific traffic characteristics within a given system. For example, at intersections, LOS is a function of average vehicle delay whereas LOS for a roadway section is defined by the average travel speed. According to NDDOT standards, updated June 2015, LOS "D" or better is acceptable on urban roadways. The interstate ramps are held to a higher standard, requiring LOS "C" or better. Refer to Table IV-1 for a breakdown of *Highway Capacity Manual* (HCM) LOS thresholds.

TABLE IV-1: HCM LOS THRESHOLDS

Control Delay (Sec/Veh) Unsignalized	Signalized	Volume < Capacity	Volume > Capacity
≤ 10	≤ 10	A	F
> 10-15	> 10-20	B	F
> 15-25	> 20-35	C	F
> 25-35	> 35-55	D	F
> 35-50	> 55-80	E	F
> 50	> 80	F	F

Figure IV-6, Figure IV-7 and Figure IV-8 illustrate the LOS for both A.M. and P.M. peak for existing, 2020 and 2040 time periods, respectively. The following caveats should be noted prior to reviewing the capacity analysis results.

Analysis Tools

Capacity analysis was conducted using Synchro, which applies deterministic equations published in the HCM. HCM capacity analysis is an industry and NDDOT standard; however, HCM logic does not account for queue blockages of turn lanes. This is an important consideration for Sheyenne Street where significant queues develop during peak hours due to lack of capacity. The Synchro analysis was supplemented with SimTraffic analysis, a microsimulation capable of evaluating queue blockages. The worse LOS results between Synchro and Sim Traffic is reported below.

The alternatives at the I-94 and Sheyenne Street interchange functional area, which includes the intersections at Beaton Drive, North Ramps, South Ramps and 21st Avenue/ Christianson Drive, were evaluated using a Vissim microsimulation model to incorporate any potential merging, diverging, weaving and queueing complications

present under existing and future build and no-build scenarios. Vissim is a more comprehensive microsimulation tool that requires substantially more effort to develop and calibrate.

Traffic Control Signal Timing

The capacity analysis results may not fully represent current operations experienced along the corridor because traffic control signal timing plans were optimized to highlight the operational potential of each intersection.

Capacity Analysis Results

As illustrated in Figure IV-6, under existing conditions the corridor has some congested areas but primarily operates efficiently in terms of average delay per vehicle. Congestion on the corridor is primarily induced by bottlenecks at major intersections like 32nd Avenue and the I-94 interchange intersections. The majority of the capacity issues are created by queue lengths blocking adjacent lanes, limiting the overall capacity potential of the intersection. For example, at 17th Avenue during the A.M. peak the northbound queue extends beyond the 19th Avenue intersection; during the P.M. peak, the southbound queue extends beyond the 14th Avenue intersection, blocking turn lanes and driveways.

The corridor quickly becomes oversaturated. By 2020, eight of the 13 study intersections operate at LOS "E" or worse during either the A.M. or P.M. peak; six of those operate at LOS "E" or LOS "F" during both the A.M. and P.M. peaks.

By 2040 all 13 study intersections operate at LOS "E" or worse during either the A.M. or P.M. peak; nine are deficient for both A.M. and P.M. peaks. Queues are expected to worsen through 2040.

One of the more critical bottlenecks along the corridor, under existing and future conditions, is the I-94 interchange intersections. The majority of motorists on Sheyenne Street funnel onto I-94 traveling eastbound in the morning hours and return home during the evening hours; this scenario creates congestion and poor operations at both interchange intersections. Specifically, the funnel effect of southbound left-turns and northbound right-turns onto the eastbound on-ramp creates queues that spill back outside of the turn lanes and block adjacent through lanes during the A.M. peak.

FIGURE IV-6: EXISTING LEVELS OF SERVICE

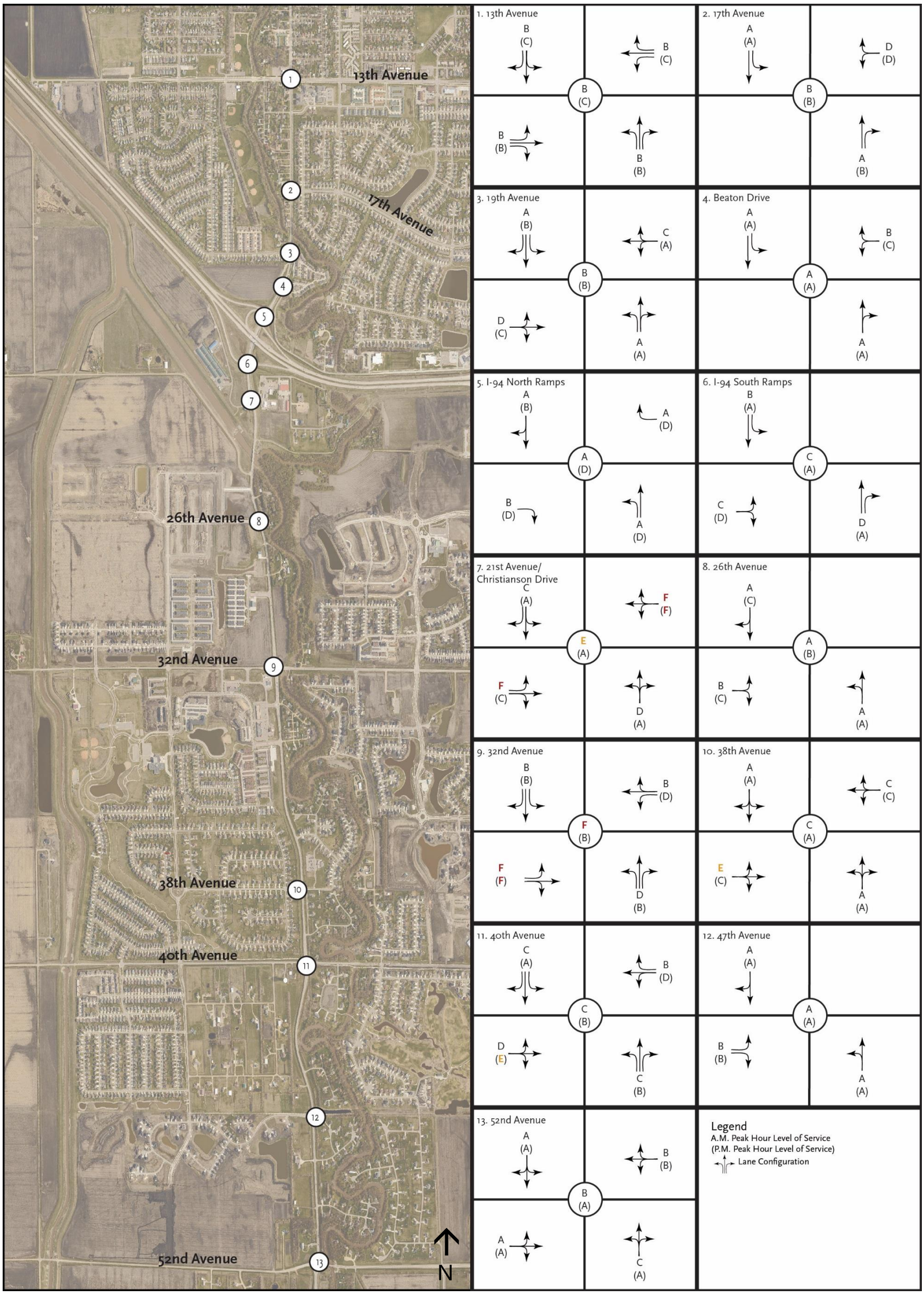


FIGURE IV-7: 2020 LEVELS OF SERVICE

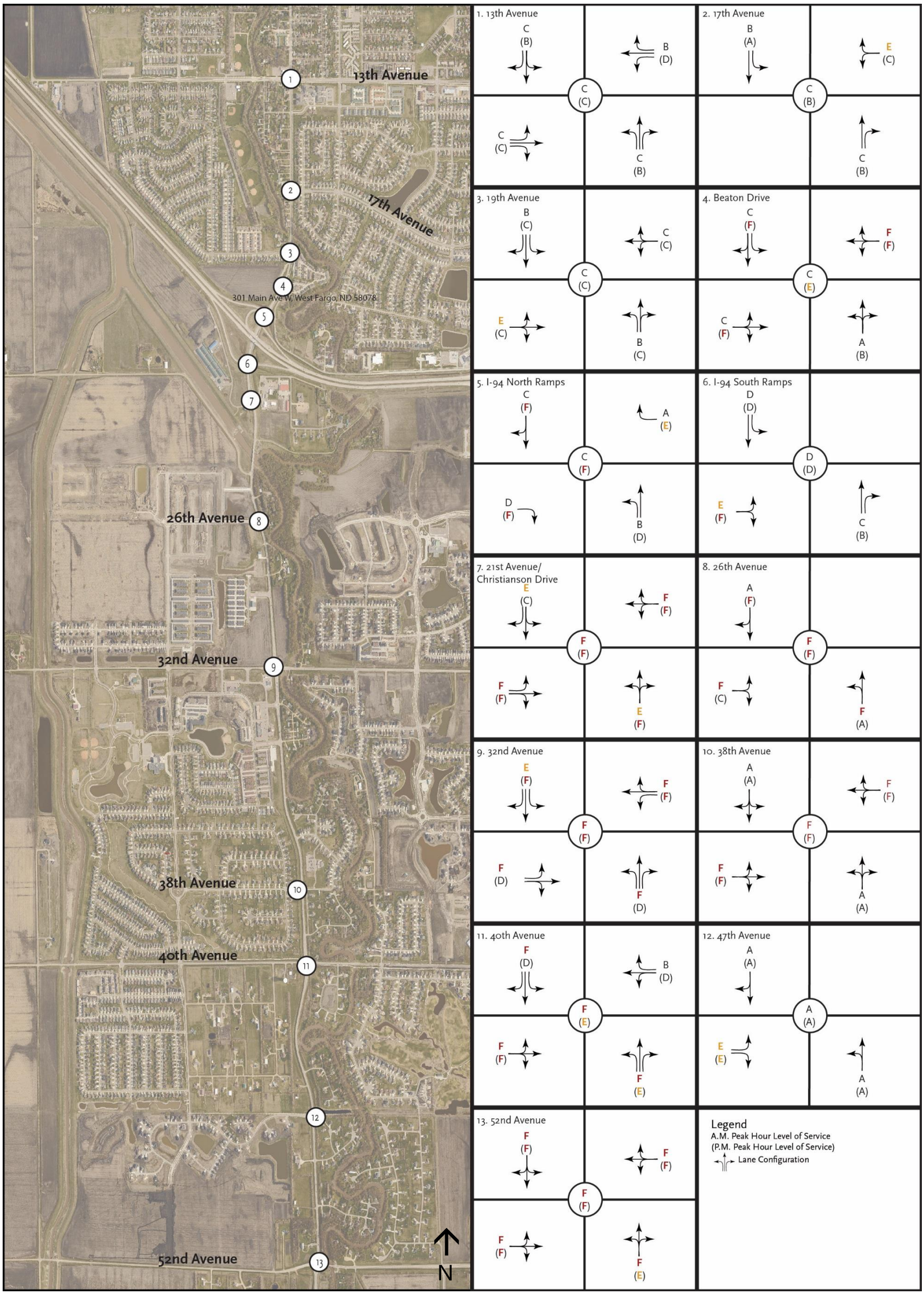
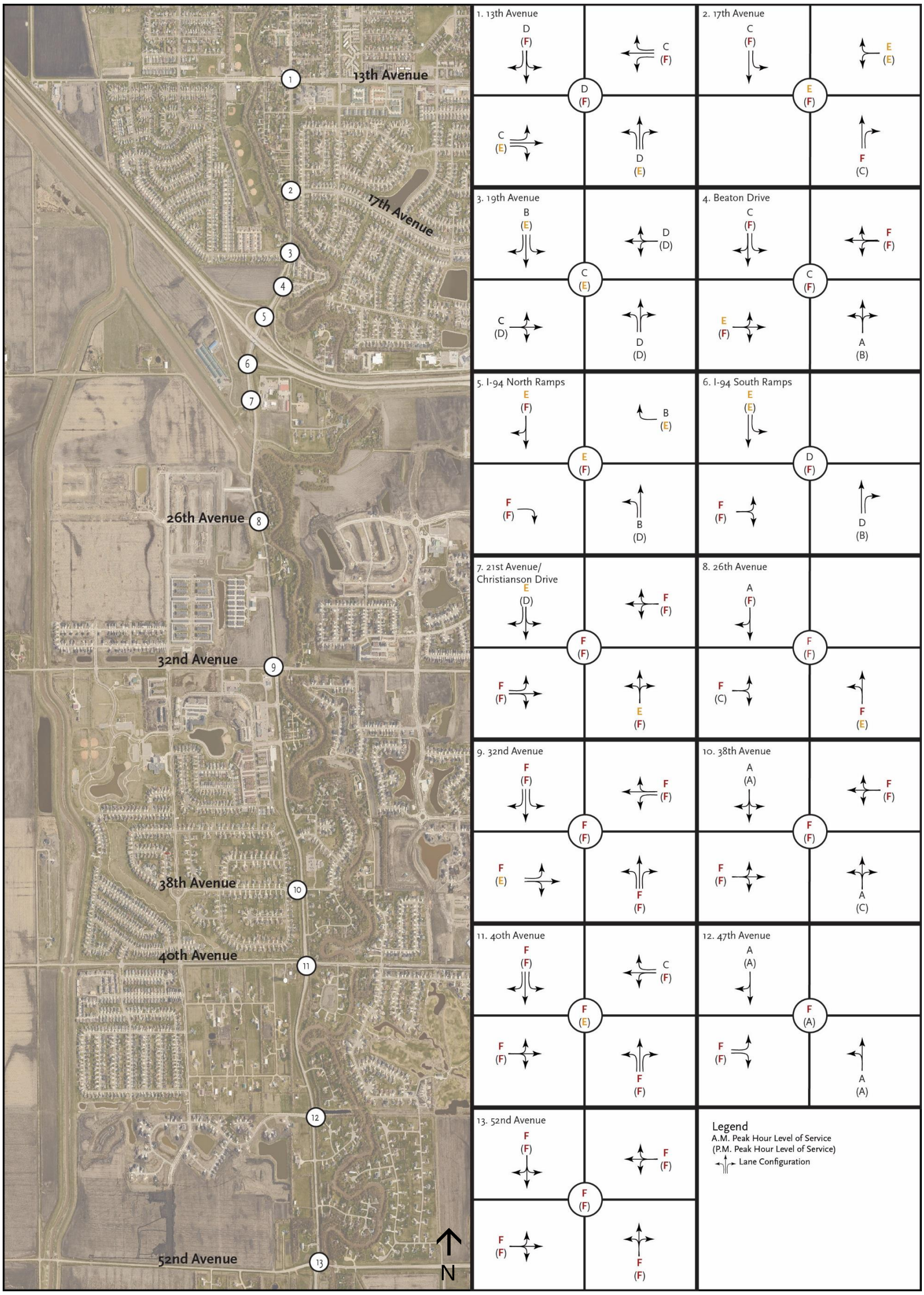


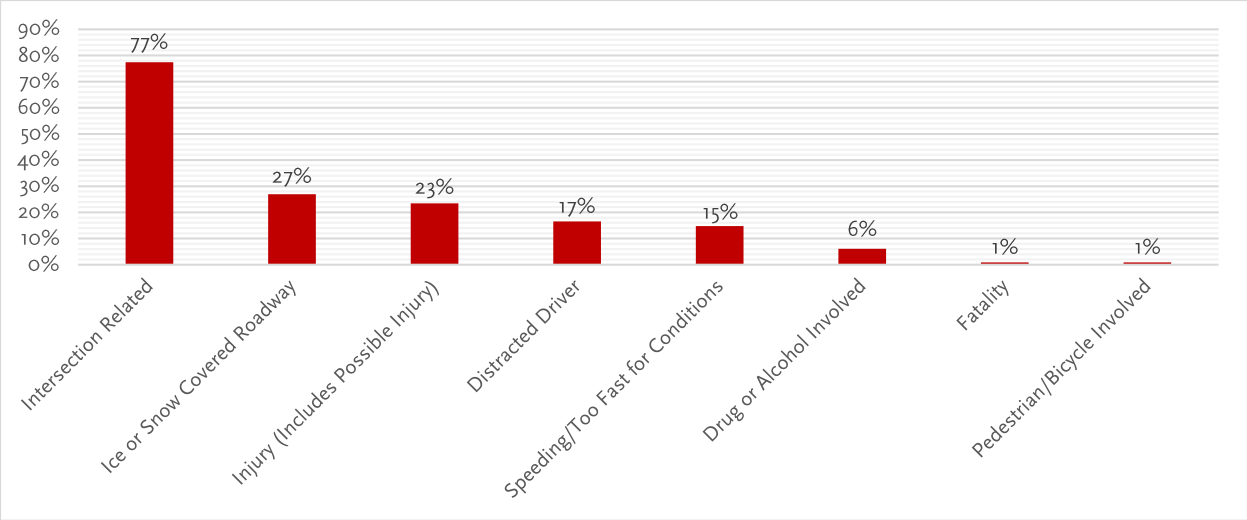
FIGURE IV-8: 2040 LEVELS OF SERVICE



Crash History

Safety is of utmost importance when evaluating a corridor; reviewing historic crash information is vital to identifying existing deficiencies. Three years of crash records (March 1, 2011 to February 28, 2014) obtained from NDDOT showed 38 crashes per year in the study area. This included one fatality and nine crashes per year resulting in an injury (includes the possible injury classification). The National Safety Council (NSC) estimates the economic impacts of crashes based on wage and productivity losses, medical and administrative expenses, motor vehicle damage and employer costs due to injuries. Using this data, the total costs associated with crashes within the study area were nearly $907 thousand per year. Upon further review of the crash data, crash trends were identified, shown in Figure IV-9.

FIGURE IV-9: CRASH TRENDS



Crash Hotspots

To identify overrepresented crash locations within the study area, a two-phase approach was adopted. First, crash frequency was studied to identify locations with the highest number of crashes. This is the most straightforward approach to determining locations susceptible to crashes (refer to Figure IV-10). This approach, however, ignores the rate at which crashes occur. Typically, intersections with a high number of crashes also carry high traffic volumes. Many times, a low volume location may have fewer overall crashes, but on a per car basis have a much higher susceptibility to crashes. Therefore, it is beneficial to identify which locations in the study area experience a statistically high crash rate. To identify statistically significant crash rates, the critical crash rate methodology was used. This method was developed by the Minnesota Department of Transportation (MnDOT) and is included in the *NDDOT Design Manual*. The method incorporates traffic volumes and crash rates for a particular location and compares this rate against crash rates for similar facilities.

According to the critical crash rate methodology, intersections with crash rates under the critical rate are considered "safe". Locations with crash rates above the critical rate are considered "overrepresented" and in need of further review because there is a high probability that conditions at the site are contributing to the higher crash rate. Various filters were used during the critical crash rate analysis to allow intersections and links to be compared against similar facilities. For intersections, this included functional classification types and traffic control. For links, this included the urban/rural cross-section context and roadway surface. After evaluating each

scenario, only one intersection was considered "overrepresented" according to the critical crash methodology: Sheyenne Street and 32nd Avenue.

Trend Analysis

Once crash hotspots were identified using crash frequency and critical crash analysis, a detailed review of the crash reports was conducted. The detailed review was also supplemented with an informal Road Safety Audit (RSA). RSAs allow the study team to identify contributing factors that may not be obvious in the crash reports. The RSA team considered safety of all road users, qualitative estimates and reports on road safety issues and opportunities for safety improvements. Studies have found that RSAs produce a 20 to 40 percent reduction in crashes (FHWA, 2012). Based on the results of detailed evaluation of crash reports and the RSA, the following trends were identified. If solutions were obvious, they are noted below; other improvement strategies will be developed and evaluated in subsequent chapters.

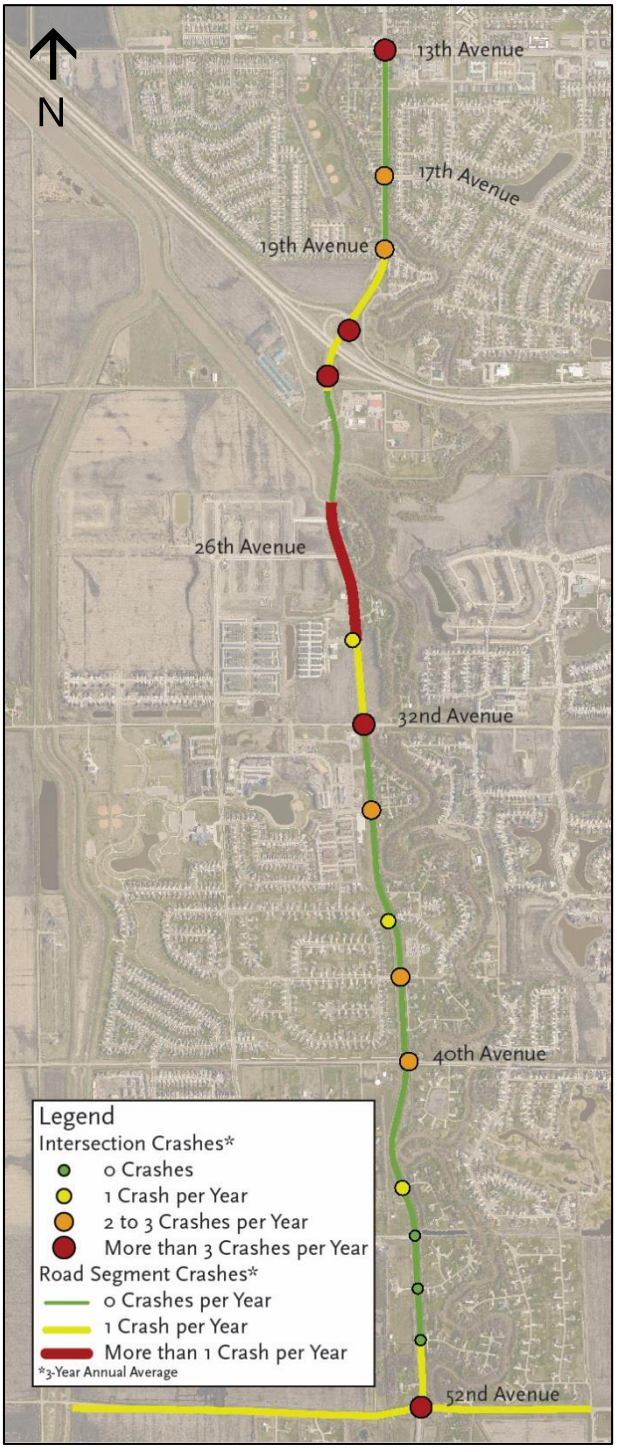
Sheyenne Street Intersections at 13th Avenue, I-94 South Ramps

Of the crashes at these two intersections, 71 percent (20/28) were rear-end types. These intersections experience an increased potential for rear-end crashes due to long queues and delays, particularly on the westbound approach at the 13th Avenue intersection and the northbound through/right and southbound left-turn movements at the I-94 South Ramp. Long queues often interfere with motorist expectancy and long delays produce stop-and-go traffic. Both of these scenarios increase rear-end crash potential. Improved operations at these intersections may mitigate rear-end crash potential by reducing stop-and-go traffic and queue lengths.

Sheyenne Street Intersections at 17th Avenue, 19th Avenue

Rear-end crashes made up 78 percent (7/9) of total crashes at these intersections. Site visits indicate that one of the contributing factors is poor corridor progression resulting in stop-and-go traffic. These intersections are currently not interconnected or coordinated; however, work is currently ongoing to install fiber optic interconnect along Sheyenne Street and will be completed in 2016. Once interconnected, reliable coordination can be implemented, potentially improving traffic progression and mitigating rear-end crash potential.

FIGURE IV-10: SEGMENT AND INTERSECTION CRASHES ON SHEYENNE STREET



Sheyenne Street Intersection at I-94 North Ramps

Motorists attempting to turn right from the westbound I-94 off-ramp to Sheyenne Street going north accounted for 80 percent (8/10) of crashes at this intersection. The majority of motorists were travelling too fast and lost control of their vehicle or stopped for traffic, even though there is a new lane for this movement, and were rear-ended by the motorist behind them.

FIGURE IV-11: I-94 OFF-RAMP ONTO NORTHBOUND SHEYENNE STREET

Sheyenne Street Intersection at 32nd Avenue

Southbound rear-end crashes were 37 percent (7/19) of the crashes at this intersection. While rear-end crashes are prevalent at traffic control signals, particularly those with long queues and delays, the majority of such crashes occurred during off-peak periods where delays and queues are minimal. During the RSA it was deduced that one of the potential causes for this trends was the high-speed rural nature of this corridor. When heading south, the nearest traffic control signal is more than a full mile north in a traditional urban setting. Traffic control signals along roadways in rural settings may interfere with motorist expectancy.

Motorists running a red light made up 26 percent (5/19) of crashes at this intersection. These types of crashes are very serious considering the potential for angle crashes and injuries. Two contributing factors were noted during site visits:

- Motorists tend to run yellow and occasionally the beginning of red lights during peak periods when queues and delays are long. This is common at intersections with poor operations; motorists tend to become frustrated and more likely to take chances.
- Motorists frequently travel faster than posted speeds on the minor approaches. High speeds require longer all-red intervals, which could help alleviate this concern.

FIGURE IV-12: LEFT-TURNING TRAFFIC AT 34TH AVENUE

Sheyenne Street Intersections at 21st Avenue/Christianson Drive, 34th Avenue and 38th Avenue

Eighty-six percent (12/14) of crashes at these intersections involved a motorist attempting to make a left-turn. These crashes were rear-end or sideswipe type crashes. There are no turn lanes at these locations, an improvement that would mitigate these crashes.

Sheyenne Street Intersection at 52nd Avenue

Fifty percent (5/10) of the crashes at this intersection are not reasonably corrected by engineering improvements. Examples include a motorist who fell asleep, a motorist swerving to avoid an animal and multiple vehicles who lost control on an icy roads. Thirty percent (3/10) occurred when a motorist incorrectly travelled through the

roundabout (i.e. misunderstanding the right-of-way rules). These types of crashes will naturally diminish as roundabouts become more prevalent in the metro area. It is important to note that these types of crashes were low-impact property damage only crashes.

52nd Avenue

Four crashes occurred on 52nd Avenue between the Sheyenne River Diversion to 4th Street. No trends were identified for these crashes.

Traffic Control

Appropriate traffic control is essential for efficient traffic operations and crash mitigation. The Sheyenne Street corridor includes a variety of traffic control devices, such as traffic control signals, stop control and a roundabout. Figure IV-15 illustrates the existing traffic control within the study area.

Selecting the appropriate traffic control device requires consideration of traffic patterns, volumes, roadway geometry and lane configurations. The 2009 *Manual on Uniform Traffic Control Devices* (MUTCD) published by the Federal Highway Administration (FHWA) was used to guide these decisions. The MUTCD includes standards for all-way stop control, two-way stop control, traffic control signals and pedestrian hybrid beacons. Standards include a variety of vehicular volume, pedestrian volume and crash frequency thresholds for multiple roadway contexts to warrant traffic control devices.

FIGURE IV-13: TRAFFIC CONTROL SIGNAL AT 13TH AVENUE AND SHEYENNE STREET

The MUTCD does not have warrants for roundabouts or pedestrian beacons. Under the appropriate traffic conditions and roadway environments, these traffic control measures offer safety and/or operational benefits. These measures will be included in the discussion as potential traffic control options in Chapters VII through X.

FIGURE IV-14: ROUNDABOUT AT 52ND AVENUE AND SHEYENNE STREET

FIGURE IV-15: EXISTING TRAFFIC CONTROL

Existing Traffic Control

Collected peak hour traffic volumes were extrapolated throughout the course of the day using daily distribution factors from 24-hour tube counts along the corridor. The following is a summary of the traffic control analysis under 2014 traffic conditions:

- There are currently no two-way stop control intersections that meet traffic control signal warrants.
- All intersections under traffic control signals meet signal warrants.
  - » While right turns are typically excluded when doing a warrant analysis, 19th Avenue is currently only warranted if 25 percent of right turns are included in minor approach totals. This is the dominant movement out of the development as vehicles are funneling out during the A.M. peak and likely would contribute to long queues if unsignalized.
- All-way stop control was not studied in this corridor due to the poor operations and progression induced by this device along the corridor.
- All local streets that meet two-way stop control warrants have stop control on the minor street approaches.
  - » The Golden Spike Road approach onto Sheyenne Street has overgrown trees blocking the view of the stop sign (Figure IV-16). Crash records do not indicate this has created safety issues. However, ensuring visibility of this sign is important for any driver unfamiliar with the area.

FIGURE IV-16: OBSCURED STOP SIGN AT GOLDEN SPIKE ROAD

- Although pedestrian and bicycle data is not available throughout the entire corridor, data collected at key intersections, supplemented by observations during field reviews, indicate that minimum pedestrian thresholds to warrant a pedestrian hybrid beacon are not met within the study area.

Future Traffic Control

Because traffic volumes are expected to grow significantly through 2040, traffic control analysis was completed through 2040 to determine future traffic control needs throughout the corridor.

52nd Avenue

Currently, the roundabout at 52nd Avenue operates very efficiently. With less than one thousand vehicles entering the roundabout during the A.M. and P.M. peak, there is plenty of capacity. However, by 2040, projected traffic at this intersection will increase more than 475 percent and traffic will vary greatly from 9,600 on the west approach to 25,875 on the east approach. As vehicles try to enter the existing single-lane roundabout under these conditions, it is unlikely they will find an acceptable gap, resulting in long delays (estimated delay is more than 40 minutes per vehicle during the A.M. peak) for a single-lane roundabout.

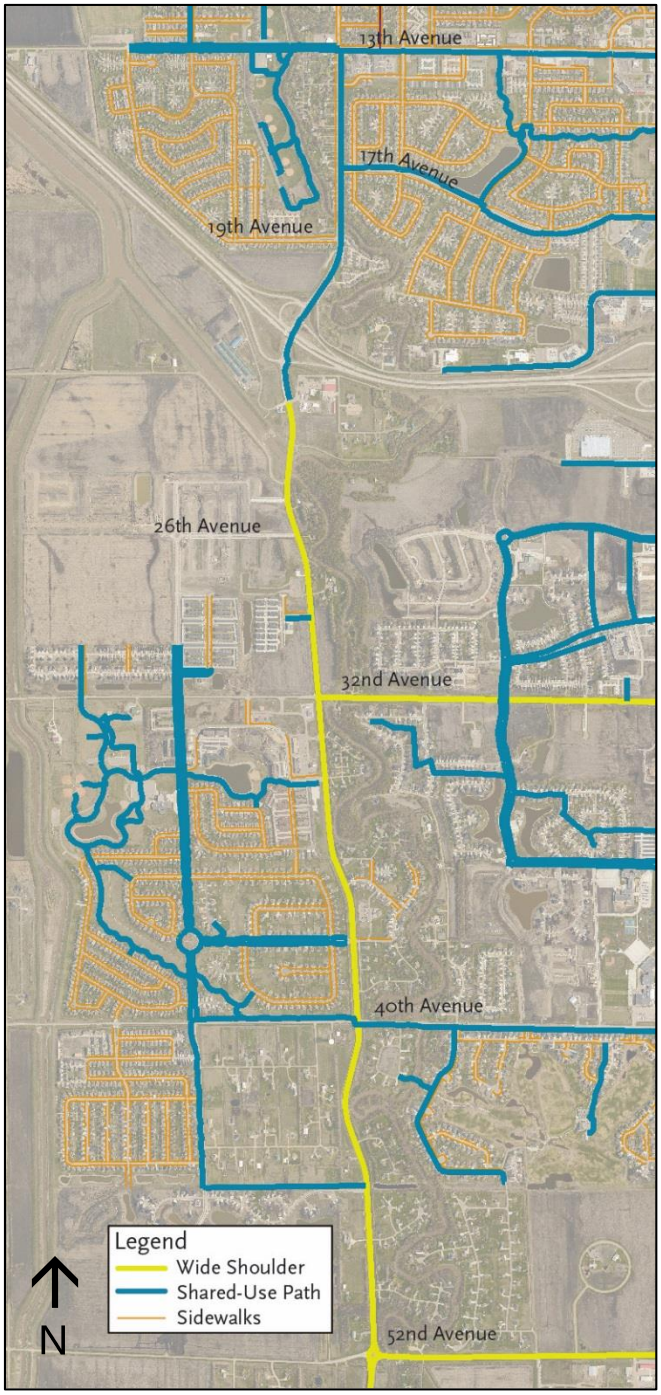
Traffic Control Signals

The following two locations will warrant traffic control signals by 2020:

- Sheyenne Street and 26th Avenue (installation programmed for 2015).
- Sheyenne Street and 52nd Avenue (warranted by 2020, existing roundabout will not provide acceptable LOS under projected 2020 volumes).

Pedestrian and Bicycle Facilities

FIGURE IV-17: PEDESTRIAN AND BICYCLE FACILITIES



In urban areas, walking and biking is an important component of the transportation system. Enhancing the ability of travelers to walk or bike involves not only providing the infrastructure but also linking urban design, streetscapes and land use to encourage walking and biking. Designing roadways to accommodate all types of users is commonly termed "complete streets." This type of roadway design approach offers many benefits.

- Streets designed with sidewalks, raised medians, traffic calming measures and treatments for travelers with disabilities improves pedestrian safety. Research has shown that sidewalks alone reduce vehicle-pedestrian crashes by 88 percent (FHWA, 2002).
- Multiple studies have found a direct correlation between the availability of walking and biking options and obesity rates (CDC, 2011). The Centers for Disease Control and Prevention recently named adoption of complete streets policies as a recommended strategy to prevent obesity.
- Complete streets offer inexpensive transportation alternatives for roadway users. A recent study found that most families spend far more on transportation than food (US Department of Labor, 2014).
- A recent study found that people who live in walkable communities are more likely to be socially engaged and trusting than residents living in less walkable communities (Rogers et al., 2011).

Metro COG, in conjunction with member local units of government, other interested stakeholders and the public at-large developed and approved the Fargo-Moorhead Metropolitan Area Complete Streets Policy Statement in 2010. This report is designed to follow that guidance.

Field Survey

A field survey of the study area was conducted via bicycle. A helmet-mounted camera was used to document the deficiencies.

Network-Wide Pedestrian Mobility and Safety

Only 20 percent of the study area has pedestrian facilities along the corridor. Only 10 percent of the study area has pedestrian facilities on both sides of the street. City of West Fargo ordinance requires sidewalks on both sides of the street but prohibits bicycles on sidewalks if the rider is 12 years of age or older.

Cyclist Comfort on Shoulders

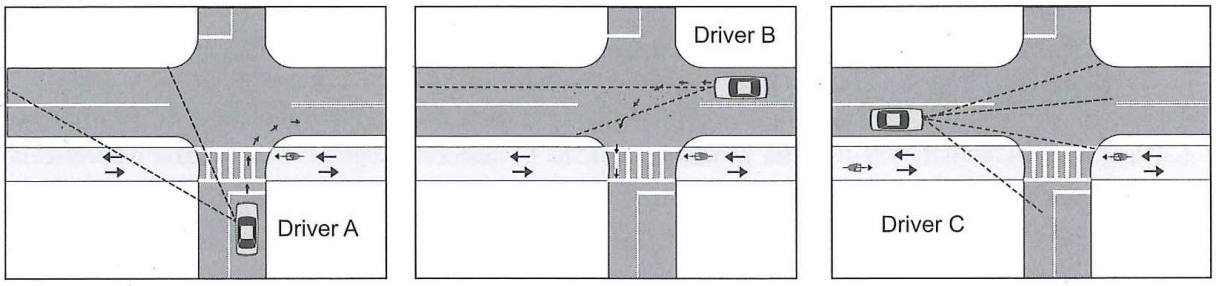
In study section South Sheyenne Street and parts of study section 52nd Avenue, there is a shoulder wide enough to meet design standards for bicycle activity. However, the high speeds and volumes are undesirable for novice bicycle riders, such as children. The construction of Legacy Elementary School makes this particularly concerning.

FIGURE IV-18: CHALLENGING BICYCLE LOCATION ON 52ND AVENUE (TAKEN FROM BICYCLE WITH HELMET-MOUNTED CAMERA)

Motorist Expectancy on Shared-Use Paths

In study sections North Sheyenne Street and I-94 Interchange, there is a narrow eight-foot shared-use path (design standards specify 10 feet as the preferred minimum width for a shared-use path). However, recent design guidance has discouraged the use of shared-use paths on only one side of the street where right-of-way (ROW) permits and bicycle activity is considerable because it interferes with motorist expectancy (refer to Figure IV-19).

FIGURE IV-19: SHARED-USE PATH CONFLICTS



Right turning Driver A is looking for traffic on the left. A contraflow bicyclist is not in the driver's main field of vision.

Left turning Driver B is looking for traffic ahead. A contraflow bicyclist is not in the driver's main field of vision.

Right turning Driver C is looking for left turning traffic on the main road and traffic on the minor road. A bicyclist riding with traffic is not in the driver's main field of vision.

Source: Guide for the Development of Bicycle Facilities, Fourth Edition

Facility Maintenance

The shoulders in study section South Sheyenne Street are frequently covered in gravel and areas of the shared-use path in study section I-94 Interchange have grass growing through the concrete segment cracks. Poor maintenance of facilities can create trip hazards, or in the case of the shared-use path, complications for wheelchair-bound pedestrians.

Accessibility

The Americans with Disabilities Act (ADA) requires detectable warning panels on curb ramps. Many curb ramps in the study area do not meet that requirement.

Pedestrian and Bicycle Crash History

Safety is critical when developing an appealing pedestrian and bicycle network. According to national studies, pedestrians represent a disproportionate percentage of road-related fatalities, and thus, special focus should be given to addressing these safety concerns (FHWA, 2014). There was only one pedestrian crash and no bicycle crashes along the corridor. The lone pedestrian crash resulted in the only fatality along the corridor. The crash occurred south of 21st Avenue/ Christianson Drive, when a pedestrian tried to cross Sheyenne Street. This area of Sheyenne Street does not have pedestrian facilities. The pedestrian was walking in the ditch, out of sight of the motorist, until he entered the traffic stream. This crash highlights the importance of not only pedestrian facilities throughout the entirety of the corridor but also traffic control at desired crossing locations.

Pedestrian and Bicycle Generators

Legacy Elementary School was constructed along 52nd Avenue west of Sheyenne Street. Construction for the school began in the summer of 2014, and opened fall of 2015. The school holds 550 students and 65 staff members. This location is the largest pedestrian and bicycle generator on the corridor. There are few other major pedestrian and bicycle generators on the corridor; future planned developments are not anticipated to be major generators.

Figure IV-20 illustrates the site plan for Legacy Elementary School. Enhancing pedestrian and bicycle access to the school is essential. Studies have found that children cannot assess crossing scenarios as effectively as adults due to their limited roadway experience (Tabibi et al., 2003). The area surrounding Legacy Elementary School is mostly undeveloped but platted and planned for construction. City of West Fargo ordinance requires sidewalks on both sides of the street in new developments, so as developments are constructed, sidewalks will be implemented on each side of the road, connecting to the school. This leaves only 52nd Avenue without pedestrian and bicycle facilities adjacent to Legacy Elementary School.

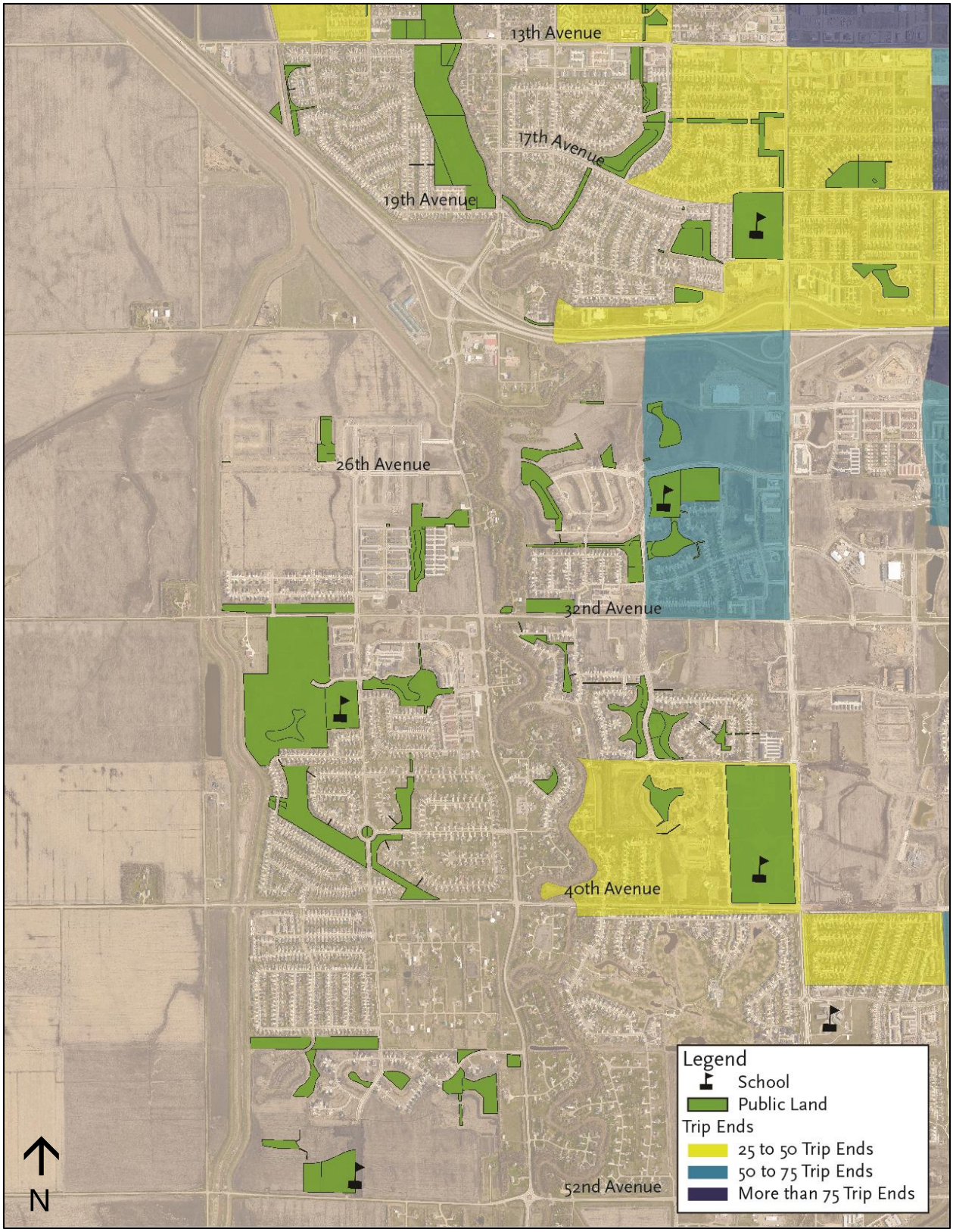
FIGURE IV-20: LEGACY ELEMENTARY SITE PLAN

Many routes typically used by children walking or biking to and from school are hindered with connectivity gaps and high-speed, high-volume crossings. Later in this report, Safe Routes to School (SRTS) plans will be developed to determine where crossing improvements are required. Implementing a SRTS plan is an opportunity to make walking and biking to school safer and more accessible for all children by improving pedestrian and bicycle infrastructure along designated routes.

Transit

West Fargo is served by Metro Area Transit (MAT). Currently, 21 fixed routes serve the metro area. There are no routes or stops within the study area. In West Fargo, where auto-ownership rates are very high and metro congestion is reasonable, transit predominately serves a social service function. Riders are often those who are physically or economically unable to travel by private automobile, such as children, the elderly, disabled and low-income families. As congestion begins to build metro-wide, transit will increasingly offer an attractive alternative to the single occupancy vehicle, while also spurring pedestrian and bicycle activity.

FIGURE IV-21: 2020 TRANSIT NEEDS ASSESSMENT



Research points to a direct correlation between transit demand and residential and employment density measured in units per acre (Alshalalfa et al., 2007). Specifically, a minimum of seven dwelling units per acre or 25 jobs per acre is generally considered to support a fixed-route hourly transit. Evaluating areas that meet this threshold will be used to indicate areas that may benefit from transit service. Trip ends (any origination or end of a trip) from the LRTP's 2020 model were used as a proxy for minimum densities. As noted earlier, full build-out was evaluated and illustrated in Figure IV-21 to estimate the potential for this corridor to support a transit route.

The large amount of low density residential development and lack of other destinations suggest this corridor is not likely to be able to support an hourly fixed route service. All areas west of Sheyenne Street have fewer than 25 trip ends per acre. There is limited commercial activity in the corridor and few facilities that are city or metro-wide destinations. This analysis is supported by Metro COG's *Transit Development Plan 2012 -2016* (TDP). The TDP identified corridors that may support transit in cost constrained and unconstrained models and recommended routes to serve those corridors. Sheyenne Street was not included in the recommended transit route expansion.

Access Management

Access management is the process of balancing the competing needs of traffic movement and land access. Access points introduce conflicts and friction into the traffic stream. Allowing dense, uncontrolled access spacing results in safety, operational and aesthetic deficiencies:

- According to *NCHRP Report 420: Impact of Access Management Techniques,* every unsignalized driveway increases the corridor crash rate by approximately two percent.
- Research included in the HCM found that roadway speeds were reduced an average of 2.5 miles per hour for every ten access points per mile.
- The safety and operational issues caused by dense access spacing potentially makes an area less attractive to developers and the general traveling public. Multiple national studies, including *NCHRP Report 420*, have shown most people have no problem making a slightly longer trip, including U-turns, to access destination businesses so long as the ride is pleasant and congestion free.

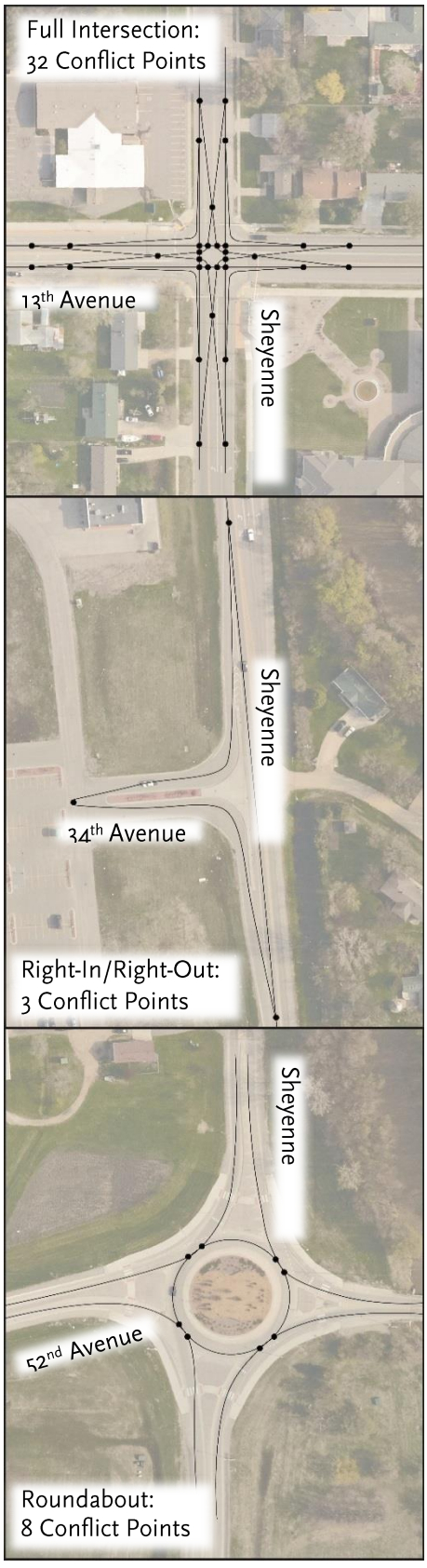
According to access management guidelines outlined in the City of West Fargo ordinances, desired access spacing on urban arterials is 660 feet with 330 feet being the minimum for developed areas. As illustrated in Table IV-2 below, only the North Sheyenne Street study section exceeds both the preferred and maximum allowable access spacing. While this holds true for calculated numbers of access points based on averaged access points, there are many locations along the corridor where adjacent accesses are less than the 330-foot minimum allowable spacing guideline.

TABLE IV-2: ACCESS SPACING

Section	Termini	Access Points[2]	Maximum Allowable Access Points[3]	Preferred Allowable Access Points[3]
North Sheyenne	13th Avenue - Beaton Drive	26	11	6
I-94 Interchange	Beaton Drive - 21st Avenue /Christianson Drive	3	7	3
South Sheyenne	21st Avenue /Christianson Drive - 52nd Avenue	26	48	24
52nd Avenue[1]	Sheyenne Diversion - 4th Street	10	25	13

[1]Treated as minor arterial throughout.
[2]Access points include termini, platted developments. Counts aligned access points as one access.
[2]Doesn't count field access points not routinely used.
[3]Based upon 330 foot (minimum) and 660 foot (preferred) City of West Fargo access spacing guidelines.

FIGURE IV-22: CONFLICT POINTS



This traditional method of counting the number of access points along a corridor and comparing it to the maximum allowable driveways is flawed for two reasons:

- All access points are treated equally. For example, this methodology treats a field access with minimal activity equal to an intersecting arterial road that carries thousands of vehicles per day.
- All configurations are treated equally. For example, this methodology treats a right-in/right-out driveway with only three conflict points equal to a driveway with full access that has 32 conflict points (refer to Figure IV-22).

To account for those flaws, a three-step methodology was developed:

1. Translate access points into *conflict points.*
2. Assign the following *conflict potential* scoring criteria to each access (refer to Figure IV-23 for *conflict potential* assignment).
   a. Category 0: Field approach no longer or rarely in use.
   b. Category 1: Access to five or less single family homes.
   c. Category 2: Access to more than five but less than 25 single family homes.
   d. Category 3: Local road with more than 25 homes (single or multi-family) or commercial development.
   e. Category 4: Local roadway or Collector roadway with 2,000 ADT or greater.
   f. Category 5: Arterial roadway.
3. Multiply *conflict points* by *conflict potential* to get *access risk.*

The methodology described above will be used to compare existing access conditions between alternatives developed later in the report against desirable access conditions. Desirable access spacing considers the 660 feet and configures the access spacing in the same fashion as other successful access controlled arterials in the metro area like Veterans Boulevard, Main Avenue, 45th Street and others. This includes the following spacing and designations: one mile arterial (C5) spacing, half-mile collector (C4) spacing, quarter-mile high-volume local road (C3) spacing, with limited access (right-in/right-out or ¾ access) local roads in between to meet the 660 foot spacing.

Table IV-3 illustrates that all locations meet the desired access risk. This indicates that the majority of the access points along the corridor only access small developments or single-family homes, creating minimal conflict potential. This does not imply that no access management strategies will be required, particularly as the corridor continues to build-out and new access points are required or desired by developers. The greater the degree of access management, the greater the subsequent safety and operational benefits.

FIGURE IV-23: CONFLICT POTENTIAL

TABLE IV-3: ACCESS RISK

Section	Termini	Access Risk[2]	Desired Access Risk	Factor Over Desired Access Risk
North Sheyenne	13th Avenue -17th Avenue	208	260	0.8
	17th Avenue to Beaton Drive	122	221	0.6
I-94 Interchange	Beaton Drive - 21st Avenue/Christianson Drive	105	301	0.3
South Sheyenne	21st Avenue/Christianson Drive - 32nd Avenue	163	637	0.3
	32nd Avenue - 40th Avenue	185	703	0.3
	40th Avenue - 52nd Avenue	121	720	0.2
52nd Avenue	Sheyenne Diversion - Sheyenne Street[1]	62	732	0.1
	Sheyenne Street - 4th Street	58	348	0.2

[1]Treated as minor arterial throughout.
[2]Access points include termini, platted developments. Counts aligned access points as one access.
[2]Doesn't count field access points not routinely used.

ROADWAY ALIGNMENT

Sheyenne Street is one of the most historic and unique roadways in West Fargo. Proposed typical sections will be driven by capacity, safety, pedestrian and bicycle needs. However, the horizontal and vertical roadway alignments will largely be dictated by the Sheyenne River.

Horizontal Alignment for Sheyenne Street

The planning and design of the horizontal alignment for proposed changes to Sheyenne Street will need to address three key issues:

- Due to the horizontal alignment of Sheyenne Street and the close proximity to the Sheyenne River, there are several locations where the roadway has experienced sliding in the past. The City of West Fargo has adopted ordinances requiring a minimum setback of 100 feet for any structure and river buffering standards that will be incorporated into final designs. Figure IV-24 illustrates five locations where roadway sliding is a concern and/or ROW is restricted. Geotechnical studies will need to be completed in later phases of the project to verify soil stability, determine final alignment and identify whether bank stabilization is needed.
- Acquisition of ROW will be required to enable the Sheyenne Street corridor to meet current City of West Fargo standards, to promote efficient maintenance and to be consistent with similar corridors in the area. Additional ROW is likely required at key intersections where additional turn-lanes are required.
- Sight distance and safety conditions were examined along the corridor to identify deficiencies and opportunities for improvement. A potential sight-distance restriction was identified at Sheyenne Street and 24th Avenue due to the steep grade and curved roadway. Refer to Figure IV-25 for an illustration of the deficiency.

FIGURE IV-24: RESTRICTED ROW AND SLIDING CONCERN

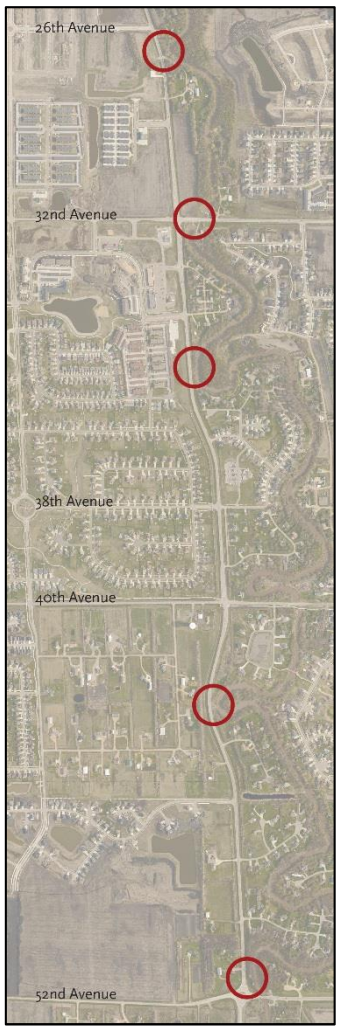


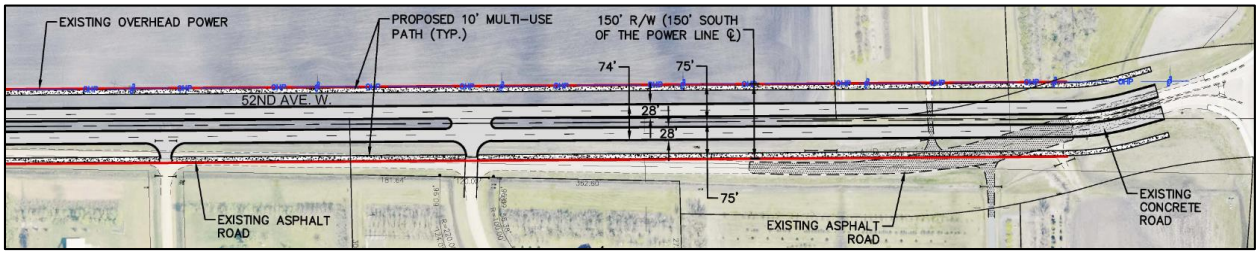
FIGURE IV-25: POTENTIAL SIGHT DISTANCE RESTRICTION AT SHEYENNE STREET AND 24TH AVENUE

Horizontal Alignment for 52nd Avenue

52nd Avenue west of Sheyenne Street does not currently run along the section line. This is the result of a barn located on the west approach of the Sheyenne Street and 52nd Avenue intersection prior to construction of the roundabout. The alignment places this section of 52nd Avenue into Horace city limits. City of West Fargo staff developed a range of long-term improvement alternatives for realignment and reconstruction of this roadway, ultimately selecting to realign 52nd Avenue to follow the power line. City of West Fargo staff has coordinated with the City of Horace for this realignment. The proposed realignment balances the need to improve 52nd Avenue alignment while minimizing ROW impacts.

In addition to the jurisdictional complications of this roadway, the major realignment design decision involves maximizing the available property. This is influenced by the off-center alignment of the roadway and the power line to the north of the corridor that is not parallel to the section line or current roadway alignment.

FIGURE IV-26: PROPOSED REALIGNMENT OF 52ND AVENUE TO FOLLOW POWER LINE



An interim solution that included paving the existing roadway to provide reasonable access to Legacy Elementary School was completed in Summer 2015. This solution did not include any other amenities.

Vertical Alignment

Older properties along the river do not have easements between homes and the river. This lack of easements prevents flood mitigation measures such as levees to be constructed adjacent to the river. Although the Sheyenne River Diversion mitigates the majority of flood concerns, ice jams and major flood events may still create flooding concerns on the Sheyenne River, at least until the Red River Diversion is operational. During these high water events, the Sheyenne Street corridor is an integral part of the city's river containment plan. The vertical alignment of Sheyenne Street will need to consider primary and secondary containment of water during flood events; Sheyenne Street may need to be designed in a fashion that acts as a dam. The river profile during high flow conditions was established through modeling efforts that will be used to establish minimum street grades from I-94 to 52nd Avenue. Defining detailed horizontal alignments is outside the scope of this report, but will be evaluated in greater detail in later phases of project development.

Utilities

Coordinating potable and wastewater distribution and collection lines with roadway construction is important to avoid later impacts to Sheyenne Street traffic. Any improvements to underground utilities will be made as part of the Sheyenne Street roadway project. These improvements may include:

- City Utilities. While all new development that has occurred in the past ten years has been connected to City of West Fargo sewer and water systems, there are still many residential areas along the corridor serviced by rural water, wells and septic systems. The reconstruction of Sheyenne Street will provide a cost-effective opportunity to extend city utilities to these areas, specifically south along Sheyenne Street and west along 52nd Avenue to serve future developments.
- Storm Sewer. Storm sewer improvements will be needed to accommodate drainage. If flood mitigation is incorporated into the designs, this corridor will require isolated storm lines discharging to the east and west. Portions of the corridor can continue to drain into existing storm facilities but some amount of runoff would need to be conveyed to a new pumping station that would discharge into the Sheyenne River. The siting of the lift station will require coordination and permitting from Southeast Cass Water Resource District, United States Army Corps of Engineers and the City of West Fargo.

Defining specific utilities improvement strategies is outside the scope of this report but will be evaluated in later phases of project development.

Intelligent Transportation Systems

Intelligent Transportation Systems (ITS) is the application of advanced technology to solve transportation problems. ITS encompasses a broad range of communication based information and electronics technologies. When integrated into the transportation system's infrastructure, and in vehicles themselves, these technologies relieve congestion, improve safety and enhance productivity. ITS solutions are often employed as cost effective alternatives to improve traffic operations or safety without costly roadway improvements.

Video detection cameras are mounted on part of the signal structure and are used primarily to detect traffic for signal phasing purposes. Video detection cameras can also provide live video feed for engineers needing to view intersection operations. Additionally, video detection can be designed to count traffic automatically. Currently, video detection is installed at five signalized study intersections:

- 13th Avenue
- 17th Avenue
- 19th Avenue
- 32nd Avenue
- 40th Avenue

FIGURE IV-27: VIDEO DETECTION UNITS AT SHEYENNE STREET AND 19TH AVENUE

The only other ITS along the corridor is a video monitoring system located at the Sheyenne Street interchange. The City of West Fargo is in the process of installing a fiber optic interconnect backbone through the city that connects each traffic control signal to the Public Works building. Once the infrastructure is in place, a central control system (Centracs) will be installed to allow for control, operations and communications of the traffic signals and ITS applications remotely.

Applicable ITS solutions were evaluated and incorporated into alternatives. ITS solutions may provide operational and/or safety benefits. Potential ITS applications along the corridor may include pan-tilt-zoom cameras, dynamic speed display signs, dynamic curve warning systems, traffic adaptive signal systems and/or dynamic message signs.

Lighting

Studies have found that roadway lighting reduces fatalities up to fifty percent (Green et al., 2003). Lighting design and spacing is required to meet AASHTO standards according to the NDDOT *Design Manual*. Existing light levels were estimated using Visual Lighting Software, using the illuminance method of calculation. Where lighting did not exist, NDDOT warrants were studied. Lighting analysis by study section is detailed below. The NDDOT lighting warrants for unlit urban streets include:

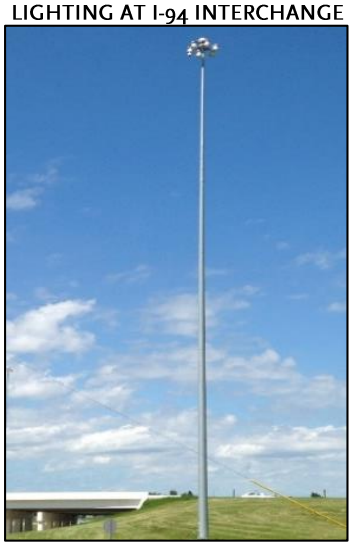
- Sections where curb and gutter are present on at least one side of the road.
- Sections through cities where substantial development is present on both sides of the road and the highway is interregional or the ADT is greater than 1,000.
- A segment of roadway between two fully illuminated intersections one-half mile or less apart.

FIGURE IV-28: EXISTING LIGHT IN NORTH SHEYENNE STREET SECTION

North Sheyenne: Sheyenne Street from 13th Avenue to Beaton Drive

- Existing lights consist of standard, non-decorative davit type poles with cobra head type luminaires.
- Luminaires have high-pressure sodium lamps that produce an orange color.
- Lights are currently placed using a staggered configuration on both sides of the roadway.
- Existing lighting meets AASHTO standards with the current roadway cross-section. Existing luminaires were assumed to be 150 watt HPS with MSC 2 optics.
- Decorative combination traffic control signal and light standards are used at the signalized intersections of 17th Avenue and 19th Avenue. Traffic signal poles at 13th Avenue are a non-decorative type.

FIGURE IV-29: HIGH MAST LIGHTING AT I-94 INTERCHANGE



I-94 Interchange: Sheyenne Street from Beaton Drive to 21st Avenue/ Christianson Drive

- Existing lights at the interchange consist of high mast light towers, which are located along I-94. High mast light towers are placed in each quadrant within the I-94 ROW.
- Between Beaton Drive and the I-94 North Ramps, there are four davit-type poles with cobra head lights.

- Between the I-94 South Ramps and 21st Avenue/ Christianson Drive there are vertical-mount type luminaires mounted to utility power poles.
- All luminaires of the various types have high-pressure sodium lamps.
- Existing lighting along I-94, including the on- and off-ramps, is assumed to meet AASHTO standards due to the recent installation of high mast light towers.
- Existing traffic control signals at the I-94 North Ramps and I-94 South Ramps are temporary in design and do not have lights mounted to them.

South Sheyenne: 21st Avenue/ Christianson Drive to 52nd Avenue

FIGURE IV-30: EXISTING LIGHT IN SOUTH SHEYENNE STREET SECTION

- Existing lights consist of vertical-mount type luminaires mounted to utility power poles.
- Luminaires have 400 watt high-pressure sodium lamps.
- Lights are currently placed only on the side the power line is located.
- Lights are limited to only being placed on the power line poles, which are spaced from 200 to 275 feet apart. In addition, the light poles are offset from the pavement edge, approximately forty feet on average. A sample 1,000-foot roadway section was analyzed and the existing lighting does not meet AASHTO standards, but does meet NDDOT lighting warrants based on ADT.
- Existing traffic control signals at 32nd Avenue and 40th Avenue are temporary in design and do not have lights mounted to them.

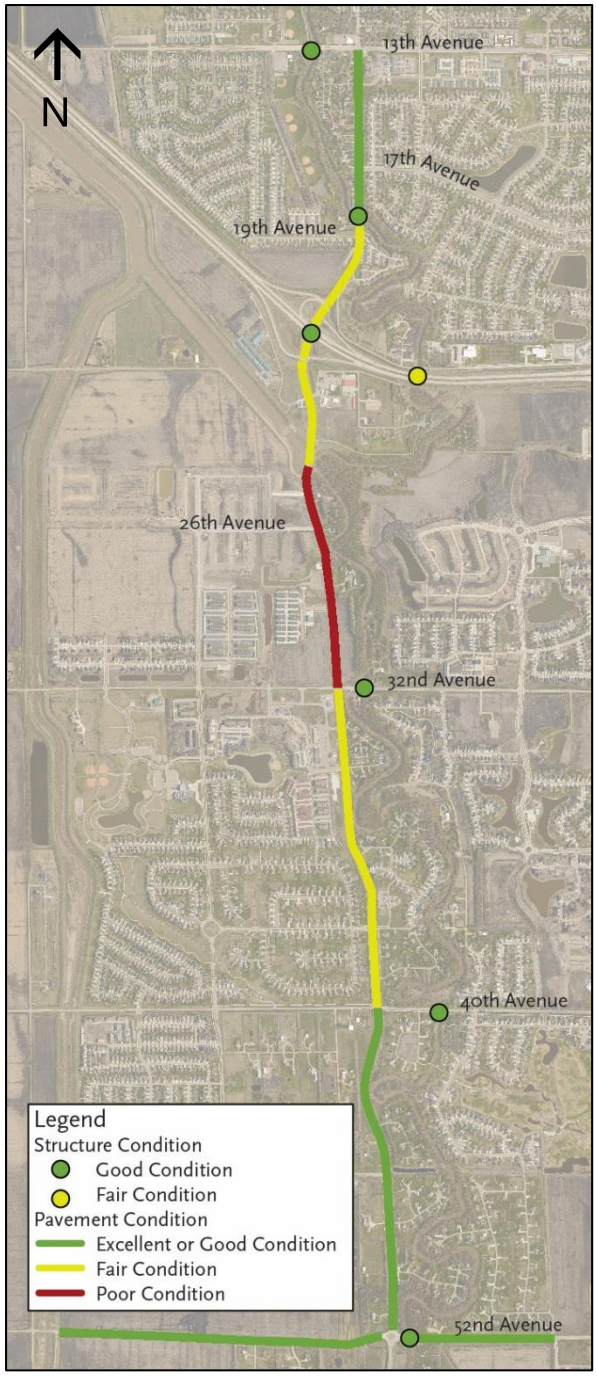
52nd Avenue: 52nd Avenue from the Sheyenne River Diversion to 4th Street

FIGURE IV-31: EXISTING LIGHT ON 52ND AVENUE

- Currently, the location with lighting along this study section is the roundabout intersection at 52nd Avenue and Sheyenne Street.
  - » Existing lights at the roundabout are architecture shoebox type luminaires mounted to steel poles with no mast arms.
  - » Luminaires have metal halide lamps that produce a daylight, white color.
  - » Lights are currently placed around the roundabout with a few lights branching off each end for transitioning purposes. Existing lighting at the roundabout is assumed to meet AASHTO standards because of the recent roundabout construction.
- The section of 52nd Avenue east of Sheyenne Street met the previous NDDOT lighting warrant pertaining to day-to-night crash ratios, but would not meet updated warrants until fully developed, improved to an urban section or if the City of West Fargo is willing to pay for 50 percent of the installation costs and 100 percent of the maintenance and operating costs.
- The section of 52nd Avenue west of Sheyenne Street did not meet previous warrants unless the City of West Fargo was willing to pay for 50 percent of the total cost. With updated warrants, the section of 52nd Avenue west of Sheyenne Street would meet warrants once fully developed, improved to urban section or if the City of West Fargo is willing to pay 50 percent of the installation costs and 100 percent of the maintenance and operating costs.

Pavement and Structure Conditions

FIGURE IV-32: PAVEMENT AND STRUCTURE CONDITION



Studies have found timely pavement rehabilitation has the potential to be six to 14 times more cost effective than rebuilding a deteriorated road (AASHTO, 2009). Another study found that rough roads adds an average of $335 to the annual cost of owning a car due to damaged tires, suspensions, reduced fuel efficiency and accelerated vehicle depreciation (AASHTO, 2009). The need for roadway expansion will drive the need to improve roadway surfaces and structures. However, under the no-build alternative, rehabilitation of existing roadways and structures will need to be considered and accounted for.

Results from the City of West Fargo's Operational Conditions Index (OCI) report were used to evaluate current conditions for the roadways in the study area. The index ranges from zero to 100, with zero describing the poorest condition and 100 the best condition. OCI ratings are then translated into "Excellent" (100 to 85), "Good" (84 to 70), "Fair" (69 to 40) and "Poor" (30 to zero) classifications. Figure IV-32 shows the pavement condition for the study area. OCI data was only available from 21st Avenue/ Christianson Drive to 52nd Avenue. Estimates were made for the remaining areas of the corridor by evaluating the surface conditions, comparing surface conditions to sections where data was available and considering pavement type, year of construction and rehabilitation. This evaluation was completed by staff with experience completing pavement surface distress surveys.

Additionally, NDDOT bridge inspection reports were evaluated to determine the existing sufficiency rating of the bridges in the study area and whether any bridges are classified as functionally obsolete or structurally deficient. Sufficiency ratings are then translated into "Excellent", "Fair" and "Poor" classifications. A bridge with a sufficiency rating of 80 or less may be considered for rehabilitation with federal funding. A bridge with a sufficiency rating of 50 or less may be considered for replacement with federal funding. As part of the inspection, it was also noted if bridges are found to be functionally obsolete or structurally deficient. Since there were no bridges found functionally obsolete or deficient, definitions are not provided in this report.

All roadways and bridges along the corridor are in "Fair" condition or better, with the exception of Sheyenne Street from the Sheyenne River Diversion bridge south of I-94 to 32nd Avenue, which is in "Poor" condition. This section of Sheyenne Street carries high volumes of daily traffic and has not been rehabilitated since 2006. It is

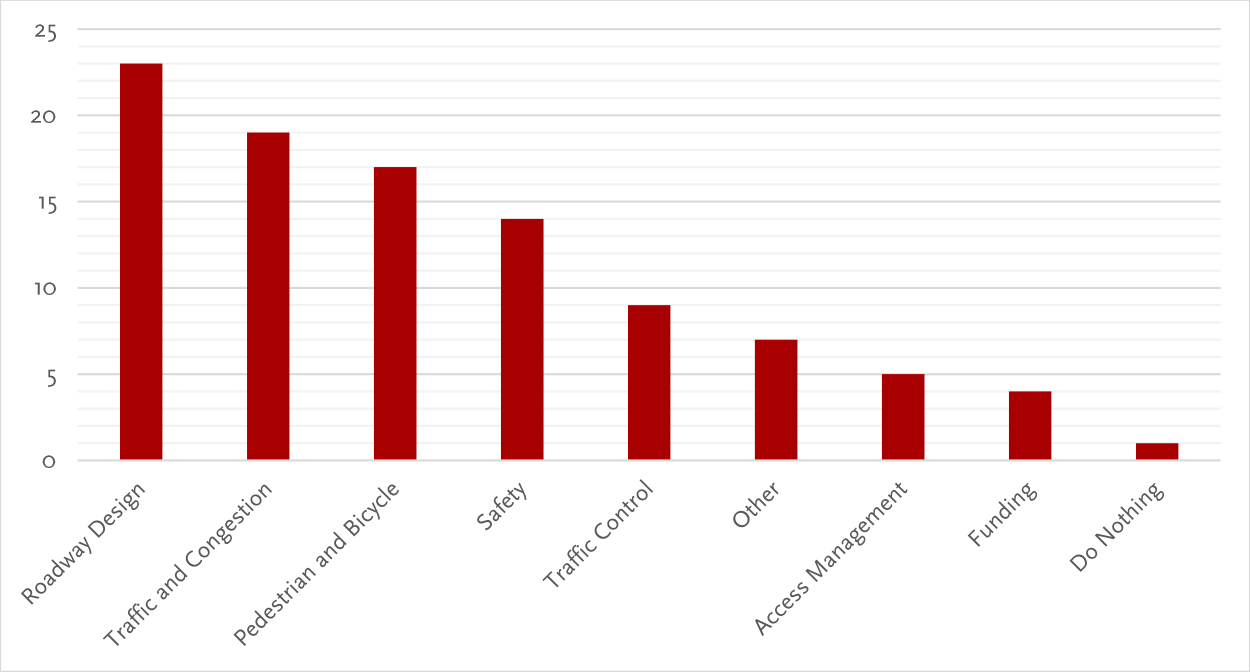
important to note that volumes are similar north of the I-94 interchange, however, this section of roadway is concrete which has a longer lifecycle than asphalt pavement.

Although the remainder of the corridor is not in imminent need of rehabilitation, each roadway section will still need periodic concrete pavement repair, asphalt overlay, crack seal and chip seal through the 2040 study horizon. No significant bridge improvements would likely be required during the study horizon either.

Summary of Public Comments

During Public Input Meeting #1, more than 100 comments, both formal and informal, were received, regarding existing and future needs of the corridor. Figure IV-33 below summarizes the public comments received (both formal and informal) gathered as part of that public input meeting, with a summary of the most frequently submitted comments below.

FIGURE IV-33: SUMMARY OF COMMENTS RECEIVED AT PUBLIC INPUT MEETING #1



Roadway Design

Twenty-three comments were left regarding roadway design. Overwhelmingly, attendees requested left-turn lanes in the South Sheyenne Street study section. Four comments requested additional capacity. Seven comments included concerns about the area between the I-94 North Ramps and I-94 South Ramps intersections. Comments ranged from flooding issues under the I-94 bridges and geometry changes to the ramps.

Traffic and Congestion

Nineteen comments were made regarding traffic along the corridor. Ten comments were made on the difficulties of making turning movements onto Sheyenne Street. Five comments were noted regarding general congestion at locations throughout the corridor.

Pedestrian, Bicycle and Transit

Seventeen comments were received regarding pedestrian, bicycle and transit facilities along the corridor. Overwhelmingly, the comments requested shared-use paths on both sides of Sheyenne Street with amenities to make crossing easier. Residents noted that there are currently few crossings from the east to the west, despite many of the parks and schools located on the west side of Sheyenne Street.

Safety

Fourteen comments were left on the topic of safety. Passing on the right was noted at 32nd Avenue and 38th Avenue (three comments). Poor lighting, visibility and sight distance issues were noted at various locations along the corridor (five comments).

Traffic Control

Nine comments were received related to traffic control signals and signal timings. Four comments requested improved signal timing and/or left-turn phasing.

Funding

Four comments were received regarding funding. Two of these comments noted they have already been assessed for 32nd Avenue and 40th Avenue and have concerns that further assessments will "assess many residents out of being able to afford to live" in the area.

Neighborhood Context

A number of residents along the corridor verbally expressed concern over the potential impacts to adjacent residential neighborhoods of a reconstructed and widened Sheyenne Street, especially in light of future projected traffic volumes. Many residents who live near or adjacent to Sheyenne Street requested the roadway design respect the existing residential nature of the corridor; suggestions included buffering, streetscaping and substantial pedestrian accommodations to ensure the roadway continues to blend with existing and future residential development in the study area.

V) Environmental Conditions

The existing environmental conditions, or affected environment, are the baseline conditions that may be affected by any recommendations for build alternatives. Contained below are the environmental features that are evaluated to help mitigate undue environmental impacts with proposed improvements.

Purpose and Need Statement

The purpose and need for the project have been developed under guidance pursuant to 23 CFR 450 Appendix A (Linking the Transportation Planning and NEPA Processes). Developing a project purpose and identifying project needs at the corridor planning level allows for the evaluation, prioritization and elimination of alternatives. The purpose and need will further be carried into the NEPA phase of project development (if applicable) to aid in the selection of a preferred alternative.

Need for the Project

The need for the proposed project along Sheyenne Street from 13th Avenue to 52nd Avenue and along 52nd Avenue from the Sheyenne River Diversion to 4th Street is driven by increasing motorist delay; congestion from development along the two corridors; safety concerns due to crash susceptibility and lack of multimodal opportunities. Current and projected needs within this corridor include capacity, social demands, economic development and safety.

Capacity

Sheyenne Street

The existing land use abutting Sheyenne Street is predominantly residential (approximately 73 percent of the total land use), and according to 2010 Census data, approximately 36 percent of the total West Fargo population lives in the neighborhoods surrounding the Sheyenne Street corridor. By 2040, 53 percent of the total West Fargo population is expected to live in the surrounding neighborhoods based on growth projections in the 2040 LRTP.

Development surrounding the Sheyenne Street corridor has increased significantly in recent decades. The area surrounding the corridor is anticipated to experience continued accelerated growth that will likely result in full build-out in less than 10 years. This estimate is reinforced by the fact that nearly all residential sites in the study area are currently platted.

The lack of land use diversity within the study corridor leads to pronounced A.M. and P.M. peaks in traffic volumes as motorists travel out of the corridor in the morning and back into the corridor in the afternoon. Under existing conditions, the corridor has some congested areas but primarily operates at an acceptable level of delay according to NDDOT design standards. Under future conditions however, it is anticipated that driver delay will increase to unacceptable levels according to NDDOT standards. The anticipated growth of roadway users will result in additional strain on a corridor that is currently at or near capacity in most locations. Under existing roadway configurations, future average per vehicle delays are anticipated to exceed several minutes at most locations. Long delays produce traffic backups that block turn lanes, driveways and even adjacent intersections during peak periods.

FIGURE V-1: NORTHBOUND QUEUES AT 32ND AVENUE INTERSECTION

52nd Avenue

Legacy Elementary School opened fall of 2015 west of Sheyenne Street with access from 52nd Avenue. 52nd Avenue was paved summer of 2015 to provide reasonable access to the school. It is a basic two-lane road with no pedestrian/bicycle amenities, lighting or turn lanes as shown in Figure V-2. Further improvements to the roadway on 52nd Avenue are still required to efficiently access Legacy Elementary School. This includes the need for at least the implementation of adequate turn lanes and improved lighting.

The eastern portion of 52nd Avenue, from Sheyenne Street to 4th Street is part of a future major arterial system that will connect Sheyenne Street to Trunk Highway 75 in Minnesota. This currently serves as one of only five corridors with east-west connectivity from West Fargo to Moorhead. This is the southern-most corridor with direct connectivity across all three cities, which is vital considering the south portion of the metro is the primary growth center. This level of connectivity will continue to promote increased traffic volumes.

FIGURE V-2: 52ND AVENUE BEFORE PAVING IN SUMMER 2015

Safety

Sheyenne Street

According to historic data, the study area experiences an average of 38 crashes per year, 37 of which occurred on Sheyenne Street. This includes an average of nine crashes per year resulting in injury, and one recorded fatality over the past three years. Detailed trend analysis of this crash data indicated a direct correlation between corridor capacity and safety. The majority of crashes identified within the analysis were attributed to deficient motorist delay (according to NDDOT standards), excessive traffic backups at intersections and a lack of turn lanes within the corridor. These deficiencies could be mitigated with capacity enhancements such as turn lanes, improved signal progression and improved intersection operations.

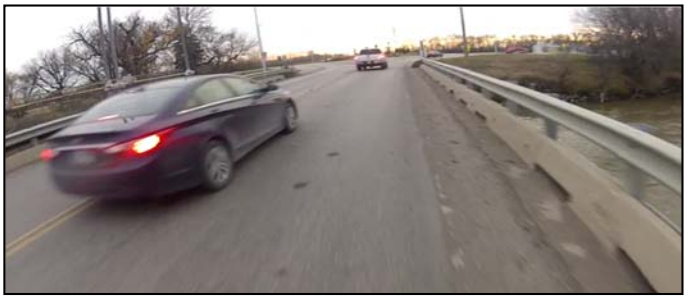
The lack of capacity also results in bottlenecks when crashes occur (refer to Figure V-3). This results in an increased potential for secondary crashes as motorists do not expect stopped traffic and long backups in the middle of the road, particularly during off-peak periods.

FIGURE V-3: CRASH ON SHEYENNE STREET (LEFT) AND ENSUING TRAFFIC BACKUP (RIGHT)

52nd Avenue

This section of the corridor currently lacks proven safety measures common in urban settings such as pedestrian/bicycle facilities and lighting. Legacy Elementary School has been constructed along the north side of this section of 52nd Avenue; 52nd Avenue will serves as one of the primary access corridors for the school, further emphasizing the need for additional safety measures.

FIGURE V-4: EXAMPLE OF CHALLENGING BICYCLE CONDITIONS ALONG THE CORRIDOR (TAKEN FROM BICYCLE HELMET CAMERA)



Social Demands and Economic Development

Sheyenne Street

The lack of employment, shopping or dining opportunities compounded by the disproportionally high percentage of residential developments within the area, creates an economic demand for commercial land uses along the corridor. The majority of the remaining undeveloped land within the project corridor has already been platted for residential development, however, there is still land available for commercial development around the I-94 interchange. The lack of multimodal considerations along the Sheyenne Street corridor, coupled with existing and projected traffic capacity issues serve to reduce the attractiveness of the corridor to the expansion of neighborhood commercial developments which are typical within the immediate study area. Improved capacity, access management and pedestrian/bicycle accommodations will improve the conditions for neighborhood commercial retail developments.

52nd Avenue

With Legacy Elementary School, 52nd Avenue functions as one of the primary corridors for transporting upwards of 550 students and 65 staff members to-and-from the school daily. As highlighted previously, this section of roadway is currently a gravel roadway with no pedestrian/bicycle amenities, lighting or turn lanes. The school opened fall of 2015 and became one of the largest pedestrian and bicycle generator within the project corridor, driving the need for an upgrade to an urban facility.

Purpose of the Project

The purpose of the proposed project is to address capacity needs, safety issues and social and economic development along Sheyenne Street between 13th Avenue and 52nd Avenue, and along 52nd Avenue from the Sheyenne River Diversion to 4th Street.

Affected Environment

Wetland Delineation

The field wetland delineation for the Sheyenne Street Corridor Study was completed in July of 2014. Fourteen wetlands, totaling approximately 17.02 acres, were delineated within the study area. In addition, an area of Other Waters of the United States (OWUS) (Sheyenne River) occurred in three places within the study area totaling approximately 2.78 acres, or 1,495 linear feet. All wetlands occurred as artificially created ditches, with the exception of wetlands adjacent to the Sheyenne River.

A wetland delineation report was submitted to the U.S. Army Corps of Engineers (USACE) requesting a jurisdictional determination for the identified wetlands. The wetland delineation report is attached to this memo as Appendix C. Maps depicting the location and extents of each wetland can be found in this report. In a letter dated October 14, 2014, the USACE determined three of the 14 identified wetlands to be jurisdictional. A copy of this letter can be found in Appendix D. Wetland impacts will be determined during the design phase of the proposed project. Should the project result in impacts to jurisdictional wetlands, all appropriate USACE permits would be acquired.

Cultural Resources

The Class III Cultural Resource Inventory was conducted on July 17, 2014. A Class III inventory is a systematic, detailed field survey required to formulate a preliminary determination of the significance of resources and their eligibility for listing on the National Register of Historic Places. The Class III inventory involved a pedestrian survey of the area of potential affect (APE). During the course of the inventory, no newly identified cultural resources were recorded. The boundary of one previously identified cultural site lead appeared to cross into the APE; however, no evidence of it was observed. Based on the vague initial recording of this site lead, it is unlikely to be encountered during the proposed project.

Noise Analysis

Noise data was collected for 21 receptor sites located throughout the project corridor the week of September 8th, 2014. Refer to Figure V-6 for the results of the preliminary noise analysis. All sites were monitored during both A.M. and P.M. peak traffic flows. Recorded sound levels under existing conditions ranged from 53.0 dBA to 70.3 dBA. The collected noise data will be used to validate the Traffic Noise Model (TNM) for existing and future noise levels throughout the corridor using both the current alignment as well as project design alternatives once available.

The FHWA noise abatement criteria for single or multi-family housing is 67 dBA while most commercial property has an abatement criterion of 72 dBA. Within North Dakota, a receptor is deemed impacted if either of the two following conditions are met:

- Traffic generated noise levels are within 1 dBA of the FHWA noise abatement criteria,
- When an increase of 15 dBA is projected to occur, regardless of the absolute noise level, either upon project completion or projected twenty year hence.

Under current conditions, the majority of the receptor locations are at or near impact thresholds. Therefore, analysis of abatement measures will likely be required for any project that moves into the design phase. Noise abatement, typically in the form of a noise wall, must be determined reasonable and feasible in accordance with the NDDOT Noise Policy and Guidance for it to be considered and implemented. Based on the reasonable and feasible guidelines established in this document, incorporation of a noise wall into the design of this project is unlikely.

The noise analysis report is not complete and thus is not attached as an appendix. The noise analysis report will only be completed once alternatives have been established and analyzed. This requires both horizontal and vertical alignments of the preferred alternative which is outside the scope of the current phase of this project. Therefore, the full noise analysis report will be completed during later stages of project development.

Section 4(f)

The only potential Section 4(f) properties located within the project corridor are shared-use paths located along the east side of Sheyenne Street north of the I-94 interchange as well as along 40th Avenue. These facilities would be retained in conjunction with any proposed project alternative; therefore, their use would be considered temporary. In addition to the shared-use paths, there are also several schools and parks located with a half mile radius of the project corridor. None of these facilities would be directly impacted by any of the proposed alternatives along the Sheyenne Street corridor, but would benefit indirectly via improved traffic flow within the area and the incorporation of additional shared-use paths throughout the project corridor.

Environmental Justice

Using the Environmental Protection Agency's (EPA) EJSCREEN mapping tool, it was determined that there are no low-income or minority census block groups within or adjacent to the project corridor. Therefore, impacts to low-income or minority neighborhoods are not anticipated.

FIGURE V-5: WETLANDS IN STUDY AREA

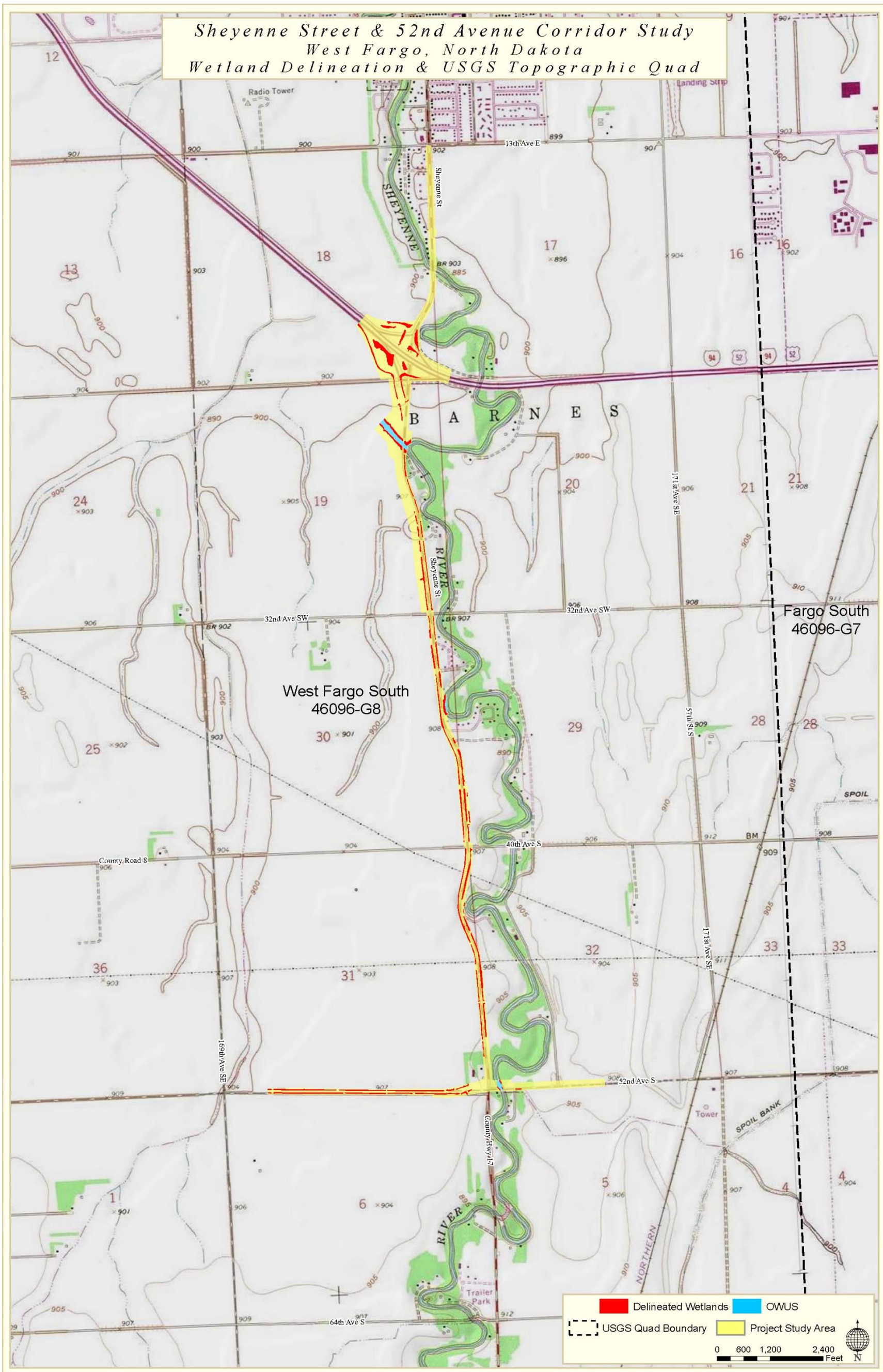
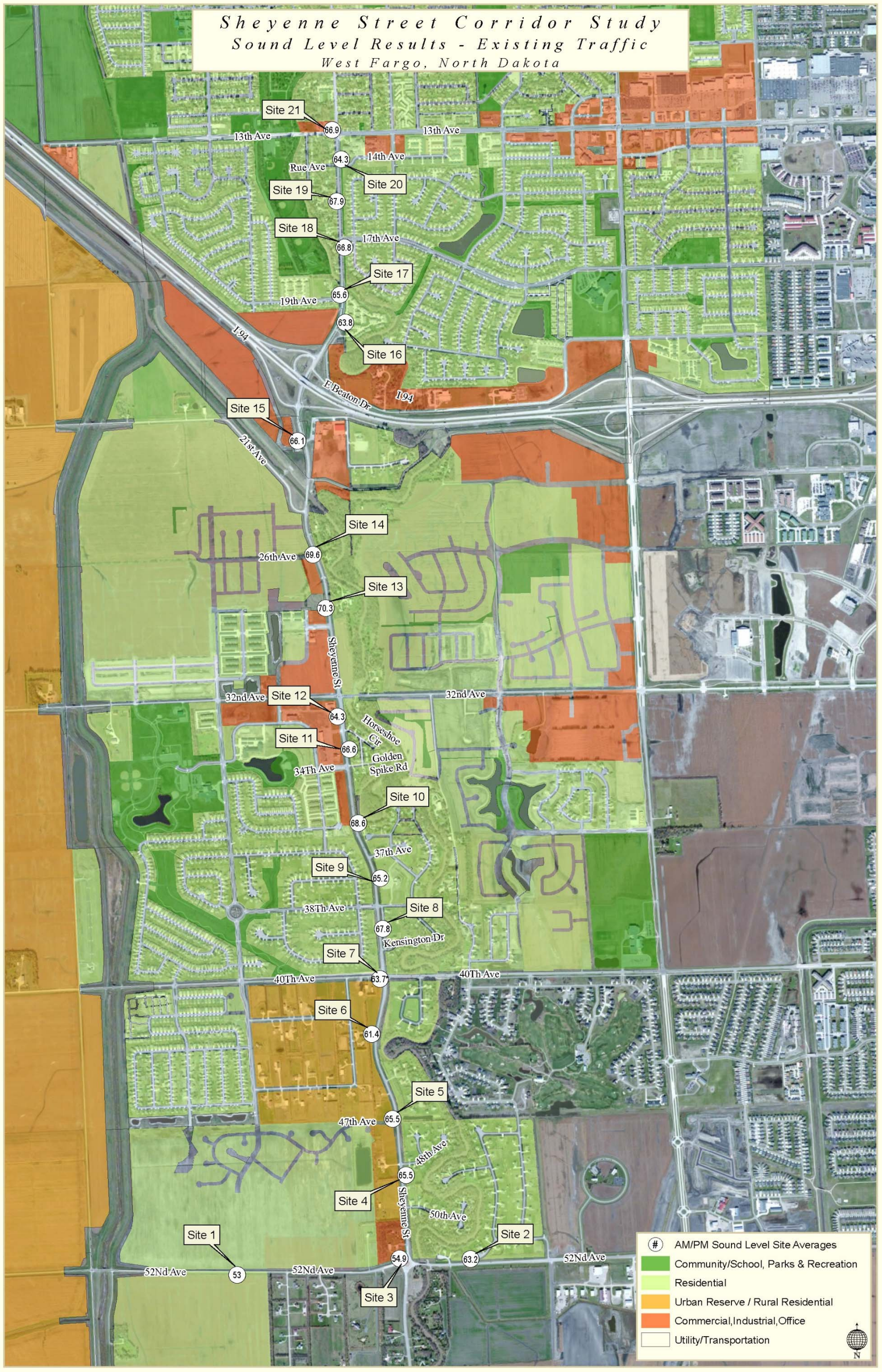


FIGURE V-6: PRELIMINARY NOISE ANALYSIS RESULTS



VI) Alternatives Analysis Methodology

The study team started with a list of any and all alternatives that could be applicable for the context of an interchange and urban arterial roadway. Next, a screening and prioritization methodology was developed that follows guidance regarding the linking of planning and NEPA, pursuant to 23 CFR 450 Appendix A. Accordingly, there are two ways in which the transportation planning process can limit the alternative solutions to be evaluated during the NEPA process: (a) shaping the purpose and need for the project or (b) evaluating and eliminating alternatives from detailed study in the NEPA process prior to its start. This process has three steps to limit alternative solutions:

- Does not meet Purpose and Need Statement (PNS) of the project. Therefore, any alternative that does not achieve an acceptable LOS according to NDDOT standards, improve safety or support social and economic development was discarded.
- Benefit/Cost Ratio less than one. Benefits of proposed alternatives must outweigh the costs of the alternative. For example, an alternative such as a left-turn flyover at the interchange will meet LOS standards but the cost will exceed the benefits, especially considering the available range of feasible and cost effective alternatives. Benefit/Cost (B/C) assumptions are discussed later.
- Project prioritization. A scoring criteria was developed to rate critical criteria that varies for interchange and roadway alternatives.

Interchange Alternatives Analysis Approach

Eight alternatives were developed for the Sheyenne Street interchange. Benefits and costs of each alternative were quantified or qualified, scored and ranked based on five value planning criteria: safety, mainline operations, local operations, cost and environmental impacts, as detailed below. These criteria were weighted by the SRC to replicate the values of stakeholders and responsible agencies in the context of the interchange.

Safety

Safety is quantified in terms of crash potential. Reliable crash modification factors were not available for the interchange alternatives, so crash reduction factors were estimated using the following strategy:

- Angle crashes were adjusted based on a comparison of crossing conflict points. This strategy related the number of locations where two vehicles could conflict at an angle to the potential for angle crashes.
- Rear-end crashes were adjusted based on a comparison of total delay and congestion. This strategy is based on the connection between rear-end crashes with long queues that interfere with motorist expectancy and stop-and-go traffic associated with intersections with poor operations.
- Sideswipe crashes were adjusted based on a comparison of merging and diverging conflict points. This strategy related the number of locations where two vehicles are required to enter or exit a lane with the likelihood of a sideswipe crash occurring. Essentially, more lane changing means greater potential for sideswipe crashes.
- Single vehicle crashes were not included in the analysis. The single vehicle crashes at the interchange were all either attributable to roadway conditions (i.e. icy) or driver error (i.e. too fast for conditions). These factors were not considered in design but useful when trying to compare differing interchange configurations.

A value planning score from zero to 10 was assigned using the following methodology:

1. A score of zero to 10 was assigned for angle, rear-end and sideswipe crash potential. Zero was assigned to the worst conditions for a particular crash type and 10 for the best conditions, with the other alternatives distributed in between.
2. Each crash type was weighted based on existing crash patterns. Under current conditions, the following crash distributions are experienced between the three crash types: 18 percent angle crashes, 68 percent rear-end crashes and 14 percent sideswipe crashes.
3. Each crash type was then weighted based on crash severity. There were no confirmed injuries or fatalities for the three crash types, so this was weighted at one for each.
4. The average score using the weights described above was assigned for each alternative.

Local Operations

Local traffic operations refers to the combined operations on Sheyenne Street, including between the two ramp intersections. This includes not only traffic passing through the intersection, but also any required merging behavior directly downstream from the intersection. Local operations was gauged using traffic simulation models that estimate delay per vehicle, which was then translated to LOS. For alternatives where a separate North Ramp and South Ramp intersection remains, the intersection operations were combined to provide an equal comparison against alternatives where the two intersections were combined into one (Single Point Urban Interchange, Modified Single Point Urban Interchange). Furthermore, the average delay per vehicle for the A.M. peak and P.M. peak hours were averaged to account for differing operations for each alternative. For example, the Southwest Loop alternative has an total delay of 27.5 seconds (the sum of the North Ramp and South Ramp intersections) in the A.M. peak and 13.7 seconds (again, the sum of the North Ramp and South Ramp intersections) in the P.M. peak. These two delays were averaged together to get 20.6 seconds of average vehicle delay, for a score of six.

TABLE VI-1: LOCAL OPERATIONS SCORING FOR INTERCHANGE ALTERNATIVES

Rating	Label	Level Of Service	Motorist Delay (Sec/Veh)	
			Unsignalized	Unsignalized
0	Overcapacity; Breakdown of Flow	F	>70	>100
1			50-70	80-100
2	Unstable Flow, Operating at Capacity	E	43-50	68-80
3			35-43	55-68
4	Approaching Unstable Flow	D	30-35	45-55
5			25-30	35-45
6	Stable Flow with Reasonable Delay	C	20-25	28-35
7			15-20	20-28
8	Reasonable Free-Flow	B	13-15	15-20
9			10-13	10-15
10	Free-Flow	A	≤ 10	≤ 10

Mainline Operations

Mainline operations refers to the operations of I-94 as it intersects with the Sheyenne Street on- and off-ramps. Different interchange configurations result in different mainline operations. Mainline operations were studied at the 500-foot section upstream of off-ramps and the 500-foot section downstream of on-ramps.

According to the HCM, freeway operations is reported as density (passenger cars per mile per lane). Directly upstream and downstream of ramps during the 2040 A.M. and P.M. peak periods produced LOS “E” and “F” for all alternatives. This is not uncommon at ramps during peak periods. This does however indicate that at some

point in the future, additional capacity along mainline I-94 may be required. This level of analysis on I-94 is outside the scope of this report. Capacity enhancements were not needed along this stretch of I-94 based on analysis completed for the 2040 LRTP; as such, no capacity enhancements along this stretch of I-94 are included in the current LRTP.

Each alternative produced significantly different mainline operations results. To report mainline operations, two 500-foot sections were reported: the A.M. peak downstream section for the eastbound on-ramp (shown in orange in Figure VI-1) and the P.M. peak upstream sections (shown in red in Figure VI-1) for the westbound off-ramp(s). For the alternatives where the northwest loop ramp was still used, the two 500-foot upstream sections were averaged to provide one upstream section result.

FIGURE VI-1: AREAS STUDIED FOR MAINLINE OPERATIONS

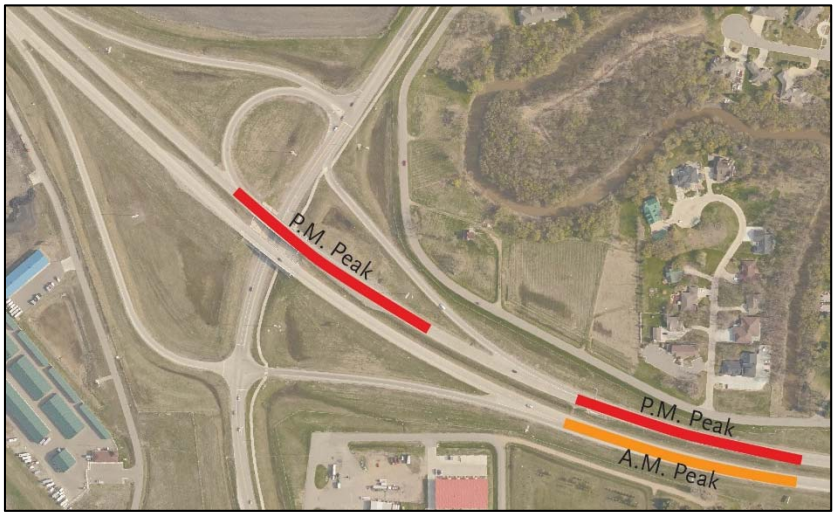


TABLE VI-2: MAINLINE OPERATIONS SCORING FOR INTERCHANGE ALTERNATIVES

Rating	Label	Description
0	Very Poor	Alternative with the highest average density
1-9	Poor – Very Good	Score is relative to alternative's performance versus the alternative with the highest and lowest average density
10	Excellent	Alternative with the lowest average density

Cost, Construction Impacts and Schedule

This section quantifies the cost, construction impacts and schedule. These three items are directly correlated; for example, the greater the cost, the greater the construction impacts, the greater construction impacts, the longer the schedule.

TABLE VI-3: CONSTRUCTION IMPACTS SCORING FOR INTERCHANGE ALTERNATIVES

Rating	Label	Description
0	Very Poor	Alternative with the highest combination of cost, construction impacts and construction duration
1-9	Poor – Very Good	Score is relative to alternative's performance versus the alternative with the highest and lowest combination of cost, construction impacts and construction duration
10	Excellent	Alternative with the lowest combination of cost, construction impacts and construction duration

Environmental Impacts

An assessment of the permanent impacts to the environment, including ecological (i.e. flora, fauna, air quality, water quality, visual, noise), socioeconomic impacts (i.e. environmental justice), business impacts and impacts to cultural, recreational and historical resources. Also considered under this criteria are drainage and hydraulic issues.

TABLE VI-4: ENVIRONMENTAL IMPACTS SCORING FOR INTERCHANGE ALTERNATIVES

Rating	Label	Description
0	Unacceptable	The environmental impacts are severe and the project does not comply with state and/or federal environmental laws
2	Poor	The project introduces environmental impacts that are both significant in number and require extensive mitigation
4	Fair	The project introduces new environmental impacts that will require extensive mitigation
6	Good	The project introduces new environmental impacts that can be addressed through standard and accepted mitigation approaches
8	Very Good	The project introduces no new environmental impacts
10	Excellent	The project improves upon the existing environmental conditions while introducing no new environmental impacts

Benefit-Cost Analysis

Using guidance from the "User Benefit Analysis for Highways" developed by AASHTO, a B/C analysis was conducted to provide a systematic evaluation of the economic advantages (benefits) and disadvantages (costs) of each interchange alternatives. This analysis was conducted using the following additional resources:

- The US DOT's "Revised Departmental Guidance on Valuation of Travel Time in Economic Analysis" published July 9th, 2014 quantifies the value of travel time for passenger and freight transportation. MnDOT updated national values to represent in-state conditions. These values were used as they provide a greater representation of the West Fargo financial environment than national figures.
- The estimation of travel time savings included both the driver and passengers in the vehicle (i.e. vehicle occupancy rates). This information was collected from the National Household Travel Survey.
- MnDOT values for remaining service life and discounting benefits from future years to present values were used for alternatives expected to exceed the 25 year study horizon of this project.
- Crash reduction benefits were quantified using National Safety Council figures as detailed earlier in this report.

B/C analysis was specifically used to compare improvement decisions versus build alternatives. For example, a left-turn flyer over maneuver would not meet B/C when compared to other turning movement alternatives (i.e. loop over straight off-ramp). This analysis was not used to compare technically feasible alternatives against a No-Build alternative because the No-Build alternative became so oversaturated under future conditions that the model could not accurately replicate operational conditions.

Roadway Alternatives Analysis Approach

Alternatives were developed for the Sheyenne Street roadway. Benefits and costs of each alternative were quantified or qualified, scored and ranked based on four value planning criteria: capacity and operations, crash potential, property impacts and construction costs. These criteria were not weighted.

Capacity and Operations

Capacity and operations refers to the combined operations on Sheyenne Street at the study intersections. To calculate this score, the 2040 intersection operations for all study intersections were averaged together for the A.M. and P.M. peak, weighted based on traffic volume entering the intersection and then assigned a score that corresponds to the average A.M. and P.M. motorist delay based on Table VI-5.

TABLE VI-5: CAPACITY AND OPERATIONS SCORING FOR ROADWAY ALTERNATIVES

Rating	Label	Level Of Service	Motorist Delay (Sec/Veh)	
			Unsignalized	Signalized
10	Free-flow	A	≤ 10	≤ 10
9	Reasonable free-flow	B	10-15	10-20
8	Stable flow with reasonable delay	C	15-17	20-24
7			17-19	24-28
6			19-22	28-32
5			22-25	32-35
4	Approaching unstable flow	D	25-27	35-40
3			27-29	40-45
2			29-31	45-50
1			31-35	50-55
0	Unstable flow, operating at capacity	E	35-38	55-60
-1			38-41	60-65
-2			41-44	65-70
-3			44-47	70-75
-4			47-50	75-80
-5	Overcapacity; breakdown of flow	F	50-54	80-85
-6			54-58	85-90
-7			58-62	90-95
-8			62-66	95-100
-9			66-70	100-105
-10			>70	>105

Safety

Safety was quantified in terms of crash potential. Reliable Crash Modification Factors were not available for roadway alternatives, so crash reduction factors were estimated using the following strategy.

- Rear-end crashes were adjusted based on a comparison of total delay and congestion. This strategy is based on the connection between rear-end crashes with long queues that interfere with motorist expectancy and stop-and-go traffic associated with intersections with poor operations.
- Single vehicle crashes were not included in the analysis. The single vehicle crashes along the corridor were attributable to roadway conditions (i.e. icy) or driver error (i.e. too fast for conditions).
- All other crashes were adjusted based on a comparison of corridor-wide access risk. This strategy related the number of access points, conflict points given the access configuration (crossing, merging and diverging) and conflict potential given the roadway uses (driveway, arterial roadway, etc.).

A value planning score from zero to 10 was then assigned using the following methodology:

1. A score of zero to 10 was assigned for angled, rear-end and sideswipe crash potential. Zero was assigned to the worst conditions for a particular crash type and 10 for the best conditions, with the other alternatives distributed in between.
2. Each crash type was weighted based on existing crash patterns. This was different for each study section. For the North Sheyenne Street Section, rear-end crashes made up 90 percent of all crashes and angle crashes made up 10 percent of all crashes; for the South Sheyenne Street Section rear-end crashes made up 59 percent, angle crashes made up 25 percent, single-vehicle crashes made up 11 percent and sideswipe and head-on crashes made up five percent.
3. Each crash type was then weighted based on crash severity.
4. The average score using the weights described above was then assigned for each alternative based on how it related to the lowest and highest safety score.

For the 52nd Avenue section, there were no crash trends, access risk between alternatives were similar and operations were dependent upon one controlled intersection. Thus, alternatives were scored using crash modification factors for improvements such as implementation of a raised median with turn lanes (39 percent reduction in crashes), implementation of lighting (49 percent reduction in crashes), construction of pedestrian and bicycle facilities (74 percent reduction in crashes for pedestrians), etc. This information was qualitatively used to develop a scoring grade from zero to 10.

TABLE VI-6: SAFETY SCORING FOR ROADWAY ALTERNATIVES

Score	Label	Description
0	Very Poor	Alternative with the highest estimated crash potential and access risk
1-9	Poor – Very Good	Scoring is relative to alternative's performance versus the alternative with the highest and lowest estimated crash potential and access risk
10	Excellent	Alternative with the lowest estimated crash potential and access risk

Property Impacts

Property impacts was qualitatively scored based on roadway expansion needs, boulevard impacts and ROW acquisition required. The impacts for each alternative vary and may range from minor impacts during construction to the removal of boulevards and boulevard trees to expanding ROW. Access revisions may also impact properties. However, each alternative maintains some form of access onto Sheyenne Street for every property along the corridor. Property impacts from access revisions are not included in this criteria.

TABLE VI-7: PROPERTY IMPACTS SCORING FOR ROADWAY ALTERNATIVES

Score	Label	Description
0-3	Very Poor	ROW impacts resulting in building impacts
4-6	Poor – Very Good	ROW impacts resulting in acquisition only
7-10	Excellent	ROW widening with no right-of-way impacts

Construction Cost

Planning level cost estimates were prepared based on the typical section for each alternative.

TABLE VI-8: CONSTRUCTION COST SCORING FOR ROADWAY ALTERNATIVES

Score	Label	Description
0	High Cost	$15 million per mile
1		$13.5 million per mile
2		$12 million per mile
3		$10.5 million per mile
4	Moderate Cost	$9 million per mile
5		$7.5 million per mile
6		$6 million per mile
7		$4.5 million per mile
8	Low Cost	$3 million per mile
9		$1.5 million per mile
10		Rehabilitation and maintenance only

VII) Alternatives Development & Analysis: North Sheyenne Street

Four alternatives were developed for the North Sheyenne Street section, all with varying costs, operations and impacts:

- Do-Nothing
- Three-Lane Section
- Five-Lane Section
- Five-Lane Section with Driveway Protection Lane

Under all alternatives, existing full accesses are maintained at 13th Avenue, 14th Avenue, 17th Avenue and 19th Avenue. Traffic operations at LOS "E" or worse were considered deficient, in accordance with the NDDOT *Traffic Operations Manual* published June 2015. Only two alternatives were found to be technically feasible according to the established screening criteria provided in Chapter VI) Alternatives Analysis Methodology.

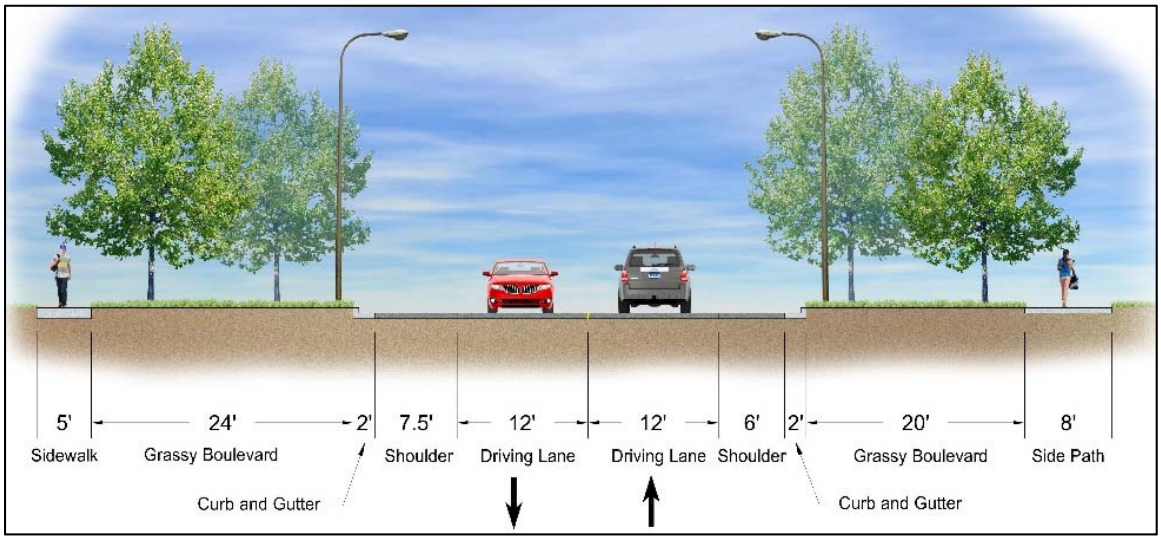
Alternatives to Carry into Project Development

Two alternatives will be carried forward into project development.

Do-Nothing

This alternative would not make any changes to the existing configuration. Intersections at 13th Avenue, 17th Avenue and 19th Avenue would remain signalized with turn lanes.

FIGURE VII-1: DO-NOTHING ALTERNATIVE FOR NORTH SHEYENNE STREET SECTION



2020 and 2040 Traffic Operations

Intersection operations will be acceptable at LOS "C" or better for the three signalized locations through 2020. However, long queues that block adjacent driveways and intersections are expected.

TABLE VII-1: 2020 TRAFFIC OPERATIONS FOR DO-NOTHING ALTERNATIVE FOR NORTH SHEYENNE STREET SECTION

Intersection	A.M. Peak LOS	P.M. Peak LOS
13th Avenue	C	C
17th Avenue	C	B
19th Avenue	C	C

By 2040, this alternative would result in deficient operations, long queues and delays. 17th Avenue experiences deficient operations during the A.M. peak and all three study intersections experience LOS "E" or F" during the P.M. peak. 17th Avenue queues block adjacent intersections and driveways during the A.M. and P.M. peak. Average per vehicle delays in the P.M. peak exceed 90 seconds at 13th Avenue and 17th Avenue. While it may be acceptable for certain corridors to operate deficiently during peak hours, the regional significance of Sheyenne Street, south of 13th Avenue, will likely require more efficient operations. Furthermore, the prevalent crash trend in this section of Sheyenne Street is attributed to poor operations and long queues and delays. This alternative would likely exacerbate this trend through 2040.

TABLE VII-2: 2040 TRAFFIC OPERATIONS FOR DO-NOTHING ALTERNATIVE FOR NORTH SHEYENNE STREET SECTION

Intersection	A.M. Peak LOS	P.M. Peak LOS
13th Avenue	D	F
17th Avenue	E	F
19th Avenue	C	E

Five-Lane Section

This alternative would add one more through lane in each direction with a two-way left-turn lane. The boulevard would be reduced to between 11 and 12 feet with the sidewalk and shared-use path maintained. With this alternative, it is possible that some of the existing boulevard trees may be impacted. The expanded roadway, plus boulevard and shared-use path/sidewalk fits within the existing right-of-way.

2020 and 2040 Traffic Operations

During the A.M. peak, all study intersections operate at LOS "B" through 2020. During the P.M. peak, 13th Avenue operates at LOS "C" while 17th Avenue and 19th Avenue operate at LOS "A".

TABLE VII-3: 2020 TRAFFIC OPERATIONS FOR FIVE-LANE SECTION ALTERNATIVE FOR NORTH SHEYENNE STREET SECTION

Intersection	A.M. Peak	P.M. Peak
13th Avenue	B	C
17th Avenue	B	A
19th Avenue	B	A

This alternative improves operations through 2040, with all intersections at LOS "C" or better during the A.M. peak. During the P.M. peak, 13th Avenue operates at LOS "D" due to deficient operations along 13th Avenue. Increasing the eastbound through movement from one lane to two lanes improves overall intersection LOS to "C". Some deficient approach LOS remain, but average per vehicle delays are reduced to approximately 10 seconds for 17th Avenue and 19th Avenue during the P.M. peak and 40 seconds for 13th Avenue. Improved operations would likely decrease crash potential in this section of the corridor.

TABLE VII-4: 2040 TRAFFIC OPERATIONS FOR FIVE-LANE SECTION ALTERNATIVE FOR NORTH SHEYENNE STREET SECTION

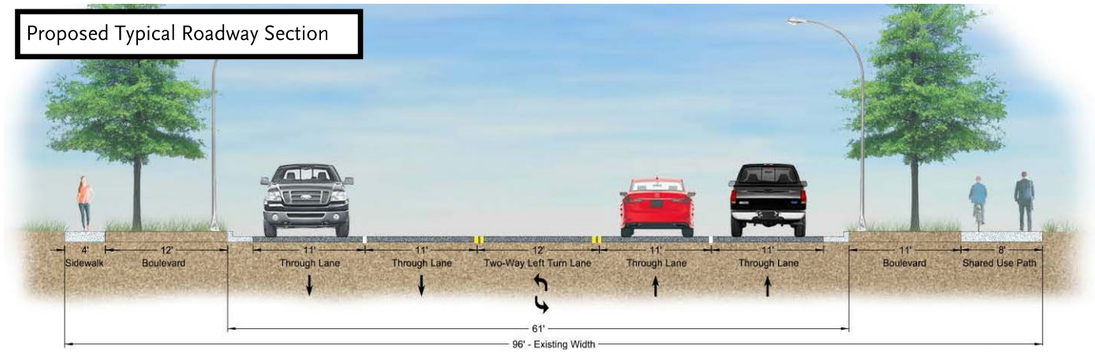
Intersection	A.M. Peak	P.M. Peak
13th Avenue	C	D
17th Avenue	B	B
19th Avenue	B	B

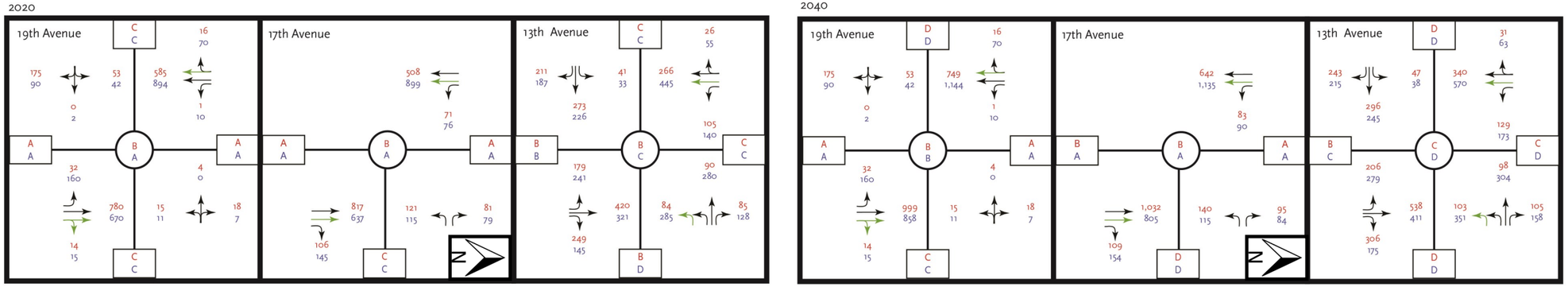
The 2020 and 2040 LOS, assumed intersection lane configurations, proposed access layout and example plan view layout for this alternative can be seen in Figure VII-2.

Access Controls

While access density is a concern on Sheyenne Street, the access risk is low, due to low volumes on the intersecting roadways, which are mainly driveways. It is expected the additional through lanes and two-way left-turn lane should mitigate many of the potential conflicts in-to and out-of driveways. Furthermore, most residential lots have turnarounds in their yards that prevent the need to back out onto Sheyenne Street. Finally, traditional access control methods, like medians will not work on this section because there are few other options to access these homes.

North Sheyenne Street Section: Five-Lane Section from 13th Avenue to 19th Avenue





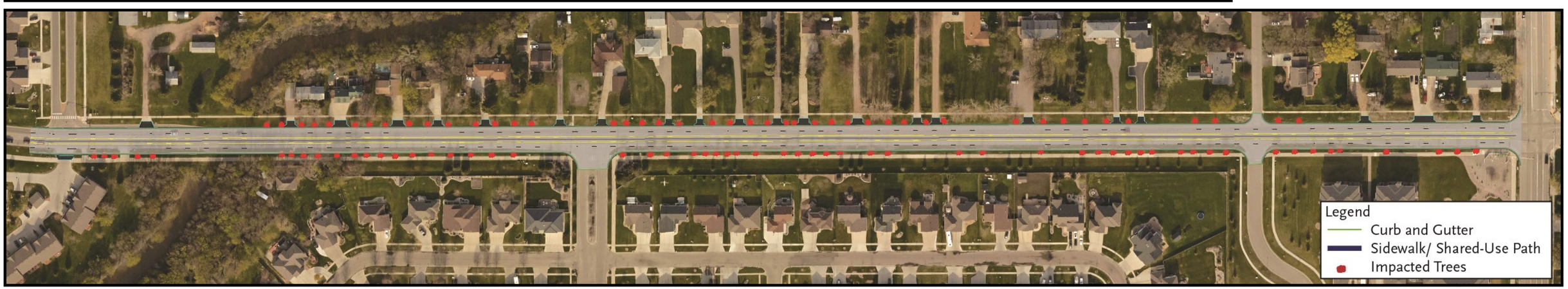
Peak Hour Traffic Operations

Lane Configuration*

C / C — AM Peak Approach LOS / PM Peak Approach LOS

B / A — AM Peak Intersection LOS / PM Peak Intersection LOS

*Green Arrow Indicates New Lane



Performance for Technically Feasible Alternatives

Performance for each technically feasible alternative includes the criteria established in Chapter VI) Alternatives Analysis Methodology: capacity and operations, safety, property impacts and construction cost.

TABLE VII-5: PERFORMANCE SUMMARY FOR TECHNICALLY FEASIBLE ALTERNATIVES FOR NORTH SHEYENNE STREET SECTION

Criteria	Do-Nothing	5-Lane Section
Operations	-2	7
Safety	2	7
Property Impacts	10	7
Cost	10	4
Total	20	25

The Do-Nothing alternative scored highly in property impacts and cost and poorly in safety and traffic operations. The Five-Lane Section alternative requires roadway expansion and would likely impact boulevards, resulting in lower property impacts and cost scores. However, with two through lanes and a two-way left-turn lane, operations and capacity are improved and crash potential is reduced.

Public Comments

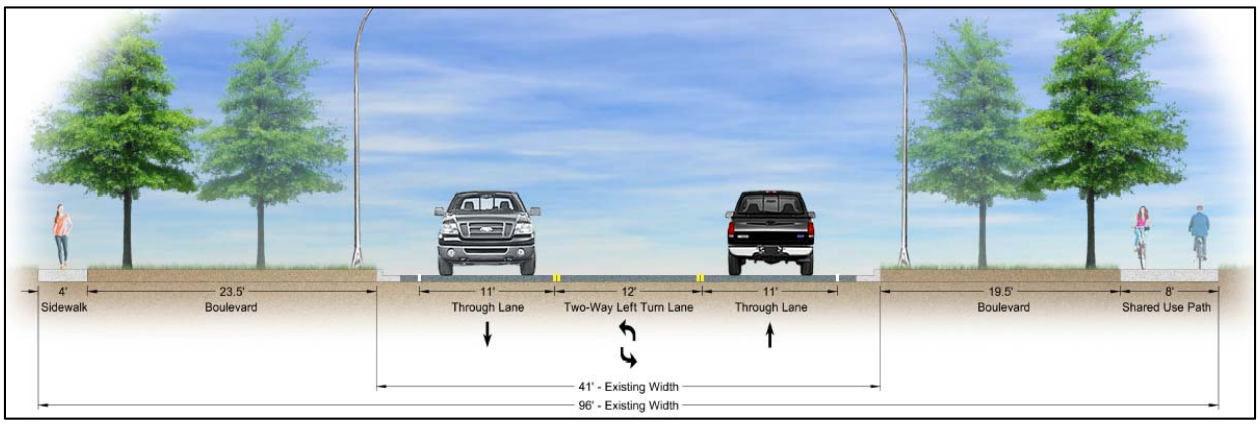
Nine comments were received regarding the North Sheyenne Street section alternatives presented at Public Input Meeting #2, three at the meeting and six e-mails after the meeting. Comments focused on impacts to the boulevard, trees and property (five comments) and traffic forecasts with significant growth despite the area being fully developed (three).

Discarded Alternatives

Three-Lane Section

This alternative would eliminate the existing shoulders and add a two-way left-turn lane, maintaining one through lane in each direction. No construction would be needed, only restriping. This alternative has no additional capacity for through movements but would reduce delays associated with turning movements into the many access points along the corridor. This alternative would conserve the grassy boulevard and trees as they exist currently.

FIGURE VII-3: THREE-LANE SECTION ALTERNATIVE FOR NORTH SHEYENNE STREET SECTION



2020 and 2040 Traffic Operations

Traffic operations for this alternative would remain unchanged at the study intersections when compared to the Do-Nothing alternative, which are deficient according to NDDOT standards. Refer to Table VII-1 and Table VII-2

for a summary of 2020 and 2040 traffic operations. This alternative was discarded due to poor operations that do not meet the Purpose and Needs Statement for this project.

Five-Lane Section with Driveway Protection Lane

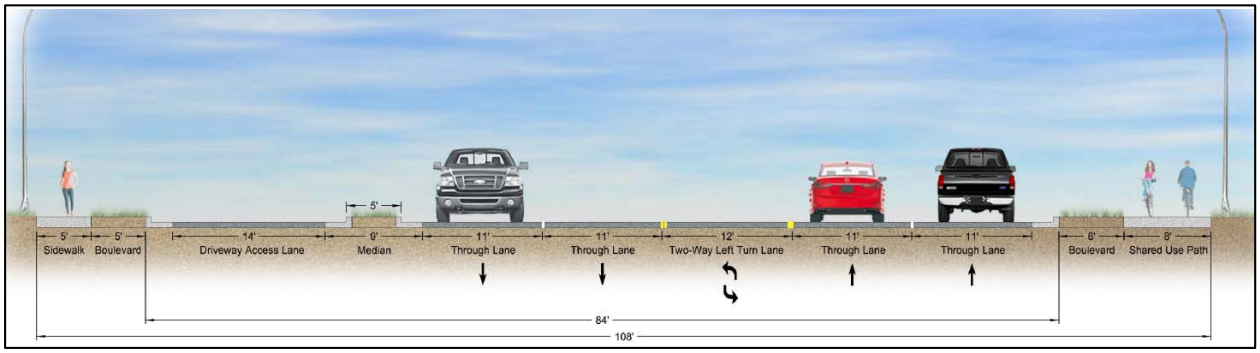
This alternative would feature two through lanes in each direction with a two-way left-turn lane. It would further reduce the boulevard but maintain the sidewalk and shared-use path. Additionally, this alternative provides a median and frontage road configuration on the west side to provide a lane for vehicles to safely enter and exit residential driveways. This design is currently found in the study area on 17th Avenue between Charleswood Estates Drive and 1st Street. While this alternative largely remains within the existing right-of-way, boulevard trees would certainly be impacted.

FIGURE VII-4: DRIVEWAY PROTECTION LANE ON 17TH AVENUE

This alternative was discarded because it did not meet a qualitative B/C analysis. Currently, there are very few issues with the multiple access points on the corridor. Most properties with accesses on Sheyenne Street have turnarounds in their yard to allow for easy access out of the property. Moreover, there have been complications with the driveway protection lane on 17th Avenue with people going the wrong way, creating additional conflicts. While accesses along this corridor are densely spaced, access risk analysis shows access management is not a critical problem in this section. The SRC felt that the additional cost did not provide any additional benefit.

FIGURE VII-5: TURNAROUNDS IN DRIVEWAYS ADJACENT TO SHEYENNE STREET

FIGURE VII-6: FIVE-LANE SECTION WITH DRIVEWAY PROTECTION FOR NORTH SHEYENNE STREET SECTION



VIII) Alternatives Development & Analysis: Interchange Functional Area

Eight alternatives were developed for the interchange functional area, all with varying costs, operations and impacts:

- Do-Nothing (DN)
- Southwest Loop Alternative (SWL)
- Roundabouts with Southwest Loop (RSWL)
- Northeast Ramp Alternative (NER)
- Northeast Loop Alternative (NEL)
- Southeast Loop Alternative (SEL)
- Diverging Diamond Interchange Alternative (DDI)
- Single Point Urban Interchange Alternative (SPUI)
- Modified Single Point Urban Interchange Alternative (MSPUI)

Three build alternatives were found to be technically feasible and compared against the Do-Nothing alternative. Lane configurations in each alternative were developed primarily considering the needs of the interchange. Because the interchange bridges have a useful life of over twice the roadway's useful life, it is important that lane needs of the interchange are evaluated first. The lane configurations will be refined to be consistent with the North Sheyenne Street and South Sheyenne Street sections' prioritized alternatives. There are ample opportunities to add and drop lanes throughout the corridor.

LOS "D" will be acceptable for both Beaton Drive and the 21st Avenue/Christianson Drive intersections, per the NDDOT *Traffic Operations Manual* and consistent with the rest of the analysis in this report. However, at the North Ramp and South Ramp intersections, LOS "C" will be required. This will mean less delay at the intersection ramps, potentially preventing future queueing onto the interstate.

Alternatives to Carry into Project Development

Do-Nothing Alternative

This alternative would not include any geometric configuration or traffic control changes at the interchange.

FIGURE VIII-1: TRAFFIC BACKED UP ONTO MAINLINE I-94 DURING P.M. PEAK

By 2040, the existing configuration will be totally deficient, with average per vehicle delay at the North Ramp and South Ramp intersections exceeding four minutes. Operations at the North Ramp intersection impacts mainline operations causing queues to back up onto the interstate; queues from the westbound to southbound loop ramp

back up onto the interstate far enough to block the westbound to northbound off-ramp. Cost and construction impacts would be limited. Since pavement on Sheyenne Street is currently rated "Fair", it is expected that there would be some maintenance required before 2040.

No new environmental impacts are expected.

TABLE VIII-1: DO-NOTHING ALTERNATIVE VALUE PLANNING SCORES SUMMARY

Criteria	Results (2040 Conditions)	Score
Safety	0% reduction in crashes	0
Local Operations	A.M. peak: LOS F (113.0 sec/veh) P.M. peak: LOS F (282.0 sec/veh)	0
Mainline Operations	A.M. peak downstream density: 50 P.M. peak upstream density: 316	0
Cost and Construction Impacts	Maintenance and rehabilitation only	10
Environmental Impacts	No additional environmental impacts	8

Southwest Loop Alternative

The Southwest Loop (SWL) alternative includes constructing a loop ramp in the southwest quadrant of the interchange and a right-turn lane on the eastbound off-ramp. The westbound to northbound off-ramp is realigned with the westbound to southbound off-ramp and the westbound on-ramp. Additionally, this alternative features three through lanes in each direction under I-94 as well as turn lanes at Beaton Drive and 21st Avenue/Christianson Drive. It will require replacement of the overpass bridges to accommodate the extra Sheyenne Street lanes.

At Beaton Drive, the third through lane is added for southbound traffic and dropped for northbound traffic. At 21st Avenue/Christianson Drive, the third through lane is carried south to accommodate the high traffic volumes expected by 2040.

TABLE VIII-2: SOUTHWEST LOOP ALTERNATIVE VALUE PLANNING SCORES SUMMARY

Criteria	Results (2040 Conditions)	Score
Safety		8
Local Operations	A.M. peak: LOS C (27.5 sec/veh) P.M. peak: LOS B (13.7 sec/veh)	7
Mainline Operations	A.M. peak downstream density: 41 P.M. peak upstream density: 64	8
Cost and Construction Impacts	Estimated cost: $17,870,000	4
Environmental Impacts	Limited impacts; may require mitigation	7

Safety

The Southwest Loop alternative scored an eight in the safety category. Below is a summary of defining safety characteristics for this alternative:

- 5 crossing conflicts
- 9 merging/diverging conflicts
- 90 percent reduction in operations versus the No-Build alternative

With efficient operations, this alternative is expected to significantly reduce rear-end type crashes. Additionally, by removing the southbound to eastbound crossing conflicts at the South Ramp intersection, angle and left-turn crashes are also expected to be reduced.

Local Operations

During the 2040 A.M. peak, the North Ramp operates at LOS "A" and the South Ramp at LOS "C"; during the 2040 P.M. peak, the North Ramp and South Ramp intersections operate at LOS "A". Additionally, with the four tightly spaced intersections, weaving maneuvers could impact local operations and safety.

FIGURE VIII-2: SOUTHWEST LOOP ALTERNATIVE FOR SHEYENNE STREET INTERCHANGE

Mainline Operations

During the A.M. peak, the downstream section analyzed had a density of 40.8, or LOS "E". During the P.M. peak, the upstream sections analyzed had an average density of 63.8, or LOS "F". However, deficient mainline operations were common across all alternatives.

Construction Impacts

This alternative would require the least amount of ROW with few impacts to adjacent properties because it utilizes most of the existing roadway. Impacts to the shared-use path along the east side of Sheyenne Street is expected. The existing spanwire traffic control signal systems at the ramp intersections would be removed and replaced with a permanent signal, as well as an additional signal installed at the intersection of Sheyenne Street and 21st Avenue/Christianson Drive. This alternative presents the shortest construction schedule. Construction would present fewest concerns to surrounding property owners and temporary impacts such as disruptions or delays to the traveling public.

The total cost for this alternative is $17,870,000. This is reported in 2015 dollars.

Environmental Impacts

This alternative would remain largely within the existing interchange footprint. Deviations from the existing alignment would be minimal and occur within the existing ROW. Realignment of the on- and off-ramps would result in permanent impacts to artificial non-jurisdictional wetlands; therefore, wetland mitigation would not be required.

Additional Considerations

This alternative would likely benefit from expanding the northwest loop ramp to include additional storage to prevent queueing back onto the interstate. An expanded loop may have impacts to the property in the northwest quadrant.

Northeast Ramp

The common interchange configuration in the metro area, and NDDOT Fargo-District, is to have a near-side off-ramp with left-turn lanes. This was recommended to replace the northwest loop ramp as part of the *Horace Road Interchange Traffic Operations Study* completed by NDDOT in 2008.

FIGURE VIII-3: WESTBOUND OFF-RAMP AT VETERANS BOULEVARD

The Northeast Ramp alternative adds a loop ramp in the southwest quadrant of the interchange and removes the loop ramp in the northwest quadrant replacing it with a near-side off-ramp with double left-turn lanes. Westbound to northbound and westbound to southbound vehicles will all use a new, straightened ramp. Additionally, this alternative features three lanes in both directions from 21st Avenue/Christianson Drive to the North Ramp. From the North Ramp to Beaton Drive there are two lanes in both directions.

TABLE VIII-3: NORTHEAST RAMP ALTERNATIVE VALUE PLANNING SCORES SUMMARY

Criteria	Results (2040 Conditions)	Score
Safety		6
Local Operations	A.M. peak: LOS C (34.9 sec/veh) P.M. peak: LOS B (33.5 sec/veh)	6
Mainline Operations	A.M. peak downstream density: 41 P.M. peak upstream density: 62	9
Cost and Construction Impacts	Estimated cost: $16,806,000	4
Environmental Impacts	Limited impacts; may require mitigation	7

Safety

The Northeast Ramp alternative scored a six in the safety category. Below is a summary of defining safety characteristics for this alternative:

- 12 crossing conflicts
- 10 merging/diverging conflicts
- 83 percent reduction in operations versus the No-Build alternative

The improved operations reduces rear-end crash potential. The removal of the northwest loop in favor of a double left-turn lane increases the number of crossing conflicts, increasing angle crash potential. Furthermore, removing the horizontal curvature may result in very high speeds approaching the North Ramp intersection. This could be mitigated by relocating this intersection to the north, which would result in major impacts to Beaton Drive. Beaton Drive is very important to providing access to large employers in West Fargo.

Local Operations

During the 2040 A.M. peak, the North Ramp operates at LOS "A" and the South Ramp at LOS "C"; during the 2040 P.M. peak, the North Ramp operates at LOS "C" and South Ramp intersection operates at LOS "B". The realignment of the ramps may result in intersection compaction between the North Ramp intersection and the Beaton Drive intersection, creating spillback concerns into the future. This was not shown in the 2040 models, but would likely be seen beyond 2040 or under very high growth scenarios.

Mainline Operations

During the A.M. peak, the downstream section analyzed had a density of 41.3, or LOS "E". During the P.M. peak, the upstream section analyzed had an average density of 61.6, or LOS "F".

Construction Impacts

This alternative would be fully constructed within the existing ROW with few impacts to adjacent properties. It utilizes most of the existing roadway, with the exception of straightening the northeast ramp. Impacts to the shared-use path along the east side of Sheyenne Street is expected. The existing spanwire traffic control signal systems at the ramps would be removed and replaced with a permanent signal, as well as an additional signal installed at the intersection of Sheyenne Street and 21st Avenue/Christianson Drive. This alternative presents a relatively short construction schedule. Construction would present some concerns to surrounding property owners and temporary impacts such as disruptions or delays to the traveling public, especially when construction on the northeast ramp occurred.

The total cost for this alternative is $16,806,000. This cost is reported in 2015 dollars.

Environmental Impacts

This alternative would remain largely within the existing interchange footprint. Deviations from the existing alignment would be minimal and occur within the existing ROW. Realignment of the off-ramps would result in permanent impacts to artificial non-jurisdictional wetlands; therefore, wetland mitigation would not be required.

FIGURE VIII-4: NORTHEAST RAMP ALTERNATIVE FOR SHEYENNE STREET INTERCHANGE

Additional Considerations

A few items would need to be refined during project development for this alternative. Realignment of the northeast ramp will likely require some form of reconfiguration of Beaton Drive. Beaton Drive is crucial for access to development in this area. It is likely that ROW acquisition may be required.

Furthermore, expanding the northwest loop ramp to include additional storage would likely be required to prevent queueing back onto the interstate. An expanded loop would likely have impacts to the property in the northwest quadrant.

Summary

Operationally, this alternative nearly operates at LOS "D" during both A.M. and P.M. peak hours, just 0.1 seconds away during the A.M. peak and 1.5 seconds during the P.M. peak. This is well within daily variation and rounding error.

Modified Single Point Urban Interchange

The Modified Single Point Urban Interchange (MSPUI) alternative consolidates the two ramp intersections into one intersection. It requires new loop ramps in the northwest and southwest quadrants and realigns all on- and off- ramps. This alternative requires unique routing for the eastbound to northbound traffic as it merges into the northbound lanes on Sheyenne Street. This would operate in a similar fashion to a continuous green T-intersection, an FHWA endorsed alternative intersection design. According to FHWA, this design has been found to reduce angle crashes by 96.8 percent, injury crashes by 70 percent and total crashes by 60 percent, when compared to traditional signalized T-intersections, along with operational benefits associated with not stopping one direction of traffic (FHWA, 2010). Northbound traffic on Sheyenne Street never has to stop; auxiliary lanes are provided for the westbound to northbound traffic as well as the eastbound to southbound off-ramp traffic to facilitate a free merge.

FIGURE VIII-5: CONTINUOUS GREEN T-INTERSECTION IN ARLINGTON, VIRGINIA

Source: Federal Highway Administration

TABLE VIII-4: MODIFIED SINGLE POINT URBAN INTERCHANGE ALTERNATIVE VALUE PLANNING SCORES SUMMARY

Criteria	Results (2040 Conditions)	Score
Safety		9
Local Operations	A.M. peak: LOS A (7.2 sec/veh) P.M. peak: LOS A (9.9 sec/veh)	10
Mainline Operations	A.M. peak downstream density: 41 P.M. peak upstream density: 60	10
Cost and Construction Impacts	Estimated cost: $24,560,000	0
Environmental Impacts	Many impacts; will require mitigation	6

Safety

The Modified SPUI alternative scored a nine in the safety category. Below is a summary of defining safety characteristics for this alternative:

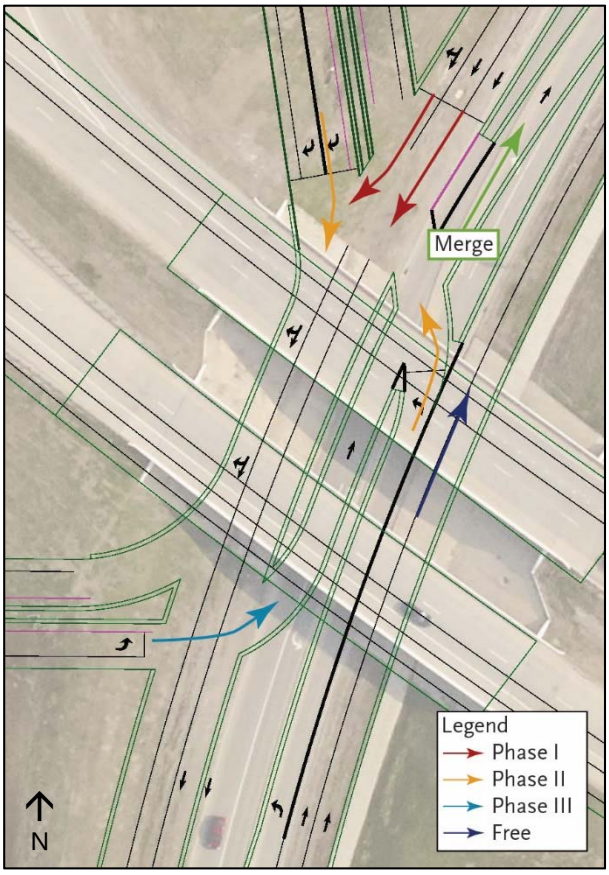
- 9 crossing conflicts
- 7 merging/diverging conflicts
- 95 percent reduction in operations versus the No-Build alternative

The Modified SPUI alternative produced the greatest reduction in queues resulting in the greatest potential for rear-end crash reduction. This alternative also had the fewest merging/diverging conflicts and third fewest crossing conflicts.

Local Operations

This alternative has the lowest average per vehicle delay as it travels through the network. This is mainly attributable to the reduction in stop control from two intersections to one, reducing weaving maneuvers, allowing northbound traffic to travel through the network without stopping and increasing the distance between the traffic control signal at the interchange ramp and the proposed traffic control signal at 21st Avenue/Christianson Drive, alleviating spillback concerns. Through 2040, the interchange ramp intersection operates at LOS "B" during the P.M. peak and LOS "A" during the A.M. peak.

FIGURE VIII-6: SIGNAL PHASING FOR MSPUI ALTERNATIVE



Mainline Operations

With the lowest average densities, the Modified SPUI alternative provided the relative best mainline operations. During the A.M. peak, the downstream section had a density of 40.8, or LOS "E". During the P.M. peak, the upstream section analyzed had a density of 59.8, LOS "F".

Cost, Construction Impacts and Schedule

This alternative would require additional ROW for the construction of the southwest loop, realignment and reconstruction of the existing ramps and northwest loop and the widening of Sheyenne Street. Impacts to the shared-use path along the east side of Sheyenne Street are expected. The existing spanwire traffic control signal systems at the ramps would be removed and replaced with a permanent signal near the center of the interchange, as well as an additional signal system at the intersection of Sheyenne Street and 21st Avenue/Christianson Drive. Construction would directly impact access, aesthetics and traffic in the work zone, specifically the interstate traffic and to the business and residential areas adjacent to the construction site. This alternative would be the most expensive to build and would take the longest to construct. Construction would present concerns to surrounding property owners and temporary impacts including disruptions or delays to the traveling public.

The total cost of this alternative is $24,560,000. This cost is reported in 2015 dollars.

Environmental Impacts

This alternatives results in the greatest amount of ROW impacts at 5.5 acres. Current land use of the impacted area is primarily actively farmed agricultural land that would be converted to part of the transportation network. The city has discussed the potential of minor ROW impacts associated with this interchange alternative. While the property owner is in late stages of development planning, they have been receptive and indicated they are willing to sell some portion of the property. This alternative would have associated impacts to artificial non-jurisdictional wetlands; therefore, wetland mitigation would not be required.

The northwest leg of the Modified SPUI alternative would reduce the distance between residents to the north and the roadway, which could result in increased noise volumes, but these impacts are not expected to be significant.

Additional Considerations

This alternative would require a unique merging maneuver for the eastbound to northbound left-turn maneuver. This type of continuous green T-intersection configuration has been proven safe and effective throughout the country. However, simplifications could eliminate some of the merge movements. It would eliminate the benefits afforded to northbound traffic, but it would maintain the other benefits of the alternative.

The local operations of this alternative would still operate at LOS "A" during the A.M. peak and LOS "B" during the P.M. peak, leaving its local operations value planning score at nine.

FIGURE VIII-7: SIMPLIFIED MSPUI

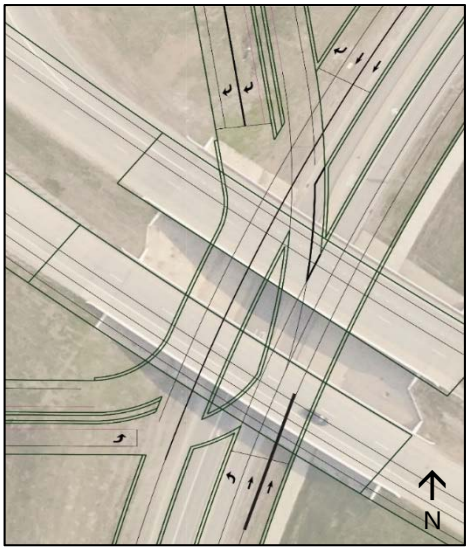
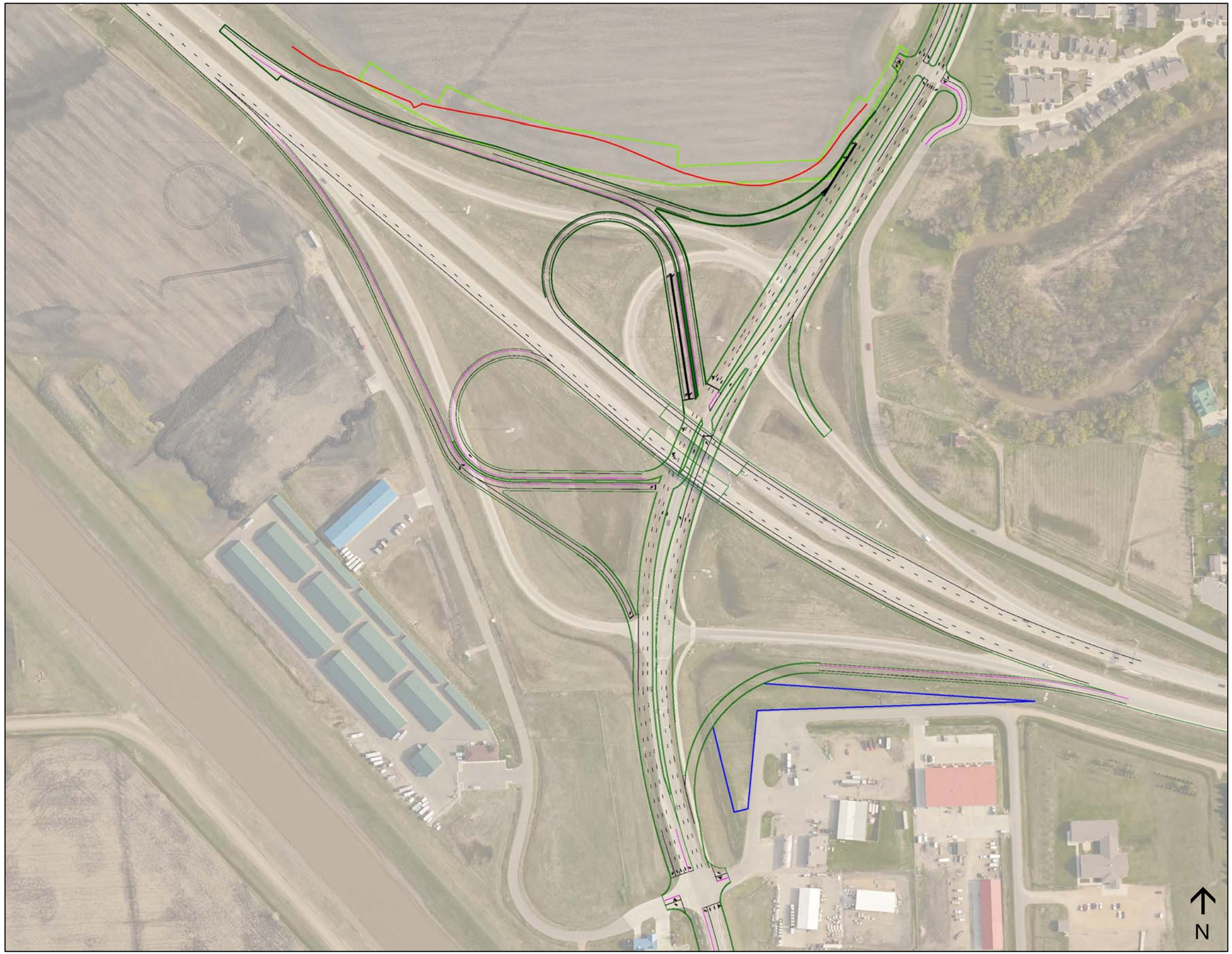


FIGURE VIII-8: MODIFIED SINGLE POINT URBAN INTERCHANGE ALTERNATIVE FOR SHEYENNE STREET INTERCHANGE



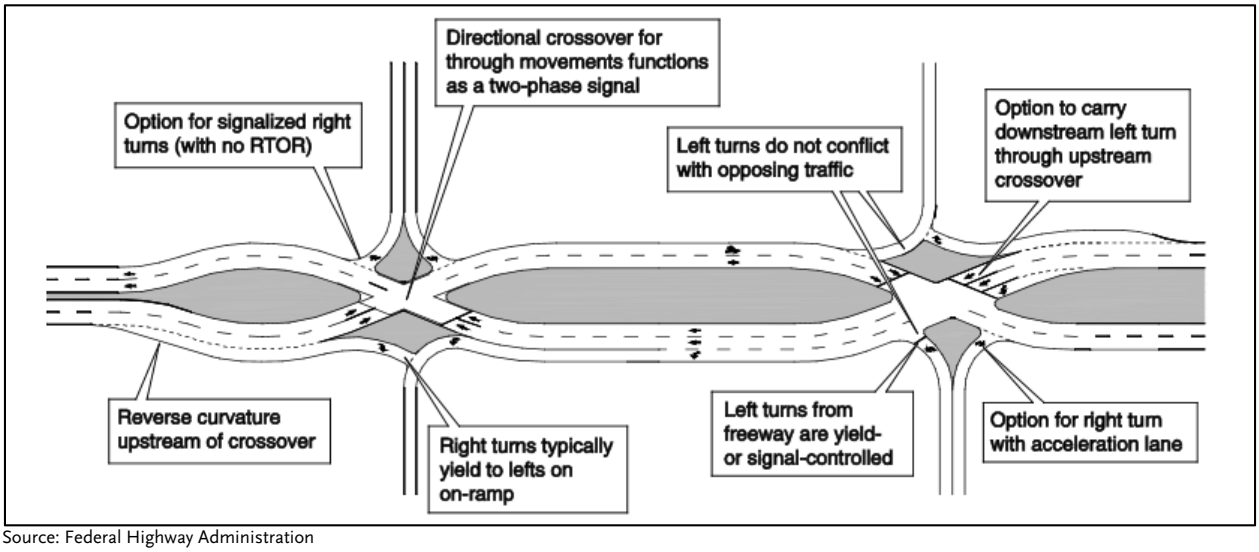
Technically Infeasible Under Current Standards

Diverging Diamond

Using LOS "C" for ramp intersections, the Diverging Diamond Interchange (DDI) was found to be technically infeasible. However, if using a lower threshold, like LOS "D", it would likely be found technically feasible.

The DDI alternative requires the two directions of traffic on Sheyenne Street to cross to the opposite side of the road before traveling under the I-94 bridges. This allows left-turning and right-turning traffic to perform a free-flow movement onto the on-ramps. The free-flowing movements reduce the signal phases to two at each intersection, significantly reducing delays.

FIGURE VIII-9: KEY CHARACTERISTICS OF DIVERGING DIAMOND INTERCHANGE



Source: Federal Highway Administration

This alternative adds capacity to Sheyenne Street with three through lanes south of the North Ramp intersection to 21st Avenue/Christianson Drive. It eliminates the use of the northwest loop ramp but converts the westbound off-ramp to free flow movements with auxiliary lanes.

TABLE VIII-5: DIVERGING DIAMOND INTERCHANGE ALTERNATIVE VALUE PLANNING SCORES SUMMARY

Criteria	Results (2040 Conditions)	Score
Safety		6
Local Operations	A.M. peak: LOS C (33.4 sec/veh) P.M. peak: LOS D (39.8 sec/veh)	5
Mainline Operations	A.M. peak downstream density: 55 P.M. peak upstream density: 106	7
Cost and Construction Impacts	Estimated cost: $16,381,000	4
Environmental Impacts	Limited impacts; may require mitigation	7

Safety

The DDI alternative scored a six in the safety category. Below is a summary of defining safety characteristics for this alternative:

- 13 crossing conflicts
- 10 merging/diverging conflicts
- 82 percent reduction in operations versus the No-Build alternative

The DDI has the most conflict points of any of the build alternatives. The major reduction in operations is still enough to provide substantial safety benefits versus the No-Build alternative.

Local Operations

During the 2040 A.M. peak, the North Ramp operates at LOS "A" and the South Ramp at LOS "C"; during the 2040 P.M. peak, the North Ramp intersection operates at LOS "B" and the South Ramp intersection operates at LOS "C". Combined, the operations at the interchange under this configuration are LOS "D" during the P.M. peak, considered operationally deficient for the interchange.

The operational requirements of a DDI create very long queues on major approaches as each major movement takes turns maneuvering through the interchange. This alternative, more than the others, creates potential problems with upstream intersections.

Mainline Operations

Mainline operations suffered under the DDI alternative when compared to the other build alternatives; it had the highest average densities of any build alternatives. During the A.M. peak, the downstream section had a density of 54.8, or LOS "F". During the P.M. peak, the upstream section analyzed had a density of 105.7, LOS "F".

Construction Impacts

This alternative would require limited additional ROW and few impacts to adjacent properties. It utilizes most of the existing roadway on Sheyenne Street. Impacts to the shared-use path along the east side of Sheyenne Street are expected. The existing spanwire traffic control signal systems at the ramps would be removed and replaced with a permanent signal, as well as an additional signal installed at the intersection of Sheyenne Street and 21st Avenue. The realignment of the on- and off- ramps at the North Ramp intersection are expected to cause temporary delays to the traveling public. Construction would present few concerns to surrounding property owners and temporary impacts such as disruptions or delays to the traveling public.

The total estimated cost for this alternative is $16,381,000. This cost is reported in 2015 collars.

Environmental Impacts

This alternative would remain largely within the existing interchange footprint. Deviations from the existing alignment would be minimal and occur within the existing ROW. Realignment of the on- and off-ramps at the North Ramp intersection would result in permanent impacts to artificial non-jurisdictional wetlands; therefore, wetland mitigation would not be required.

Additional Considerations

Zipper Merge

The future conditions models were run with an equal lane utilization rate for the northbound to eastbound on-ramp. However, changing the lane utilization rate to 25 percent and 75 percent has negative impacts on operations at the North Ramp and South Ramp intersections. During the 2040 A.M. peak, the North Ramp intersection operates at LOS "C" while the South Ramp intersection operates at LOS "D". Queues at the South Ramp intersection extend into the 21st Avenue/Christianson Drive and North Ramp intersections as vehicles try to funnel onto the eastbound on-ramp. During the 2040 P.M. peak, the North Ramp operates at LOS "B" while the South Ramp operates at LOS "C". Based on these operations, the value planning score for local operations would be reduced from five to three. There was no change on mainline operations.

TABLE VIII-6: DDI ALTERNATIVE LANE UTILITIZATION LOCAL OPERATIONS SCORE

Criteria	Results (2040 Conditions)	Score
Local Operations	A.M. peak: LOS E (74.4 sec/veh) P.M. peak: LOS D (41.4 sec/veh)	3

Interim Solution

The DDI also provides the opportunity for staged implementation. The current I-94 bridges can tightly fit four lanes under the bridge. The DDI alternative could be implemented with two lanes in both directions, with efficient operations through 2020, until funding is secured to replace the I-94 bridges to accommodate six or more lanes on Sheyenne Street.

FIGURE VIII-10: DIVERGING DIAMOND INTERCHANGE ALTERNATIVE FOR SHEYENNE STREET INTERCHANGE

Summary

The multiple zipper merge present in this alternative could have negative impacts on traffic operations and safety. The timidity of upper Midwest drivers is widely acknowledged, which could be a barrier to acceptable South Ramp intersection operations. An imbalanced lane utilization will render this alternative deficient. It is recommended this alternative not be carried forward into project development.

Performance and Prioritization

Performance for each alternative includes the criteria established in Chapter VI) Alternatives Analysis Methodology, including safety, local and mainline operations, construction impacts and environmental impacts. Based on technical scoring, the Modified SPUI alternative scored highest with 35 points, followed closely by the Southwest Loop alternative with 34 points. The Southwest Loop alternative scored higher in the cost and environmental impacts categories while the Modified SPUI alternative scored higher in safety, local and mainline operations. The Northeast Ramp alternative was ranked third with strong mainline operations and environmental impacts scores. The Diverging Diamond Interchange alternative was ranked fourth due to lower safety and local and mainline operations scores.

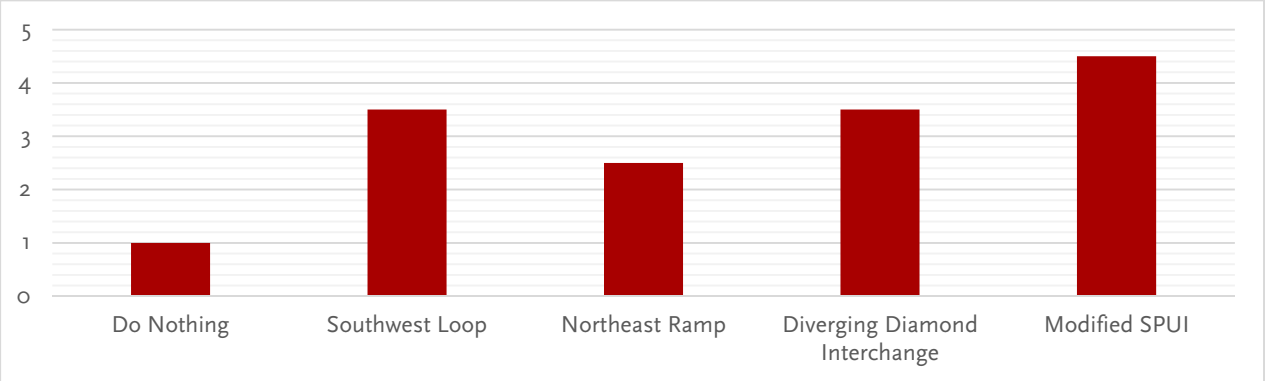
The SRC weighted the value planning criteria. The weighted value planning criteria were applied to the technical scores for the weighted ranking. Based on the weighted ranking, the Modified SPUI alternative was the first ranked alternative with 8.21 points. The Southwest Loop alternative was ranked second, followed by the Northeast Ramp alternative.

TABLE VIII-7: SUMMARY OF FEASIBLE ALTERNATIVES WITH WEIGHTED AND UNWEIGHTED PRIORITIZATION

Alternative	Safety	Weight	Local Ops	Weight	Mainline Ops	Weight	Cost	Weight	Environmental	Weight	Weighted Total	Weighted Rank	Technical Total	Technical Rank
DN	0		0		0		10		8		1.75	5	18	5
SWL	8		7		8		4		7		7.18	2	34	2
NER	6	29.1%	6	25.9%	9	26.2%	4	12.4%	7	6.4%	6.60	3	32	3
DDI	6		5		7		4		7		5.82	4	29	4
MSPUI	9		10		10		0		6		8.21	1	35	1

The SRC was also asked to prioritize the alternatives based on preference.

FIGURE VIII-11: SRC'S PREFERRED ALTERNATIVE



The Modified SPUI alternative performed best in all scenarios: unweighted technical ranking, weighted ranking and SRC preference, even when isolating the preference of technical representatives from NDDOT divisions and local government. Technical representatives from NDDOT divisions prioritized the Modified SPUI alternative first then the Diverging Diamond Interchange alternative, even though the technical analysis placed it fourth.

Public Comments

Two comments were received regarding the I-94 alternatives presented at Public Input Meeting #2. Both were from property owners surrounding the interchange; they believed the Modified SPUI alternative would provide a balance of access and operations but also raised concerns about additional ROW needed.

Alternative Growth Scenarios

Bridges have a lifecycle of more than 50 years. To evaluate future scenarios beyond the 20 year study horizon, estimates were made regarding growth beyond 2040. This may help mitigate the potential to rebuild the interchange bridges before their useful life has expired, as required for the current bridges. After 2040, there will be no areas surrounding the interchange with growth potential. The increases in volumes will be due to regional traffic growth outside the study area. To estimate future traffic growth, traffic growth at interchanges in built-out areas from around the metro area was reviewed. Specifically, the following interchanges and results were found:

- University Drive and I-94: 0.3 percent growth between 2000 and 2013
- 25th Street and I-94: Negative growth between 2005 and 2013
- Main Avenue and I-29: 4.5 percent growth between 2005 and 2013

It is clear there are a wide range of outcomes possible under this scenario. A growth rate of two percent was assumed to consider the results of the three interchange growth rates, but weighting it towards the University and 25th Street interchanges due to similar land uses. Furthermore, two percent per year is a commonly accepted growth rates on a regional corridor, like Sheyenne Street. Microsimulation models were run to evaluate the LOS and level of traffic processed through the North Ramp and South Ramp intersections.

When capacity is less than demand, the microsimulation models cannot process all the traffic input into the model in the one-hour peak period. This results in vehicles unable to enter the model, since modeled links are completely occupied by vehicles. Thus, the higher the percent of traffic processed, the more efficient the network.

Summary of 2065 Operations

By 2065, only the Modified SPUI alternative offers acceptable operations during the P.M. peak with a two percent annual growth rate. The Modified SPUI alternative provides LOS "A" during the A.M. peak and "C" during the P.M. peak. The Southwest Loop alternative operates efficiently during both A.M. and P.M. peaks with a one percent average annual growth rate, but fails during the P.M. peak with a two percent average annual growth rate. Both the Northeast Ramp alternative and Diverging Diamond Interchange alternative fail during one or both peak hours for one and two percent average annual growth rates.

TABLE VIII-8: SUMMARY OF 2065 OPERATIONS

Alternative	2065 A.M. Peak		2065 P.M. Peak	
	Traffic Processed 1% (2%)	LOS* 1% (2%)	Traffic Processed 1% (2%)	LOS* 1% (2%)
SWL	93.7% (83.7%)	C (D)	98.0% (75.6%)	D (F)
NER	93.2% (80.2%)	D (F)	95.4% (76.8%)	E (F)
DDI	78.6% (44.6%)	F (F)	92.5% (74.1%)	E (F)
MSPUI	95.0% (83.3%)	A (A)	96.9% (85.7%)	C (C)

Technically Infeasible Alternatives

Four more build alternatives were considered. Two build alternatives studied, the Single Point Urban Interchange alternative and Roundabouts with Southwest Loop alternative, did not operate at acceptable levels of service; they were not carried forward for further analysis as they did not meet the PNS for this project. Two additional build alternatives studied, the Northeast Loop alternative and Southeast Loop alternative, did not have a B/C ratio greater than one and were not carried forward.

Southeast and Northeast Loop Alternatives

These alternatives would add loop ramps in the northeast and/or southeast quadrants of the interchange. By adding these loop ramps, there would be property impacts and large ROW acquisitions required. Furthermore, the movements the new ramps would serve were projected to serve very few cars through 2040; the northeast ramp would serve a projected 250 cars during the peak hours while the southeast ramp would serve a projected 45 cars during the peak hours.

Single Point Urban Interchange

The Single Point Urban Interchange (SPUI) alternative combined both the north and south ramps into one signalized intersection. Difficult merging conditions on the eastbound ramp during the A.M. peak resulted in poor operations and long queues at this intersection. With more than 1,900 vehicles during the A.M. peak by 2040, the ramp becomes oversaturated, making merge maneuvers difficult.

FIGURE VIII-12: LONG QUEUES AT EASTBOUND ON-RAMP DURING A.M. PEAK

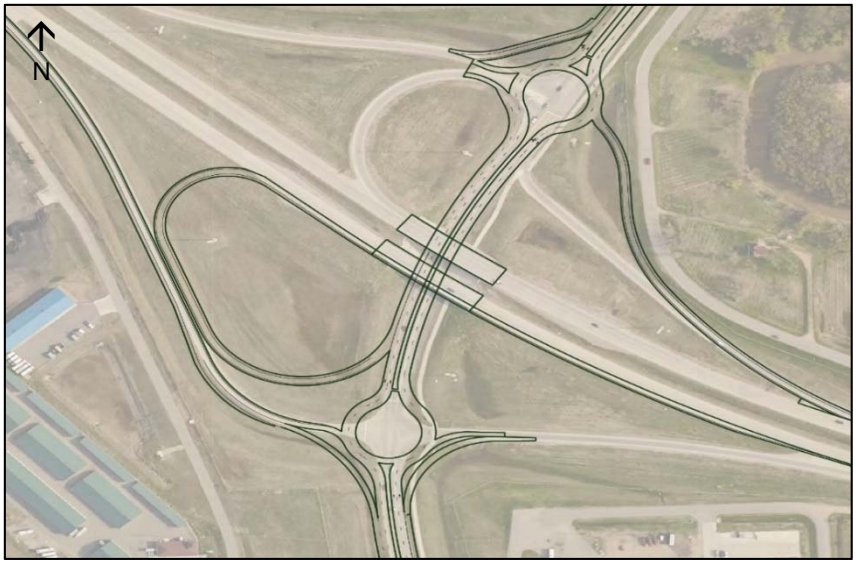
FIGURE VIII-13: SINGLE POINT URBAN INTERCHANGE ALTERNATIVE FOR SHEYENNE STREET INTERCHANGE

Roundabouts with Southwest Loop

This alternative would convert the two signalized ramp intersections into roundabouts. However, not assigning ROW leads to severe queueing on the eastbound off-ramp, with queues onto the interstate during the P.M. peak. Additionally, this alternative required the intersection of 21st Avenue/Christianson Drive to be relocated further south to increase stacking distance for southbound vehicles during the P.M. peak.

FIGURE VIII-14: LONG QUEUES ON THE EASTBOUND OFF-RAMP

FIGURE VIII-15: ROUNDABOUTS WITH SOUTHWEST LOOP ALTERNATIVE FOR SHEYENNE STREET INTERCHANGE



Even though this alternative experiences deficient operations by 2040, it could be easily implemented using the existing roadway. This alternative can operate efficiently with no southwest loop ramp and two lanes in each direction through 2020.

Design Factors

The following design factors affect each build alternatively differently.

Posted Speed

Currently, the speed limit along I-94 through the project corridor is posted at 65 miles per hour. I-94 transitions to 55 miles per hour one-quarter mile east of the interchange and to 75 miles per hour one-half mile west of the interchange. West Fargo has grown rapidly to the south and west, changing the context of this interchange; this interchange is no longer rural in nature and the posted speed limit could be changed to reflect the urban context.

The alternatives evaluated reflect the 65 miles per hour design speed. If consideration is given to lower the speed limit to 55 miles per hour, the construction costs for all alternatives could potentially be reduced, specifically the Modified SPUI alternative. For the Modified SPUI alternative, the southwest loop ramp is designed for 25 miles per hour; at that design speed, an acceleration lane of 1,220 feet is required for motorists to enter a 65 miles per hour freeway. This required length pushes the acceleration lane for the southbound to eastbound on-ramp into the existing northbound to eastbound on-ramp. Therefore, the existing infrastructure in place cannot be used. If the speed limit was reduced to 55 miles per hour, the required acceleration lane length would be reduced to 780 feet, allowing for the use of the existing northbound to eastbound on-ramp. No major changes to the other designs would result if the speed was changed.

Drainage

Two alternatives to eliminate roadway inundation from taking place were investigated. Further analysis will be required after a preferred alternative is selected in the NEPA phase of the project.

New Large Pump Station

This alternative would remove the existing six-inch pump and replace the existing twin eight-inch pumps with one single lift station with a gate well structure. Where possible, storm water would gravity drain to the Sheyenne River via a storm sewer network. Due to the low elevation of Sheyenne Street below I-94, storm water from the roadway will still be required to be pumped into the Sheyenne River.

The new lift station would be sized large enough to handle all drainage from Sheyenne Street as well as the areas around the interchange. During times of high water in the Sheyenne River, a sluice gate in the gate well structure would be closed and storm water runoff would be pumped over the sluice gate into the Sheyenne River.

New Pump Station with Storm Water Storage

This alternative would be very similar to the previous alternative with two major differences: the pump required to pump the storm water would be smaller and detention ponds would be constructed to help store storm water during heavy rain events. The most likely location of the detention ponds would be the areas between I-94 and the on- and off- ramps. During heavy rain events, storm water would flow into the detention ponds and slowly be pumped into the Sheyenne River via a lift station and gate well structure.

Prior to either of the above alternatives being incorporated into the proposed Sheyenne Street interchange project, a hydraulic analysis of the area would have to be conducted. This analysis would determine the amount of water that would be required to be pumped. This analysis would also determine the required amount of storage.

FIGURE VIII-16: PEDESTRIAN AMENITIES ON EAST SIDE OF 45TH STREET INTERCHANGE IN FARGO

Pedestrian and Bicycle Accommodations

The existing pedestrian and bicycle accommodations are not sufficient in the interchange functional area. The existing eight-foot shared-use path on the east side of Sheyenne Street crosses the free-flow right-turn movements on-to and off-of the interstate without any pedestrian phases or turn restrictions. Any recommended alternative will need to provide better accommodations for pedestrians that improve crossing safety north and south of the interstate.

For the Southwest Loop, Northeast Ramp and Modified SPUI alternatives, standard practice at these types of interchange would put a shared-use path on one side of the interchange. Adding a path to the west side of Sheyenne Street adds conflict potential; both the Southwest Loop alternative and Modified SPUI alternative add a fourth roadway to cross while the east side will only have two roadways to cross. Pedestrian amenities such as signal heads and right-turn-on-red (RTOR) restrictions can be implemented to improve pedestrian crossings at the free flow northbound to eastbound on-ramp. The Modified SPUI alternative incorporates one free-flow unsignalized crossing that would likely require a beacon or signal to control traffic.

The DDI alternative offers two ways to incorporate pedestrian and bicycle amenities, a center walkway or a walkway on the outside of the diverging diamonds. Pedestrian amenities on the outside of the roadway are undesirable because it limits the ability to change sides of street and increases conflict with free flowing traffic.

Incorporating pedestrian amenities into a center walkway design reduces pedestrian-car conflicts at free movements and easily transitions the shared-use path from the east side of Sheyenne Street north of the interchange to the south side of Sheyenne Street south of the interchange. Facilities as a center walkway have four fewer pedestrian-car conflicts when compared to outside walkways.

FIGURE VIII-17: CENTER WALKWAYS AT SPRINGFIELD, MISSOURI DDI

Source: Federal Highway Administration

Adjacent Intersections

FHWA requires that the two closest major intersections be included in the analysis of an interchange. Although Beaton Drive and 21st Avenue/Christianson Drive are not currently "major" intersections, as development occurs, they will become very important. Thus, the study area extended to these two intersections. Because the parcels surrounding these areas are currently vacant, but ready for development, additional focus was given to potential traffic generation from these areas.

Based on TRB's *Access Management Manual,* the minimum spacing from a ramp intersection to the next full access intersection should be no less than 2,640 feet, with minimum spacing for a right-in/right-out only intersection no less than 990 feet. Following this minimum spacing would require closing not only Beaton Drive to the north, but also converting 19th Avenue to right-in/right-out only; south of the interchange, this spacing would not permit any full accesses until south of 24th Avenue. Furthermore, this minimum spacing for full intersections is not met at any interchanges throughout the metro, with most having full access points less than 1,000 feet away.

Beaton Drive

The parcel surrounding the west approach of Beaton Drive is currently vacant, but zoned for commercial office park uses. The West Fargo Zoning ordinances intends this land use type for "office, office showroom or office warehouse" type developments that benefit from high visibility and high quality surrounding development.

Traffic Generation

As noted above, the owner of this parcel is in late stages of development. While no specific tenants are known, it is likely the parcel will be a mix of office and commercial. Based on this type of development, the following trip generation rates could be expected, based on ITE's *Trip Generation Manual.*

TABLE VIII-9: TRIP GENERATION FOR WEST APPROACH OF BEATON DRIVE AT FULL BUILD-OUT

Development Scenario	Projected ADT
Equal Split of Office and Commercial	5,600

Traffic Control

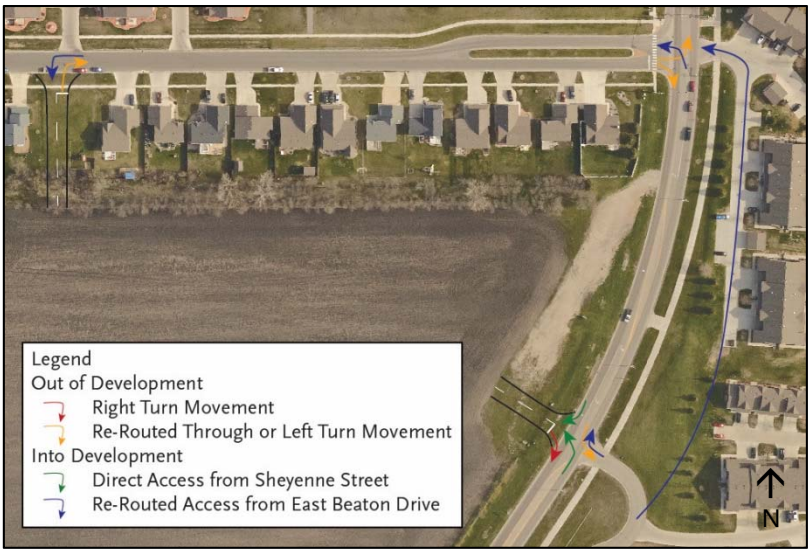
The MUTCD provides volume-based warrants for the installation of traffic control signals. Given the expected land use, Beaton Drive could warrant a traffic control signal when fully developed.

Access Management

Further consideration was given to access management at this intersection due to the potential of closely spaced signalized intersections, which could have negative impacts on traffic flow and efficiency.

With a full access, vehicles would not be required to do any re-routing but may experience longer delays trying to find a gap in traffic. A traffic control signal will be warranted with full build-out; while the intersections would be closely spaced, it would likely not cause poor operations, since the configuration is seen at most interchanges in the metro area.

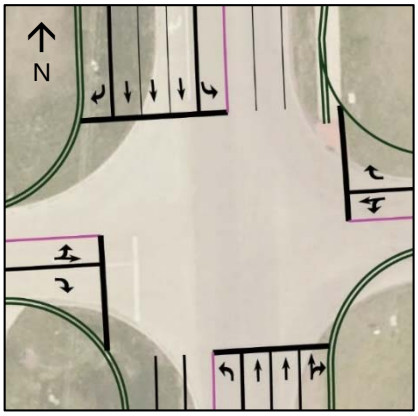
FIGURE VIII-18: REQUIRED REROUTING WITH ACCESS MANAGEMENT AT BEATON DRIVE



With a ¾ access, all movements entering the west approach of Beaton Drive would remain unchanged. However, to make a through or left-turn movement out of the development they would need to reroute to 19th Avenue, which is currently signalized. More restrictive access management, like right-in/right-out or rerouting Beaton Drive is likely unnecessary and would produce negative impacts on the neighboring residential properties. This access management strategy would force traffic through a private drive, which is unacceptable according to city staff.

21st Avenue/Christianson Drive

FIGURE VIII-19: PROPOSED LANE CONFIGURATION AT 21ST AVENUE/CHRISTIANSON DRIVE



The parcels surrounding this intersection are zoned for office park, heavy commercial/ light industrial and light commercial uses with the site development standards of the Interstate Corridor Overlay zone applied. The Interstate Corridor Overlay zone permits all underlying uses but requires higher quality developments due to visibility from the interstate. Heavy commercial/ light industrial uses could include light manufacturing, plumbing shops, wholesale distribution facilities, repair shops, vet clinics and other similar uses. Light commercial uses encompass a wide array of permitted uses; they may include general merchandise retail businesses like drugstores, business or personal services such as banks and barber shops, social businesses likely bowling alleys, hotels, schools or greenhouses.

Because developers have already begun preparing parcels for development, no additional development scenarios were prepared for this intersection. Expected land uses along Christianson Drive (west approach) include an auto body shop, hotel, general commercial, a construction company and the new Harley Davidson for a total projected ADT of 9,900. Expected land uses along 21st Avenue (east approach) are less specific but are expected to be general commercial uses, along with the existing gas station and ATV sales for a total projected ADT of 4,500. Based on these projected ADTs, this intersection will meet the 8-hour and 4-hour warrant for the installation of a traffic control signal likely before 2020.

Intersection Relocation

This intersection could potentially be relocated further south to increase the signal spacing between this and the South Ramps intersection to improve operations. However, based on queue length analysis from the four technically feasible alternatives, this is unnecessary, but provides improved operations. Finding the balanced location that does not negatively impact ramp operations but does not interfere with motorist expectancy coming across the Sheyenne River Diversion is important. The SRC voted to relocate this intersection. However, the final decision is dependent on the alternative. Relocating this intersection is unnecessary for the Modified SPUI alternative, but more important for operations under other alternatives.

FIGURE VIII-20: DRIVEWAY PROVIDING REDUNDANT ACCESS TO EAST SIDE OF SHEYENNE STREET

Driveway

Currently, there is a driveway south of the 21st Avenue/Christianson Drive intersection on the east side of Sheyenne Street. At full development, it is possible this access could absorb some of the traffic expected to use 21st Avenue. However, for this analysis, it was assumed that all traffic would use 21st Avenue because it would be signalized. Also, an access point so near the bridge would interfere with motorist expectancy and would likely be a restricted access.

Queueing

Queue spillback from closely spaced adjacent intersections can have impacts on capacity and operations, leading to safety concerns, especially on the interchange ramp intersections. Provided below is average and maximum queue lengths for 2040 A.M. and P.M. peak hours for the three build alternatives to be carried into project development. Queues shown for A.M. peak are for northbound approaches while queues shown for P.M. peak are for southbound approaches, the direction of the dominant flow during their respective peak period.

TABLE VIII-10: 2040 A.M. PEAK QUEUEING ON NORTHBOUND APPROACHES

A.M. Peak Northbound Approach Queues	Southwest Loop Alternative	Northeast Ramp Alternative	MSPUI Alternative
Beaton Drive	5'/165'	5'/115'	10'/140'
North Ramp	15'/185'	35'/320'	80'/330'
South Ramp	335'/685'	355'/735'	
21st Avenue/Christianson Drive	605'/1,390'	575'/1,450'	565'/1,225'

Average Queue in Feet/ Maximum Queue in Feet
Red text indicates blocks upstream intersection

During the 2040 A.M. peak, maximum queues at the I-94 South Ramp extend into the 21st Avenue/Christianson Drive intersection for both the Southwest Loop alternative and Northeast Ramp alternative. Average queues do not impact adjacent intersections under any build alternative.

TABLE VIII-11: 2040 P.M. PEAK QUEUEING ON SOUTHBOUND APPROACHES

P.M. Peak Southbound Approach Queues	Southwest Loop Alternative	Northeast Ramp Alternative	MSPUI Alternative
Beaton Drive	5'/95'	5'/85'	5'/80'
North Ramp	35'/450'	155'/700'	60'/380'
South Ramp	25'/335'	45'/480'	
21st Avenue/Christianson Drive	140'/655'	160'/695'	105'/670'

Average Queue in Feet/ Maximum Queue in Feet
Red text indicates blocks upstream intersection

During the 2040 P.M. peak, maximum queues at 21st Avenue/Christianson Drive block the South Ramp intersection for both the Southwest Loop alternative and Northeast Ramp alternative. Relocating the access further south would be recommended to prevent a maximum queue occurrence from impact South Ramp intersection operations. While southbound queues at 21st Avenue/Christianson Drive are comparable for the Modified SPUI alternative, the consolidated ramp intersection provides additional queue storage space without impacting operations. Average queues do not impact adjacent intersections under any build alternative.

Queueing impacts each alternative differently:

- The Southwest Loop alternative would require 21st Avenue/Christianson Drive to relocate further south to prevent queuing during A.M. and P.M. peak hours from impacting operations.
- The Northeast Ramp alternative would also require 21st Avenue/ Christianson Drive to relocate further south to prevent queueing during A.M. and P.M. peak hours from impacting operations.
- The Modified SPUI would not require any location changes for the adjacent intersections because of the increased distance between intersections with consolidation of the ramps.

IX) Alternatives Development & Analysis: South Sheyenne Street Section

Four alternatives were developed for the South Sheyenne Street Section, all with varying costs, operations and impacts:

- Do-Nothing
- Four-Lane Section
- Six-Lane Section
- Five-Lane Section with Reversible Flow Lanes

Under all alternatives, access management is provided, with sub-options where multiple solutions may provide similar benefits. Traffic operations at LOS "E" or worse were considered deficient in accordance with the NDDOT *Traffic Operations Manual*. Only one alternative was found to be technically feasible according to the established screening criteria provided in Chapter VI) Alternatives Analysis Methodology.

Design Factors

Prior to analyzing each alternative, it is critical to establish a set of baseline criteria considered with each alternative. The following design factors were considered for the alternatives as appropriate.

Diversion Bridge Crossing

FIGURE IX-1: SHEYENNE RIVER DIVERSION BRIDGE

The current Sheyenne River Diversion bridge crossing south of 21st Avenue/Christianson Drive likely will need to be altered in some fashion to accommodate expected traffic growth and facilitate pedestrian and bicycle connectivity. The cost to replace the bridge is estimated to be $7.68 million. Alternative improvement designs for this bridge may include rebuilding, widening or the construction of an additional bridge built alongside the current bridge. The specifics of the bridge design will be refined during later stages of analysis once preferred alternatives for the interchange and roadway design have been selected.

Turn Lanes and Medians

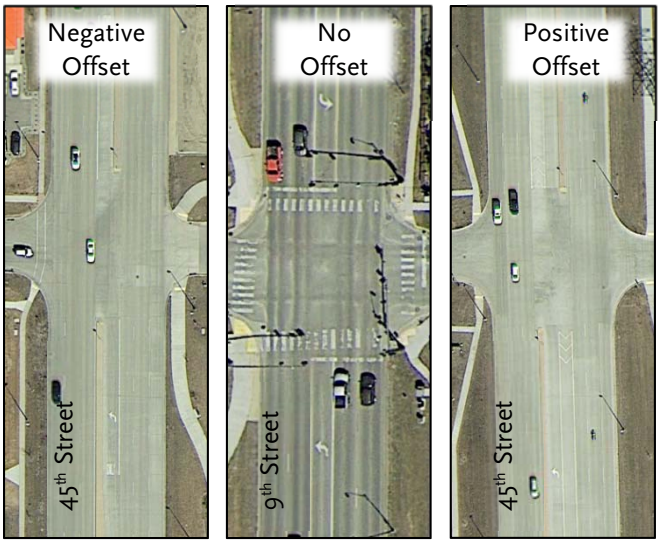
National Highway Traffic Safety Administration research found that approximately 40 percent of all reported crashes occur at intersections, with more than 20 percent of all fatal crashes occuring at intersections. Improving sight lines for left-turning vehicles can help mitigate this dangerous crash trend. At signalized intersections with permissive and/or permissive/protected left-turns, positive offset left-turn lanes will help with increased sight distance and gap acceptance; FHWA research found that positive offset turn lanes in Wisconsin resulted in a 33.8 percent reduction in total crashes when compared to intersections with no offset or negative offset. Positive offset turn lanes were recommended throughout the corridor for safety considerations. These offsets can be narrowed during project development if ROW is constricted.

FHWA research has found that raised medians reduce motor vehicle crashes by 15 percent and reduce vehicle speeds on the roadway, which could reduce crash severity as well (FHWA, 2013). Raised medians have also been found to decrease delays more than 30 percent for vehicle traffic and can provide locations for additional

lighting, further increasing safety along the corridor (Green, et al., 2003). Additionally, raised medians provide pedestrian crossing benefits. They can act as pedestrian refuge islands that permit pedestrians to cross one direction of traffic at a time, reducing gap acceptance requirements. FHWA research has found that raised medians at marked pedestrian crossings can reduce pedestrian crashes by 46 percent; at unmarked pedestrian crossings, raised medians have been found to reduce pedestrian crashes by 39 percent (FHWA, 2013).

Because of limited access points along Sheyenne Street, medians will be relatively easy to implement. Raised medians along Sheyenne Street would follow similar design as 9th Street/ Veterans Boulevard, Main Avenue, 40th Avenue and other major roadways throughout West Fargo.

FIGURE IX-2: NEGATIVE OFFSET TURN LANE, NO OFFSET TURN LANE AND POSITIVE OFFSET TURN LANE



Access Management

The proposed access management plan included in the report was developed based on the technical access risk analysis, City of West Fargo ordinances, operational considerations and discussions with the SRC and public. It is still possible that the proposed access management plan will see some variations during project development and public involvement.

Traffic Control

Sheyenne Street and 26th Avenue will warrant a traffic control signal by 2020. Installation occurred in 2015. It is likely that the Sheyenne Street and 52nd Avenue intersection will also warrant traffic control signal by 2020. This will be discussed later in this chapter.

Based on distance from current or planned signalized intersections and future expected volumes, additional intersections are candidates for future traffic control signal installation, given they meet warrants:

- Sheyenne Street and 34th Avenue. This intersection serves one of the few commercial developments along Sheyenne Street and high density residential development. It is one-quarter mile south of 32nd Avenue and three-quarters mile north of 40th Avenue or one-half mile north of 38th Avenue, all acceptable spacing for urban corridors.

FIGURE IX-3: STRIP COMMERCIAL AT 34TH AVENUE

- Sheyenne Street and 38th Avenue. This intersection serves low to medium density residential and provides an alternative access to both Aurora Elementary School and Legacy Elementary School as well as Rendezvous Park. It is one-half mile south of 34th Avenue and one-quarter mile north of 40th Avenue, acceptable spacing for urban corridors. Ideally, traffic control signals would be spaced at approximately equal spacing of one-half mile. However, Sheyenne Street between 32nd Avenue and 40th Avenue has been developed and the City of West Fargo has received negative feedback during previous discussions for roadway realignment and a traffic control signal at 36th Avenue.
- Sheyenne Street and 47th Avenue. This intersection serves low to medium density residential and will provide an alternative access to the Legacy Elementary. It is one-half mile south of 40th Avenue and one-half mile north of 52nd Avenue.

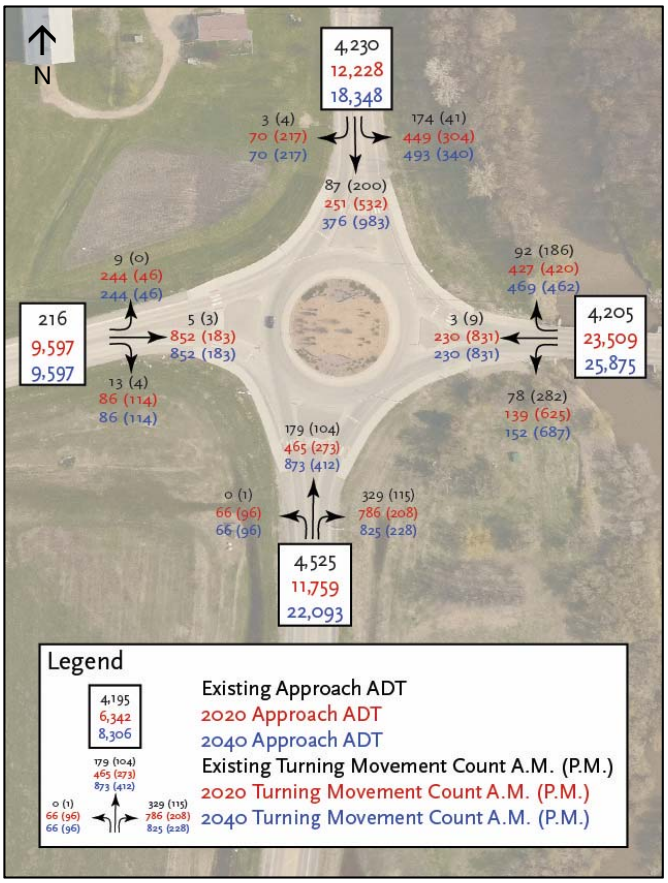
Traffic control signals at these intersections were not included in operational analysis presented in this report. As traffic increases and patterns become more established, additional analysis will be necessary before a traffic control signal should be considered. Typically, spacing at one-half mile intervals is considered the most effective for progression and corridor operations. However, this is not always feasible; one-quarter mile is the smallest distance between traffic control signals that was considered to support effective operations. Traffic control signals at all three locations would likely not have negative impacts given their spacing between existing and planned signals. No additional intersections along the corridor are expected to warrant a signal.

52nd Avenue and Sheyenne Street Intersection

Currently, the roundabout at 52nd Avenue operates very efficiently. With less than 1,000 vehicles entering the roundabout during the A.M. and P.M. peak, there is plenty of capacity. However, by 2040, projected traffic at this intersection will increase more than 475 percent and traffic is expected to range from 9,600 on the west approach to 25,875 on the east approach. As vehicles try to enter the existing single-lane roundabouts under these conditions it is unlikely they will find an acceptable gap, resulting in long delays (estimated delay is more than forty minutes per vehicle during the A.M. peak) for a single lane roundabout.

Roundabout operations are LOS "F" with a single-lane, two-lane or three-lane roundabout. Their operation can be seen in Table IX-1. A two-lane roundabout would increase the existing footprint of the intersection and require additional receiving lanes in all directions. A three-lane roundabout with two through lanes and a right by-pass lane further improves operations (average per vehicle delay is approximately six minutes during the A.M. peak, which is still deficient) and further increases the roundabout footprint. It would require a six-lane section on both Sheyenne Street and 52nd Avenue.

FIGURE IX-4: 52ND AVENUE 2040 TURNING MOVEMENT COUNTS



Given the operational deficiencies of even the multi-lane roundabout, it was replaced with a traffic control signal for the operational analysis included in this report. This traffic control signal will not be needed until the multi-lane cross-section on Sheyenne Street reaches 52nd Avenue.

TABLE IX-1: ROUNDABOUT OPERATIONS AT 52ND AVENUE AND SHEYENNE STREET

Roundabout Alternative	2040 A.M. Peak	2040 P.M. Peak
Single-Lane Roundabout	F (2,800 sec/veh)	F (2,470 sec/veh)
Two-Lane Roundabout	F (615 sec/veh)	F (560 sec/ veh)
Three-Lane Roundabout	F (375 sec/veh)	F (640 sec/veh)

Bicycle and Pedestrian Facilities

Given the high projected traffic volumes and 40 miles per hour speed limit on the south segment of Sheyenne Street, it is preferable to provide off-street bicycle facilities (shared-use path) rather than on-street facilities (bicycle lanes) to provide a facility that could be used by novice and advanced cyclists alike. A shared-use path could also be used by pedestrians, which is especially needed given the lack of any existing sidewalks along the corridor.

Since access points are generally well spaced between 21st Avenue/Christianson Drive and 52nd Avenue (850 feet apart, on average), potential conflicts between vehicles and path-users stemming from sight distance issues would be less pronounced than they would be in denser urban settings with poorer access spacing.

A shared-use path on Sheyenne Street would be consistent with adjacent shared-use paths located along 32nd Avenue, 40th Avenue and 47th Avenue. Metro COG's *2011 Fargo-Moorhead Metropolitan Bicycle and Pedestrian Plan* also identifies a shared-use path along Sheyenne Street in its list of long range plan.

bicycle facility projects; a shared-use path on both sides was also included in the programmed 2018 Sheyenne Street reconstruction project between 19th Avenue and 32nd Avenue.

Connectivity

Between the South Ramp and 32nd Avenue intersections, existing and planned traffic control signals will be spaced approximately every one-half mile. However, south of 32nd Avenue, signal spacing will remain at one-mile, with no additional intersections currently warranting a signal. As the corridor builds out, the need to connect the two sides will increase with traffic, likely meeting warrants for traffic control signal installation.

It is likely that future traffic control signal locations could include pedestrian crossing amenities but given the low pedestrian and bicycle generation on the east side of the corridor, costly pedestrian specific amenities likely wouldn't be justified. Raised medians, included in most of the roadway alternatives presented below, could be designed as a pedestrian refuge island to facilitate safe pedestrian crossings.

Notable Geometric Improvements

Under any alternative, analysis indicates additional turn lanes will be needed at the following intersections by 2020:

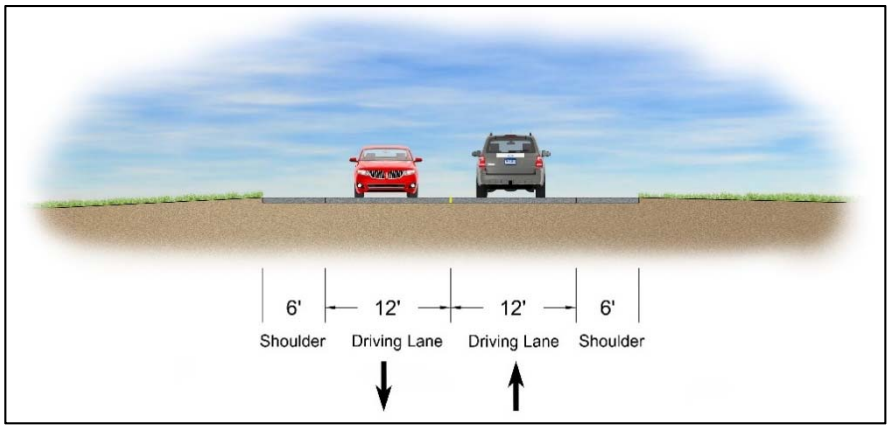
- Double left-turn lanes at the eastbound approach at 32nd Avenue
- Double left-turn lanes at the southbound approach at 40th Avenue
- Double left-turn lanes at the westbound and southbound approach at 52nd Avenue
- Double right-turn lanes at the northbound approach at 52nd Avenue

Alternatives to Carry into Project Development

Do-Nothing Alternative

No geometric, access management or traffic control changes would be made. Under this alternative, Sheyenne Street would remain a rural roadway with one 12-foot driving lane in each direction. There would be no construction cost or property impacts. Poor traffic operations would result in long queues and delays.

FIGURE IX-5: DO-NOTHING ALTERNATIVE FOR SOUTH SHEYENNE STREET SECTION



2020 and 2040 Traffic Operations

By 2020, the existing configuration already results in deficient operations at all intersections excluding 47th Avenue. During the A.M. peak, average per vehicle delay ranges from 90 seconds at 26th Avenue to nearly thirty minutes at 38th Avenue. During the P.M. peak average per vehicle delay ranges from nearly two minutes at 26th Avenue to nearly 13 minutes at 52nd Avenue.

TABLE IX-2: 2020 TRAFFIC OPERATIONS FOR DO-NOTHING ALTERNATIVE FOR SOUTH SHEYENNE STREET SECTION

Intersection	A.M. Peak	P.M. Peak
26th Avenue*	F	F
32nd Avenue*	F	F
38th Avenue	F [F]	F [F]
40th Avenue*	F	E
47th Avenue	A [E]	A [E]
52nd Avenue	F [F]	F [F]

**Denotes intersection is signalized*
At unsignalized intersections: X [X] = Overall intersection LOS [Worst approach LOS]

Operations continue to worsen through 2040. During the A.M. peak, average per vehicle delay exceeds five minutes at all deficient locations with locations like 52nd Avenue experiencing average per vehicle delays longer than 45 minutes, signifying total breakdown of the models used for analysis; during the P.M. peak, average per vehicle delay again exceeds five minutes at all deficient locations. Long queues during both peak hours block turn lanes, drive ways and adjacent intersections, negatively impacting operations.

TABLE IX-3: 2040 TRAFFIC OPERATIONS FOR DO-NOTHING ALTERNATIVE FOR SOUTH SHEYENNE STREET SECTION

Intersection	A.M. Peak	P.M. Peak
26th Avenue*	F	F
32nd Avenue*	F	F
38th Avenue	F [F]	F [F]
40th Avenue*	F	E
47th Avenue	F [F]	A [F]
52nd Avenue	F [F]	F [F]

**Denotes intersection is signalized*
At unsignalized intersections: X [X] = Overall intersection LOS [Worst approach LOS]

Six-Lane Section Alternative

This alternative features three 12-foot lanes in both directions, with a six-foot median, 12-foot left-turn lane and eight-foot turn lane buffer. The proposed six-lane typical roadway section (with left-turn lanes) is 105 feet wide from back-of-curb to back-of-curb, and 137 feet wide total assuming shared-use paths are constructed on both sides of the roadway. The roadway footprint would be wider where additional turn lanes are warranted, including right-turn lanes, double left-turn lanes, etc. It is recommended that additional roadway width is provided to create no left-turn lane offset to improve sight lines for left-turning vehicles. This additional width is already included in the presented cross-section width. This typical section would require approximately six acres of expanded ROW. Expected roadway width can be refined during project development.

2020 and 2040 Traffic Operations

In 2020, a six-lane section would be expected to operate at LOS "C" or better at all locations during the A.M. peak, with the exception of 52nd Avenue, where LOS "D" is expected during the A.M. peak hour. During the P.M. peak hour, all intersections operate at LOS "C" except 38th Avenue at LOS "F", which is common at two-way stop control intersections on principal arterials. By 2040, the six-lane section alternative produces deficiencies at 38th Avenue during the A.M. and P.M. peak hour and 52nd Avenue during the A.M. peak.

TABLE IX-4: 2020 TRAFFIC OPERATIONS FOR SIX-LANE SECTION ALTERNATIVE FOR SOUTH SHEYENNE STREET SECTION

Intersection	*A.M. Peak*	*P.M. Peak*
26th Avenue*	A	A
32nd Avenue*	C	C
38th Avenue	A [E]	F [F]
40th Avenue*	C	B
47th Avenue	A [B]	A [C]
52nd Avenue*	D	C

**Denotes intersection is signalized*
At unsignalized intersections: X [X] = Overall intersection LOS [Worst approach LOS]

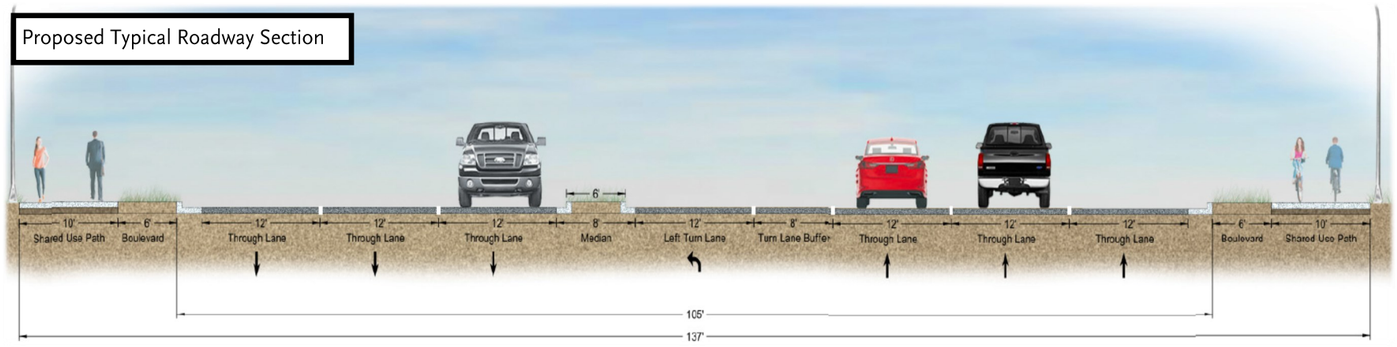
TABLE IX-5: 2040 TRAFFIC OPERATIONS FOR SIX-LANE SECTION ALTERNATIVE FOR SOUTH SHEYENNE STREET SECTION

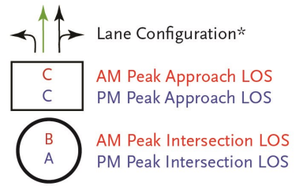
Intersection	*A.M. Peak*	*P.M. Peak*
26th Avenue	A	A
32nd Avenue	C	C
38th Avenue	E [F]	E [F]
40th Avenue	D	C
47th Avenue	A [C]	A [E]
52nd Avenue	E	C

**Denotes intersection is signalized*
At unsignalized intersections: X [X] = Overall intersection LOS [Worst approach LOS]

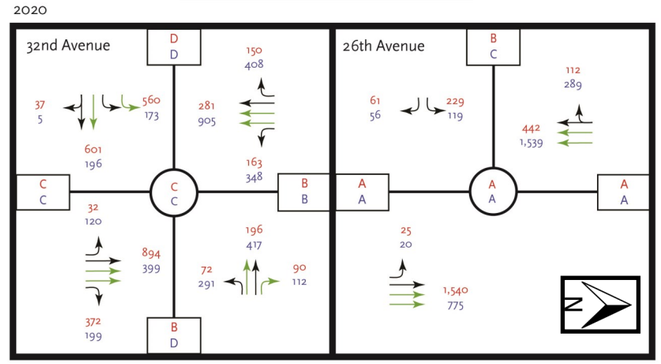
South Sheyenne Street Section: Six-Lane Section from the Sheyenne River to 32nd Avenue

Proposed Typical Roadway Section

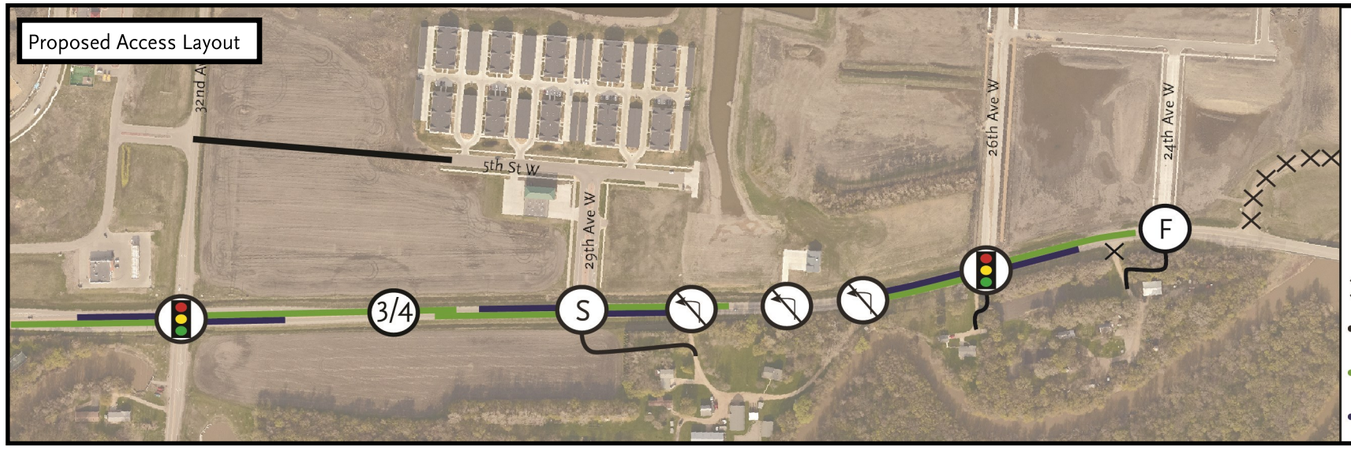




Peak Hour Traffic Operations



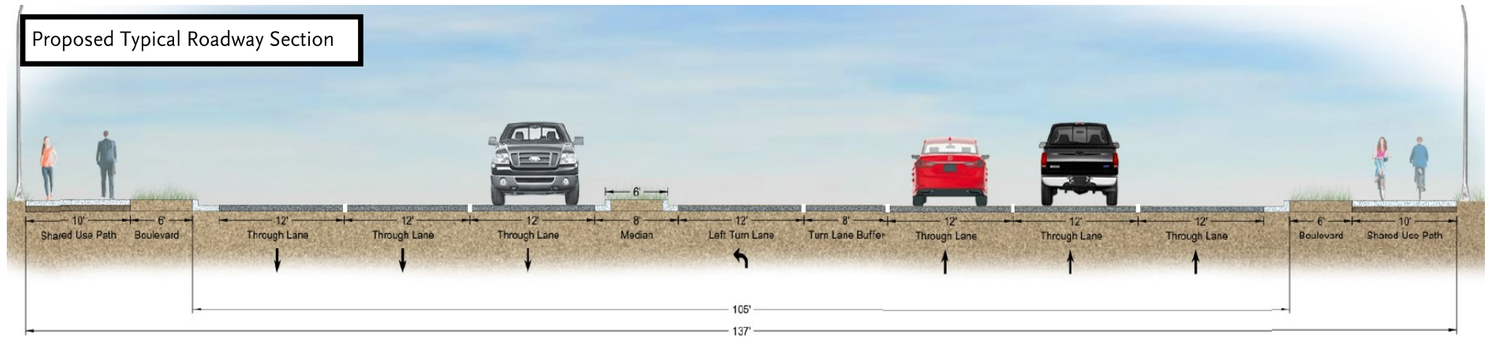
Proposed Access Layout



Conceptual Plan View

FIGURE IX-7: SUMMARY OF SIX-LANE SECTION ALTERNATIVE FOR SOUTH SHEYENNE STREET SECTION FROM 32ND AVENUE TO 40TH AVENUE

South Sheyenne Street Section: Six-Lane Section from the 32nd Avenue to 40th Avenue

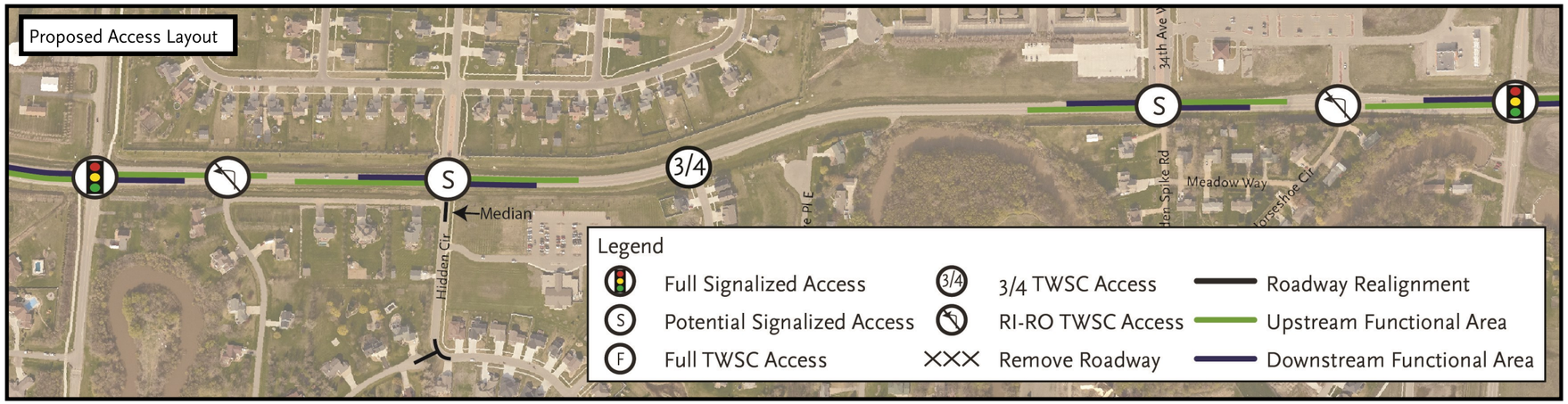


Lane Configuration*

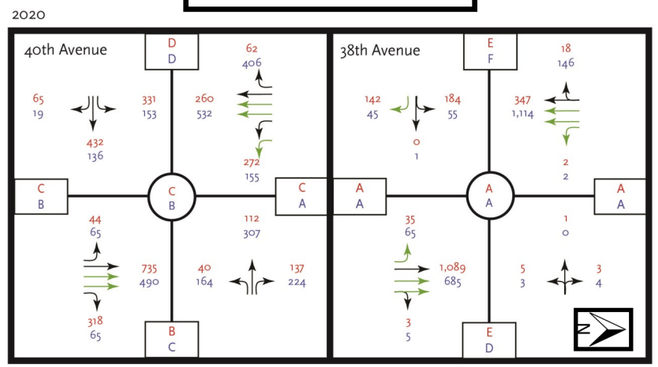
C C — AM Peak Approach LOS / PM Peak Approach LOS

B A — AM Peak Intersection LOS / PM Peak Intersection LOS

*Green Arrow Indicates New Lane



Peak Hour Traffic Operations



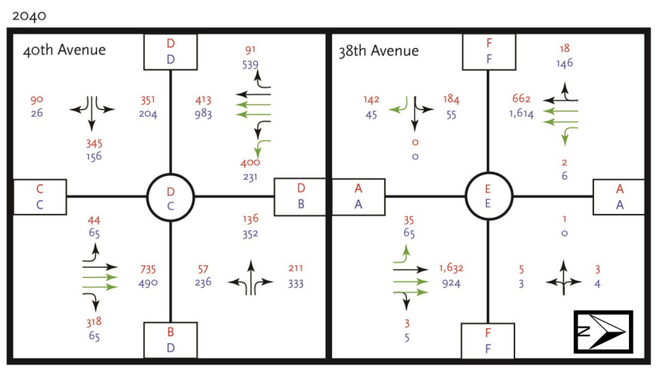
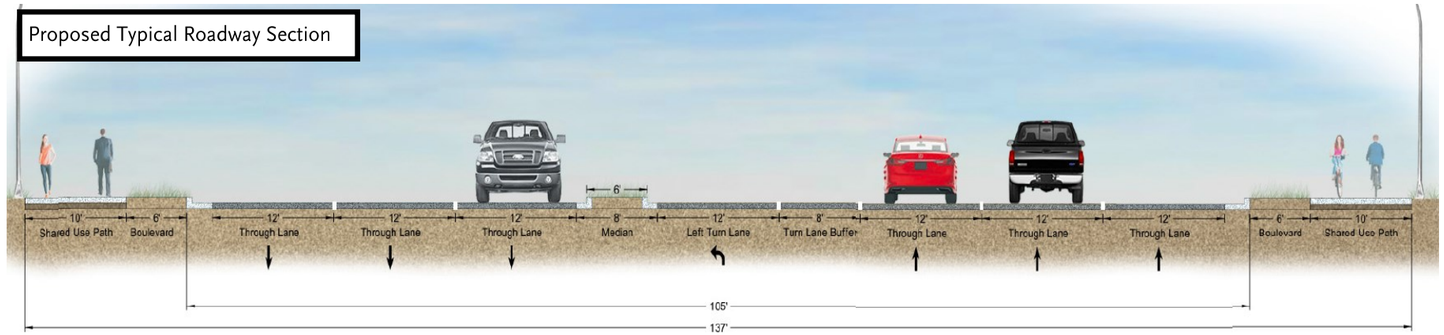


FIGURE IX-8: SUMMARY OF SIX-LANE SECTION ALTERNATIVE FOR SOUTH SHEYENNE STREET SECTION FROM 40TH AVENUE TO 52ND AVENUE

South Sheyenne Street Section: Six-Lane Section from the 40th Avenue to 52nd Avenue

Proposed Typical Roadway Section



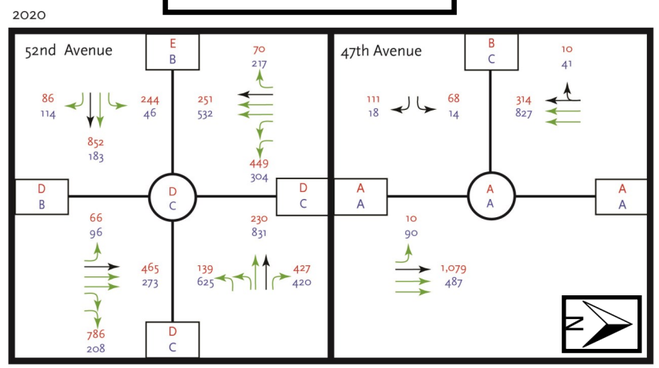
Lane Configuration*

C C — AM Peak Approach LOS / PM Peak Approach LOS

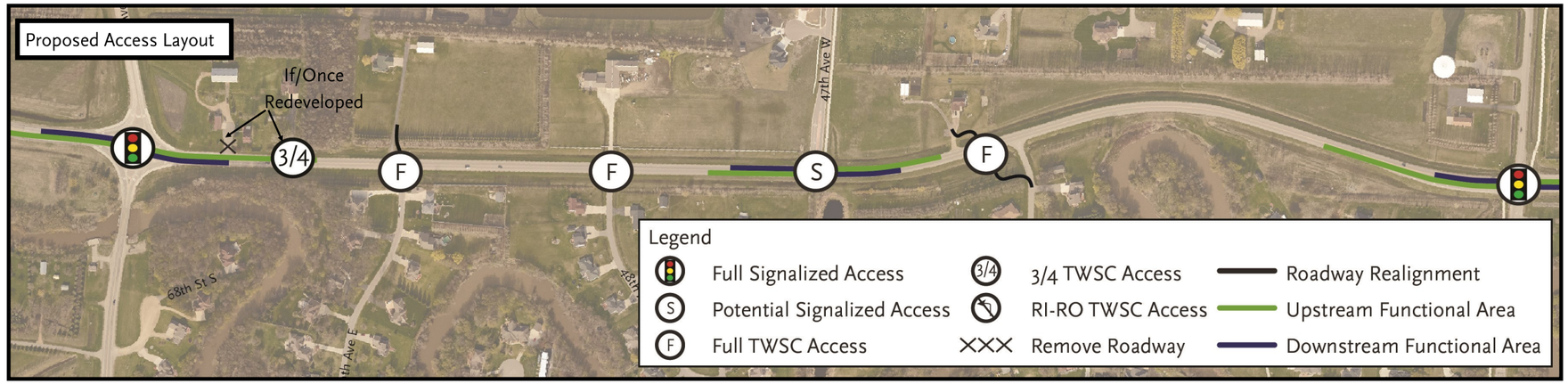
B A — AM Peak Intersection LOS / PM Peak Intersection LOS

*Green Arrow Indicates New Lane

Peak Hour Traffic Operations



Proposed Access Layout



Conceptual Plan View

Performance and Prioritization

Performance for each technically feasible alternative includes the criteria established in Chapter VI) Alternatives Analysis Methodology: capacity and operations, safety, property impacts and construction cost. The six-lane section improves operations and safety, but does result in some ROW acquisition and represents a much higher cost when compared to the Do-Nothing alternative.

TABLE IX-6: PERFORMANCE SUMMARY FOR TECHNICALLY FEASIBLE ALTERNATIVES FOR SOUTH SHEYENNE STREET SECTION

Criteria	Do-Nothing	6-Lane Section
Operations	-9	5
Safety	2	8
Property Impacts	10	4
Cost	10	2
Total	13	19

Public Comments

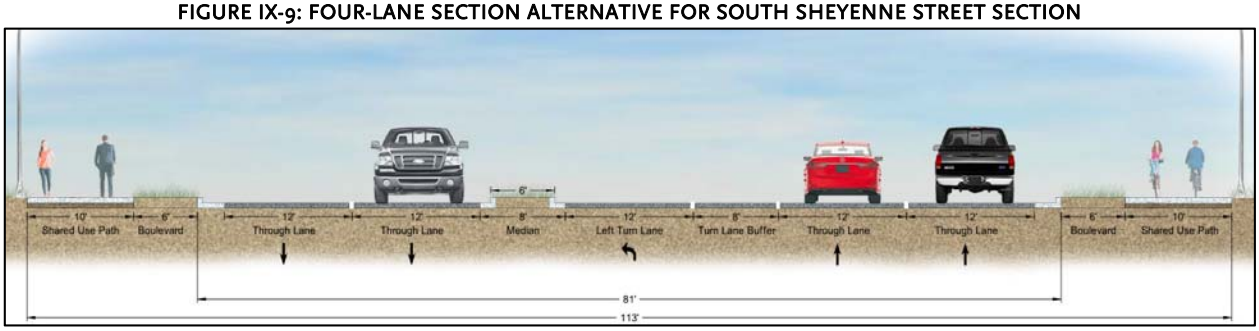
Seven comments were received regarding the South Sheyenne Street section alternatives presented at Public Input Meeting #2. Comments focused on speed and safety (five), property impacts as a result of expanding the roadway (three) and funding through assessments (three).

Discarded Alternatives

Four-Lane Section with Raised Medians and Turn Lanes

This alternative would feature two 12-foot through lanes in each direction as specified within the 2016 to 2019 TIP. It also includes a six-foot median, 12-foot left-turn lanes and eight-foot turn lane buffer. The proposed typical four-lane section would have a back-of-curb to back-of-curb width of 81 feet at locations with left-turn lanes, with an overall cross section width of 113 feet if shared-use paths are present on both sides of the roadway. The roadway footprint would be wider where additional turn lanes are warranted, including right-turn lanes, double left-turn lanes, etc. It is recommended that additional roadway width is provided to at least provide no offset at opposing left-turn lanes to improve sight lines and reduce left-turn crash potential. This is considered in the presented cross-section width. This typical section would largely fit within existing ROW, with some new ROW way required. This alternative improves operations and capacity, but still results in deficient operations during the peak periods. Since most study intersections are deficient by 2040, this alternative was discarded because it does not meet the PNS for this project.

FIGURE IX-9: FOUR-LANE SECTION ALTERNATIVE FOR SOUTH SHEYENNE STREET SECTION



2020 and 2040 Traffic Operations

By 2020, a four-lane section would provide LOS "D" or better during the A.M. peak. During the P.M. peak, only 38th Avenue operates deficiently.

TABLE IX-7: 2020 TRAFFIC OPERATIONS FOR FOUR-LANE SECTION ALTERNATIVE FOR SOUTH SHEYENNE STREET SECTION

Intersections	A.M. Peak	P.M. Peak
26th Avenue*	A	A
32nd Avenue*	D	B
38th Avenue	A [E]	F [F]
40th Avenue*	C	C
47th Avenue	A [C]	A [D]
52nd Avenue*	D	C

*Denotes intersection is signalized
At unsignalized intersections: X [X] = Overall intersection LOS [Worst approach LOS]

By 2040, deficiencies are expected at most study intersections. During the A.M. peak, only 26th Avenue and 47th Avenue are expected to operate at LOS "B" or better. During the P.M. peak, 32nd Avenue operates at LOS "E" and 38th Avenue at LOS "F".

TABLE IX-8: 2040 TRAFFIC OPERATIONS FOR FOUR-LANE SECTION ALTERNATIVE FOR SOUTH SHEYENNE STREET SECTION

Intersections	A.M. Peak	P.M. Peak
26th Avenue*	B	B
32nd Avenue*	E	E
38th Avenue	F [F]	F [F]
40th Avenue*	E	C
47th Avenue	A [C]	A [D]
52nd Avenue*	E	D

*Denotes intersection is signalized
At unsignalized intersections: X [X] = Overall intersection LOS [Worst approach LOS]

Five-Lane Section with Reversible Flow Lanes Alternative

This alternative would have five travel lanes, with the number of lanes in each direction varying by peak period. During peak periods, it is proposed to have three travel lanes in the peak direction with one two-way left-turn lane and one travel lane in the off-peak direction. During off-peak periods, the section would function as a typical five-lane section with two travel lanes in each direction with a two-way left-turn lane. This alternative was considered due to the directional volume imbalance experienced during peak periods on Sheyenne Street.

When provided on the proper corridor, reversible flow lanes can offer improved traffic flow in a narrower roadway cross section. Similar corridors throughout the country experienced a 3.5 percent to 25 percent reduction in travel times for the peak direction (TRB, 2004).

One of the primary concerns with reversible flow lanes is crash potential. Left-turning type crashes are typically associated with reversible operations on arterial roadways. These types of crashes often occur when vehicles turn left in front of traffic moving the same direction due to confusion about which lanes have reversed operations and when vehicles turn left from minor approaches onto reversible flow lanes due to confusion about which lane to use. Published safety related data for segments converted to reversible flow operations is inconclusive, but most show an increase in crash potential, which conflicts with the PNS for this project (TRB, 2004). Ultimately, safety may be dependent on driver familiarity with the corridor, reversible operations, clear signage and indications of the operations.

This alternative improves operations and capacity, when compared against the Do-Nothing alternative, but still results in deficient operations during the peak periods. Rear-end crash potential is reduced with better

operations but increased crash potential exists for angle and head-on crashes due to operational confusion. This alternative was discarded because of crash potential characteristics which do not meet the PNS for this project.

2020 and 2040 Traffic Operations

By 2020, this alternative is expected to result in LOS "C" or better at all study intersections during the A.M. peak hour. During the P.M. peak hour, only 38th Avenue will operate deficiently at LOS "F".

FIGURE IX-10: PROPOSED TIME OF DAY OPERATIONS FOR REVERSIBLE FLOW LANE SECTION (NORTHBOUND)

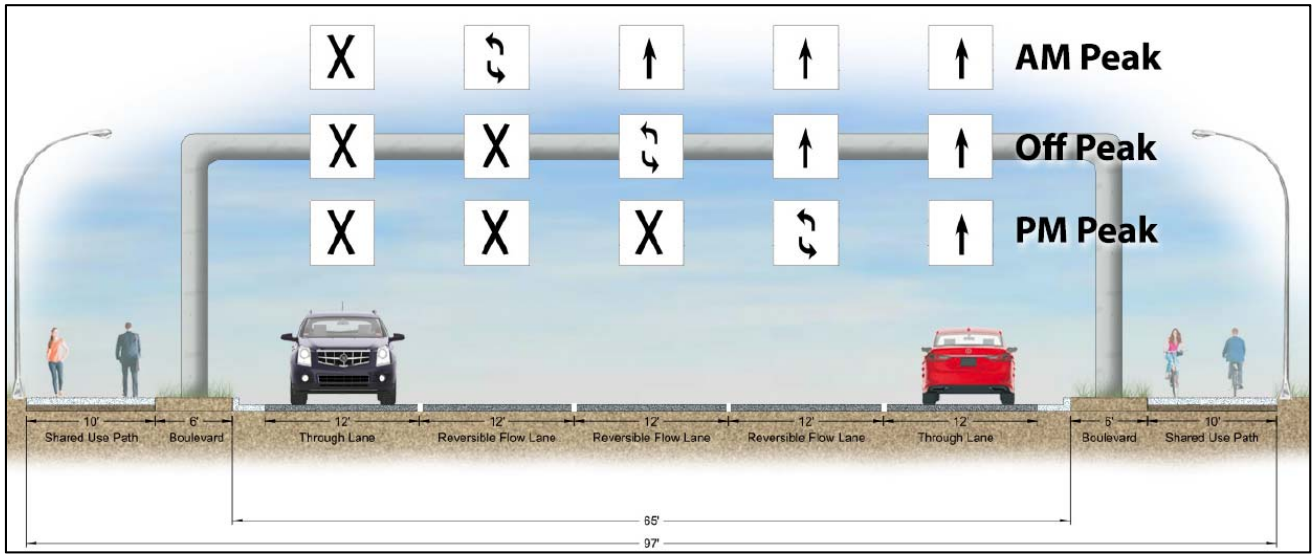


TABLE IX-9: 2020 TRAFFIC OPERATIONS FOR REVERSIBLE FLOW LANES ALTERNATIVE FOR SOUTH SHEYENNE STREET SECTION

Intersection	A.M. Peak	P.M. Peak
26th Avenue*	A	A
32nd Avenue*	B	C
38th Avenue	A [F]	F [F]
40th Avenue*	C	C
47th Avenue	A [B]	A [E]
52nd Avenue*	C	C

*Denotes intersection is signalized
At unsignalized intersections: X [X] = Overall intersection LOS [Worst approach LOS]

By 2040, all intersections will operate at LOS "D" or better during the A.M. peak hour. During the P.M. peak hour, only 38th Avenue will operate deficiently at LOS "F".

TABLE IX-10: 2040 TRAFFIC OPERATIONS FOR REVERSIBLE FLOW LANE ALTERNATIVE FOR SOUTH SHEYENNE STREET SECTION

Intersection	A.M. Peak	P.M. Peak
26th Avenue*	A	B
32nd Avenue*	D	D
38th Avenue	A [F]	F [F]
40th Avenue*	C	C
47th Avenue	A [D]	A [F]
52nd Avenue*	D	D

*Denotes intersection is signalized
At unsignalized intersections: X [X] = Overall intersection LOS [Worst approach LOS]

Interim Build Solution

Given the existing need for improvements to Sheyenne Street and West Fargo's limited funds, the city desires to improve Sheyenne Street from 13th Avenue to 40th Avenue before 2020, when a full breakdown of traffic flow is expected under the existing conditions. The city is planning to provide an interim solution between 32nd Avenue and 40th Avenue that would build the four-lane alternative immediately and build the final, six-lane section when congestion once again starts to become an issue. This would require the design to include all aspects of the six-lane section, with the exception of the third lane for both directions. Specifically, this would include ROW acquisitions, location of shared-use paths, utilities and traffic control signals. This will permit the extra lanes to be included with minimal challenges at a future data, sometime between 2020 and 2040. While the four-lane section does not meet the PNS through 2040 due to operational deficiencies, it is acceptable through 2020. This interim build solution would need to be reviewed and approved by NDDOT and FHWA to ensure future plans do not sacrifice the original investment.

The City of West Fargo intends to build Sheyenne Street from the interchange to 32nd Avenue to the full six-lane section.

TABLE IX-11: 2020 TRAFFIC OPERATIONS FOR FOUR-LANE SECTION FOR INTERIM BUILD SOLUTION

Intersections	*A.M. Peak*	*P.M. Peak*
26th Avenue*	A	A
32nd Avenue*	D	B
38th Avenue	A [E]	F [F]
40th Avenue*	C	C
47th Avenue	A [C]	A [D]
52nd Avenue*	D	C

*Denotes intersection is signalized
At unsignalized intersections: X [X] = Overall intersection LOS [Worst approach LOS]

TABLE IX-12: 2040 TRAFFIC OPERATIONS FOR SIX-LANE SECTION FOR INTERIM BUILD SOLUTION

Intersection	*A.M. Peak*	*P.M. Peak*
26th Avenue	A	A
32nd Avenue	C	C
38th Avenue	E [F]	E [F]
40th Avenue	D	C
47th Avenue	A [C]	A [E]
52nd Avenue	E	C

**Denotes intersection is signalized*
At unsignalized intersections: X [X] = Overall intersection LOS [Worst approach LOS]

X) Alternatives Development & Analysis: 52nd Avenue Section

Three alternatives were developed for 52nd Avenue between the Sheyenne River Diversion and Sheyenne Street, all with varying costs, operations and impacts:

- Do-Nothing
- Two-Lane Section
- Four-Lane Section

Alternatives were only developed for this section of 52nd Avenue, despite the identified study area spanning 52nd Avenue from the Sheyenne River Diversion to 4th Street. No recommendations for 52nd Avenue from Sheyenne Street to 4th Street were made due to a variety of reasons, including imminent development, other concurrent studies occurring on 52nd Avenue from Sheyenne Street to 4th Street and finally no logical termini. Any improvement to 52nd Avenue would likely stretch from Sheyenne Street to Veterans Boulevard or 45th Street, not 4th Street.

The only existing study intersection for this section of roadway is the Sheyenne Street and 52nd Avenue intersection. Given the extremely limited development on this corridor, a proactive access management plan was developed. Traffic operations at LOS "E" or worse were considered deficient in accordance with the NDDOT *Traffic Operations Manual*. Both build alternatives were found to be technically feasible according to the established screening criteria provided in Chapter VI) Alternatives Analysis Methodology.

Project Development

Improvements to this section of 52nd Avenue are unlikely to occur in the near future given the immediate list of projects to be locally funded. Specific improvements will likely need to be revisited when the project is imminent. This project will also be fully funded using local funds, meaning it will not be held to the same environmental standards as the rest of the project.

Prioritized Alternative: Two-Lane Section

This alternative would feature one 12-foot through lane in each direction with left-turn lanes, a painted turn lane buffer, lighting and eight-foot raised median. There would be a shared-use path on both sides with grassy boulevards separating the pedestrian and bicycle facilities from the roadway. The provision of medians can be used to provide pedestrian refuge islands to facilitate safe crossings of 52nd Avenue. The roundabout would be converted to a traffic control signal and lighting would be installed to improve safety for all roadway users.

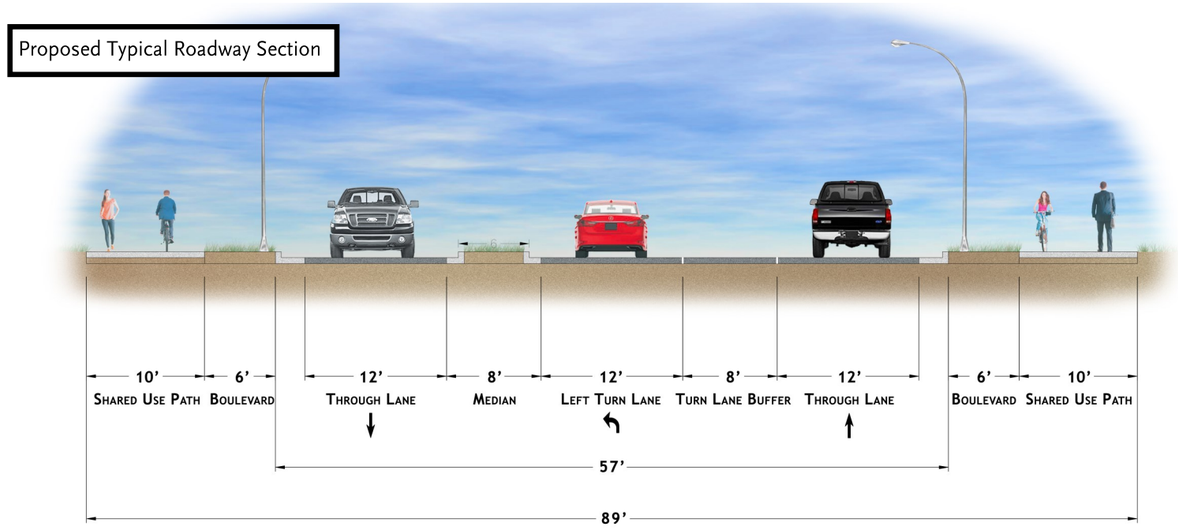
The horizontal alignment of the roadway would be realigned to follow the powerline on the north side of the roadway. This limits the amount of ROW required and minimizes the curvature in the roadway. Refer to Figure IV-26 in Chapter IV) Existing and Future Needs Assessment.

Technically, this alternative scored second. However, the SRC felt the two-lane section alternative was appropriate for this section of 52nd Avenue for the following reasons:

- It is currently only a local road. This section of 52nd Avenue is not currently classified, but will likely be classified as a collector in the next update. While collectors are eligible for federal funding, because they lack regional significance, they rarely receive federal funding. Operating at a deficient LOS for two hours during the day is likely acceptable.

FIGURE X-1: SUMMARY OF TWO-LANE SECTION ALTERNATIVE FOR 52ND AVENUE SECTION FROM THE SHEYENNE RIVER DIVERSION TO SHEYENNE STREET

52nd Avenue Section:
Two-Lane Section from
Sheyenne River Diversion to Sheyenne Street



- Uncertainty with Red River Diversion bridges. Currently, the Red River Diversion bridges are planned for 40th Avenue and 76th Avenue. However, they could be realigned to locations with interchanges at I-29, which would mean 32nd Avenue or 52nd Avenue. If that happens, this section of 52nd Avenue would likely be reclassified and serve a more regional purpose, making operations important.
- Uncertainty with future regional growth. Traffic projections were made assuming significant growth in Horace. If the timing of that growth is slower than assumed, a two-lane section will provide efficient operations on 52nd Avenue.

Given these uncertainties, it is recommended that in this section, ROW for a four-lane section with median and turn lanes be secured and during construction it should be graded and prepared for a four-lane section when traffic demands.

2020 and 2040 Traffic Operations

The roundabout at 52nd Avenue and Sheyenne Street is converted to a signalized intersection. No other intersections are available, but they would likely operate quite well along 52nd Avenue. This intersection operates deficiently by 2020; average per vehicle delays exceed two minutes during the A.M. peak and one minute during the P.M. peak. By 2040, average per vehicle delays approach three minutes during the A.M. peak and two minutes during the P.M. peak.

TABLE X-1: 2020 TRAFFIC OPERATIONS FOR TWO-LANE SECTION ALTERNATIVE FOR 52ND AVENUE SECTION (ONLY 52ND AVENUE AND SHEYENNE STREET INTERSECTION)

Intersection	A.M. Peak	P.M. Peak
52nd Avenue	F	E

TABLE X-2: 2040 TRAFFIC OPERATIONS FOR TWO-LANE SECTION ALTERNATIVE FOR 52ND AVENUE SECTION (ONLY 52ND AVENUE AND SHEYENNE STREET INTERSECTION)

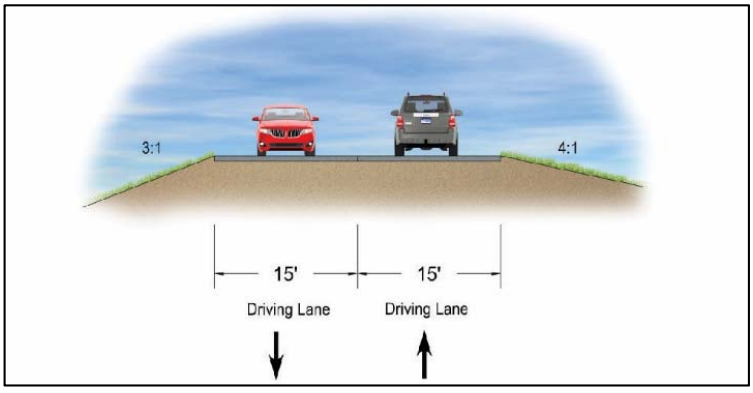
Intersection	*A.M. Peak*	*P.M. Peak*
52nd Avenue	F	E

Other Technically Feasible Alternatives

Do-Nothing Alternative

This alternative would feature one 15-foot through lane in each direction, maintaining the existing asphalt laid in summer 2015, with no additional improvements. No ROW acquisition would be required as well as no additional traffic control or pedestrian amenities provided. The roundabout will be maintained at the Sheyenne Street and 52nd Avenue intersection. Deficient operations are expected at the 52nd Avenue and Sheyenne Street intersection by 2020.

FIGURE X-2: DO-NOTHING ALTERNATIVE FOR 52ND AVENUE SECTION FROM THE SHEYENNE RIVER DIVERSION TO SHEYENNE STREET



This alternative would not provide any safety enhancements, like medians, lighting, bicycle and pedestrian facilities and turn lanes. These amenities have measurable impacts with regards to reducing crashes. Medians and left-turn lanes have been found to reduce total crashes by 39 percent, lighting to reduce nighttime crashes by 49 percent and pedestrian and bicycle facilities to reduce pedestrian crashes by 74 percent (FHWA, 2013).

2020 and 2040 Traffic Operations

With this alternative, the 52nd Avenue intersection operates deficiently by 2020; average per vehicle delay exceeds 14 minutes during the A.M. peak and 13 minutes during the P.M. peak. By 2040, average per vehicle delay exceeds 46 minutes during the A.M. peak and 41 minutes during the P.M. peak.

TABLE X-3: 2020 TRAFFIC OPERATIONS FOR DO-NOTHING ALTERNATIVE FOR 52ND AVENUE SECTION (ONLY 52ND AVENUE AND SHEYENNE STREET INTERSECTION)

Intersection	A.M. Peak	P.M. Peak
52nd Avenue	F [F]	F [F]

X [X] = Overall intersection LOS [Worst approach LOS]

TABLE X-4: 2040 TRAFFIC OPERATIONS FOR DO-NOTHING ALTERNATIVE FOR 52ND AVENUE SECTION (ONLY 52ND AVENUE AND SHEYENNE STREET INTERSECTION)

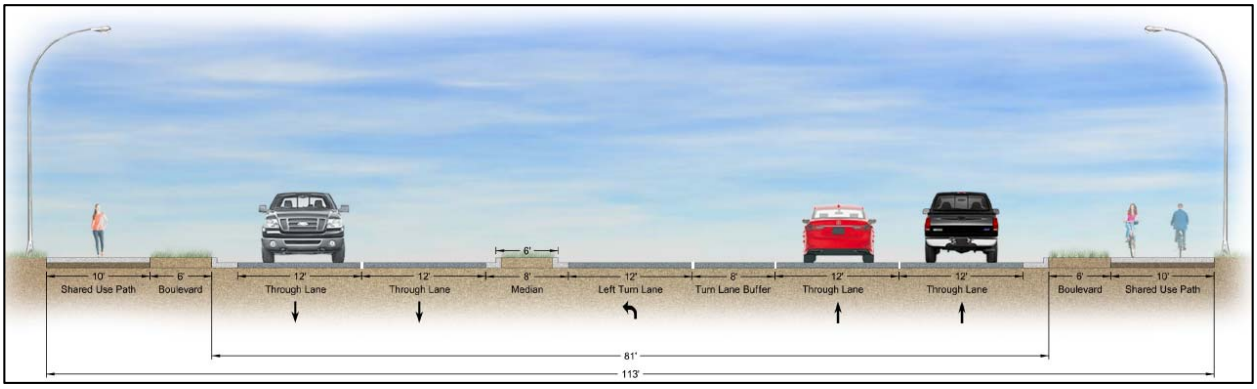
Intersection	A.M. Peak	P.M. Peak
52nd Avenue	F [F]	F [F]

X [X] = Overall intersection LOS [Worst approach LOS]

Four-Lane Section with Raised Medians and Turn Lanes

This alternative would feature two 12-foot through lanes in each direction with left-turn lanes, a painted turn lane buffer and eight-foot raised median. There would be a shared-use path on one side of the roadway and a sidewalk on the other with grassy boulevards separating the facilities from the roadway. The provision of medians can be used to provide pedestrian refuge islands to facilitate safe crossings of 52nd Avenue. This alternative would also convert the roundabout to a traffic control signal and install lighting to improve safety for all roadway users. The horizontal alignment of the roadway would also be realigned to follow the powerline on the north side of the roadway, similar to the previous alternatives. This limits the amount of ROW required and minimizes the curvature in the roadway.

FIGURE X-3: FOUR-LANE SECTION ALTERNATIVE FOR 52ND AVENUE SECTION FROM THE SHEYENNE RIVER DIVERSION TO SHEYENNE STREET



2020 and 2040 Traffic Operations

At the 52nd Avenue and Sheyenne Street intersection, operations are improved. The roundabout is converted to a signalized intersection. By 2020, the 52nd Avenue and Sheyenne Street intersection operates at LOS "D" during the A.M. peak but acceptably at LOS "C" during the P.M. peak. The operations remain unchanged through 2040.

TABLE X-5: 2020 TRAFFIC OPERATIONS FOR FOUR-LANE SECTION ALTERNATIVE FOR 52ND AVENUE SECTION (ONLY 52ND AVENUE AND SHEYENNE STREET INTERSECTION)

Intersection	A.M. Peak	P.M. Peak
52nd Avenue	D	C

TABLE X-6: 2040 TRAFFIC OPERATIONS FOR FOUR-LANE SECTION ALTERNATIVE FOR 52ND AVENUE SECTION (ONLY 52ND AVENUE AND SHEYENNE STREET INTERSECTION)

Intersection	A.M. Peak	P.M. Peak
52nd Avenue	D	C

Performance for Technically Feasible Alternatives

Performance for each technically feasible alternative includes the criteria established in Chapter VI) Alternatives Analysis Methodology: capacity and operations, safety, property impacts and construction cost.

TABLE X-7: PERFORMANCE SUMMARY FOR TECHNICALLY FEASIBLE ALTERNATIVES FOR 52ND AVENUE SECTION

Criteria	Do-Nothing	2-Lane Section	4-Lane Section
Operations	-10	-1	2
Safety	0	7	10
Property Impacts	10	6	4
Cost	10	6	5
Total	10	18	21

The Do-Nothing alternative adds no capacity and does not improve operations; crash potential will remain unchanged and no pedestrian amenities will be provided. However, no properties will be impacted and no construction costs incurred.

The Two-Lane Section alternative also does not add capacity on 52nd Avenue, but does improve the Sheyenne Street and 52nd Avenue intersection, yet it remains deficient. Implementation of turn lanes, pedestrian and bicycle facilities, lighting and medians contributes to a reduced crash potential. This alternative has little impacts to surrounding properties.

The Four-Lane Section alternative adds roadway capacity and further improves the intersection at Sheyenne Street. Implementation of turn lanes, pedestrian and bicycle facilities, lighting and medians contributes to a reduced crash potential. It is likely this alternative will have minor impacts to surrounding properties.

Reiterating, technically the Two-Lane Section alternative was prioritized by the SRC for a variety of reasons including lack of regional significance, uncertainty with the Red River Diversion bridge placement and uncertainty with regional population growth.

Public Comments

No comments were received regarding the 52nd Avenue section alternatives presented at Public Input Meeting #2.

Safe Routes to School

Many routes typically used by children walking to-and-from school are hindered with connectivity gaps and high-speed, high-volume crossings. Studies have found that due to their limited roadway experience, children cannot assess crossing scenarios as effectively as adults (Tabibi, et al., 2003). Starting a Safe Routes to School (SRTS) program is an opportunity to make walking and bicycling to school safer and more accessible for all children by improving pedestrian and bicycle infrastructure along designated routes.

The SRTS goal is to increase the number of children who choose to walk and bicycle. On a broader level, SRTS programs can enhance children's health and wellbeing, ease traffic congestion near the school and improve air quality, ultimately improving all community members' overall quality of life.

SRTS activities are eligible to compete for funding alongside other programs, including the Recreational Trails program or the Transportation Alternatives Program (TAP) set out in the Moving Ahead for Progress in the 21st Century (MAP-21) bill.

SRTS programs include five "E"s:

- Engineering. Creating operational and physical improvements to infrastructure surrounding schools to reduce speeds and conflict potentials with motor vehicle traffic and establish safer and fully accessible crossings, walkways, trails and bikeways.
- Education. Teaching children about the broad range of transportation choices, instructing them in important lifelong bicycling and walking safety skills and launching driver safety campaigns near schools.
- Enforcement. Partnering with local law enforcement to ensure traffic laws are obeyed near schools, including speed enforcement, yielding to pedestrians in crosswalks, proper walking and cycling behaviors and initiating community enforcement, like crossing guard programs.
- Encouragement. Using special events and activities to promote walking and bicycling.
- Evaluation. Monitoring and documenting outcomes and trends through data collection, including collection of data before and after implementation of any of the previously mentioned "E"s.

The focal point of this study will be the Engineering category. While the other four "E"s are essential for a successful SRTS program, education, enforcement, encouragement and evaluation are typically policy decisions that should be implemented consistently throughout a municipality. Metro COG completed a SRTS study for all of West Fargo that identified global recommendations for each "E". This is scheduled to be updated in 2016, according to the 2015-2016 Unified Planning Work Program. At this time it is suggested all 2011 recommendations for education, enforcement, encouragement and evaluation be revisited, revised and refined as necessary.

The first step in developing a SRTS improvements map is to determine exactly how far pedestrians and cyclists are willing to commute to school. Multiple studies have found the average maximum distance a person will travel is around one-quarter mile if walking and one-half mile if bicycling (Alshalalfah, et

FIGURE X-4: LEGACY ELEMENTARY

al., 2007; Iacono et. al., 2008). A one-half mile buffer was used for consistency with the previous West Fargo SRTS study.

Local Standards

As previously noted, the area surrounding the Legacy Elementary school is currently undeveloped but platted and planned for construction. All new plats surrounding the school will be required to follow City of West Fargo sidewalk ordinances:

- Sidewalk construction is required on both sides of a street and sidewalks must be reconstructed when damaged by a contractor or homeowner.
- All sidewalks must be built to the standards set forth in the Americans with Disabilities Act.
- Sidewalks abutting a property must be maintained by the owner or occupant of the property. Specifically, sidewalks must be cleared of ice and snow within 48 hours of notification by the Superintendent of Streets. Fines can be imposed if not cleared within 48 hours of notification.

West Fargo typically supplements speed restrictions with electronic driver feedback signs (Figure X-5). The City of West Fargo has applied for Federal Safe Routes to School grant dollars over the past several years for the installation of driver feedback signs. These signs notify motorists of their speed and have the capability to store speed data. The West Fargo Police Department feels that these signs have persuaded drivers to slow down near school sites. For congruency between all West Fargo elementary schools, driver feedback signs will be recommended where speeding may be considered a potential concern.

Engineering Improvement Plan

Refer to Figure X-6 for the proposed SRTS map. The following critical aspects of the plan are discussed below and recommended for consideration during the 2016 Safe Routes to School Study to be completed by Metro COG in 2016.

Driver Feedback Signs

Local and national experience indicate that reducing speed limits with static signs are ineffective if roadway design remains constant. It is recommended that a proactive pedestrian and bicycle safety approach is implemented at Legacy Elementary School to prevent speeding before it become an issue.

FIGURE X-5: DRIVER FEEDBACK SIGN NEAR CHENEY MIDDLE SCHOOL

Intersection of 9th Street West and Legacy Elementary North Driveway

This intersection was selected for traffic control for the following reasons:

- Proximity to front door of the school building.
- Located at T-intersection permitting the implementation of a pedestrian refuge island.
- Centrally located for pedestrians and cyclists coming from the north or south, reducing the need for multiple crossings on 9th Street. Fewer crossings limit the number of focal points for drivers and concentrates activity at one location, naturally increasing the respect motorists will have for the crossing. Low volume crossings often become an afterthought for motorists if they frequently pass the crossing without any activity.

To ensure safe pedestrian and bicycle crossing at this location, three improvements are recommended:

- Pedestrian refuge island within existing raised median.
- Marked crosswalk with advanced stop lines.

- "Stop Here for Pedestrians" signs in median and alongside road with the legend "State Law" at the top of the sign.

Studies have found that advanced stop lines, coupled with "Stop Here for Pedestrians" signs reduce vehicle-pedestrian conflicts by 90 percent (FHWA, 2000). If compliance becomes a concern, rectangular rapid flashing beacons (RRFB) could be considered at this location.

Intersection of 9th Street West and 52nd Avenue

This north/south 52nd Avenue crossing at 9th Street West may experience minimal pedestrian volumes upon completion of the school due to the lack of development south of 52nd Avenue. However, the half-section between 9th Street West and the Sheyenne Diversion is contained within West Fargo city limits and will likely be comprised of residential land uses. Once development occurs and shared-use paths are established, in-roadway signs are recommended.

Studies have found in-roadway signs command an 87 percent driver compliancy rate for yielding to pedestrians under similar designs (NCHRP, 2006). It is important to note that in-roadway signs create challenges for roadway maintenance personnel. The local standard is to remove these signs during winter months where snow plows will frequently use 9th Street and pedestrian activity is typically lower. It may be appropriate to wait to install in-roadway signs until development south of 52nd Avenue has occurred.

If compliance becomes a concern, RRFB or pedestrian hybrid beacons (PHB) could be considered and implemented once development occurs to the south of 52nd Avenue.

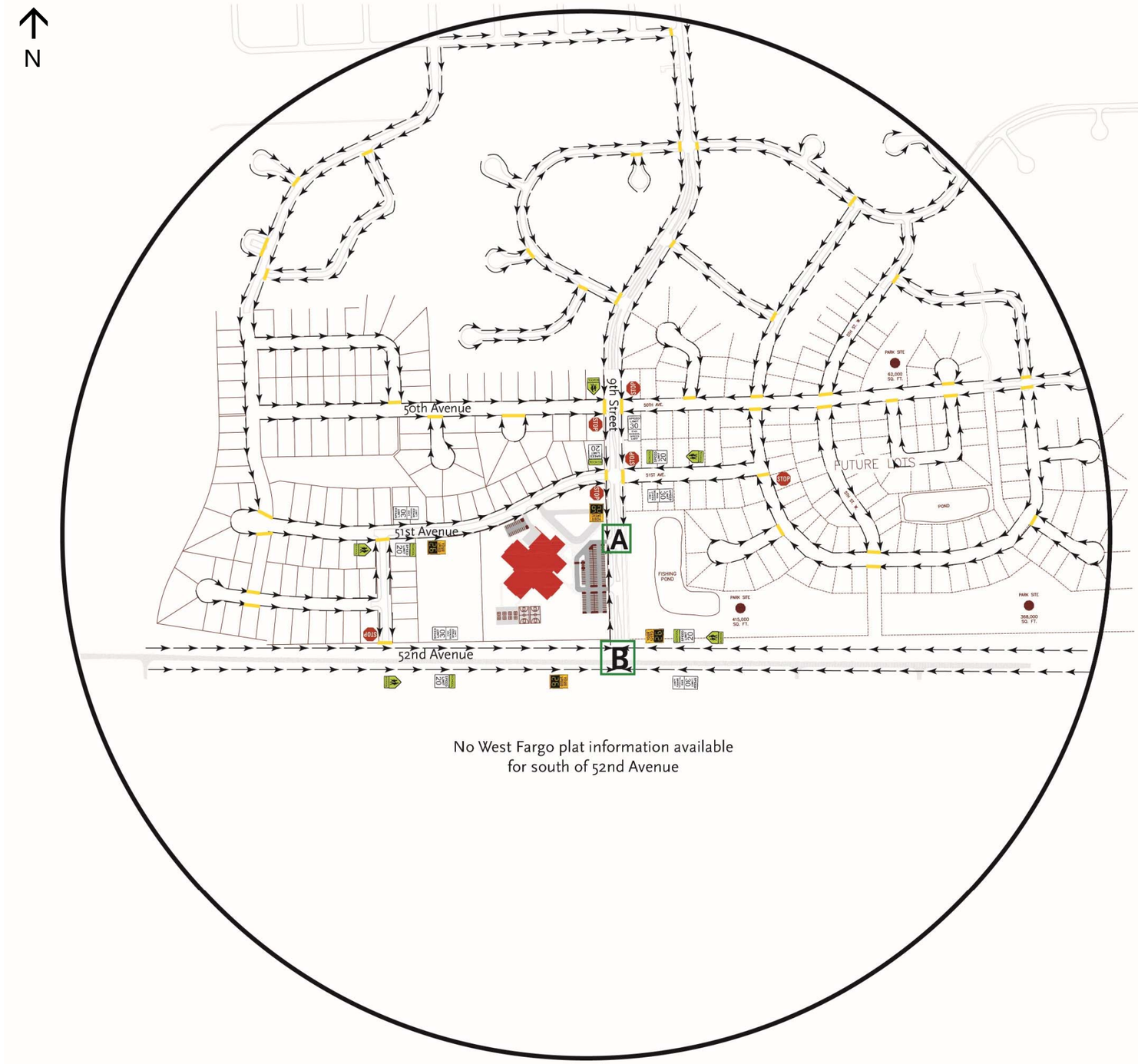
Cost

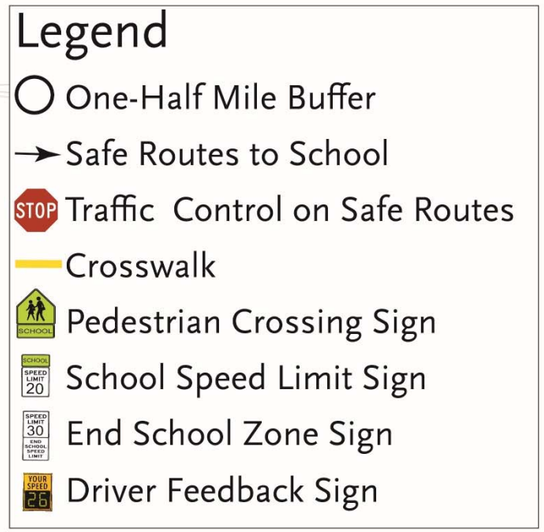
The total cost of school related improvements is estimated at $155,000 and is broken down in Table X-8. All costs are estimated and include installation. This estimate does not include a refuge island on 52nd Avenue, since it is incorporated into the roadway alternatives cost. Estimated costs are in 2015 dollars.

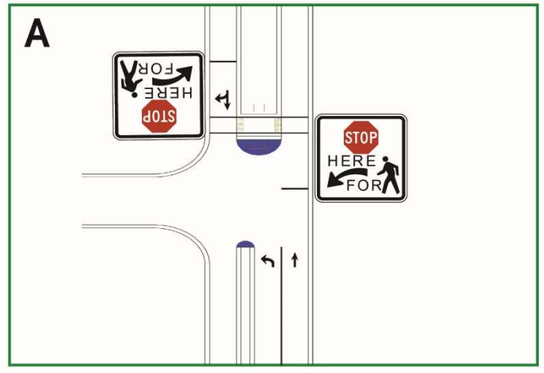
TABLE X-8: ESTIMATED COSTS FOR SAFE ROUTES TO SCHOOLS IMPROVEMENT PLAN

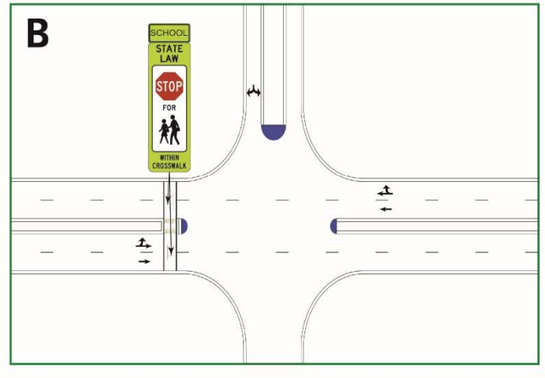
Improvement	Quantity	Unit Cost	Total Cost
Stop Control Sign	6	$500	$3,000
Pedestrian Crossing with School Legend	5	$500	$2,500
Speed Limit Sign with School Legend	5	$500	$2,500
Speed Limit Sign with End School Speed Limit Legend	5	$500	$2,500
Driver Feedback Sign	3	$1,500	$4,500
Stop Here for Pedestrian Sign with Advanced Stop Bar	2	$750	$1,500
In-Roadway Sign with School Legend	2	$500	$1,000
Painted Crosswalk	45	$2,500	$112,500
Pedestrian Refuge Island	1	$25,000	$25,000
Total			$155,000

FIGURE X-6: SAFE ROUTES TO SCHOOL PLAN FOR LEGACY ELEMENTARY









XI) Parks and Aesthetic Considerations

Sheyenne Street is one of the most vibrant corridors in the entire metro area. As roadway improvements occur, parks and aesthetic enhancements should be considered to embrace the character of the corridor. The purpose of this section is to identify opportunities for enhancements to consider for inclusion as part of later projects. State regulations of planning funding preclude the study team from developing more detailed plans.

Figures Figure XI-3, Figure XI-4, Figure XI-5 and Figure XI-6 illustrate the opportunity areas. This includes a variety of trees, bushes, shrubs and landscaping opportunities. The more unique opportunities are further explained below.

Intersection Improvements

Intersections were categorized as primary, secondary and tertiary to highlight the degree of improvements recommended at each location. Focus was given to the primary intersections at the north and south termini of Sheyenne Street. Secondary intersections include some lesser landscaping enhancements to add life to the corridor. At the terminus, the corridor transitions to the city's downtown to the north and transitions to Horace at the south terminus. To accentuate this transition, decorative intersection paving, crosswalks and fences should be considered.

Viewsheds

What makes Sheyenne Street so vibrant is the roadway's proximity to the Sheyenne River. However, the river is primarily blocked from view by vegetation lining the river. The proposed aesthetics plan includes selective pruning and/or clearing some of this vegetation to provide a better view of the river. This could be supplemented with benches or other landscaping to further accentuate the view. Bank stability and habitat impact will be evaluated during later stages of project development to ensure this pruning can be done safely and responsibly.

Gateways

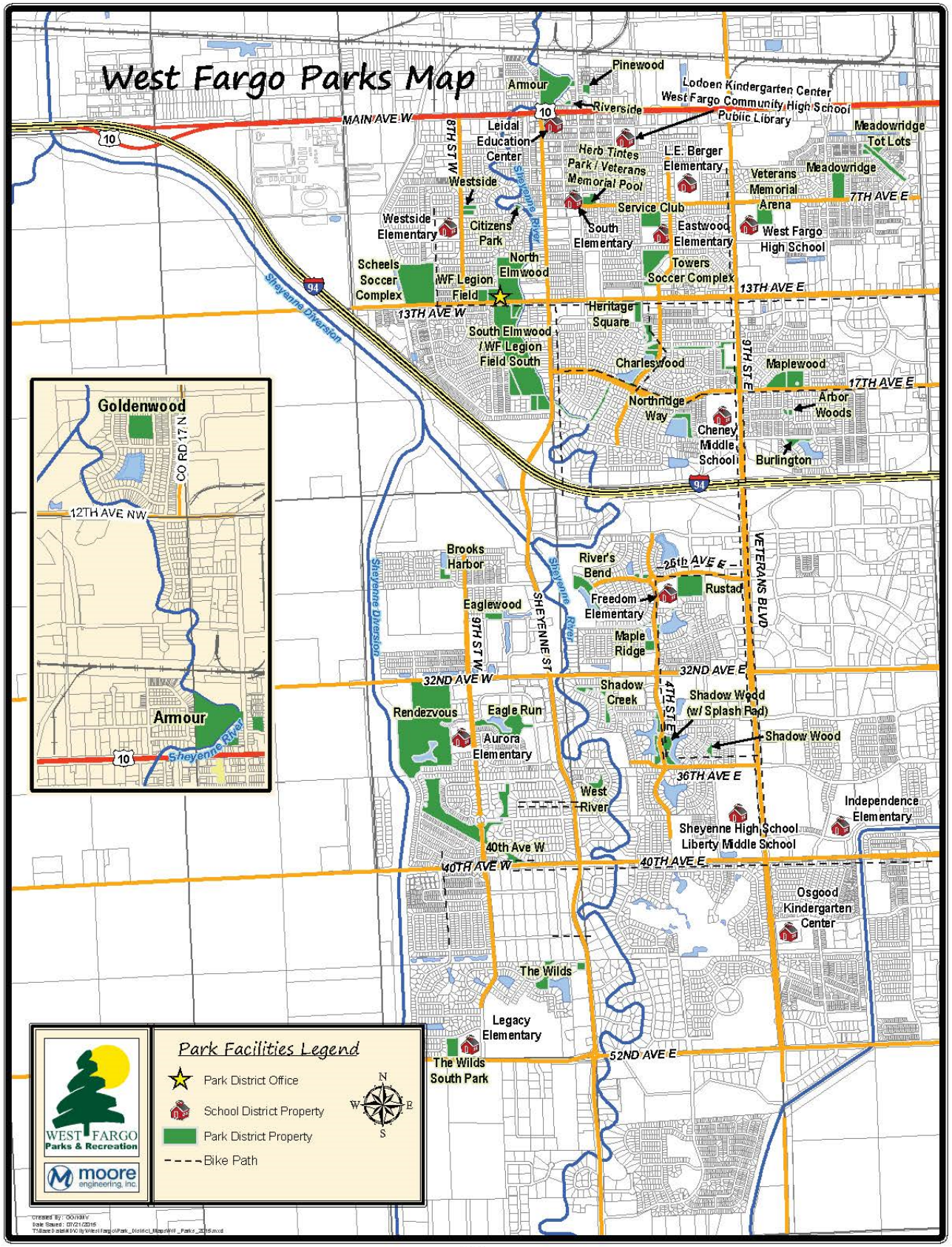
Three gateway/community entrance opportunities were identified;

- 13th Avenue. At this intersection, Sheyenne Street transitions from a roadway that primarily moves regional traffic and provides access to residential land uses south of 7th Avenue to West Fargo's downtown, north of 7th Avenue. A wayfinding sign is proposed to direct traffic toward the downtown, a goal of City of West Fargo staff.
- 52nd Avenue. At this intersection, County Road 17 transitions to Sheyenne Street and jurisdiction transitions from Horace to West Fargo. This provides an excellent gateway opportunity, particularly considering the current roundabout at this intersection. Although future improvements include converting this roundabout to a signal in the future, the roundabout will likely be maintained for many years.
- I-94. The highest volumes of traffic enter Sheyenne Street from I-94, particularly from outside the city. This provides an opportunity to welcome motorists to West Fargo. An example sign is illustrated in the figures that matches the context of the corridor.

Parks

As part of the corridor study, the study team held a meeting with the West Fargo Planning Department and West Fargo Parks District to discuss park opportunities. From this meeting, it was noted that the city prefers larger parks and the study area includes a variety of large parks just off of Sheyenne Street such as Rendezvous Park, South Elmwood, parks associated with Aurora Elementary and Legacy Elementary schools and other dedicated parks included within development plans in the area. The small group discussed all possible park opportunities.

FIGURE XI-1: WEST FARGO PARKS MAP



Source: West Fargo Parks District

The location with the greatest potential is the confluence of the Sheyenne River and the Sheyenne Diversion. Currently, this area, owned by the Southeast Cass Water Resource District, is a popular fishing area. This area has been discussed as a potential park location, including by the National Guard, which has previously shown interest in helping to make improvements to the area. The two major challenges with the park include river bank stability, and associated safety issues, and how to connect the west side of the park with the east, with Sheyenne Street running in between. Again, the purpose of this chapter is to identify opportunities, not design the park. If the Sheyenne River Diversion bridge is replaced as part of roadway improvements, an opportunity may exist to lengthen the bridge and allow a path underneath the bridge to connect the two sides.

Past discussions of this area have included a pedestrian and bicycle bridge just east of Sheyenne Street. This would connect the shared-used paths along Sheyenne Street, and all of the residential land uses along Sheyenne Street, to major pedestrian and bicycle generators to the east like the future Recreation Center, major commercial centers and schools.

FIGURE XI-2: PREVIOUSLY DISCUSSED BICYCLE AND PEDESTRIAN CONNECTION

FIGURE XI-3: AESTHETIC IMPROVEMENTS FROM 13TH AVENUE TO I-94

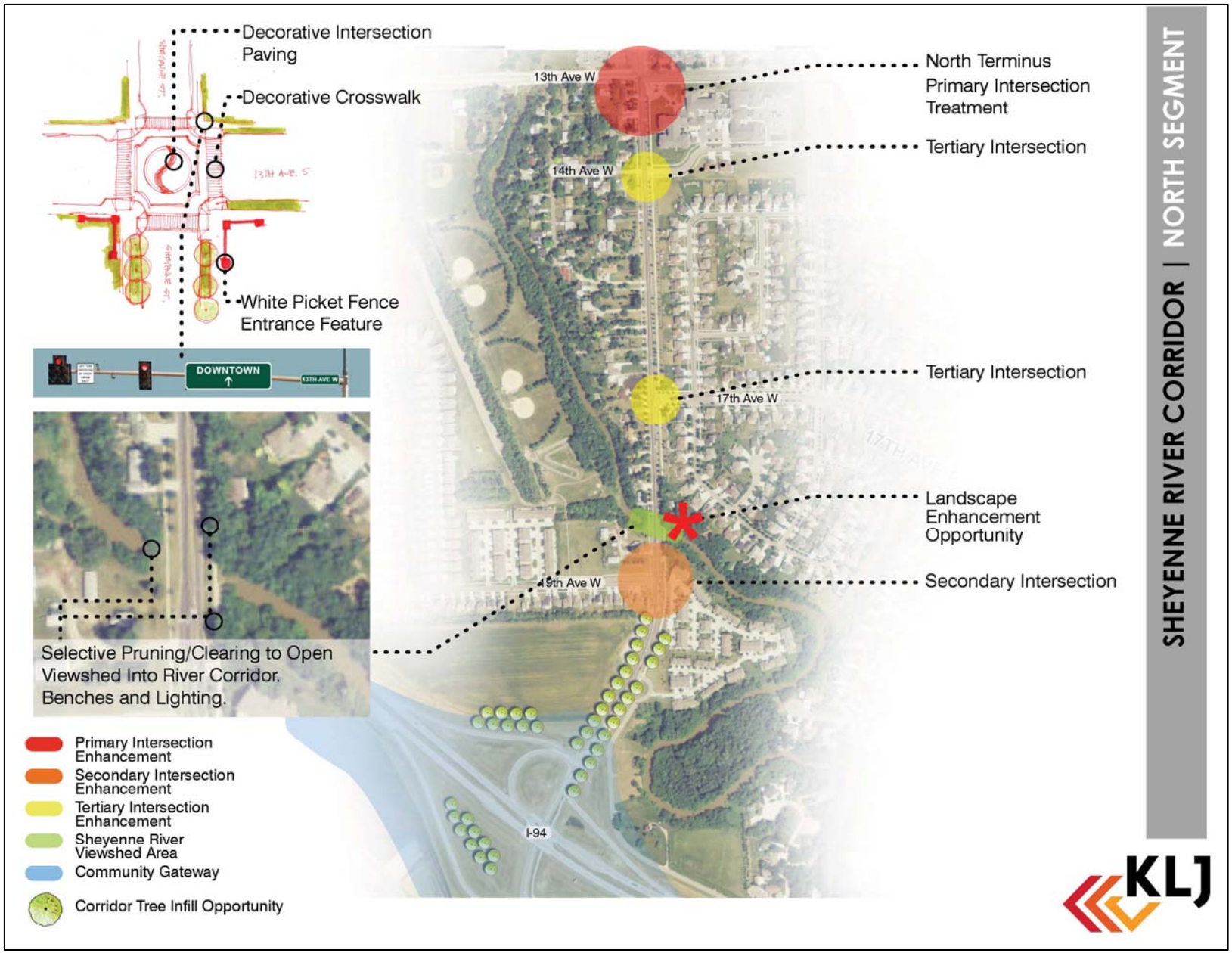
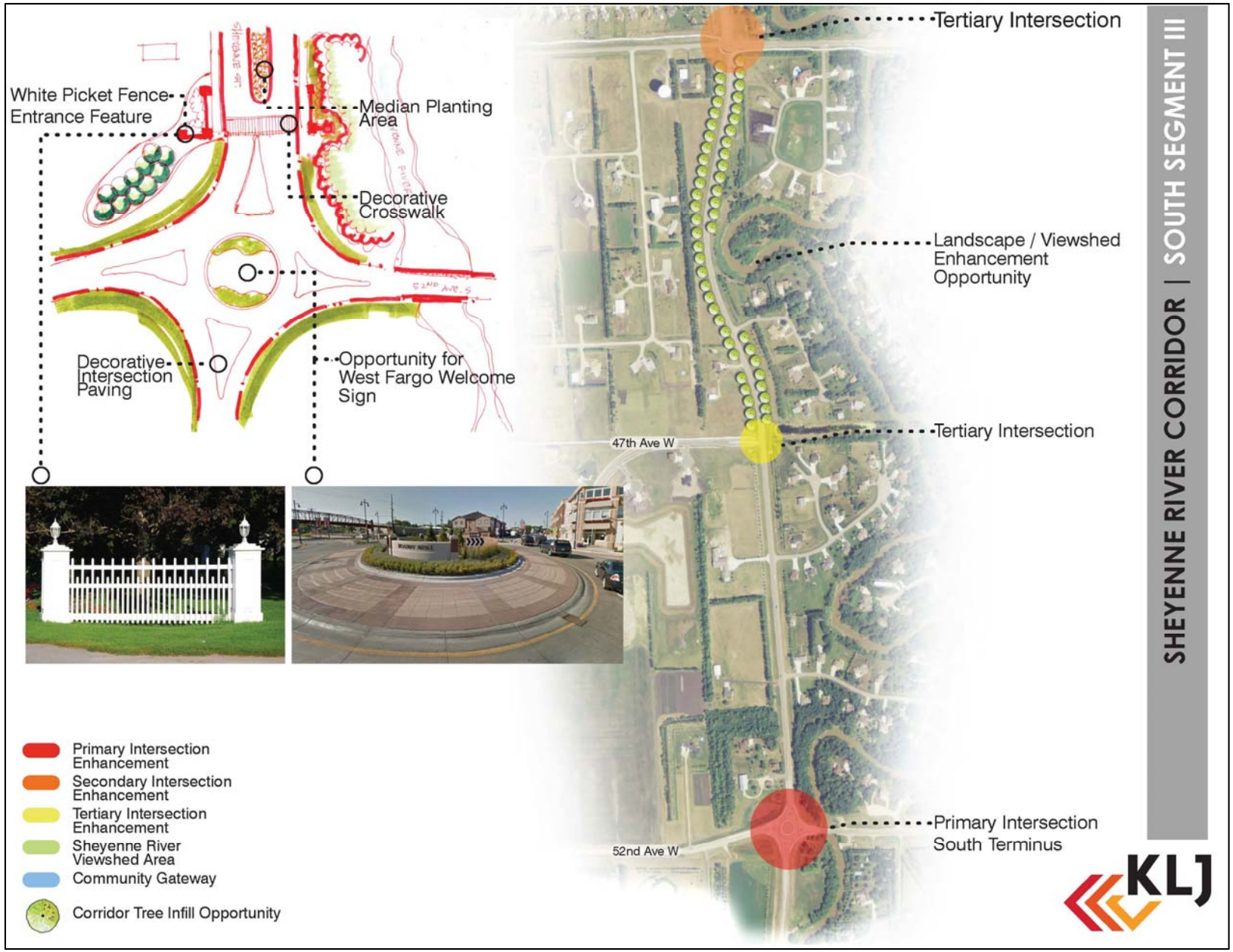


FIGURE XI-4: AESTHETIC IMPROVEMENTS FROM I-94 TO 32ND AVENUE

FIGURE XI-5: AESTHETIC IMPROVEMENTS FROM 34TH AVENUE TO 40TH AVENUE

FIGURE XI-6: AESTHETIC IMPROVEMENTS FROM 40TH AVENUE TO 52ND AVENUE



XII) Implementation Plan

Currently, federal funds through the NDDOT Interstate Maintenance (IM) and the NDDOT Urban Roads Program (URP) are programmed in the 2016 to 2019 Metro COG TIP. Therefore, a very clear implementation plan is foreseeable for the most imminent needs along Sheyenne Street. What follows is an assessment of how to proceed with implementing key elements of the recommendations in this report. Additionally, this chapter will clarify decisions which need to be considered to transition the currently programmed improvements along the Sheyenne Street corridor from the planning phase to the NEPA phase of project development.

Programmed Improvements

As discussed in earlier chapters, there are three programmed federal aid projects for the Sheyenne Street corridor in the 2016 to 2019 TIP:

- Reconstruction from 19th Avenue to 32nd Avenue
- Reconstruction of the Sheyenne Street interchange
- Reconstruction from 32nd Avenue to 40th Avenue

Figure XII-1 shows the anticipated funding strategy for each study section of the *Sheyenne Street Corridor Study*. As shown, all but the North Sheyenne Street section and the 40th Avenue to 52nd Avenue section of the South Sheyenne Street section of the corridor have federal funding programmed.

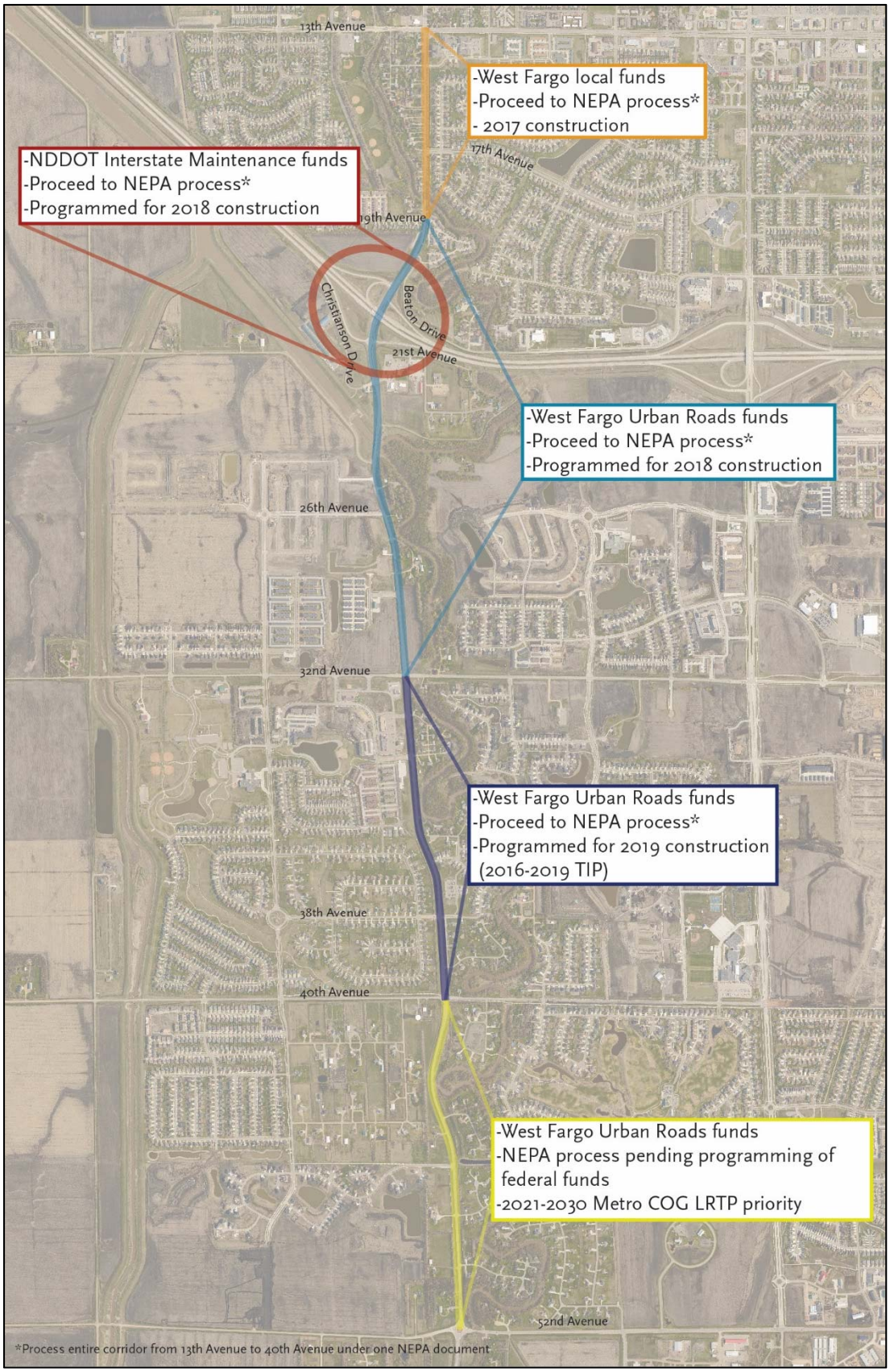
- The North Sheyenne Street section, from 13th Avenue to 19th Avenue, will be locally funded either through special assessments or local sales tax by the City of West Fargo. Following completion of this study, West Fargo will proceed to include these costs within its Capital Improvement Program (CIP). Therefore, this segment of Sheyenne Street is considered imminent, in that West Fargo intends to program local funds within its CIP.
- The southernmost segment of South Sheyenne Street, from 40th Avenue to 52nd Avenue, currently has no Federal or local funding programmed in the 2016 to 2019 TIP or the West Fargo CIP. The need for improvements on this stretch of the corridor are the least pressing. Pursuant to the 2040 LRTP, funding for this section of Sheyenne Street would likely occur in the 2021 to 2030 time frame based upon cooperatively developed priorities for NDDOT URP Funds. Given the recent inclusion of the Fargo 64th Avenue overpass in the Draft 2016-2019 TIP, this section of Sheyenne Street is one of two remaining unfunded federal aid programmed priorities contained within Metro COG's 2040 LRTP. The other being the widening of 52nd Avenue from Sheyenne Street to 45th Street.

Transition from Planning to NEPA

It is recommended the corridor alternatives from 13th Avenue to 40th Avenue, including the reconstruction of the Sheyenne Street Interchange, proceed into the NEPA phase as a consolidated environmental document. The benefits of having a soon-to-be-completed corridor study should greatly aid in this transition.

Figure XII-2 shows the prioritized list of alternatives for each of the study sections of the *Sheyenne Street Corridor Study*. As noted, some alternatives have been dismissed based on technical screening criteria, including a corridor level PNS. In the case of the interchange, several alternatives were discarded because they don't meet PNS, nor do they measure well against pre-determined technical criteria agreed to between the City of West Fargo, Metro COG and NDDOT. For the interchange, the No-Build alternative and the three technically feasible alternatives should proceed into NEPA.

FIGURE XII-1: FUNDING STRATEGIES FOR RECOMMENDED IMPROVEMENT AREAS



The study team has completed a pre-NEPA environmental screening of potential impacts along the Sheyenne Street corridor. Based on this analysis there is no reason to believe that an Environmental Assessment (EA) would be needed to determine a finding of no significant impact (FONSI).

Based on the corridor level pre-NEPA assessment, it would appear a consolidated NEPA action could be processed as a Documented Categorical Exclusion (DCE) for the interrelated reconstruction projects between 13th Avenue and 40th Avenue. Following completion of the corridor study, a formal interpretation should be requested from FHWA on the consolidation of the three interrelated improvement projects within the Sheyenne Street travel corridor. This request should also seek clarification on proceeding with the integrated improvements as a DCE based on the pre-NEPA corridor level environmental assessment.

This recommendation is supported pursuant to guidance from the NDDOT *Design Manual* (Section II-02) and 40 CFR 1508.27. The approach also fits within the framework established by Metro COG's *Policy & Process for Linking the Planning and NEPA* (2014), which was developed in cooperation with NDDOT and FHWA. This approach also appears to meet the intent of environmental streamlining inherent in Moving Ahead for Progress for the 21st Century (MAP-21).

No federal aid is imminent for the portions of Sheyenne Street from 13th Avenue to 19th Avenue. However, there are several reasons to include the 13th Avenue to 19th Avenue section of the Sheyenne Street reconstruction in a future NEPA document:

1. There may be a "Federal Nexus" to including this project given its operational relationships to the areas south of 19th Avenue.
2. Project PNS established for the overall project corridor suggest that improvements within this stretch of Sheyenne Street are related to the overall needs for improvements throughout the Sheyenne Street Corridor.
3. The public involvement process for improvements to the south of 19th Avenue would likely need to consider and discuss conditions and alternatives being considered north of 19th Avenue. If West Fargo is to proceed with project development on Phase I of the Sheyenne Street from 13th Avenue to 19th Avenue immediately following the corridor study, with the intent to construct in 2017, it may not be feasible to connect this segment of the corridor in a future NEPA action. West Fargo will want to coordinate project phasing and implementation for this phase of reconstruction with NDDOT prior to moving it into project development, independent of Phase II and III, both of which will need to proceed into NEPA.

Consideration should be given to how to transition the phase of Sheyenne Street from 40th Avenue to 52nd Avenue into NEPA. The preliminary recommendation would be to not move the improvements envisioned south of 40th Avenue into the NEPA phase at this time. The only caveat would be if NDDOT and Metro COG could commit to programming a portion of federal aid for this section with the 2017 to 2020 TIP process (e.g. Advance Construction). If not, transition of the 40th Avenue to 52nd Avenue phase of the Sheyenne Street reconstruction into NEPA should be delayed until federal aid is programmed in the TIP.

Depending on the time between completion of the corridor study and the eventual NEPA phase for the segment of Sheyenne Street from 40th Avenue to 52nd Avenue, background and future year analysis regarding the alternatives defined during the corridor study phase may need to be reevaluated during NEPA. Metro COG's current policy on Linking Planning and NEPA suggests no more than a five year gap between completion of a corridor study and the NEPA phase is allowable without having to reconsider alternatives developed, dismissed and prioritized as part of the corridor study.

Project Phasing and Implementation

Table XII-3 demonstrates a potential strategy for implementation of improvements along the Sheyenne Street Corridor. Since federal aid is currently programmed across two years in the current Metro COG TIP, "phases" have been used as opposed to specific years. This recognizes that NDDOT and Metro COG have some programming flexibility to best fit existing funds to meet a logical phasing plan of very significant projects.

Table XII-1 shows the anticipated cost splits by phase for completion of the Sheyenne Street project, as developed at the corridor study level. All existing programmed URP dollars are assumed with Phase II and Phase III. The remainder of local costs will be programmed within the City of West Fargo's CIP.

TABLE XII-1: ANTICIPATED COSTS FOR EACH PROJECT PHASE

Implementation Phase	West Fargo Share*	Urban Roads Funds*	Total*
Phase I (13th to 19th)	$5.00	$0.00	**$5.00**
Phase II (19th to 32nd)**	$13.87	$5.68	**$19.55**
Phase III (32nd to 40th)	$5.97	$4.35	**$10.32**
Programmed Total	***$24.84***	***$10.03***	***$34.87***
Phase Iv (40th to 52nd)	$10.32	$0.00	**$10.32**
Total (All Phases)	**$35.16**	**$10.03**	**$45.19**

*All costs in millions and 2015 dollars.
**Phase II includes costs for Sheyenne Street between the North and South Ramp intersection construction estimated at $2.0 million.

Table XII-2 shows the anticipated funding needs for the three remaining prioritized build alternatives for the Sheyenne Street interchange. There is currently $25 million included in the TIP for this project. Cost splits are shown based on a 90 percent federal share of Interstate Maintenance (IM) funds. These costs only include reconstruction of the ramps and the two I-94 overpass bridges. Costs related to changes to the I-94 mainline are not assumed as part of the corridor study cost estimate for the reconstruction. Reconstruction of Sheyenne Street between the North Ramp and South Ramp intersections cannot use IM funds. For this reason, $2.0 million was added to the Phase II costs, where these costs are eligible for Urban Roads funds. Detailed analysis regarding the I-94 mainline was not included within the scope of this project.

TABLE XII-2: ANTICIPATED COSTS FOR REMAINING PRIORITIZED ALTERNATIVES FOR SHEYENNE STREET INTERCHANGE

Sheyenne Street Interchange	NDDOT Federal*	NDDOT Local*	Total*
Modified SPUI	$20.30	$2.26	**$22.56**
Southwest Loop	$14.28	$1.59	**$15.87**
Northeast Ramp	$13.33	$1.48	**$14.81**

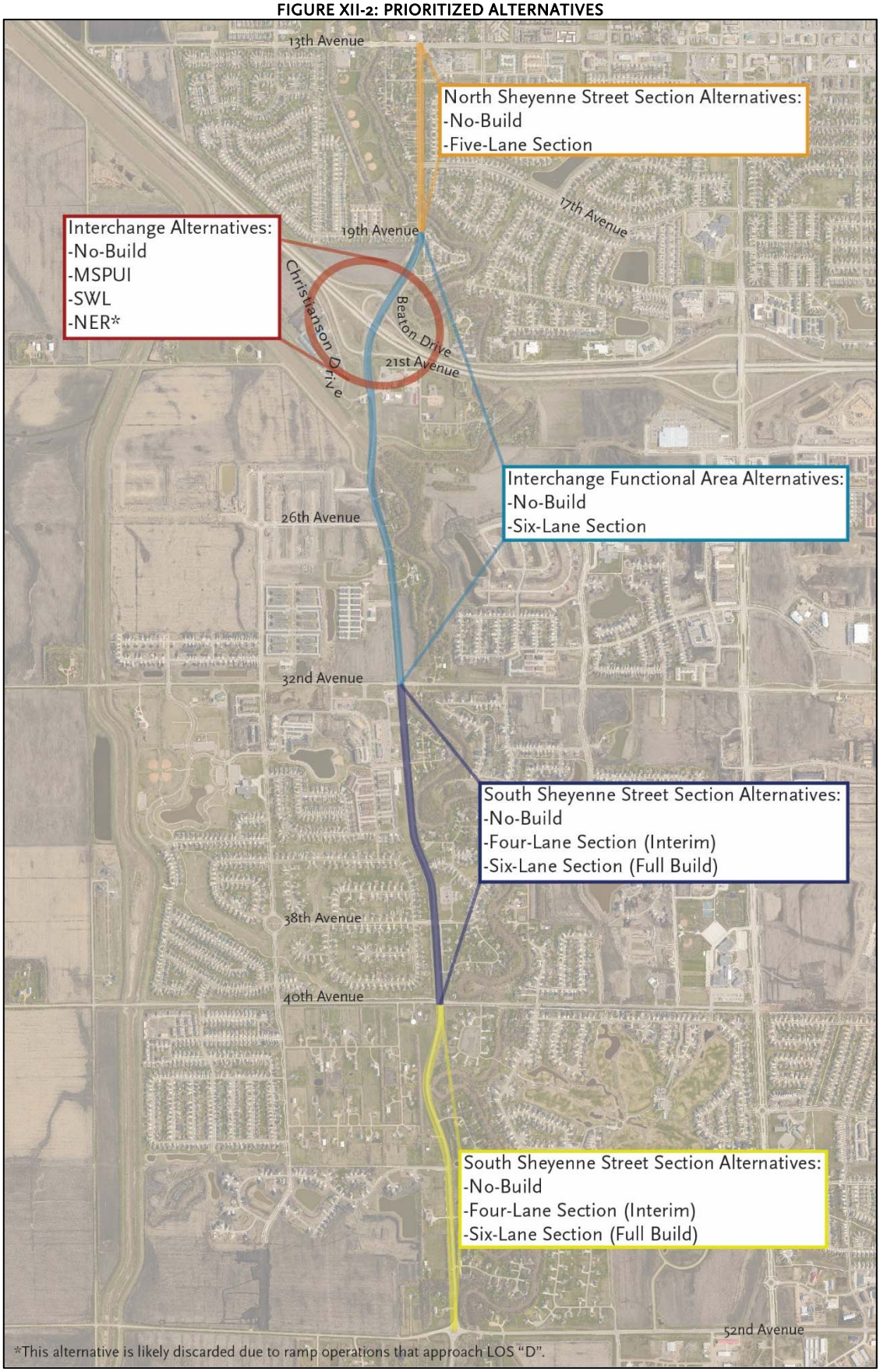
*All costs in millions and 2015 dollars.

TABLE XII-3: IMPLEMENTATION SUMMARY

Section	Termini	Termini	Alternatives Considered	Alternative Carried into NEPA	Linking to NEPA	Costs (In Millions)	Programming	Phase*	Notes
North Sheyenne Street	13th Avenue	19th Avenue	▪ No-Build ▪ 3-Lane Section ▪ 5-Lane Section ▪ 5-Lane Section with Driveway Protection	▪ No-Build ▪ 5-Lane Section	NEPA may delay project while awaiting approvals on southern project approvals. Still include public input meetings as part of project development.	$5.00	Local funds	I 2017	City of West Fargo has prioritized the construction of this section and is planning for construction in 2017.
Interchange Functional Area	19th Avenue	32nd Avenue	▪ No-Build ▪ 6-Lane Section	▪ No-Build ▪ 6-Lane Section	**Process as one environmental document (following completion of corridor study).**	$19.55	2018 Urban Roads funds ($5.68 million programmed).	II 2018	More detailed analysis needed on diversion bridge alternatives in project development.
Sheyenne Street Interchange	North Ramp	South Ramp	▪ No-Build ▪ SW Loop ▪ NE Ramp ▪ DDI ▪ MSPUI ▪ SPUI ▪ Roundabouts with SW Loop ▪ SE Loop ▪ NE Loop	▪ No-Build ▪ MSPUI ▪ SW Loop ▪ NE Ramp**		Varies by alternative: $15.87 – $22.56	IM funds included in both 2018 and 2019.	II 2018-2019	Includes only reconstruction of the ramps and two I-94 bridges. Mainline I-94 costs not yet considered.
South Sheyenne Street	32nd Avenue	40th Avenue	▪ No-Build ▪ 4-Lane Section ▪ 5-Lane Section with Reversible Flow ▪ 6-Lane Section	▪ No-Build ▪ 4-Lane Section (Interim) ▪ 6-Lane Section (Full Build)		$10.32	2019 Urban Roads funds ($4.35 million programmed in TIP).	III 2019	1.0 mile at $10.32 million per mile.
	40th Avenue	52nd Avenue	▪ No-Build ▪ 4-Lane Section ▪ 5-Lane Section with Reversible Flow ▪ 6-Lane Section	▪ No-Build ▪ 4-Lane Section (Interim) ▪ 6-Lane Section (Full Build)	Future environmental document (unless federal aid imminent for 2020).	$10.32	Future Urban Roads project (Metro LRTP 2021-2030).	IV	1.0 mile at $10.32 million per mile.

*Year of construction subject to funding availability. All costs shown in 2015 dollars.
**Likely to be discarded due to operations that approach LOS "D", which is considered deficient.

FIGURE XII-2: PRIORITIZED ALTERNATIVES



XIII) Study Summary

Next Phase

With both the South Sheyenne Street Section and the interchange programmed for 2018 construction, it is imperative that this corridor study lead directly into project development. This will include finalizing the environmental document, securing ROW and leading into design and construction. This corridor study provides valuable information that can be used directly in the next phases. The environmental phase in particular will be extremely expedited due to the work completed during the corridor study. Horizontal alignments and ROW information in the corridor study is necessary for project design. However, several items noted in this study are beyond the scope of this report and need to be studied further during the project development phases; this includes, but is not limited to, vertical alignment development, utilities coordination with rural neighborhoods, future noise analysis, etc.

Future Studies

During the analysis of the I-94 interchange with Sheyenne Street, it was noted that by 2040, mainline I-94 would likely see deficient operations in peak directions due in large part to the high volumes and directional splits. Mainline capacity cannot be evaluated without studying a much wider scope, as a new auxiliary lane would need to be carried through the Veterans Boulevard and 45th Street interchanges, in both directions. It is recommended that this be studied in greater detail before volumes exceed capacity on mainline I-94.

By 2019, the Sheyenne Street interchange, the tri-level portion of the I-29 and I-94 interchange and University Avenue will be experiencing improvements. Considering the widespread improvements likely on the I-94 corridor, it is recommended that these improvements be studied in concert to understand implications between improvements at each location. This should also include the interchanges in between (Veterans Boulevard, 45th Street and 25th Street) and potentially the 32nd Avenue interchange, just one mile south, which will be improved in 2017.

Prioritized Improvements

A variety of solutions were prioritized throughout the study area for each of the study sections. These alternatives, along with other technically feasible alternatives, will be carried forward into the NEPA process.

- A five-lane section, including two through lanes in each direction and a two-way left-turn lane, from 13th Avenue to 19th Avenue on Sheyenne Street is to be constructed in 2017. A shared-use path and sidewalk combination, as it exists today, will continue to be used throughout this section.
- I-94 interchange reconfiguration with three through lanes in each direction plus turn lanes and merge lanes. This is programmed for 2018 and 2019 construction.
- A six-lane section, including three through lanes in each direction with turn lanes, medians where necessary and shared-use paths on both sides, from 19th Avenue to 32nd Avenue on Sheyenne Street is programmed for construction in 2018. Sheyenne Street from 32nd Avenue to 40th Avenue is programmed for construction in 2019 and will likely occur in stages, with a four-lane section with turn lanes and medians constructed initially, with designs for six-lanes to be implemented once traffic demands warrant extra capacity. The section of South Sheyenne Street from 40th Avenue to 52nd Avenue will not be reconstructed in the next five years but is planned with a similar cross-section.
- A two-lane section, with one through lane in each direction with turn lanes, medians where necessary, a shared-use path on both sides and traffic control for crossings to Legacy Elementary, on 52nd Avenue from the Sheyenne River Diversion to Sheyenne Street. 52nd Avenue east of Sheyenne Street needs to be studied as part of a larger 52nd Avenue corridor study that extends to a logical termini, like 45th Street, where the current cross-section begins.

FIGURE XIII-1: SUMMARY OF PRIORITIZED ALTERNATIVES